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Decentralized Bribery and Market Participation*

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June 14, 2013

Abstract

I propose a bribery model that examines decentralized bureaucratic decisionmaking. There are multiple stable equilibria. High levels of bribery reduce an economy's productivity because corruption suppresses small business, and reduces the total graft even though individual bribe size might increase. Decentralization prevents movement towards a Pareto-dominant equilibrium. Anti-corruption efforts, even temporary ones, might be useful to improve participation if they lower demanded bribe levels and thus encourage small businesses to participate.

Keywords: corruption, bribery, decentralization.

JEL: D73.

Consider a person who goes to take a driving test. A given inspector can recognize a bad driver, and perfectly understands the welfare costs of allowing one on the road. Unlike the obvious evil of putting unqualified drivers on the road, denying deserving drivers their licenses does not produce welfare externalities, ignoring congestion. There are ways to deny a qualified applicant a license safely: for instance, forgetting to check a rear-view mirror can be inflated into "reckless driving". Would coercing a bribe from a qualified individual

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in return for a well-deserved permit make so much a difference? I show that this “transfer bribery”¹ bears significant economic consequences. When an expected bribe is too high, corruption hinders participation. A permit-seeker planning to drive a cab is more likely to pay a bribe, whereas a permit-seeker planning to drive merely for pleasure is liable to refrain from applying in the first place, if he expects coercion. A bribe that discourages participation is likely to discourage the participation of applicants with the least bribe-paying potential. This tendency improves a corrupt inspector’s chances of collecting bigger bribes, since the only participants left applying will be willing to pay at the anticipated bribe level. In response, corrupt inspectors raise their required bribes, which hinders participation even further. In an equilibrium in which all potential applicants participate, smaller—but more frequent—bribes from everyone constitute a Pareto-dominant outcome. However, because decision-making is decentralized, it might be impossible to shift towards a Pareto-dominant equilibrium.

To illustrate my point, I propose a model of bribery with the centralized government² absent. Corruption is often systemic: in a corrupt society, it is never the case, for example, that the police are corrupt, while educators are not. Moreover, a corrupt policeman could eventually interact as a client with a corrupt educator, who in turn could be a client of a corrupt doctor. And in such interactions, corrupt officials would themselves, as clients, prefer to pay diminished bribes. But an individual change in bribe-taking behavior will not alter the bribe amount that bribe-givers as a whole expect to give, and this critical issue cannot be modeled assuming single centralized bureaucracy.

The literature has reached an empirical consensus that corruption is detrimental to welfare, and significantly reduces both long-term growth and near-term investment. Corrupt economies are mostly closed and heavily regulated. They spend more on capital investment (though via less efficient projects), but less on maintenance, healthcare and education. Corruption is reinforced by deficiencies in education, low income levels, ethnic heterogeneity,

¹Shleifer and Vishny (1993) calls this *corruption without theft*, Bliss and Di Tella (1997) calls this *surplus-shifting corruption*, and Drugov (2010) calls this *extortion*.

²For examples of business-to-business corruption, see The Independent (1995); The Register (2012); The St. Petersburg Times (2012).

weak institutions, and lack of trust in the society³.

A vast segment of the literature on corruption seeks to explain the differences in corruption levels between countries. It includes a model proposed by Andvig and Moene (1990), which suggests that corruption becomes easier for one bureaucrat if other bureaucrats become corrupt as well; Alesina and Angeletos (2005) provide a model of theft from government coffers, which argues that, because of corruption, more redistribution does not necessarily bring more equality; Dzhumashev (2012) argues that corruption can, by jeopardizing the stability of income, prevent access to efficient means of production, thereby discouraging risk-averse investors; Ryvkin and Serra (2012) demonstrate that uncertainty about corruptibility discourages systemic bribery. Multiple equilibria are frequently found, explaining striking differences in penetration of corruption across countries (see Del Monte and Pappagni (2007) on differences in corruption levels among regions of Italy). Beyond stating the difference, Mauro (2004) shows how corruption-borne differences in the efficiency of an economy perpetuate over time, causing divergence of development trajectories.

Most of the models mentioned above are concerned with differences in rates of involvement in corruption in different equilibria, whereas in my model the difference is in market participation. The important exception is Bliss and Di Tella (1997). They argue that corruption can lower competition, move the market towards a monopoly outcome, and allow bureaucrats to siphon away all the monopoly profits. They, too, establish that less market participation can come part in parcel with corruption: after all, less market participation is optimal from the bureaucrat's point of view in their model. In my model, however, bureaucrats would rather attract better participation, but are rendered unable by decentralization. Svensson (2003) uses a model similar to mine to accompany a survey from Uganda to illustrate that the size of a bribe demand depends on a firm's prospects. He predicts that because of bribes, investment in a less profitable sector with more liquid assets might be preferable to investment in a more profitable sector that features less investment reversibility precisely because officials demand bigger bribes in the second scenario.

³See, *inter alia*, Mauro (1995, 1997); Tanzi and Davoodi (1997); Ades and Di Tella (1999); La Porta et al. (1999); Djankov et al. (2002); Fan et al. (2009).

The rent-seeking literature, pioneered by Tullock (1967) and Krueger (1974), argues that transfers are not necessarily harmless to society since the very existence and maintenance of these transfers is usually an outcome of the political struggle between transfer-payers and transfer-receivers (Tullock, 1971). The wastefulness of transfer technology, resulting either from wasteful redistribution of resources by investors or from bureaucratic misallocation, is complementary to my argument, which does not rely on any competition, innate or induced.

This paper is organized as follows. First, I introduce the general model and define the equilibrium. I then examine the model’s predictions: I demonstrate how to combat corruption using exit facilitation, and I illustrate that transfer bribery might keep the economy in a bad equilibrium where small entrepreneurs do not start up their businesses. Finally, I discuss the model’s limitations and potential extensions, and conclude. The appendix contains proofs of all Results.

1 The Model

Agents interact in a single-period game. There is a continuum of measure 1 of risk-neutral agents, whose preferences are defined over a single good, eligible for consumption or investment. There are two types of agents: *investors* and *inspectors*, both of positive measure.

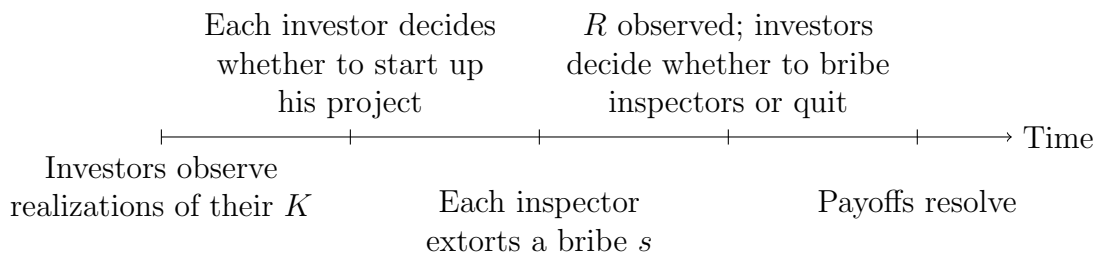


Figure 1: Timing of the game

Investors draw a *project* of size K , where K is the number of units required to be invested. This can take two values, K_L and K_H , with probabilities λ and $1 - \lambda$.⁴ A project yields a

⁴The heterogeneity of K could be motivated not by technology, but by the pledgeable income of investors.

random, idiosyncratic return $R \geq 0$, with a finite mean, independent of K , drawn from the distribution with pdf $f_R(\cdot)$ and cdf $F_R(\cdot)$, both of which are differentiable.

After investment, each investor is assigned a random inspector, entrusted to approve the project, but who instead attempts to extort a *bribe*, a sum of money s , from the project's profits. If the realized project's profits after paying the bribe are too small, the project can be cancelled, and the investor recovers a fraction ϕ of his investment. Each inspector gets a finite number of projects for approval, so that each project is approved by exactly one inspector.

Each investor must decide whether to pursue his investment project. Starting a project of size K earns the expectation of

$$E_R \max(RK - s, \phi K) - K = (E_R \max(R - s/K, \phi) - 1) K.$$

If the post-bribe net return is less than ϕ , the investor cancels the project. The investor cannot be forced to pay a bribe, but he can choose to take everything as much as possible and walk away.

An investor starts his project if his expected net return is positive, i.e., if

$$E_R \max(R - s/K, \phi) - 1 \geq 0. \tag{1}$$

Result 1 *If an investor with a project of some value of K (ϕ) finds it optimal to start his project facing the bribe level of s^* , investors with projects of larger K (ϕ) will find it optimal to start their projects too.*

Proof. See Appendix. ■

An inspector observes neither K nor R , so his bribe demand cannot depend on either⁵. In equilibrium, each inspector knows the sizes of the projects which are started up by investors, and on this he will form his beliefs $E_K[\cdot]$ about the possible size of the project at his mercy. Since inspectors are risk-neutral, the amount of projects per inspector does not

⁵I will relax this assumption later.

affect the decision for each individual project. We will assume that investors are distributed across inspectors randomly, and that the number of investors for each inspector is identically distributed and bounded from above, to close the model. An inspector's problem is then to demand a bribe s that solves

$$\max_s sP(RK - s > \phi K) = \max_s sE_K[(1 - F_R(s/K + \phi))]. \quad (2)$$

When the problem is well-defined, and the solution is in $(0, +\infty)$, the maximum point will be a solution to the first-order condition:

$$E_K[(1 - F_R(s^*/K + \phi))] = s^* E_K[1/K f_R(s^*/K + \phi)],$$

$$s^* = \frac{E_K[(1 - F_R(s^*/K + \phi))]}{E_K[1/K f_R(s^*/K + \phi)]}. \quad (3)$$

An equilibrium (pure strategy perfect Bayesian) is a collection of

- $s^* \in R_+$: size of the bribe, amount of money taken out of the project's profits if the bribe gets paid;
- $K^* \in R_+$: the critical level of investment such that investors with projects of size $K \geq K^*$ decide to pursue them;

such that

- s^* solves the inspector's problem (2), given rational beliefs that only projects above K^* are implemented ($E_K[\cdot] = E[\cdot | K \geq K^*]$), and
- an investor with a project of size K^* is weakly better off starting the project, and all owners of projects with $K < K^*$ find it suboptimal to pursue their projects, given rational beliefs about the bribe size s^* .

This is a perfect Bayesian solution concept because the inspectors' beliefs about the distribution of projects' sizes depend upon the equilibrium decisions of investors.

Result 2 *An equilibrium exists.*

Proof. See Appendix. ■

Potential outcomes are divided into three classes depending on the investors' participation, given that no investors are indifferent to participation and abstention⁶:

- **full participation:** both K_H and K_L type projects start up;
- **partial participation:** only K_H projects start up;
- **no participation:** no projects are started up.⁷

The “full participation” and “no participation” equilibria are pooling, whereas the “partial participation” equilibrium is separating.

Result 3 *When a partial participation equilibrium exists, so does a full participation equilibrium, given a big enough λ .*

Proof. See Appendix. ■

Observe that the opposite case does not necessarily need to be true: even when all projects are large, the hazard rate of the return distribution might force inspectors to demand bribes small enough to allow positive profits to small projects. Result 3 also establishes some important comparative statics: the opportunity to switch from a partial participation equilibrium to full participation equilibrium will arise when the proportion of investors handling small projects increases. Later I will show that this opportunity is worth pursuing.

Result 4 *In a full participation equilibrium, an increase in the proportion of small project investors λ leads to decrease in the equilibrium amount of bribe s^* when (3) has a unique solution.*

⁶The equilibria where investors with $K = K^*$ are indifferent between participating and not, and they therefore split nontrivially between participating and abstaining, can be shown to be unstable.

⁷If a partial equilibrium exists, then an argument similar to the intuitive criterion of Cho and Kreps (1987) refines away the no participation equilibrium: the bribe cannot be expected to be so big that the best possible project is not executed, because what type of projects would support these bribes?

Proof. See Appendix. ■

This implies that the equilibrium bribe in full participation equilibrium is smaller than the equilibrium bribe level in partial participation equilibrium: the bribe in partial participation equilibrium is equal to the bribe in full participation equilibrium when the proportion of small investors λ is zero.

How restrictive is the assumption that (3) has a unique solution? When $\lambda = 0$, (3) diminishes to solving $s/K_H = \frac{1-F_R(s/K_H)}{f_R(s/K_H)}$, which has a unique solution when $x - \frac{1-F_R(x)}{f_R(x)}$ is increasing, known in auction literature as Myerson's regularity condition, implied by the assumption of nondecreasing hazard rate for the distribution of R . The same holds for the case in which $\lambda = 1$. The hazard rate assumption does not guarantee that (3) has a unique solution for $\lambda \in (0, 1)$: the change in s affects the proportion of large and small projects remaining after a bribe payment. The likelihood that remaining projects constitute large investments increases with the size of the bribe, which can cause the right-hand side of (3) to increase.

Next, I examine the comparative statics.

1.1 Recovery Rate Affects Bribery

The rate of recovery influences the threshold at which an investor decides that the bribe demanded of him is too high and abandons a project. It therefore has a strong effect on corruption. Define $H(x|\phi) = \frac{E_K[1-F_R(x/K+\phi)]}{E_K[1/K f_R(x/K+\phi)]}$, the right-hand side of (3). The bribe size demanded by inspectors is indicated by the intersection of the 45° line with $H(x|\phi)$.

Result 5 *Suppose there is no uncertainty about the project size K . In this case, an increase in ϕ reduces the bribe level $s = H(s|\phi)$ as long as $F_R(\cdot)$ has an increasing hazard rate.*

Proof. See Appendix. ■

Many distribution families (including uniform, normal and χ^2) feature an increasing hazard rate, and the result is intuitive: a better recovery rate makes it more attractive for an investor to cancel a project, prompting inspectors to reduce their demands. If returns

are exponentially distributed, with no uncertainty about investment size, the recovery rate has no effect on the equilibrium bribe demand.

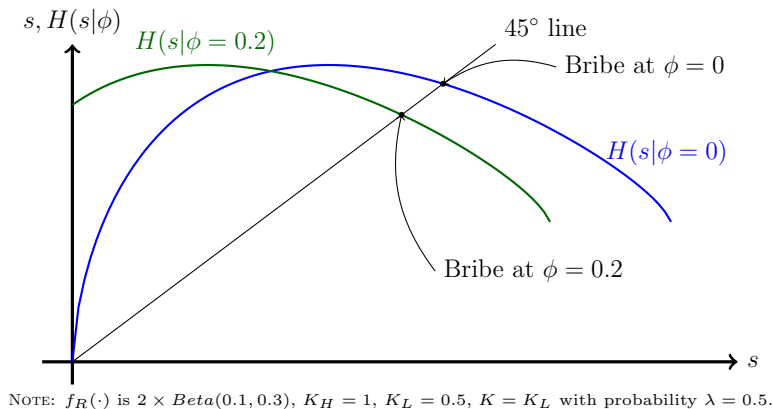


Figure 2: Increase in recovery rate lowers the bribe.

Result 6 *If $E_K[1/\kappa f'_R(s^*/K + \phi)]$ is not too negative, increase in ϕ reduces the inspector's decision about the optimal bribe level.*

Proof. See Appendix. ■

Figure 2 illustrates the logic⁸. An increase in ϕ means a parallel shift of $H(\cdot|\phi)$ to the left. For bribe level to decrease, $H(x|\phi)$ has to decrease locally, and this determines the “not too negative” clause.

Better recovery rates can cause reductions in bribes because a given inspector will realize that investors have better outside opportunities, and therefore less likely to tolerate bribes. This can motivate a bribe-taker to demand industry-specific investments from potential investors before they can apply for a permit. This also suggests that industries with better recovery rates should tend to suffer less from corruption, especially when one endogenizes decisions by corrupt officials to choose the industry to target.⁹ This seems to be a strong and intuitive recipe for fighting corruption: make investment more recoverable, possibly by stimulating industries with easier recoverability. This does not mean that governments

⁸When intersections with the diagonal are “from above”, with $s < H(s|\phi)$ for s locally on the left from intersection (and vice versa from the right), like on Figure 2, these are local maxima. Intersections “from below”, when $s > H(s|\phi)$ locally on the left of intersection, are local minima.

⁹See Svensson (2003) for a test of the influence of opportunity costs on corruption.

should subsidize cancellations, because then less lucrative projects may start up only to be cancelled.

To ease presentation, ϕ will be set to 0 for the rest of the paper.

1.2 Decentralized Corruption Deters Entry

For this part, I will use an environment that features heterogeneity with respect to project size and exponential returns: $R \sim \text{Exp}(\alpha)$, so that $P(R > t) = e^{-\alpha t}$. As seen in Result 4 and later, in the presentation, this specific assumption about the distribution of R is readily generalizable.

If both types of projects are started, the utility of the inspector as a function of the bribe amount s is

$$sP(RK > s) = s \left(\lambda e^{-\alpha \frac{s}{K_L}} + (1 - \lambda) e^{-\alpha \frac{s}{K_H}} \right). \quad (4)$$

To solve for the equilibrium, consider the best response of inspectors. The first-order condition of the inspector's problem (4) is

$$s = \frac{1}{\alpha} \frac{\lambda e^{-\alpha \frac{s}{K_L}} + (1 - \lambda) e^{-\alpha \frac{s}{K_H}}}{\frac{\lambda}{K_L} e^{-\alpha \frac{s}{K_L}} + \frac{1 - \lambda}{K_H} e^{-\alpha \frac{s}{K_H}}} = \frac{K_L}{\alpha} \left(1 + \frac{\left(1 - \frac{K_L}{K_H}\right) e^{\alpha s \left(\frac{1}{K_L} - \frac{1}{K_H}\right)}}{\frac{\lambda}{1 - \lambda} + \frac{K_L}{K_H} e^{\alpha s \left(\frac{1}{K_L} - \frac{1}{K_H}\right)}} \right). \quad (5)$$

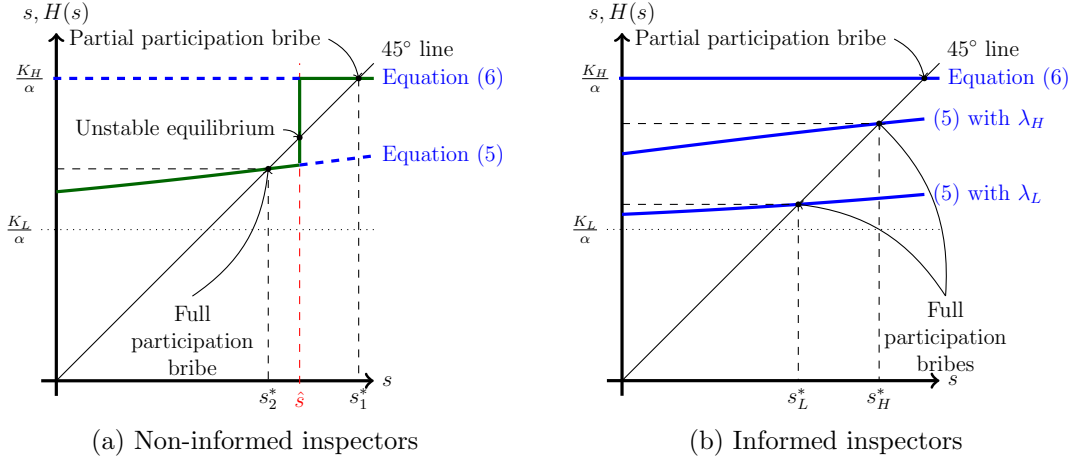
The right-hand side is an increasing function of s , starting from a value above $\frac{K_L}{\alpha}$ and converging to $\frac{K_H}{\alpha}$. Therefore, (5) has a solution.

When only projects of size K_H are started, the inspector's first-order condition's right-hand side changes:

$$s = \frac{1}{\alpha} \frac{0 \times e^{-\alpha \frac{s}{K_L}} + 1 \times e^{-\alpha \frac{s}{K_H}}}{\frac{0}{K_L} e^{-\alpha \frac{s}{K_L}} + \frac{1}{K_H} e^{-\alpha \frac{s}{K_H}}} = \frac{K_H}{\alpha}. \quad (6)$$

There might be multiple equilibria present under reasonable assumptions. Figure 3a shows an example of such an outcome. The bribe s_1^* is a partial participation equilibrium bribe: when inspectors demand this bribe, only projects of size K_H start up. Inspectors, expecting only projects of type K_H , pick their bribe size extortion decision according to (6),

and choose s_1^* as their bribe choice. The bribe of size s_2^* is the full participation equilibrium bribe: both types of projects find it optimal to start up, since even smallest projects will start up ($s_2^* < \hat{s}$). Inspectors, expecting both types of projects to start up, choose the extorted bribe size using Equation (5), and choose s_2 .



Note: $\alpha = 0.2$, $K_L = 1$, $K_H = 2$, $\lambda = 0.6$. \hat{s} is the bribe that agents with type L projects can pay and be indifferent between starting up the project or not; Equation (1) holds with equality for $K = K_L$ and $s = \hat{s}$. Both partial and full participation equilibria exist. For Figure 3a, the solid line connects the relevant parts of Equations (5) and (6) to reveal the best response of the investors. For Figure 3b, the expected return of the low-type project allows for the existence of full participation equilibrium. λ_H and λ_L are defined below, in Equation (7).

Figure 3: Multiple equilibria

Both equilibria are stable: a tiny perturbation in the fundamentals of both investors' and inspectors' problems does not make either equilibrium go away. The full participation equilibrium needs either a large enough λ or $E[R]$ to exist. Lower $\frac{K_H}{K_L}$ also lowers the bribe size without affecting the participation constraint for K_L types.

The welfare costs of bribery are found not so much in the loss of less lucrative projects (those that get cancelled), but rather in the squandering of small projects in the partial participation equilibrium. Even though a temporary effort in lowering bribes cannot remove bribes completely, it can be strong enough to move the economy into an equilibrium where more projects are started up. Both inspectors and investors of all types are better off in a full participation equilibrium:

- large project investors pay smaller bribes (Result 4), and therefore both collect higher profits in each project, and liquidate fewer projects;

- small project investors now collect a positive net expected profit (since their participation constraint is satisfied), and are therefore better off;
- inspectors' total graft is larger: the total bribe collection in a full participation equilibrium is larger than it would be were the bribe amount set at the partial participation equilibrium level; that amount of total collection is larger than the total bribe amount in the partial equilibrium because of stronger participation.
- since all inspectors are identical, the expected graft per inspector is larger.

Were inspectors able to communicate and make centralized decisions, they could facilitate movement into a better equilibrium, for instance by announcing that they are going to levy smaller bribes. If inspectors could coordinate on such centralized deviation, they would do so.

If inspectors had perfect information about every project's size, this shortcoming would not be an issue, as inspectors could charge bribes proportional to the size of each project. Even imperfect information would ease the participation constraint on the small projects' investors, potentially inviting them to participate. This would not, however, destroy the partial participation equilibrium.

Assume that an inspector obtains a correct signal about the size of the project with probability $q > \frac{1}{2}$. The inspector would update his belief in the probability of observing a low-type project:

$$\lambda_H = \frac{(1-q)\lambda}{q(1-\lambda) + (1-q)\lambda}, \quad \lambda_L = \frac{q\lambda}{q\lambda + (1-q)(1-\lambda)}. \quad (7)$$

Since $q > 1/2$, then $\lambda_L < \lambda < \lambda_H$, where λ_i is the probability of observing a low-size project conditional on size $i \in \{L, H\}$. For every signal, each inspector will solve a bribe demand problem similar to (3). These problems are illustrated on Figure 3b: s_i^* is the bribe demand by the inspector who observes signal i .

Result 7 *If a partial participation equilibrium exists, then given a large enough q , so will a*

full participation equilibrium.

Proof. See Appendix. ■

This does not preclude the existence of a partial participation equilibrium. Even if q is big enough, to cause a full participation equilibrium to exist, the anticipation that small businesses will not start up will lead inspectors to rationally disregard signals about the projects' size. Investors with small projects will stay away, reaffirming the beliefs of inspectors. Even if investors could cooperate and start up a positive mass of small projects to manifest their collective potential, the decentralization of decisionmaking would allow individual inspectors neither to comprehend the organized deviation nor to attempt lowering the bribe to attract small businesses. Unless $q = 1$, the problem of squandering small projects persists.

2 Discussion and Extensions

Competition among investors is assumed away to illustrate that the multiplicity of equilibria is not driven by strategic complementarities or rent-seeking. One could assume that the return distribution is stochastically improving if there are fewer projects starting up. This could yield two equilibria, one with high profits and high bribes, and another with low profits and low bribes, depending upon the functional form of stochastic improvement. On the other hand, more competition induces more innovation, and hence in the long run the total graft might be higher in a more competitive allocation.

Risk aversion is not modeled explicitly, but the results are robust. Risk-averse investors' participation constraints will be harder to satisfy, but this will not change investor behavior after investment, since I assume no uncertainty about R at the point of decision to pay the bribe. Hence, the bribe amount will not be affected unless the set of participating projects is affected. Inspectors risk aversion, on the other hand, will somewhat change the inspector's problem. Particularly, if the Bernoulli utility of s dollars of bribe is $u(s) = (s + \mu)^\rho - \mu^\rho$,

where $\rho \in (0, 1)$ and $\mu > 0$, the inspector's choice equation (3) becomes

$$s = \rho \frac{E_K[1 - F_R(s/K)]}{E_K[1/K f_R(s/K)]} + \overbrace{\mu \left(\left(1 + \frac{s}{\mu}\right)^{1-\rho} - 1 \right)}^{\text{increases in } s}.$$

When μ is zero, only the first term remains. The second part of the right-hand side increases more slowly than the left-hand side given a big enough s , so the optimal solution exists if the solution existed originally. The solution is continuous in μ and ρ . If, in addition, $u'(0) = \rho\mu^{\rho-1} \leq 1$, this can be interpreted as a wasteful bribe-pocketing technology, where the transfer of s produces $(s + \mu)^\rho - \mu^\rho \leq s$ of cash in the inspector's pocket.

Honest inspectors who do not ask for bribes will relax the participation constraint, creating a more hospitable atmosphere for small businesses, but at the same time, they will let the big fish go away un-squeezed. The body of corrupt officials might actually be interested in cleansing the ranks in order to induce more participation from investors, depending upon the shapes of distributions of R and K , but not necessarily to the socially optimal levels.

A general equilibrium model would provide a richer view of ways in which corruption hurts society. It could feature the choice of role, decisions of a policymaker regarding the inspectors' remuneration package, taxation and supervision over the inspectors, the decision of each investor to run a "good" or "bad" project (with unfavorable properties like negative externalities; in the current model, inspectors cannot all be dismissed because they are implicitly assumed to deter all "bad" projects), and the decision of an inspector to prevent a "bad" project or let it be carried out for a bribe. One can contemplate the wage effects: higher wages in alternative employment can lower the average bribe amount demanded, because the projects would become relatively less profitable. But at the same time, higher wages can increase the average collected graft amount too, since some of the inspectors would prefer alternative employment. One can also see that the squandering of small projects would lead to lower demand for labor, and therefore lower wages, having an indirect effect on ex-post inequality. However, all this will obscure the main interaction I want to elucidate: the relationship between "good" project starters and corrupt inspectors.

3 Conclusion

In this study, I find that transfer bribery is not economically neutral. Too high a bribe might not only kill the *less lucrative* projects, but also discourage *small* businesses from opening up, since bureaucrats cannot distinguish an investment size from the investment's return. Joint deviation into a better equilibrium where small projects start up is not feasible due to decentralization. A large enough crackdown on corruption, even temporary, can induce better participation by lowering the bribes temporarily, which will change the beliefs of inspectors and lower the bribes in the long run. Granted, such a crackdown increases both the sum of bribes collected and the number of those who pay bribes, both of which are common measures of corruption levels in the empirical literature, but all agents will be better off.

A Proofs of Results

Result 1: Fix the level of bribe s . Let $K' > K$, and let $E_R \max(R - \frac{s}{K}, \phi) \geq 1$ hold for K . Observe that $\frac{s}{K'} < \frac{s}{K}$, and therefore $R - \frac{s}{K'} > R - \frac{s}{K}$ for every R . Therefore, $\max((R - \frac{s}{K'}), \phi) \geq \max((R - \frac{s}{K}), \phi)$. Take expectations to obtain the result.

Let $\phi' > \phi$. Observe that $\max((R - \frac{s}{K}), \phi) \leq \max(\max((R - \frac{s}{K}), \phi), \phi') = \max((R - \frac{s}{K}), \phi')$ for every R . Take expectations to obtain the result.

Result 2: An equilibrium with no participation always exists. Whether either full or partial participation equilibria exist can be ascertained by solving (3) and verifying the participation constraints.

Result 3: In a partial participation equilibrium, the bribe level s_1^* solves $s_1^*/K_H = \frac{1 - F_R(s_1^*/K_H + \phi)}{f_R(s_1^*/K_H + \phi)}$. Since we assumed that a partial participation equilibrium exists, this satisfies the participation constraint for investors with large projects: $E_R \max(R - s_1^*/K_H, \phi) > 1$. The equation that sets the bribe level s_2^* when both types of projects participate at $\lambda = 1$ is

determined from

$$s_2^* = \frac{\lambda(1 - F_R(s_2^*/K_L + \phi)) + (1 - \lambda)(1 - F_R(s_2^*/K_H + \phi))}{\lambda f_R(s_2^*/K_L)/K_L + (1 - \lambda)f_R(s_2^*/K_H)/K_H} \Big|_{\lambda=1} = \frac{1 - F_R(s_2^*/K_L + \phi)}{f_R(s_2^*/K_L + \phi)/K_L},$$

which produces $s_2^*/K_L = s_1^*/K_H$. Since $E_R[\max(R - s_2^*/K_L, \phi)] = E_R[\max(R - s_1^*/K_H, \phi)] > 1$, there is a full participation equilibrium at $\lambda = 1$. By continuity of s_2 with respect to λ , for λ close to 1, the participation constraint will still hold.

Result 4: For the purpose of clarity, $\phi = 0$; nothing changes if ϕ is positive. Let $s^*(\lambda)$ denote the bribe demanded in the full participation equilibrium when the proportion of small projects is equal to λ .

If only K_L (K_H) types of projects were present in the economy, which corresponds to $\lambda = 1$ ($\lambda = 0$), the bribe levels are

$$s^*(1)/K_L = \frac{1 - F_R(s^*(1)/K_L)}{f_R(s^*(1)/K_L)}, \quad s^*(0)/K_H = \frac{1 - F_R(s^*(0)/K_H)}{f_R(s^*(0)/K_H)}.$$

Therefore, $s^*(1)/K_L = s^*(0)/K_H$, which, particularly, means that $s^*(0) > s^*(1)$. Also, the uniqueness of solution to (3) guarantees that

$$s/K_L < \frac{1 - F_R(s/K_L)}{f_R(s/K_L)} \text{ when } s < s^*(1),$$

and the opposite is true if $s > s^*(1)$, because there is exactly one point where equality holds¹⁰. Similar statements hold for $s^*(0)$. Therefore,

$$\begin{aligned} s f_R(s/K_L)/K_L &> 1 - F_R(s/K_L), \quad s > s^*(1), \\ s f_R(s/K_H)/K_H &> 1 - F_R(s/K_H), \quad s > s^*(0). \end{aligned}$$

Opposite statements hold for cases when $s < s^*(1)$ and $s < s^*(0)$. Now let us return back

¹⁰If the inequality sign does not change at $s = s^*(0)$, the solution of the first-order condition is not a maximum, but rather an inflection point, assumed away when I was discussing the statement of the inspector's problem.

to the full participation equilibrium. For every $\lambda \in (0, 1)$, no bribe level above $s^*(0)$ can be a solution of the inspector's problem:

$$s \left[\overbrace{\lambda f_R(s/K_L)/K_L + (1-\lambda)f_R(s/K_H)/K_H}^{E_K[f_R(s/K)/K]} \right] > \overbrace{\lambda(1-F_R(s/K_L)) + (1-\lambda)(1-F_R(s/K_H))}^{E_K[1-F_R(s/K)]}$$

$$\Rightarrow s > \frac{E_K[1-F_R(s/K)]}{E_K[f_R(s/K)]} \text{ when } s \geq \max(s^*(1), s^*(0)) = s^*(0).$$

Therefore, the equilibrium bribe level is less than $s^*(0)$. Equivalently, one can show that no bribe level below $s^*(1)$ can be a solution in the full participation model. Unless λ is equal to 0 or 1, equilibrium bribe level has to belong to $(s^*(1), s^*(0))$.

Now fix $\lambda' \in (\lambda, 1]$. From $s^*(\lambda)$ being a unique solution of (3), we get

$$s \left[\overbrace{\lambda f_R(s/K_L)/K_L + (1-\lambda)f_R(s/K_H)/K_H}^{E_K[f_R(s/K)/K|\lambda]} \right] >$$

$$> \underbrace{\lambda(1-F_R(s/K_L)) + (1-\lambda)(1-F_R(s/K_H))}_{E_K[1-F_R(s/K)|\lambda]}, \quad s > s^*(\lambda), \quad (8)$$

$$s f_R(s/K_L)/K_L > 1 - F_R(s/K_L), \quad s > s^*(1). \quad (9)$$

Here $E_K[\cdot|\lambda]$ is the expectation with respect to K of the argument when the proportion of small projects is λ . Sum inequalities (8) and (9) weighed by $\frac{1-\lambda'}{1-\lambda}$ and $\frac{\lambda'-\lambda}{1-\lambda}$ correspondingly to obtain

$$s \left[\overbrace{\lambda' f_R(s/K_L)/K_L + (1-\lambda')f_R(s/K_H)/K_H}^{E_K[f_R(s/K)/K|\lambda']} \right] > \overbrace{\lambda'(1-F_R(s/K_L)) + (1-\lambda')(1-F_R(s/K_H))}^{E_K[1-F_R(s/K)|\lambda']},$$

$$s \geq \max(s^*(\lambda), s^*(1)) = s^*(\lambda).$$

Rewriting as $s > \frac{E_K[1-F_R(s/K)|\lambda']}{E_K[f_R(s/K)/K|\lambda']}$ when $s \geq \max(s^*(\lambda), s^*(1)) = s^*(\lambda)$, one can see that $s^*(\lambda')$ cannot be above $s^*(\lambda)$.

Result 5: When there is no uncertainty, $H_R(s|\phi) = \frac{1-F_R(s+\phi)}{f_R(s+\phi)}$. When R distribution features an increasing hazard rate, $H_R(\cdot)$ is decreasing. An increase in ϕ means a shift of $H_R(\cdot)$ to the left; hence, the intersection is happening at a smaller value of s .

Result 6: $H(x|\phi)$ is decreasing in x when

$$\frac{\partial H(x|\phi)}{\partial \phi} = \left(-\frac{E_K[f_R(x/K + \phi)]}{E_K[1/K f_R(x/K + \phi)]} - H(x|\phi) \frac{E[1/K f'_R(x/K + \phi)]}{E[1/K f_R(x/K + \phi)]} \right) < 0. \quad (10)$$

This has to hold at $x = s^*$, which makes “not too negative” to be

$$E[1/K f'_R(s^*/K + \phi)] > -\frac{E_K[f_R(s^*/K + \phi)]}{H(s^*|\phi)}.$$

The sufficient condition for Result 6 to hold would be to have $f'(s^*/K) > 0$ at $K = K_L$ and K_H .

Result 7: When the partial participation equilibrium exists, it means that for H -type projects, $s_H^* = \frac{1-F_R(s_H^*/K_H)}{f_R(s_H^*/K_H)} K_H$ satisfies the participation constraint, or that $E_R \max(R - s_H^*/K_H, 0) > 1$. When $q = 1$, $s_L^* = \frac{1-F_R(s_L^*/K_L)}{f_R(s_L^*/K_L)} K_L$, and therefore $s_H^*/K_H = s_L^*/K_L$, since the solution to $t = \frac{1-F_R(t)}{f_R(t)}$ is unique by assumption. Because of this, $\max(R - s_L^*/K_L, 0) > 1$, and therefore participation constraint is satisfied. Finally, one can see that $s_L^*(q)$ is continuous in q around $q = 1$. Therefore, there exists a q big enough to support the existence of a full participation equilibrium.

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