The Microeconomics of Corruption. A Review of Thirty Years of Research

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THE MICROECONOMICS OF CORRUPTION. A REVIEW OF THIRTY YEARS OF RESEARCH. [*]

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ABSTRACT

We review microeconomic research on corruption from the last thirty years. We start by analyzing the seminal models of corruption built on three-tier, delegation models. Then, go into more details of the context of corrupt deals, and discuss the main economic factors that affect corruption. We discuss incentives and compensation in bureaucracies, and the interplay of market and bureaucratic structure. Competition and contract design will also be reviewed in relation to procurement under corruptible agents. After reviewing the theoretical contributions, we turn to the empirical evidence. We begin discussing measurement issues, and then move to the analysis of the empirical evidence relative to the theoretical models discussed in previous sections. Finally, we cover several anti-corruption mechanisms proposed in the literature and discuss their relative merits as devices to control or eliminate illegal activities.

KEYWORDS: Corruption, Bribes, Deterrence, Bureaucracy, Competition, Game Theory, and Mechanism Design.

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1 INTRODUCTION

It is widely acknowledged that corruption is one of the most important factors affecting the creation and the distribution of wealth around the word. Nowadays, there is a consensus that corruption not only leads to redistribution of surplus, but also generates many distortions in the economy. Its consequences range from poverty to lack of investment or poor education indicators. Corruption ranks high in the list of concerns not only for the public opinion but also for governments and international organizations. Thus, national policies, but also supranational efforts to curve corruption abound. A leading example is the OECD's "Convention on Combating Bribery of Foreign Public Officials in International Business Transactions", but similar projects have been launched by the World Trade Organization, the United Nations, or the Council of Europe.

Economists have not ignored this concern. The last decades have witnessed a surge of research in economics, both theoretical and empirical, with corruption as its main issue. This paper surveys in a structured fashion some of the main lines of that research. On the theory side, our emphasis will be on how microeconomic analysis, including game theory and mechanism design, have contributed to our understanding of the mechanisms of corruption and to the design of public policies devoted to fight it. On the empirical side, we will review empirical and experimental literature that helps understanding the economic impact of corruption, as well as to test the validity of the theoretical results and the assumptions under which they are derived.

Our starting point is the standard model of corruption based on a principal-supervisor-agent (client) setting, which we discuss in Section 2. In this model, the principal –society, the public, or its representatives– delegates some task to a supervisor. The supervisor's decisions affect third parties or clients –citizens, entrepreneurs, regulated firms–. Corruption arises when these third parties and the supervisor –official– collude to take the "wrong" decision; that is, a decision that is not optimal for the principal, but one the client prefers. We discuss optimal delegation contracts that take into account this possibility of collusion (corruption). Preventing corruption is costly,

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and so one of the questions is under what conditions it is optimal to prevent corruption completely.

The core of corruption is the agreement between the official and the third party. In Section 3, we focus on the details that characterize the negotiations leading to these agreements and their stability. Apart from the issues that affect any sort of negotiations –e.g., asymmetric information– , corrupt agreements face an additional complication: their illegal nature. That is, parties cannot count on the instruments of law –and its courts– for enforcement. The deal faces the "hold-up" problem, and this in turn may be used by the principal to prevent or hinder corruption.

After discussing the three-tier, basic model of delegation and corruption, we open the lens to include in the field of vision the context in which corrupt deals take place. Thus, in Section 4 we review the trade-off between the costs of corruption and the market failures that justify regulation or, in general, public intervention. The focus is then switched to bureaucracy, its size, its compensation, incentives and selection.

An even wider angle is needed to discuss the deeper sources of corruption. In this regard, it is often argued that the existence of rents that can be illegally appropriated is a prerequisite for the existence of corruption. Also, lack of competition in the market generates rents. Therefore, improving competition is a recipe for reducing rents and, it is argued, this also leads to less corruption. Rose-Ackerman (1996) summarizes this idea when she writes that "in general any reform that increases the competitiveness of the economy helps reduce corrupt incentives." We review this allegation in Section 5. We also discuss competition on the supply side, that is, among bureaucrats. Indeed, the literature has discussed several ideas on how to organize the bureaucracy –one-stop, sequential approval, job-rotation, etc.– in order to minimize the impact of corruption. We will survey some of these discussions and those related to how market structure and bureaucracy structure may interact.

Section 6 will close the loop in theoretical discussion by returning to contract selection and exploring in depth public procurement. A recent literature has discussed at some length how corruption affects the performance of given procurement mechanisms. Here also the relationship

between corruption and competition is central. Indeed, bribery may be not only an instrument for rent extraction, but also a device that facilitates collusion. But the cuasality may also go in the opposite direction: the number of competitors affects the incidence of corruption. Moreover, these relationships are often subtle. Also in Section 6, we will discuss a few papers that study the design of optimal procurement mechanism in the presence of potentially corrupt agents.

Many theoretical aspects will be left outside the scope of this paper, some of them central to the legal and sociological analysis of corruption –culture, social norms, trust–, some also widely discussed in development economics and political economy. However, before turning to the empirical literature, we will briefly discuss one of them: corruption as a problem of –society's–multiple equilibria. Corruption and the rule of law may be two alternative, general traits of society when the returns of individual corrupt behavior depend –positively– on the prevalence of that behavior. This is the topic that we will discuss in Section 7.

After reviewing the theoretical literature, we turn to empirical issues related to corruption. The first of these has to do once more with the illegal nature of corruption: it is difficult to obtain good data on corruption, and so measuring its incidence is challenging. In Section 8 we discuss different methodological approaches to deal with this problem. We also review the most relevant empirical evidence related to corruption using three different sources: cross-country, macro evidence; results derived from field experiments; and evidence derived from lab experiments. Finally, in Section 9 we review the empirical research most closely related to our theoretical analysis: the individual incentives of bureaucrats to participate in corruption and the industrial organization aspects of bribing markets.

2 Delegation and agency

Agency theory provides the standard model of delegation in economics. It portrays the relationship of a principal and her agent. The principal draws the terms of the relationship, specifying compensation and instructions for the agent who enjoys better information or ability, but also

has its own goals. In the framework of the rules, the agent is vested with the power of taking decisions on behalf of the principal.

That framework is appropriate as a first step in describing the context of corruption: a principal –society, the public, or its representatives– drafts rules and entrusts the "power" to take certain decisions –issue a license, inspect and report on tax returns or emissions– in applying these rules to better informed officials. These decisions, on the other hand, affect third parties –citizens, entrepreneurs, regulated firms–. Corruption is the abuse of entrusted power to bend the rules – take the wrong decisions– for private gain, most often as a result of illegal –voluntary or imposed– transactions with the affected third party.

Following the seminal paper by Tirole (1986), early works in agency theory model corruption indeed as a form of collusion between an official –bureaucrat– and an entrepreneur that the former is supposed to supervise.[1] A canonical model in this literature is Laffont and Tirole (1991), where an agency is in charge of regulating a firm with unknown costs. In the traditional regulation model, the principal –Congress– faces an information disadvantage with respect to the firm. The firm's information relates to its costs, which may be high or low. The cost of any level of output may also be affected by private, unobservable effort –resources– that the firm puts into the activity. Effort imposes a private cost for the firm, $\Psi(e)$ which does not show in the accounting books. The principal designs rules that instruct the firm to produce a level of output q and also to put an amount of effort e into the activity, and the pair (q, e) could vary by "type" of firm, in exchange for some compensation that at least covers the firm's total costs. The instruction must be incentive compatible. That is, the firm must have incentives to choose the level of output and effort that corresponds to its true cost function.

Let $\beta \in \left\{ \underline{\beta}, \overline{\beta} \right\}$ be the two possible types of the firm, and $C(q, e; \beta) = (\beta - e)q$ the cost function for each of the types. The objective for the principal is to maximize the expected surplus for society, taking into account that public funds have a shadow cost. The asymmetry of information

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[1]Robert Klitgaard (1988) with his influential book about corruption contributed to popularize the principal-agent-client approach for describing and analyzing most models of corruption.

between the principal and the firm is modeled by assuming that β is the realization of a random variable that the agent –but not the principal– observes and takes the value $\underline{\beta}$ with probability ν and $\overline{\beta}$ with probability $1-\nu$. The asymmetry of information allows the firm to obtain information rents: a low cost firm can always claim that its costs are high, then produce the output $\overline{q}$ and incur the accounting costs $(\overline{\beta}-\overline{e})$ expected from a high cost firm, but do so at a lower private cost: $\Psi\left(\overline{e} - \left(\overline{\beta} - \underline{\beta}\right)\right)$ instead of $\Psi(\overline{e})$. Thus, for the firm to have incentives to claim low costs when it does have low costs, it must expects profits (rents) of at least $\pi(\underline{\beta}) = \Psi(\overline{e}) - \Psi\left(\overline{e} - \left(\overline{\beta} - \underline{\beta}\right)\right)$.

A specialized agency may improve matters for the principal by working close to the industry and so collecting industry-related information. Suppose that such agency may obtain (hard) evidence on the true value of β with probability μ. With that probability, and as long as the agency may be trusted to report truthfully, the principal won't need to pay the extra profit $\pi(\underline{\beta})$. But the agency may choose not to report truthfully, i.e., may hide information obtained. Corruption –capture– here would mean exactly that: an agreement –collusion– between the firm and the agency by which, in exchange for a bribe, the agency claims not to have obtained any evidence on β when it actually has obtained it.[2]

Laffont and Tirole investigate the optimal regulation scheme (effort and outcome) and agency compensation policy when the agency is corruptible. In order to prevent an agreement between agency and firm as to hide the former's information, the principal must compensate the agency with a bonus s whenever it produces evidence of the firm's low costs. This is the extra cost that corruptibility imposes on the principal. Still, the use of an agency has its positive side: when information is obtained by the agent, the principal saves the information rents $\pi(\underline{\beta})$. The parameters of the optimal regulation and compensation scheme, s, $\overline{e}$, $\underline{e}$, $\overline{q}$, and $\underline{q}$ balance the costs for the principal of distortions and rents.

This suggestive model may be taken as the starting point of our tour of the microeconomics

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[2]Interestingly, Kessler (2000) shows that collusion between agent and firm does not impose any cost on the principal if what the agent can monitor is the choice of effort, e, –the moral hazard aspect– rather than the cost structure, β, –the adverse selection parameter–.

analysis of corruption. We may take from it that even a corruptible agent may be of some value to the principal. The cost corruptibility imposes, the addition of a coalitional incentive constraint, must be compared to the cost linked to the "market failure" that it is supposed to address, a theme that later will be taken up by Acemoglu and Verdier (2000). However, this concise model abstracts from most of the interesting nuances related to corruption.

To begin with, the model concludes that it is always in the interest of the principal to make sure that corruption is prevented. But this "equivalence principle", first stated in Tirole (1986), does not generalize. As Celik (2009) has shown, when the firm may have more than two types, incentive compatibility of agent and firm may not be separable and the "equivalence principle" may fail. Moreover, agents may be honest or dishonest, or having different propensities to participate in corruption transactions. Tirole's "equivalence principle" is also not robust to situations in which the agent's propensity for corruption is not common knowledge. Kofman and Lawarree (1996) and Strausz (1998) have shown that it may be optimal for the principal to allow some corruption when there is asymmetric information over the agent's (corruptibility) type. Also, the model assumes bribery, as opposed to extortion: the agent can hide information, which is in the interest of the firm, but cannot produce false evidence against the firm, claiming, for instance, that the cost is low when it is in fact high. Khalil et al. (2010), in a model very similar to Tirole (1986) but with the possibility of forgery of (soft) evidence, show that when choosing among two evils, bribery and extortion, it may be worth accepting the former so as to prevent the latter. Note that bribes are always a cost to the firm, so that extortion imposes a cost on good behavior whereas bribery imposes a cost on bad behavior.[3]

The model also assumes "efficiency in collusion". That is, with probability μ, agent and firm know each other's information, so that their negotiations always lead to agreement when there

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[3]However, there are situations where bribing (capture) may be socially more costly than extortion. Auriol (2006) adapts Tirole's model to a procurement setting in which due to transaction costs, the optimal policy is to organize an open tender only for large purchases. The agent has private information regarding the uncertain demand. If demand is high, and it is optimal to organize an open tender, the firm may bribes the agent to avoid it. Then, capture leads to an inefficient decision. If the demand is low, the agent can threat the firm with organizing an open tender when it is not optimal to do so. In equilibrium, extortion only implies a redistribution of rents between the firm and the agent but the optimal policy is implemented.

is room for it. But typically information is not symmetric even between agents and firms, so that collusion is itself a problem. More importantly, the asymmetry of information, and so how difficult these agreements are, and then how corruptible the agent ends up being, may depend on the rules drafted by the principal. This research question has been pursued by (Baliga and Sjostrom, 1998) in a static setting and by (Pechlivanos, 2005) and (Chassang and Padró-i-Miquel, 2014) in an repeated game framework.

The difficulties of corrupt agreements do not only come from asymmetries of information between agent and firm, but also from what is sometimes termed the "hold-up" problem: being typically illegal themselves, these agreements cannot be enforced by courts of law, and so the parties need to find ways to make them self-enforceable. Career design for officials, penalties and rewards, and other instruments, affect the difficulty that agents and firms would find in getting to credible agreements. (E.g., Lambert-Mogiliansky et al., 2008, Buccirossi and Spagnolo, 2006, Dufwenberg and Spagnolo, 2015.) This is another point worth investigating.

Also, the model that we have discussed deals with giving the firm incentives –to exert effort, to reveal type–, whereas the probability that the agent obtained information, μ, was assumed exogenous. But finding information may be a costly activity itself, so that the probability of success may depend on the agent's effort. Giving the agent incentives may then be another issue in dealing with corruption. Here subtle questions may come to the fore. (Mookherjee and Png, 1995.) For instance, collecting a bribe may itself become a motivation for the agent to put effort into collecting information, and so there is a delicate balance between compensating officials, fighting bribery, and making regulation a success. Likewise, the selection of officials, when candidates may have differences in their cost –shame, for instance– of entering into illegal activities, may be a issue worth investigating. (Besley and McLaren, 1993.)

We will next discuss these and some other questions that pop up when we look to less abstracts models of the relationship between principals, their agents, and affected third-parties.

We may start by reviewing some of the issues that agents and firms find when aiming at illegal agreements. As we have mentioned in the previous section, an illegal agreement (bribe in exchange for bending the rules) is always tainted by fragility. If a firm pays an official a bribe –say, in cash– in exchange for an illegal "favor", and the official does not deliver, the firm may not enforce the "contract" by bringing it to a court of justice. Or vice versa: if the firm obtains the favor before the bribe is paid, the official cannot take the firm to the court if the firm does not honor its promise. If the official –agent– and the firm interact repeatedly, the loss of future –illegal– benefits may be sufficient to prevent defection, just as with collusion in oligopolist markets. Lambert-Mogiliansky et al. (2008) study a model with these characteristics. An official –bureaucrat– in charge of issuing –on behalf of the government– licences to operate in a market meets an entrepreneur who may qualify for the task and have a willingness to pay for the license, v, which is her private information. From the point of view of the official, this valuation is a draw from a random variable. The entrepreneur must first incur some cost $c > 0$ to prepare the application. But when the entrepreneur shows up in the official's window, the official may decide to ask for a bribe b in order to issue the license.[4] Just as in the "lemons problem", a one shot game between entrepreneur and official will result in the entrepreneur never incurring the cost of application: If she expected a bribe b, then she would incur the cost if $v - c \geq b$. Thus, when the entrepreneur shows up in the window, the bureaucrat's beliefs must be that the entrepreneur has a valuation $v \geq b + c$, and so he should ask for a bribe b' that is higher than the initial one, but we can repeat the argument for b', and so on. This is the type of hold-up problem that prevents "trade" between the entrepreneur and the official. The outcome is not only very inefficient socially –if the entrepreneur does qualify for the license– but also for the parties involved. The bureaucrat would prefer committing to a bribe, but there is no enforceable contract that she may offer to

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[4]Note that this is a model of extortion.

that effect.

Repetition, but also reputation, is a way out of this dilemma. If a sequence of entrepreneurs visit the window and observe previous bribe demands, then bribery –and license issuing– may be an equilibrium. Each entrepreneur incurs the cost if they observe that the same –equilibrium– bribe, say b^*, has always been demanded in the past, provided their willingness to pay is $v \geq b^* + c$. But they never incur the cost of application if they observe that some other bribe has been demanded before. For sufficient low discount factor, in equilibrium indeed the official prefers to behave as expected by the entrepreneurs. The cost of loosing the reputation, and then not receiving applications –and bribes– in the future is sufficient to restrain the official from "exploiting" an applicant that has shown up, implying a valuation $v \geq b^* + c$, by demanding a bribe of at least $b^* + c$.

Another, ancient way that parties may use to solve the hold-up problem is to exchange hostages. In the case of corruption, a piece of evidence of illegal payments or exchanges may serve as a "hostage": If one of the parties does not deliver, the other may threat with coming forward with the evidence, which would penalize the deviant. Of course, the drawback of such hostage is that evidence incriminating one party also incriminates the other. Threatening with shooting one's foot may not be credible, which renders the hostage useless.

Related to this, Buccirossi and Spagnolo (2006) have pointed to subtleties that may turn well-intentioned policies designed to thwart bribery into weapons to make it possible. In particular, they discuss how leniency policies, whereby a reporting party may be exempted from penalties, may in fact make otherwise unfeasible bribery possible. Indeed, that policy turns the threat to come forward credible, and so makes it a useful hostage. Free from penalties, a party's threat of reporting becomes credible, and then bribery may be sustained.

A particular form of leniency proposed in 2011 by Kaushik Basu became the center of a heated debate. With India and harassment bribes –extortion– in mind, Basu proposed to make bribe-giving not only legal, but also a way of recovering any bribe paid. The measure could be coupled

with double fine for bribe-taking officials. (See Basu et al. 2014.) There were several issues with the practicality of this measure, and the lack of trust on the police, i.e., on the "officials" in charge of receiving the report and acting upon it, was not the lesser of them. But even without this problem, Dufwenberg and Spagnolo (2015) have pointed to some other aspects that may render the policy counterproductive. Indeed, assume that the bureaucrat has to put some effort into studying the application for a license, for instance to check that the application meets the requirements.[5] A bribe may then be the reward for that effort. Without Basu's policy, the entrepreneur would have to bribe the official, but then the license would be issued. On the other hand, if Basu's policy is implemented, and if the bribe is paid and the license issued, then the entrepreneur would have incentives to report the bribe and get it refunded. Anticipating this, the bureaucrat will not ask and get a bribe, but will not spend the effort in issuing the license either. Corruption would be eradicated, but if the license is socially valuable, the remedy may not be all that positive.

On the contrary, if not issuing a license when it should be issued had a cost for the official –perhaps because lack of diligence may be detected and punished–, things change drastically. Here again repetition of interaction is crucial. Suppose that entrepreneurs apply for licenses in sequence. Without Basu's policy, the bureaucrat may refuse to issue a license if a bribe is not offered, and issue it otherwise. Each entrepreneur would offer the bribe as long as the license had been issued anytime in the past that the bribe was offered, but would not offer it otherwise. As before, reputation sustains this as an equilibrium if the bureaucrat is sufficient patient. The result would be that licenses would be issued, and bribes paid and not reported. But if Basu's policy was implemented, this equilibrium would no longer be possible: each entrepreneur would have an incentive to report the bribe once they had obtained the license. Under the policy, the bureaucrat would never ask for or accept a bribe, and yet she will issue the licenses since not doing so is now

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[5]Dechanaux and Samuel (2012) analze a model where the inspector must exert effort in order to find hard evidence, and the entrepreneur can either pre-empt inspection or offer bribes ex-post. They also consider the hold-up problem that we have discussed and repetition as a way to enforce illegal dealings.

costly. Thus, licenses would still be issued and bribery eradicated.

On the same theme on the effect of intervention policies and their effect on the dealings between officials and entrepreneur, Chassand and Padró-i-Miquel (2014) have recently studied the efficacy of "whistle-blowing" and the limits of it. Here the issue, rather than bribery, is how well the entrepreneur who is not complying with regulation may infer that the official –or some employee– has reported that non-compliance. By introducing noise into this inference, for example by not always intervening upon a report by a whistle-blower, the principal may complicate that inference, making it more difficult for the entrepreneur to retaliate, which makes it safer for the whistle-blower to report.[6]

4   Size, selection, and compensation of the bureaucracy

As we have mentioned in Section 2, the costs of bureaucratic corruption must be weighed against the market failure that the bureaucracy is designed to correct. Against the view, sometimes defended vehemently (e.g., Shleifer and Vishny, 1994),[7] that regulation and public intervention only extract rents and impose inefficiencies, other scholars have analyzed the trade-off between the inefficiencies associated with regulation and the costs from market failure that motivates that regulation. Regulatory capture or bribery is one of the potential costs of intervention. Acemoglu and Verdier (2000) take this approach and model the trade-off between allocating resources (human capital) to regulation and allocating them to entrepreneurship. They assume a fixed amount of potential entrepreneurs who make their career choice between productive activities and bureaucracy. The reward of the latter is a wage, w, set by the government, whereas the payoff for the former are the profits in the market. These may be obtained using a "good technology", privately more expensive but "clean", or a "bad technology", cheaper but imposing a negative

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[6]Pechlivanos (2005) also analyzes a principal–agent–firm where the repeated interaction is the mechanism for enforcing corrupt contracts. The principal may decide to implement the agent's decision or to review it. Most interestingly, it is optimal for the principal to make the auditing not observable by the firm. By doing so, he introduces noise into the agent-firm relationship, making the corruption transaction less likely.

[7]An influential book by De Soto (1989) analyzing the costs imposed by bad regulation in Peru has been widely used to support this veiw, although De Soto himself was rather discussing regulatory –formal sector– reform.

externality on society.[8] The government regulates the market by imposing taxes, τ, on the bad technology –and/or subsidies for the good one–. However, implementing this policy requires inspection, and so requires a bureaucracy. The larger the size of the bureaucracy, the larger the number of "firms" that can be inspected: inspecting one firm requires hiring one bureaucrat. Taxes –and subsidies– and wages determine the expected profitability of each occupation, and so the career choices of individuals. A certain size of the bureaucracy is necessary for the probability of inspection to be large enough so that entrepreneurs choose the good technology. On the other hand, the larger the bureaucracy the larger the resources diverted from production.

The authors then assume that bureaucrats are corruptible –and bribery is detected with an exogenous probability, θ, resulting in the bureaucrat been fired. In fact, bureaucrats, if corrupt, become bounty-hunters: they simply ask each entrepreneur they inspect for a share, α, of the cost they could impose with a bad reporting, and this irrespective of the true technology. That is, the tax, τ. Thus, a corrupt bureaucracy is a total waste: whether inspected or not, entrepreneurs do –privately– better by choosing the bad technology. Therefore, the real choices for government are either laissez faire (no bureaucracy) or a bureaucracy without incentives to be corrupt. This requires a wage $w \geq \frac{1-\theta}{\theta}\alpha\tau$.

A bureaucracy, one that is also corruptible, imposes a cost, but this cost makes it possible fixing a market failure: an externality that would otherwise result in the choice of the wrong technology. In fact, corruptibility calls for a larger bureaucracy: the larger the probability of inspection the lower the taxes, τ, needed to induce entrepreneurs to choose the good technology –a tax that is not collected if regulation succeeds– and so the lower the wage needed to prevent corruption, w.

Note that the wage w must be above the reservation utility of the bureaucrat. That is, corruptibility demands an "efficiency wage". For the threat of dismissal to be sufficient to prevent corruption, the wage in the bureaucracy must be larger than in alternative occupations. Thus,

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[8]Formally, the authors assume that it is the good technology that generates an externality, but a positive one.

large bureaucracies with high wages may not be sufficient evidence to conclude that a bureaucracy is always pure waste, but a necessary cost for reaping the benefits of regulation.

The trade-off between the cost of inducing honest behavior by the bureaucrat and its benefits is also the topic of a study by Besley and McLaren (1993). They take the size of the bureaucracy and also the proportion, ν, of entrepreneurs or citizens abiding by the regulation as given.[9] Suppose the tax, τ, is exogenous, perhaps set by the legislative. The authors consider the possibility that potential bureaucrats are heterogenous in type. In particular, each hired bureaucrat may be dishonest with some probability, γ, just as they were in Acemoglu and Verdier (2000). But with probability $1 - \gamma$ she is honest and would never take a bribe. Also, a bribe payment is detected with probability θ.

In the face of this, the government (principal) has three possible policies when setting the compensation w: pay efficiency wages, which will discourage even dishonest bureaucrats from taking bribes; pay reservation wages, which will attract both types of potential bureaucrats but do not prevent dishonest ones from taking bribes; and pay what the authors call capitulation wages, that is, wages below the reservation wage which will attract only dishonest bureaucrats, lured into the bureaucracy by the prospect of obtaining additional, illegal income $\alpha\tau$. The authors embed this framework in a dynamic model where some bureaucrats retire in each period for exogenous reasons, and a portion θ of illegal dealings is detected. The first policy is the most expensive, but results in a bureaucracy that "acts" always honest. The second policy is less expensive but some bribery occurs in every period. Dishonest bureaucrats are caught and fired, and are replaced by average bureaucrats, so that with time the bureaucracy improves. Finally, capitulation wages only attract dishonest potential bureaucrats, so even if caught taking bribes, there is no reason to fire a bureaucrat. Such bureaucracy is the least expensive, but corruption is totally widespread.[10]

Note that, although the authors do not explore this issue, a highly paid bureaucracy would be

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[9]The authors present their model in terms of tax-compliance inspection, so that what is taken as fixed is the proportion of tax-payers who owe a tax τ.

[10]The authors discuss what is the best policy for the government and argue that efficiency wages (high compensation and high honesty) is best for rich countries, but one of the other two may be best for less developed realities.

associated to a higher cost of not complying with regulation (if inspected, τ) for the entrepreneur, whereas lower wages in the bureaucracy would be associated to lower costs of non compliance: if inspected, τ if the bureaucrat is honest –i.e., never with capitulation wages– but only $\alpha\tau$ otherwise. Thus, if the level of noncompliance was the entrepreneur's decision, a less expensive bureaucracy would be a less powerful instrument to correct the market failure.

Mookherjee and Png (1995) allow for this decision on the part of the entrepreneur. For instance, we may let the social harm imposed by a technology, x –say, pollution– to be a continuous variable, so that the tax owed by an entrepreneur who chooses a value of x is τx. We may also assume that finding out evidence of this harm is costly for the bureaucrat, so that μ is a function of –private– effort e, and effort has a cost of $\Psi(e)$. The bureaucrat is expected to report the value of x, and in that case gets a compensation of wx. However, even if she finds evidence, she may decide not to report and solicit a bribe, a transaction that is exogenously detected with probability θ and, if detected, results in a penalty $p_b x$ for the bureaucrat. Both τ and p_b are chosen by the legislative, and so are not the government's choices. The government can only choose the bureaucrat's compensation w.

Suppose that

$$\tau(1-\theta) > w + \theta p_b. \tag{1}$$

The left hand side is the entrepreneur's gain per-unit of x of not been reported, and the right hand side is the bureaucrat's cost per unit of x not reported, having obtained evidence. If (1) holds, then even if evidence is obtained, the bureaucrat and the entrepreneur can mutually agree on a bribe so that the bureaucrat does not report when she finds evidence. We may assume that they share equally the proceeds in this case. If (1) is violated, then corruption is prevented, but otherwise the bureaucrat never reports. The entrepreneur and the bureaucrat play a simultaneous-move game when choosing x and e respectively, although the payoffs of the game are different depending on whether (1) holds or not.

It may be easily shown that, for a total surplus maximizing government, the optimal policy

is to set w so as to prevent corruption –(1) is reversed–. Then, the payoff for the bureaucrat is $\mu(e)wx - \Psi(e)$. Therefore, if Ψ is convex, effort is increasing in w, and as a consequence the equilibrium choice of x is decreasing in w, since the probability of detection is increasing in w.

Note that the government has two objectives when choosing w: give the bureaucrat incentives for diligence, and also prevent corruption. (Also note that, as opposed to what was the case in Section 2, this model deals with providing incentives to the "inspector", not to the agent.) The prospect of soliciting a bribe from the entrepreneur is an alternative motivation for the bureaucrat to put effort into finding evidence. However, when distinguishing between bribery-induced and indolence-induced underreporting is possible, bribery is never an efficient way to provide incentives.

Things are different if what the government detects with probability θ is the size of the harm x when it is not reported, but distinguishing when is this due to bribery or to the bureaucrat having failed to find evidence is not possible. In that case, having two objectives and only one instrument, and under some conditions (e.g., the marginal cost of effort not being very increasing), totally avoiding corruption may be too costly and then suboptimal.

5   COMPETITION

Competition, that is, the "industry organization", is a recurrent topic in the literature on corruption, whether it refers to the "supply side" –bureaucrats or officials– or the "demand side" –entrepreneurs or firms–. In fact, the latter is one of the "usual suspects" when it comes to explaining the origin of corruption. Rents, either from market power or from natural resources, would be the booty on which corruption would prey, and so the ultimate cause of corruption. (Ades and Di Tella, 1999, were perhaps the first to document the relationship between rents and corruption.) Taking this point a little further, competitive markets should then be free from the threat of corruption.

The problem with this view is one of causality and also one of implication. Should we see the

number of firms in a market, or equivalently, price-taking behavior, as a sign of the absence of corruption? Is the existence of rents a pre-requirement for corruption to exist? Bliss and Di Tella (1997) argue the fallacy behind these conclusions. Consider an industry of small firms $i \in [0,1]$ with heterogenous entry (sunk) costs k_i who need to obtain a license from a corrupt official. The official does not observe the entry cost of applicants for the license, and can set a bribe b –on top of, say, a legal entree fee r that perhaps is motivated by an externality–. If firms have constant and common marginal, they will enter only if $k_i \leq b + r$. Thus, only $F(b+r)$ firms would enter, and the official would appropriate $bF(b+r)$ bribe revenue. Optimally, the official would set a positive b^*, that solves

$$\max_b bF(b+r). \tag{2}$$

Corruption introduces a wedge between between average cost and price, and the bribe allows the official to appropriate the difference. That is, corruption generates its own rents even though firms are price-takers.[11]

This model is consistent with the already mentioned view that any –or, at least, most– regulation is simply a way for a class of politicians or officials to extract rents. Absent any reason to limit entry, corruption would be viewed as –one of– the instruments to cash those rents.

In a recent paper, Amir and Burr (2015), and building on similar arguments, put the emphasis on how corrupt officials have a vested interest in shaping the structure of the industry so as to also affect behavior. That is, if firms are not price-takers, by limiting entry the official may not only affect the number of firms, but also the margins over prices and so firms profitability. In fact, if firms are not small, rents are maximum when only one firm operates, and so the best that a corrupt official can do is to issue only one license and then extract –a fraction of– monopoly profits.

The authors also consider the case of a pre-existing industry with some already licensed firms,

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[11]Bliss and Di Tella (1997) distinguish "deep competition" from competition: if the profits upon entry depend on some efficiency parameter, then the higher the efficiency the higher the profits upon entry that firms can make and the official can extract through bribes. The effect of this "deep competition" on the rents that the official can appropriated has an ambiguous sign.

or the presence of some firms that have opted to operate in the "shadow economy" –i.e., without a license–.[12] The official will limit entry, but under quantity competition, this time she may allow for entry of more than one firm. From a second-best point of view, and depending on the existing number of firms, total entry may be too large or too small.

Amir and Burr (2015) also investigate the other side of competition, i.e., competition between officials. This supply-side aspect of competition has been present in the theoretical and practical debate on corruption at least since Rose-Ackerman suggested that it may be an instrument for corruption control. (See Rose-Ackerman, 1978.) Continuing with the example of license issuing, there are two ways –at least– in which officials may "compete". First, more than one official may be authorized to issue the same license. Second, more than one license, issued by different officials, may be required to operate. Note that in this second case the "goods" sold by the different officials are complements. That is, officials are in a vertical relationship, and do not exactly –horizontally– compete.

Shleifer and Vishny (1993) consider this second case. As in any problem of complement goods, each official imposes a vertical externality on the other when deciding how high a bribe to solicit from entrepreneurs. The externality results in double-marginalization, which implies bribes in excess of what is bribe-revenue maximizing. Thus, as in the case of vertically related producers, centralizing the issuing of licenses would result in higher rents for the official(s), but also a lower burden for the entrepreneur and so higher entry and welfare.[13]

Shleifer and Vishny assume simultaneous moves by all officials in charge of issuing licenses. If,

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[12]Choi and Thum (2005) explore the relationship between the "shadow economy" and the ability of corrupt officials to distort the working of the market. Instead of asuming the selection between the official and the shadow economy as exogenous, as Amir and Burr (2015) do, they consider explicitly the entrepreneur's choice between applying for a license and operate in the underground economy. They show that this second option severely limits the official's ability to extract bribes and mitigates the distoritions it creates.

[13]Celentani and Ganuza (2002b) explore a different type of externality and obtain a similar result. Consider a principal that delegates into a group of agents (bureaucrats) the contracting of some service with a group of providers. The principal sets the level of quality/production and he is aware that a bureaucrat can allow to a provider to supply a lower level of quality in exchange of a bribe. Bribes and corruption profits are increasing in the quality required. Taking as given, penalties and monitoring probabilities, the principal best response is to set lower levels of required quality when he expects higher level of corruption. If agents take decisions individually and do not internalize the externality, the number of corrupt transactions is high but profits for corruption (and welfare) are low. On the contrary, if bureaucrats take the decision jointly, they would maximise their profits by reducing the number of corrupt transactions, increasing also total welfare.

on the contrary, licenses must be obtained sequentially, the same type of vertical externality results in the same type of result: solicited bribes are too high with respect to the revenue maximizing levels.[14] That is, vertical competition is not a good prescription to mitigate corruption, and a "single window" for obtaining all the required licenses may be advocated based on, among other benefits, its effect on bribes.

Renewal of licenses may be regarded as nothing but a particular case where entrepreneurs need several licenses and apply to them in sequence. However, it introduces novel nuances, in particular a credibility problem for the official that is reminiscent of the one faced by the durable-goods monopolist. As Choi and Thum (2003), suppose the entrepreneur needs to apply for a license in each of two periods, and as in Bliss and Di Tella (1997), suppose the official does not know the entrepreneur's –per period– fixed cost, k_i, when they first meet.[15] If the official could commit to the bribe she will solicit in each period, she will choose b^* that solves (2). Entrepreneurs with fixed costs below $b^* + r$ would apply in the first period, and the rest would never apply. But if the official can't commit to honor her promises, she would be unable to commit not to solicit in the second period a lower bribe, b_2^n, to firms that did not apply in the first period, so as to

$$\max_{b_2^n} \left[F(b^*) - F(b_2^n) \right] b_2^n.$$

Expecting this, an entrepreneur with a fixed cost k_i above, but close to, $b^* + r$ will not apply in the first period.

Consequently, charging b^* in both periods without price-discriminating between new and old applicants is not an equilibrium if the official has no means to commit. In equilibrium, the official will in fact solicit a bribe b_1 which will induce less entry in the first period –entrants have fixed cost strictly lower than $b^* + r$–, and will price-discriminate entrepreneurs in the second period, depending on whether they are applying for renewal or are applying for the first time. The bribe

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[14]However, Lambert-Mogiliansky et al. (2008) and Lambert-Mogiliansky et al. (2007) show that reputation or repetition of this applications to the track may result in opposite results.

[15]Choi and Thum (2003) model the asymmetry of information in terms of the value of the license, v, rather than the fixed costs.

solicited to the latter will be lower than b^*, so that in the second period entry will be larger than with commitment.

Choi and Thum (2003) use this model to investigate one often-suggested measure for curbing corruption: job-rotation.[16] Replacing the official in charge of a particular task can have positive effects for different reasons, like difficulting reputation building and revelation of (corrupt) types. In the present context, job-rotation makes price-discrimination more difficult. The authors compare the results obtained when one official is in charge of issuing the license in both periods with an alternative model where the official is replaced –with some probability– by a new official in the second period. This unambiguously results is more entry, and so higher welfare, if the new official does not observe who obtained a license in the first period. But if renewal is distinguish from first-time application, the results are ambiguous.

But let us return to "horizontal competition" among officials. Amir and Burr (2015) obtain that the horizontal externality between officials will increase entry, so that optimally granting the right to issue licenses to more than one official increases entry and welfare. Although the authors do not analyze price –bribe size– effects of competition, this is probably the sort of result that is behind the idea that competition among officials may help control bribery, as argued by Rose-Ackerman (1978). Drugov (2010), one of the first attempts to formally analyze this issue, points to more subtle effects of competition. He considers its effect on the price –i.e., on entrepreneurs' outside option when bargaining with corrupt officials–, and also on the incentives for entrepreneurs to invest in compliance, as in the model by Mookherjee and Png (1995). Entrepreneurs may have different costs of compliance, increasing in the negative externality they create if they do not comply. Officials may be honest or dishonest.

With a monopolistic official, if a firm does not incur the cost of qualification –compliance–, then she may risk facing an honest official who would not issue a license. If, on the other hand, the official happens to be dishonest, the entrepreneur would obtain the license but would be asked

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[16]See, for instance, Transparency International (2006).

to pay a bribe, both whether qualified or not. Thus, the trade-off is between saving in expected costs of compliance and risking not obtaining a license.

If many officials can issue the license, unqualified entrepreneurs who meet an honest official don't get a license, but then can reapply –at a cost of delay, perhaps– to other official and this time be luckier. Eventually, she will get a license. Thus, taking the decision to invest in compliance as given, the monopoly results in less licenses being issued to unqualified entrepreneurs, and so less social harm.

However, the outside option of qualified entrepreneurs is larger under competition. Indeed, a qualified entrepreneur who has the misfortune of meeting a dishonest official will have to pay a –extortion– bribe if she is to get a license. Its outside option is to give up the profits it can make in the market. On the contrary, under competition, the entrepreneur can try her luck with a new official, hoping to find an honest one. Thus, competition among officials increases the entrepreneur's outside option, so that the expected bribe is lower, if the bribe is endogenously set by negotiations.[17] Thus, ex-post, the monopoly regime results in –larger bribes but– ex-post better allocations, whereas the competition provides stronger incentives to compliance.

The papers offers one more example of the subtleties behind proposed reforms and the relationship between bribes and compliance, one that links to the observation by Khalil et al. (2010) that extortion is a bigger problem than bribery. For suppose that bribery, but not extortion, is the problem. Since monopoly increases the bargaining power of dishonest officials, and so the size of the bribe, monopoly unambiguously results in more compliance and lower harm.

6   BRIBE COMPETITION AND BACK TO DESIGN

In the previous section we have used the metaphor of a market (or a vertically related structure) to describe corrupt transactions. Potential suppliers of a essential input (license, for in-

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[17]Drugov (2010) analyzes a little richer model, where an unqualified entrepreneur who meets an honest official, whether under competition or monopoly, can invest in qualifying and then reapply at a cost, say of discounting.

stance) trade with potential producers that use that input. We have discussed competition by the upstream suppliers and competition downstream. We may extend the metaphor to discuss competition among upstream buyers, the best example of which is public procurement.

Public procurement is managed by public officials who are instructed to follow very detailed rules to select both the terms of the contract and the identity of the contractor. Also, public procurement has often been found to be tainted by widespread corruption. Documented cases abound of officials –and relevant personalities with influence over officials– taking bribes to bend the rules so as to favor one supplier or to improve for her the terms of the transaction. Bribes have also been instruments to secure collusion among suppliers.

The theoretical literature has investigated several ways in which corruption may take place in procurement auctions. One is favoritism: the official in charge –auctioneer– may reveal the –honest– winning bid to some favored, pre-contacted bidder (Arozamena and Weinschelbaum, 2009, Burguet and Perry, 2007, Koc and Neilson, 2008), or some bidder she selects ex-post (Lengwiler and Wolfstetter, 2010, Menezes and Monteiro, 2006). The favored bidder can then change her bid to match a rival better bid or to improve her winning own bid.

This type of "favoritism" is also analyzed in Burguet and Che (2004), and Compte et al. (2005), but adding bribe competition. That is, the official bends the rules in favor of one supplier, but who that supplier may be is determined by bribe competition among all of them. On first look, bribe competition may be considered just another form of price competition, so that the effect of bribery would be an increase in the price that the principal –government– pays for the supplies: supplier who is in a better position to bid lower –a low cost supplier– is also in a better position to offer a larger bribe.[18]

Unfortunately, the effect of corruption is much more than this. Suppose, as Compte et al.

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[18]This argument was fully developed by Lien (1986) and Beck and Maher (1986), that conclude that as the contract goes to the most efficient bidder, corruption may not generate efficiency losses. Lui (1986) goes beyond that, and builds a model of queues in which bribing may generate higher total surplus. He shows that there may exist an equilibrium in which the size of the bribe positively depends on the client's opportunity costs of time. This equilibrium in which bribes determine the position in the queue, minimizes the waiting costs and improves efficiency. However, this is not a robust result: bribing may also reduce the speed of the queue.

(2005), that n ex ante symmetric suppliers compete for a contract in a first-price auction –the rules–: they simultaneously quote a price offer, and the lowest offer is accepted. Each supplier, i, has a cost of delivering, c_i, that is her private information. Absent corruption, the supplier with lowest cost indeed bids lowest and so is selected as the contractor. But now assume that, after receiving all the bids, and before making them public, the official informs every supplier what the winning bid is, and allows them to make a bribe offer. Whoever makes the highest bribe offer, is allowed to submit a new bid to match the standing winning bid. If this is common knowledge at the time of first submitting bids, then no supplier has any incentive to submit a bid lower than the maximum acceptable one, P. Indeed, doing so can only reduce the price that she will get if she wins the ensuing bribe competition. True, this may discourage a competitor from offering a bribe, but it is always better to beat that potential competitor at the bribe competition without reducing the prize they will be fighting for at that stage. That is, bribery induces endogenous collusion at the highest acceptable price and, if there is no limit to the bribe that suppliers can offer, then the official appropriates all the extra rents: suppliers expect the same rents as without bribery. That is, in particular, the lowest cost supplier will win the contract, and bribery simply results in a higher price, P.

However, bribery has a second effect, if we assume that, for whatever the reason, there is a maximum bribe that suppliers can offer, B. That limit to bribe competition then results in a distortion in the allocation of the contract: the lowest cost supplier does not have the ability to secure the contract. In fact, if the difference between P and B is sufficiently large, then all contractors will be willing to offer the highest bribe B, and so the contract will end up assigned to them in a totally random way. Thus, bribery imposes an efficiency cost on top of a transfer of rents from principal to official.

In fact, efficiency costs should be expected even in the absence of limits to bribes. Suppose, as in Burguet and Che (2004), that suppliers' bids are evaluated paying attention not only to the price but also to the quality offered. That is, each supplier i select a price p_i and a quality q_i, and

bids are evaluated according to some scoring rule that assigns to each pair (p, q) a score $S(p, q)$. To simplify, suppose, the scoring rule assigns scores according to the social value of quality, and this is $S(p, q) = q - p$. However, quality must be assesed by an expert, the official. Suppose that, when suppliers submit their bids of quality and price, they also submit a bribe offer, b_i. The official can manipulate the quality assessment, and so declare a true quality offer of q to be of quality $q + m$. She will take bids (p_i, q_i) and bribe offers b_i from all suppliers, and accept the highest bribe b_i submitted together with a bid (p_i, q_i) that can be "assessed as winning". That is, so that $S(p_i, q_i + m)$ is larger than $S(p_j, q_j)$ for all $j \neq i$. Consider only two suppliers, and suppose that each has a cost function for quality delivered, $C_i(q)$, with $C_1(q) \leq C_2(q)$ for all q. That is, supplier 1 is more efficient. Absent bribery, supplier 1 will outbid supplier 2 and also offer to deliver what is efficient: $q_1 = \arg\max_q q - C_1(q)$. She will set the price p_1 so as to obtain a score $q_1 - p_1$ that makes it impossible for supplier 2 to attain the same score with non negative profits.

Bribery changes this. Supplier 1 would have to reduce the price by m in order to still be able to guarantee a win without bribing. That may be the best course of action, if m is small. Then corruption would in fact result in the same quality and a lower price for the principal.

But that may turn to be too expensive, unless m is really small. On the contrary, supplier 1 will find it in her interest to share the market with supplier 2, if m is larger. Both supplier 1 and supplier 2 will offer bribes, and both will win with positive probability.[19] On average, the price will increase by more than the expected bribe, and the efficient firm will not be selected for sure, an inefficiency beyond rent transfers. Supplier 2 will profit from corruption, but even supplier 1 may see her expected profits increase. That is, bribe competition is not equivalent, but on the contrary, blunts price competition and serves again as an instrument for tacit collusion among suppliers.

But once we find ourselves discussing procurement models, there is a natural question that

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[19]Under complete information, the equilibrium will always be in mixed strategies.

will take us back to the beginning of this journey: facing the threat of bribery, what rules should the principal instruct the –corruptible– agent to implement? E.g., are first-price auctions, or the "true" scoring rule $S(p, q) = q - p$ best, once we know that the official may manipulate their outcome? Both Compte et al. (2005) and Burguet and Che (2004) provide *partial* remedies in the contexts the analyze. Thus, Compte et al. (2005) show that handicapping the –ex-ante– most efficient supplier may destabilize the collusive outcome, and Burguet and Che (2004) show that de-emphasizing quality in the scoring rule reduces the effect of bribery.[20]

But instead of partial remedies, we may be interested in finding what are the optimal designs for procurement under the threat of bribery. This question is very much open as of now. It is a demanding one, particularly if the official can –illegally– negotiate with suppliers between the time the rules are designed by the principal and the time of selecting the contractor in –allegedly– application of the rules.[21] We have answers for the other two possible cases.

Celentani and Ganuza (2002) analyze a procurement setting in which as before quality and price enter the preferences of the principal, $V(q) - p$; n potential bidders have private information about their production costs and the delivered quality q is certified by an official that can manipulate his report in exchange of a bribe. Then the principal designs the optimal procurement mechanism anticipating that she will pay for quality as if no corruption exists, but will obtain an exogenous low level of quality q_C with some probability γ (the probability of corruption). They show that in order to implement the optimal mechanism, the principal must use a scoring rule $S(p, q, \lambda)$ in which the higher is the probability of corruption, γ, the lower is the official discretion λ (the weight of principal's preferences for quality in the scoring rule). Moreover, Celentani and Ganuza (2002) assume a particular way in which corruption takes place and endogenize the prob-

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[20]Other studies have discuss other measures that mitigate the incidence of corruption. A recent example is the paper by Auriol and Soreide (2015) which studies the consequences of debarment as a tool to deter corruption, and its consequences for collusion.

[21]The standard approach to answer questions like this is to involke the "revelation principle" and then focus on mechanisms –rules– that consist on simply asking each agent involved to reveal her type, making sure they have incentives to answer with the truth. This is so because the principal is supposed to control and commit to applying any rules she designs. When an official can bend the rules, this commitment power is absent: the principal is only partially the designer. Not even the "revelation principle" can be generally invoked.

ability of corruption γ. The official decides to become corrupt if he anticipates that his discretion λ will be high enough and then it is worthily to do so. The higher is λ, the higher the expected quality of the procurement process q and higher the profitability of corruption (for replacing q by q_C). Then, the principal and the official play an simultaneous game, in which their best responses ($\lambda(\gamma)$ the optimal discretion level is decreasing in the expected corruption and the $\gamma(\lambda)$ corruption level is increasing in the expected discretion) determine the equilibrium level of corruption γ^*. Celentani and Ganuza (2002) undertake several comparative static exercises and show that contrary to conventional wisdom, corruption may well be increasing in competition. The intuition is that higher market competition (larger n) decreases the expected cost of quality which may lead to higher expected quality being supplied, and higher incentives for the agent to become corrupt. In we assume that the agent has to incur in some idiosyncratic cost when verify the delivered quality q, similar argument can be done regarding competition is the market of procurement officials. Higher competition allows to select a more efficient official, then the opportunity cost of reducing his discretion is higher. Since higher discretion implies higher profitability of corruption, a higher level of corruption may arise in equilibrium.[22]

We also have some answers when the official and the supplier meet and negotiate only after the contract has been assigned and its terms determined. Suppose again that the suppliers' cost function –type– is the suppliers' private information. Also, as in Burguet (2014), suppose that after price p and quality q have been committed by the contractor, the principal employs an official –inspector– to certify that the delivered quality is as contracted. Suppose that this inspector may be bribed. Several models of how bribe negotiations proceed can be posited, but for illustration suppose that the inspector is willing to certify any level of quality, irrespective of the real quality,

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[22]Laffont and N'Guessan (1999) obtain a similar result in a model of regulation similar to Laffont and Tirole (1991) in which the regulator optimally chooses the contract to be offered to the regulated firm and to the agent. They consider that agents may have different propensities of being corrupt. Then, the regulator may choose between eliminating corruption by providing incentives payments for good behavior to all agents or to save part of such incentives payments, deterring corruption only from the less corruptible agents. Laffont and N'Guessan show that greater competition among agents (better monitoring technology) may make this later corrupt regime more attractive. The idea is that in the corrupt regime, the regulator has to distort agent incentives to reduces informational rents, and with greater competition these rents are lower.

in exchange for a fixed bribe b. In this case, it is in the principal's interest to prevent bribery, and the way to do so is to distort quality both at the bottom and at the top. That is, optimally the principal gives up inducing quality from suppliers with low efficiency. This is a typical result in adverse selection models, as it reduces information rents for high efficiency suppliers. However, in this case this distortion serves to guarantee that low efficiency suppliers do not profit from claiming to have high efficiency, then committing to a high quality only to bribe the official and deliver minimum quality instead.

But optimally the principal curtails quality also at the top end of efficiency types. Asking for high levels of quality when the supplier is highly efficient requires compensating her with higher prices. The principal may be willing to pay this higher price. However, a higher price also means a stronger incentive for low types to again claim high efficiency, commit that high quality, but then bribe the inspector and deliver the lowest quality.

Thus, that bribery imposes an efficiency cost, and in particular erodes the quality of delivered goods and services, seems quite a robust conclusion. This is so even once we take into account how the principal's best instruments to respond to the threat of corruption.

7   Multiplicity of Equilibria and the Persistence of Corruption

In previous sections, we have presented corruption models that deliver a unique equilibrium, and organization designs and incentive systems that determine when agents are corrupt. While these models help in understanding important comparative statics and to design better institutions, they are unable to explain why societies with similar institutions and incentive systems have very different corruption levels. This is the motivation of a branch of the literature that explores multiplicity of equilibria in models with corruption. As Andvig and Moene (1990) point out, "corruption corrupts". The expected profitability of being involved in corrupt activities depends on the number of other people doing so. For example, the "moral cost" or guilt associated to corruption may decrease as the number of corrupt people increases. By the same token, even

if a social norm exists that stigmatizes corruption, the corresponding loss of reputation is likely to decrease when corruption is widespread. Additionally, if the resources devoted to monitoring corrupt activities are limited, the probability of detection may decrease when many others are corrupt. Andvig and Moene (1990) show that when some of these forces are in place, multiplicity of equilibria arises. In particular, we can find a low corruption equilibrium in which the cost of corruption is high and only individuals very prone to be corrupted are involved, and a high corruption equilibrium in which due to the effects described above the cost of being corrupt are relatively low, and many more individuals decide to be corrupt.

We can formalize these ideas with a very simple monitoring model based on Cadot (1987). Consider, as before, that an official is in charge of issuing licences to operate in a market. The official may decide to extort the potential entrepreneur by asking for a bribe b. The incentive system is as follows. The official receives a wage w, and with probability θ is monitored by another official (inspector). The inspector can also be honest or corrupt. If the inspector is honest, the corrupt official is fired and loses his wage. If the inspector is corrupt, he takes the bribe b and does not report anything. The official has to incur an idiosyncratic, moral cost when he asks for a bribe, c_m, distributed according to a c.d.f., G. For simplicity, we assume that γ is the proportion of both corrupt officials and corrupt inspectors. Then, an official becomes corrupt if the following condition holds.

$$(1-\theta)(w+b) + \theta\gamma w - c_m > w \iff$$

$$(1-\theta)b - (1-\gamma)\theta w > c_m.$$

The level of corruption is given by the probability that the moral cost of the official is below the threshold $c^* = (1-\theta)b - (1-\gamma)\theta w$. Then $\gamma^* = G((1-\theta)b - (1-\gamma^*)\theta w)$ defines the endogenous probability γ^* that the official/inspector are corrupt. Notice that, as both sides of the equality are increasing in the level of corruption, multiplicity of equilibria may arise. We can have a low level of corruption, where most of the inspectors are honest and the expected penalty for corruption is large. We may also have or a high level of corruption, where the probability of being

matched with a corrupt inspector is large, and consequently the expected penalty (the probability of losing the wage) is lower. The main implication of the multiplicity of equilibria is that only big anticorruption campaigns that are able to move from the high corruption equilibrium to the low corruption one, are really effective when corruption is widespread.

Tirole (1996) proposes an alternative model of collective reputation with multiple equilibria and discusses the problem of persistence. He considers a dynamic setting in which a population of principals are matched with a population of agents every period. Each principal assigns one task to the agent with whom he is matched. There are two task, 1 and 2. Task 1 generates more surplus and higher profits for the principal if the agent is honest, but yields lower profits if the agent is corrupt. The agent can be of three different types, corrupt (p_c), honest (p_h) or strategic (p_s), where $p_c + p_h + p_s = 1$. The behavior of the first two types is fixed, but the actions taken by the strategic type depend on his incentives. The strategic type receives a higher payoff when he is assigned the efficient task, task 1, that is $w_1 > w_2$. Also, independently of the task, he can obtain an additional benefit from being corrupt, b, which does not depend on the task. Then, he may give up corrupt gains if that sufficiently increases the probability of being assigned task 1 in the future. The matching also has several other properties: at the end of each period the agent either (a) dies and is replaced by a new agent with some exogenous probability, or (b) is matched with another principal. Finally, principals have only imperfect information about the past behavior of agents. They observe whether the agents have been involved in corruption in the past with noise. A bad realization of the binary signal is more likelywhen the number of periods that the agent has been corrupt is larger (at a decreasing rate). Tirole provides several interesting results. Firstly, this economy may have multiple equilibria. One is a low corruption equilibrium in which strategic agents are not involved in corruption. On the one hand, principals assign task 1 to agents having a zero record of corruption since the collective reputation of agents is good: ex-ante, agents are honest with a probability $p_h + p_s$. On the other hand, strategic agents choose to be honest in order to preserve their individual reputation. A high corruption equilibrium may also arise. In

this equilibrium, strategic types are involved in corruption. Collective reputation of agents is bad, the aggregate probability of corruption, $p_c + p_s$, is also large, and so even a clean individual reputation (no evidence of corruption in the past) is not enough to convince the principal to assign the agent task 1. Therefore, there are no incentives for strategic types to behave honestly.

The link between individual and collective reputation is important also for explaining the persistence of corruption. A short-run increase in corruption, due for example to a bubble in the financial or housing markets, may destroy collective reputation, and have long-lasting effects. By the same token, effective anti-corruption policies have to be enforced for a long time in order to allow the group to rebuild a reputation for honesty. This difference may help explaining why corruption seems a more stable equilibrium.

8 EMPIRICAL EVIDENCE ON CORRUPTION

This section covers the most relevant academic empirical evidence related with corruption. In particular we analyze the measurement of corruption, the empirical evidence on the alternative models discussed in the previous sections and the evidence on anti-corruption mechanisms. We distinguish three basic sources of empirical results: the cross-country macro evidence; the results derived from field experiments ; and the evidence derived from lab experiments.

8.1 Measurement issues

The question of measurement of corruption is complex since illegal activities, by definition, are secret transactions and, therefore, difficult to observe. The advantage of laboratory experiment on corruption is precisely the possibility to observe directly corruption in a controlled environment and at the level of an individual decision maker. Outside of labs the measurement of corruption can be made by at least three alternative methods: using perceptions, trying direct measures or using indirect methods.

8.1.1 Measuring the perception of corruption Using the perception of corruption avoids the basic problem of many direct measurement methods which imply that bureaucrats/firms should disclose their participation in corrupt activities. Obviously, people are afraid to talk about their participation in illegal activities either for fear or shame. The admission of the perception of a high degree of corruption does not bear any negative connotation/feeling on the informants. Most of the first generation studies on the determinants of corruption rely on cross country data on the perception of corruption using macro variables as explanatory variables. One of the first indicators of perception of corruption was constructed by the private company Business International and then incorporated by the Economist Intelligence Unit as part of the Business International Indicators. Mauro (1995), in the most cited article of the first generation of papers on the determinants of institutional efficiency, analyzes the determinants of corruption as defined by Business International: "the degree to which business transactions involve corruption or questionable payments". Mauro (1995) finds that corruption reduces investment and, therefore, economic growth[23]. More recently Kaufmann and Kraay developed other measures of subjective corruption in a project sponsored by the World Bank. The Worldwide Governance Indicators (WGI) of the World Bank covers 215 countries for 1996 to 2014[24]. It compiles six dimension of governance including the control of corruption. The latest estimation of corruption relies on an average of 9 different data sources for each of the 209 countries included in the study[25]. Another popular macro indicator is the Global Corruption Barometer of Transparency International.

A recurrent finding of the empirical evidence of first generation indicators, which is common also to studies based on non-subjective measures of corruption, is the negative relationship between corruption and proxies of economic development. However the direction of causality is a matter of debate yet. In addition these subjective indicators usually present the point of view of experts

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[23]Although when corruption is instrumented with ethnic fractionalization the relationship is much weaker. Other well known first generation studies on the macro-determinants of corruption include Knack and Keefer (1995) and LaPorta et al. (1999). Serra (2006) analyzes the robustness of the empirical findings based on subjective measures of corruption.

[24]The latest version available at the time writing this article in January of 2016.

[25]The only relevant country for which there is no estimation is Monaco. For a methodological review see Kaufmann et al. (2010).

who do not represent the perception of all the population[26]. Finally, the most important problem of these measures is the fact that they correspond to perception of corruption and not actual corruption. Olken (2009) is able to estimate quite accurately the amount of actual corruption in a road project. He also gathered the assessment of the people living in the area with respect to the probability of corruption in the project. The correlation between both measures was very low which implies that actual corruption was not well approximated by the perception of corruption. In addition Olken (2009) finds correlation between the perception of corruption and demographic characteristics which is especially pervasive for the measurement based on perception when we have non- random samples as the ones based on analysts or experts.

8.1.2 Direct estimates An alternative to perceived corruption is to try to measure directly corruption activities. The direct estimation implies methods that could involve direct observation of bribes, audits or the use of surveys based on hypothetical situations. Olken and Barron (2009) measure directly the bribes of truck driver to public officers in roads of the province of Aceh in Indonesia. They use a simple method: surveyors dressed as assistant to track drivers, take note of over 6,000 illegal payments to soldier, police, etc. on 304 trips. Olken and Barron (2009) find that bribes are a very significant part of the cost of the trip: illegal payment amounted to 13% of the marginal cost of the trip compared with the 10% of the salary of the truck driver. Sequeira and Djankov (2014) analyze the illegal payments to avoid clearing fees (ex. Tariff duties) in two ports: Maputo and Durban. They construct a dataset from direct observation of bribe payments to port officials for a random sample of 1,300 imports and 120 companies from South Africa. Sequira and Djankov (2014) find that bureaucrats force private companies to pay fees above the official price of clearing services in 53% of the shipments to Maputo and the 34% of all shipments to Durham. However, the mean bride was much higher in Maputo (14% of the shipment

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[26]In many countries it is possible to find subjective indicators of corruption, based for instance of the importance of corruption as a social problem, for representative samples of the population.

cost of a standard container) than in Durban (4%)[27]. Bertrand et al. (2007) use data obtained by following 822 driver's license candidates in India and collected information on whether the license was obtained as well as the time, the specific processes and the expenditure. The experimental design compares a "bonus group", which was offered a large financial reward if they could get the license in 32 days, and the "lesson group" who were offered free driving lessons. There was also a comparison group with no particular treatment, who were followed during the process. In this comparison group, close to 71% of license getters did not take the exam and 62% were not qualified to drive (test by an independent examiner) at the time they got the license. The individuals in the comparison group also paid about 2.5 times the official fee to obtain a license. Individuals in the bonus group were 13 percentage points more likely to get the license without taking the diving exam and 18 percentage points more like to obtain the license and, at the same time, fail the independent test.

The use of audits from watchdog institutions is also a methodology that could help to estimate corruption. Ferraz and Finan (2008, 2011) use official audits of municipalities in Brazil to construct a measure of political corruption in local governments. They find that around 8% of the total amount audited was diverted to illegal activities[28]. Duflo et al. (2008) uses also administrative data to measure teacher absenteeism in rural India.

In principle it is also possible to use surveys to measures bribes through questionnaires. For this purpose you need to find a procedure to encourage truth telling and word carefully your questions. The clearest example is Svensson (2003) study on the bribes paid by companies in Uganda. The basic problem with this methodology is that, no matter how careful you are in the preparation of the survey and the questionnaire, there is a high probability of underreporting.

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[27]McMillan and Zoido (2004) analyze the detailed records of illegal activities that Montesinos, secret police chief of Fujimori, in Peru. The size of the bribes ranged between 3,000 dollars per month to politicians of Fujimori's party to 1,5 million to TV stations.

[28]Other research using also administrative data includes Banerjee et al. (2004) study of health centers' charges and Atanassova et al. (2008) analysis of prices paid for good that officially should be free. Both studies refer to India.

8.1.3 Indirect estimates   These methods try to estimate illegal activities by comparing a magnitude using two or more sources that should lead to the same amount in absence of bribes[29]. Perhaps the best known examples of these techniques are the Public Expenditure Tracking Surveys (PETS)[30]. The PETS are quantitative surveys that collect information on facilities characteristics (mostly schools or clinics), financial flows and outputs. They trace the flow of resources from origin to destination and, therefore, PETS are well suited to uncover any difference between the amount of resources provided by, for instance, a governmental agency and the resources that reach the final destination (frontline facility). Reinikka and Svensson (2004) use a PETS to analyze the leakage rate in the block grant send by the central government to schools in Uganda. They estimate the leakage rate in a surprising 87%. Despite their potential to measure public funds leakages the low book-keeping quality of frontline facilities in developing countries may generate an upward bias in the estimations of leakages from PETS. Olken (2007) uses also a cross-checking technique to estimate the "missing expenditure" in the cost of rural roads projects. He compares the official project costs with the estimated cost by independent engineers considering the same specifications. Olken (2007) concludes that 24% of the cost of the roads was "missing expenditure". Fisman and Wei (2004) calculate "missing imports" as the difference between Hong Kong reported exports to China and the reported imports by China. They find that the rate of evasion was highly correlated with the tax rates of the products. In highly taxed products the evasion rate could reach 40%.

Other cross-check techniques are based on the comparison of administrative data and household surveys[31] or the comparison between official prices and market prices. The best example of this second technique is Hsieh and Moretti (2006) study of the UN oil for food program (1997-2003) to export Iraqi oil. They argue that Iraq set prices of oil below market prices to ask for bribes from buyers. Their estimation of corruption in this program amounts to USD1.3 billion or 2% of oil revenues. Another well know example is Fisman (2001) who estimates the value

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[29]For this reason some authors refer to this method as cross-checking.

[30]Montalvo (2003) describes and compares the methodologies used for different PETS.

[31]Olken (2006) finds that at least 18% of the rice of a subsidized rice program in Indonesia can be qualified as "missing rice".

of political connections to President Soeharto as the difference between accounting data of the companies and stock prices. Fisman (2001) finds that 23% of the market value of the connected companies is the result of political ties with the dictator. Obviously this type of estimation relies heavily on the assumption of efficient markets.

8.1.4 Experimental estimates   Another way of dealing with the measurement of corruption and finding mechanisms to control it is to use lab experiments. Experimental data can avoid some of the problems found in the interpretation of other measures of corruption based on field experiments. In particular, you can avoid many endogeneity concerns (omitted variable bias, bidirectional causality, etc.) Experiments also allow the analysis of the determinants of corruption among individual and not only statement about aggregated behavior. Obviously, lab experiments are not a panacea. In many occasions it is difficult to justify the external validity of experiments[32].

There are many ways in which one can simulate a corrupt environment using a lab experiment. A frequent approach is to perform a game in which the higher payoff of the briber and the bribee produce a negative externality in the other players of the game that is larger than the sum of the private gains of briber and bribee. A good example of this type of experiment is presented in Abbink et al. (2002). Depending on the type of corrupt activity one wants to simulate the game may be one shot or repeated (for instance corruption in procurement) or may involve only subjects playing the game or also passive subjects that perform activities not directly related with the experiment. This second alternative avoids the convoluted issue of forming beliefs about players' choices.

9   Fighting against corruption: the empirical evidence

In the section we discuss the finding, derived from the empirical evidence, on the determinants of corruption and possible mechanisms to combat it. We consider two aspects already discussed

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[32]Armentier and Boly (2012) discuss this issue by comparing the result of a lab and a field experiment.

from a theoretical perspective in the previous pages: the individual incentives of bureaucrats and the industrial organization aspects of competition in the briberies' market .

9.1 Bureaucratic incentives: punishment, monitoring, compensation, and selection,

We pointed out before that the most general view on the issue of regulation and corruption implies the analysis of a trade-off between the inefficiencies associated with regulation and the costs of the market failure that a particular regulation wants to correct. Bribes are a potential cost of public intervention. Gorodnichenko and Peter (2007) show that Ukrainian public workers had level of consumption similar to private sector workers although their salary was much lower. Corruption seems to give extra income to public workers and government can reduce their wage to offset the bribes they receive. In this case corruption could potentially lead to efficiency gains if the deadweight loss generated by the increase in taxation needed to increase salaries of public workers is larger than the deadweight loss coming from corruption. Although this trade-off is, in principle, theoretically relevant it is, with very few exceptions, empirically less interesting. Therefore, we are going to assume that corruption is always an activity that is worth to combat and that generates a net deadweight loss. Following Becker and Stigler's (1974) model, the basic condition for corruption in equilibrium

$$w - \overline{w} < \frac{1 - \theta}{\theta} b$$

Where w is the wage of the bureaucrat, $\overline{w}$ is the opportunity wage[33], θ is the audit intensity and b is the size of the bribe. This last component, the size of the bribe, could be weigh against the psychological discomfort of dishonesty or b could be interpreted as the net effect. Following this simple theory to reduce corruption we can increase compensation of the bureaucrats, increase the penalties if identified (reduce the outside option), increase the probability of detection, or improve the selection criteria (increase the cost of dishonesty).

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[33]The difference between w and $\overline{w}$ is also referred to as "efficiency wage"

9.1.1 Delegation, monitoring and punishment   In principle increasing monitoring, and therefore the probability of detection, or increasing punishment should reduce corruption. Obviously, it could also be the case that more monitoring implies simply a redistribution of bribes between officials at different level of the government (low ranking government workers, monitoring agents and workers at the sanctioning bodies).

Olken (2007) presents a convincing randomized field experiment on the effect of monitoring on the level of corruption using Indonesian road projects. He finds that increasing the probability of auditing from 4% to 100% reduces the discrepancies between official project cost and independently assessed cost of the projects by 8 percentage points. By contrast, grassroots monitoring in the form of citizens monitoring officials[34], had little effect. It reduced the theft of wages but did not alter the theft of materials.

Ferraz and Finan (2011)[35] show that political institutions can affect corruption by increasing political accountability. They find significantly less corruption in municipalities where majors can be reelected. In those cases the reelection incentive reduces 27% the misappropriated resources. There is also a large literature on lab experiments testing the effect of monitoring and punishment on corruption[36]. Abbink et al. (2002) find that when the probability of detection is low but the sanctions are very high, being caught once implies very hard consequences in terms of sanctions, their experiment shows a strong deterrence effect (reduces bribe offers by one third). They conclude that the old fashion top-bottom vision of detection and hard punishments as an effective way to combat corruption is correct. However, Frank and Schulze (2003), using a very different experimental set-up find that penalties were not a good mechanism to stop corruption even if the probability of detection was higher than in the original experiment of Abbink et al. (2002). Abbink and Serra (2012) discuss several reasons for these contradictory findings although more research is needed to settle this issue[37].

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[34] Olken (2007) examine two alternative interventions.

[35] Building on Ferraz and Finan (2008).

[36] Abbink and Serra (2012) present a lengthy discussion of this issue.

[37] Abbink and Serra (2012) also discuss the monitoring through the four-eyes-principle, which implies that public service decisions should be made by more than one official.

A different institutional structure is the monitoring bottom-up. For this purpose the system needs to impose some level of transparency that allows citizens and interested parties to held public officials accountable for their decisions. One basic element for this system to work is transparency. Improving public information is critical to any bottom-up strategy. If citizens can monitor public employees then electoral accountability could potentially prevent corruption[38]. In addition providing information also empowers citizens to complain when the public programs intended to improve their living conditions are not appropriately developed. Reinikka and Svensson(2005) use a PETS study in Uganda as the set-up for a policy experiment in which the government ran a newspaper campaign for parents. The original PETS study (Reinikka and Svensson, 2004) found that schools received only 20% of the funds transfer to local authorities by the central government. To reduce the diversion of public money the government of Uganda provided information to parents and schools that could help them to monitor the local officials' handling of a large school grant program. Reinikka and Svensson (2005) use the distance to the nearest newspaper selling point as an instrumental variable. They found that there was a strong relationship between the proximity of the kiosk and the reduction of the diversion of school funds. They report also an increase in enrolment and learning.

Another popular transparency strategy to prevent corruption is to publicize the initial level of wealth of politicians to have a yardstick of comparison with the wealth when they leave office. There is little research on this issue. One of the few examples is Djankov et a. (2010) who collected cross-country information on the rule of financial and conflict disclosure of member of the Parliaments. They find that public disclosure is associated with less corruption.

In the previous paragraphs we have discussed monitoring using first a top-down approach and last a bottom-up strategy. Serra (2011) proposes a lab experiment that combines both approaches. She concludes that the "combined" system of accountability is highly efficient against corruption.

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[38]Ferraz and Finan (2008) find that the dissemination of information on audits that show corruption in local governments had negative electoral effect on incumbents in local elections in Brasil.

9.1.2   Bureaucrats and compensations   Should compensations of public servants be high to prevent the temptation of corruption? This is a much debated issue. Using cross country data Rauch and Evans (2000) show that bureaucrat's wages are only significant in the explanation of one out of five measures of bureaucratic performance (the bureaucratic delay index). However, Van Rijckeghem and Weder (2001) find a significant negative effect of public wages on the ICRG index of corruption and, therefore, conclude that higher salaries lead to lower corruption. Le et al. (2013) argue that the effect of public wages on the prevention of corruption depends on the level of development of the countries. Using a new micro-level dataset and controlling for number of other determinants of corruption and country fixed effects they show that the effectiveness of public wages to reduce corruption decreases with the level of development. However Besley and McLaren (1993) and Macchiavello (2008) argue that higher public wages are not a good device to reduce corruption in less developed countries since it can generate a bad selection effect: highly motivated workers can be crowded out by individuals susceptible to be corrupted.

From a microeconomic perspective Di Tella and Schargrodsky (2003) find an interaction between monitoring intensity and public wages in their analysis of the corruption activities related with procurement in hospitals of Buenos Aires. They conclude that the degree of audit intensity is fundamental for the effectiveness of wage policies against corruption. High public wages are only effective if there is enough auditing intensity. By contrast, the effective of intensive auditing may not be sustainable over time.

The experimental literature has also debated the issue of public earnings and its deterrence effect on corruption. Using the set-up of Abbink et al (2002) but assuming that the negative externality affects to individuals doing task unrelated with the experiment, Abbink (2005) finds no effect of higher wages. Van Veldhuizen (2013) modifies the set up of Abbink et al. (2002) to inflict the negative externality of corruption on a donation that the experimenter should make to a charity. He finds that increasing public officials' wages reduce corruptibility: low paid officials accept bribes 91% of the times while among highly paid officials the proportion is reduced to 38%.

Van Veldhuizen (2013), similar to the findings of Di Tella and Schargrodsky (2003), shows that a positive monitoring rate is necessary to find this negative effect of high wages on corruption.

Armantier and Boly (2012) use the comparison of a field and a lab experiment and find that in both set-ups higher paid graders of students' exams had a lower probability of accepting bribes.

9.1.3 Selection The determinants of the recruitment of public sector workers are a less developed topic of research. Dal Bo et al. (2013) use a randomized field experiment to analyze the role of financial incentives in the recruitment of government officials. They use the Regional Development Program of Mexico. The objective was to enhance the presence of the Mexican state in 167 marginal municipalities by hiring 350 community development agents who had to identify deficiencies in the provision of public goods. The hiring of these agents was conducted using a exogenous allocation of wage offers and job offers across recruitment sites. Del Bo et al (2013) find that higher wages attracted more able applicants as measured by their IQ, and proclivity towards government work. In addition higher wage offers increase acceptance rates. Ferraz and Finan (2010) show that higher salaries increased political competition and attract more educated candidates, although the effect was small in general. Higher wages also improved the performance of politicians.

9.1.4 Incentives and institutional structures for monitoring Incentives can reduce corruption by linking performance to pay. Much of the research in this issue has been directed to the provision of education and health in less developed countries. A basic problem for the frontline provision of education and health is absenteeism. In many of those countries teachers and doctors are also a powerful civil force able to avoid the pressure to attend their obligations. Duflo et al. (2012) use a randomized experiment to test the effect of monitoring and financial incentives on teacher absenteeism in rural India. The treatment consisted in monitoring using cameras and salaries were a function of attendance. The absenteeism of the treated group fell by 21 percentage

points relative to the control group. Increasing teacher attendance does not necessarily increases child learning since it can affect intrinsic motivation to teach and demoralize teachers. Duflo et al (2012) also found that children's test scores had increased by 0.17 standard deviation in the treatment group[39]. Banerjee et al. (2008) report on a randomized evaluation of an incentive program to increase the attendance at rural health centers in India. The evaluation uses time-clocks to monitor nurses' attendance which, in turn, determined their wages. The system was initially very efficient and showed that nurses reacted to financial incentives. However, political economy considerations (nurses' pressure) undermined the program which, after one and a half years, became ineffective.

9.2   Competition and the market for bribes

We already discussed in the theory section the "double-marginalization" problem that can appear if there are multiple corrupt officials (Shleifer and Vishny, 1993). Olken and Barron (2009) use a natural experiment to test this theory exploiting the reduction in the checkpoints at which trucks in Aceh had to stop to pay bribes due to a peace agreement with a rebel group. They show an increase in the average bribes observed on the check-points on the remainder as a reaction to the withdrawal of checkpoints in Aceh. In addition Olken and Barron (2009) also show that the bribes increase the closer the truck is to the destination, which supports the idea of an ex post holdup in a chain of monopolies.

Burgess et al. (2012) study the effect of competition between bureaucrats in the context of deforestation in Indonesia. From 1998 to 2008 the number of districts increased from 292 to 483 while during the 32-year of Soeharto regime they remained mostly unchanged. This increase in the level of decentralization of the government affected also the management of the forests. In principle there were logging quotas but companies could go beyond the legal limit by paying

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[39]Muralidharan and Sundararaman (2011) find also positive effects of financial incentives on students' average test scores.

bribes to the district officials. Burgess et al. (2012) find that the increase in districts lead to increased deforestation and lower timber prices consistent with Cournot competition between districts' officials. They also find short-run substitution between alternative forms of corruption, in particular illegal logging and rents from oil and gas, although this effect disappears over time. This substitution effect in the short-run mimics the one found by Olken (2007) after the introduction of audits: the diverted expenditures decreased but the nepotism increased.

Drugov et al. (2014) study the effect of intermediaries as facilitators of corruption activities. Although experimental the set-up that they use cannot be easily compared with a particular market structure it shows the result of introducing multiple layers in a bribery experiment. Drugov et al. (2014) conduct a one-shot petty bribery game in which they change the number of intermediaries. They find that the proportion of corrupt couples of bribers and bribees increases significantly when there are intermediaries and argue that intermediaries reduce moral or psychological cost and, therefore, increase corruption.

In the theoretical part we also discussed how job rotation can have a deterrence effect on corruption by making reputation building more difficult and reveling corrupt types. Staff rotation has been a standard procedure in some industries like the financial sector. Branch directors are regularly moved to a different location to avoid the development of personal relationships with clients that can affect the profitability of the bank. There is little empirical evidence on the effect of staff rotation. Abbink (2004), using the set up of Abbink et al. (2002), includes a random reshuffling of pairs of potential bribers and public officials in every round. The rotation reduces the frequency of inefficient decisions due to bribery by two-thirds and bribes, on average, are reduced by almost one half. Needless to say that the high effectiveness of staff rotation could be the result of the particular experiment used to replicate the environment of a corruptible relationship and, in any case, it is not a cost benefit analysis. It does not consider the cost of moving a worker with experience in a particular job/location to a different job/location.

In the theory section we also show that generating incentives for parties to report wrong-doing

is a potential strategy to reduce the cost of monitoring corruption. However, as we argued, leniency policies whereby a reporting party may be exempted from penalties, may make infeasible briberies possible. To avoid this effect it is possible to design an asymmetric system of penalties and leniency program. Schikora (2011) finds, using a lab experiment, that symmetrically punished whistle-blowing has an ambiguous effect as predicted by the literature because although it reduces the impact of corruption it increases its stability. However, he finds that asymmetric leniency reduces corruption because government officials have to opportunity to avoid reciprocation without having the risk of penalization by whistle-blowing.

10   Conclusions

In this paper we present a lenghty discussion on theoretical and empirical issues related with corruption..... In the final sections we discuss empiricial issues. First of all we analyze the question of the measurement of corruption. This is a complex task since illegal activities, by definition, are secret transactions and, therefore, difficult to observe. We cover all the available methodologies: direct and indirect estimation, percived corruption and experimental elicitation of the propensity to engage in illegal activities. Using this alternative measures of corruption we then turn to the analysis of the predictive ability of the theoretical models given the available empirical evidence. Many of the mechanisms described in the theoretical models have been found to be relevant in empirical applications. There is strong evidence on the effect of monitoring and punishment on the extension of corruption. There is also increasing evidence on the"double-marginalization" effect caused by the presence of multiple corrupt officials. There is less evidence on the effect of compensations on the behaviour of burocrats. In any case, more empirical research is needed on the specific mechanisms that can be effective to deter corruption and illegal activities.

References

[1] Abbink, K., Irlenbusch B., and E. Renner (2002), "An Experimental Bribery Game," *Journal of Law, Economics, and Organization,* Vol. 18, No. 2, pp. 428-54.

[2] Abbink, K. (2004), "Staff rotation as an anti-corruption policy: an experimental study," *European Journal of Political Economy,* Vol. 20, pp. 887–906.

[3] Abbink, K. and D. Serra (2012), "Anticorruption policies: lessons from the lab," In D. Serra and L. Wantchekon (eds.) New Advances in Experimental Research on Corruption, Research in Experimental Economics. Volume 15. Emerald Group Publishing.

[4] Acemoglu, D. and T. Verdier (2000), "The Choice between Market Failures and Corruption," *American Economic Review*, Vol. 90, No. 1, pp. 194–211.

[5] Ades, A., and R. Di Tella (1999), "Rents, Competition, and Corruption," *American Economic Review*, Vol. 89, No. 4, pp. 982–993.

[6] Amir, R., and C. Burr (2015), "Corruption and socially optimal entry," *Journal of Public Economics*, Vol. 123, pp. 30–41.

[7] Armantier, O. and A. Boly (2012), "On The External Validity of Corruption Experiments." In D. Serra and L. Wantchekon (eds.) New Advances in Experimental Research on Corruption, Research in Experimental Economics. Volume 15. Emerald Group Publishing.

[8] Arozamena, L., and F. Weinschelbaum (2009), "The effect of corruption on bidding behavior in first-price auctions," European Economic Review, Vol. 53, No. 6, pp. 645–657.

[9] Auriol, E. (2006), "Corruption in procurement and public purchase", *International Journal of Industrial Organization*, Vol. 24, pp. 867– 885.

[10] Auriol, E., and T. Soreide (2015), "An Economic Analysis of Debarment," mimeo.

[11] Baliga, S., and T. Sjostrom (1998), "Decentralization and Collusion", *Journal of Economic Theory*, Vol. 83, pp. 196–232.

[12] Banerjee A, Duflo E, Glennerster R. (2008) "Putting a band-aid on a corpse: incentives for nurses in the Indian public health care system," *Journal of the European Economic Association*, Vol. 6, pp. 487–500.

[13] Banerjee A, Hanna R, Mullainathan S. (2012), Corruption. In Handbook of Organizational Economics, ed. R Gibbons, J Roberts. Princeton, NJ: Princeton University.

[14] Barr, A., and D. Serra (2010) "Corruption and culture: An experimental analysis," *Journal of Public Economics*, Vol. 194, pp 862-869.

[15] Basu, K., K. Basu, and T. Cordella (2014), "Asymmetric Punishment as an Instrument of Corruption Control," Policy Research Working Paper 6933, The World Bank.

[16] Becker, GS., and GJ. Stigler (1974), "Law enforcement, malfeasance, and compensation of enforcers," Journal of Legal Studies, Vol. 3, No 1, pp 1–18.

[17] Bertrand M, Djankov S, Hanna R, Mullainathan S. (2007), "Obtaining a driver's license in India: an experimental approach to studying corruption," *Quarterly Journal of Economics,* Vol. 122, pp. 1639–76.

[18] Besley, T., and J. McLaren (1993), "Taxes and Bribery: The Role of Wage Incentives," *Economic Journal*, Vol. 103, No. 416, pp. 119–141.

[19] Besley T, Pande R, and V. Rao. (2012), "Just rewards? Local politics and public resource allocation in South India," *World Bank Economic Review*, Vol. 26, pp. 191–216.

[20] Bliss, C., and R. Di Tella (1997), "Does Competition Kill Corruption?" *Journal of Political Economy*, Vol. 105, No. 5, pp. 1001–1023.

[21] Buccirossi, P., and G. Spagnolo (2006), "Leniency policies and illegal transactions," *Journal of Public Economics*, Vol. 90, pp. 1281–1297.

[22] Burgess, R., Hansen, M., Olken, B. Potapov, P. and S. Sieber (2012), "The political economy of deforestation in the tropics," *Quarterly Journal of Economics,* Vol. 127, No 4, pp. 1707-1754.

[23] Burguet, R., and Y.K. Che (2004), "Competitive Procurement with Corruption", *The RAND Journal of Economics*, Vol. 35, No. 1, pp. 50–68.

[24] Burguet, R., and M. K. Perry (2007), "Bribery and Favoritism by Auctioneers in Sealed-Bid Auctions", *The B.E. Journal of Theoretical Economics.* Vol. 7, No. 1.

[25] Burguet, R. (2014), "Procurement Design with Corruption", Barcelona GSE Working Paper Series, 798.

[26] Cameron, L., Chaudhuri, A., Erkal, N., and L. Gangadharan (2009) "Propensities to engage in and punish corrupt behavior: Experimental evidence from Australia, India, Indonesia and Singapore," *Journal of Public Economics*, Vol. 93, No 7-8, pp. 843-851.

[27] Celentani, M., and J. J. Ganuza (2002), "Corruption and competition in procurement", *European Economic Review*, Vol. 46, No. 7, pp. 1273–1303.

[28] Celik, G. (2009), "Mechanism design with collusive supervision," *Journal of Economic Theory*, Vol. 144, pp. 69–95.

[29] Chassang, S., and G. Padró-i-Miquel (2014), "Corruption, Intimidation, and Whistleblowing: a Theory of Inference from Unverifiable Reports," NBER Working Paper No. 20315.

[30] Choi, J.P., and M. Thum (2003), "The dynamics of corruption with the ratchet effect," *Journal of Public Economics*, Vol. 87, pp. 427–443.

[31] Choi, J. P., and M. Thum (2005), "Corruption and the Shadow Economy," International Economic Review, Vol. 46, No. 3, pp. 817–836.

[32] Compte, O., A. Lambert-Mogiliansky and T. Verdier (2005), "Corruption and Competition in Procurement Auctions," *The RAND Journal of Economics*, Vol. 36, No. 1, pp. 1–15.

[33] Dal Bo, E., Finan, F. and M. Rossi (2013), "Strengthening State Capabilities: The Role of Financial Incentives in the Call to Public Service," *Quarterly Journal of Economics*, Vol. 128, No 3, pp. 1169-1218.

[34] De Soto, H. (1989), *The Other Path*, Harper and Row.

[35] Dechenaux, E., and A. Samuel (2012), "Pre-emptive Corruption, Hold-up and Repeated Interactions," *Economica*, Vol. 79, pp. 258–283.

[36] Di Tella, R. and E. Schargrodsky (2003), "The role of wages and auditing during a crackdown on corruption in the city of Buenos Aires," *The Journal of Law and Economics*, Vol. 46, No 1, pp. 269-92.

[37] Djankov S, La Porta R, Lopez-de-Silanes F, and A. Shleifer (2010), "Disclosure by politicians," *American Economic Journal: Applied Economics*, Vol. 2, No 2, pp. 179–209.

[38] Drugov, M., Hamman, J. and D. Serra (2014), "Intermediaries in corruption: an experiment," *Experimental Economics*, Vol. 17, pp. 78-99.

[39] Drugov, M. (2010) "Competition in Bureaucracy and Corruption," *Journal of Development Economics*, Vol. 92, No 2, pp. 107-114.

[40] Duflo E, Hanna R, Ryan S. (2012), "Incentives work: getting teachers to come to school," *American Economic Review,* Vol. 102, No 4, pp. 1241-78.

[41] Dufwenberg, M. and G. Spagnolo (2015), "Legalizing Bribe Giving," *Economic Inquiry*, Vol. 53, No. 2, pp. 836–853.

[42] Ferraz, C. and F. Finan (2008), "Exposing corrupt politicians: the effects of Brazil's publicly released audits on electoral outcomes," *Quarterly Journal of Economics*, Vol. 123, pp. 703–45.

[43] Ferraz, C. and F. Finan (2010), "Motivating politicians: the impacts of monetary incentives on quality and performance," Unpublished manuscript, University California Berkeley.

[44] Ferraz, C. and F Finan (2011), "Electoral accountability and corruption: evidence from the audit reports of local governments," *American Economic Review*, Vol. 101, pp. 1274–311.

[45] Ferraz, C., Finan, F. and DB. Moreira (2010), "Corrupting learning: evidence from missing federal education funds in Brazil," Unpublished manuscript, University California Berkeley.

[46] Fisman, R. (2001), "Estimating the value of political connections," *American Economic Review*, Vol. 91, pp. 1095–102.

[47] Fisman, R. and SJ. Wei (2004), "Tax rates and tax evasion: imports in China," *Journal of Political Economy,* Vol. 112, pp 471–96.

[48] Fisman, R. and E. Miguel (2007), "Corruption, Norms and Legal Enforcement: Evidence from Diplomatic Parking Tickets," *Journal of Political Economy,* Vol. 115, No 6, pp. 1020-1048.

[49] Glewwe, P., Nauman, I. and M. Kremer (2010), "Teacher incentives," *American Economic Journal: Applied Economics*, Vol. 2, No 3, pp 205–27.

[50] Gorodnichenko Y, Peter KS. (2007), Public sector pay and corruption: measuring bribery from micro data. *Journal of Public Economics*, 91:963–91

[51] Hasker, K., and C. Okten (2008) "Intermediaries and Corruption," *Journal of Economic Behavior & Organization,* Vol. 67, pp 103-115.

[52] Hsieh, CR. and E. Moretti (2006), "Did Iraq cheat the United Nations? Underpricing, bribes, and the Oil for Food Program," *Quarterly Journal of Economics,* Vol. 121, pp 1211–48.

[53] Hunt, J. (2007) "How corruption hits people when they are down. *Journal of Development Economics*, Vol. 84, pp 574–589.

[54] Kaufmann, D., Kraay, A. and M. Mastruzzi (2010) "The Worldwide Governance Indicators: methodology and analytical issues", PRWP 5430.

[55] Kahn, CM., Silva, ECD. ans JP. Ziliak (2001) "Performance-based wages in tax collection: the Brazilian tax collection reform and its effects," *Economic Journal*, Vol. 111, pp 188–205.

[56] Kessler, A. S. (2000), "On Monitoring and Collusion in Hierarchies," *Journal of Economic Theory*, Vol. 91, No. 2, pp. 280–291.

[57] Kessler, J and L. Vesterlund (2011) "The External Validity of Laboratory Experiments", mimeo, University of Pittsburgh.

[58] Khwaja, AI. and A. Mian (2005), Do lenders favor politically connected firms? Rent provision in an emerging financial market. Quarterly Journal of Economics, 120:1371–411.

[59] Klitgaard, R. (1988): Controlling Corruption. Berkeley: University of California Press.

[60] Koc, S. A., and W. S. Neilson (2008), "Interim bribery in auctions", *Economics Letters*, Vol. 99, No. 2, pp. 238–241.

[61] Kofman, F., and J. Lawarree (1996), "On the optimality of allowing collusion," *Journal of Public Economics,* Vol. 61, pp. 383–407.

[62] Laffont, J.J., and J. Tirole (1991), "The Politics of Government Decision-Making: A Theory of Regulatory Capture," *Quarterly Journal of Economics*, Vol. 196, No. 4, pp. 1089–1127.

[63] Laffont, J.J., and T. N'Guessan (1999), "Competition and corruption in an agency relationship" Journal of Development Economics, Vol. 60, pp. 271–295.

[64] Lambert-Mogiliansky, A., M. Majumdar, and R. Radner (2007), "Strategic Analysis of Petty Corruption: Entrepreneurs and Bureaucrats," *Journal of Development Economics*, Vol. 83, No. 2, pp. 351–367.

[65] Lambert-Mogiliansky, A., M. Majumdar, and R. Radner (2008), "Petty corruption: A game-theoretic approach," *International Journal of Economic Theory*, Vol. 4, pp. 273–297.

[66] Le, V., de Haan, J and E. Dietzenbacher (2013), "Do higher government wages reduce corruption? Evidence from a novel dataset," CESifo working paper 4254.

[67] Lengwiler, Y, and E. Wolfstetter (2010), "Auctions and corruption: An analysis of bid rigging by a corrupt auctioneer," *Journal of Economic Dynamics and Control*, Vol. 34, No. 10, pp. 1872–1892.

[68] Lien, D. (1986), "A note on competitive bribery games", *Economics Letters*, 337- 341.

[69] Mauro, P. (1995), "Corruption and growth," *Quarterly Journal of Economics* Vol. 110, pp 681–712.

[70] McMillan, J. and P. Zoido (2004), "How to subvert democracy: Montesinos in Peru," *Journal of Economic Perspectives*, Vol. 18, No 4, pp 69–92.

[71] Menezes, F. M., and P. K. Monteiro (2006), "Corruption and auctions", *Journal of Mathematical Economics*, Vol. 42, No. 1, pp. 97–108.

[72] Mocan N. (2008), "What determines corruption? International evidence from microdata", *Economic Inquire*,. Vol. 46, pp 493–510.

[73] Montalvo, J. G. (2003), "Designing a PETS in education for the Republic of Philippines: lessons from previous PETS experiences", World Bank, mimeo,.

[74] Monteiro, J. and C. Ferraz (2010), "Does oil make leaders unaccountable? Evidence from Brazil's offshore oil boom," Unpublished manuscript, PUC-Rio.

[75] Mookherjee, D., and I.P.L. Png (1995), "Corruptible Law Enforcers: How Should They Be Compensated?" *Economic Journal*, Vol. 105, No. 428, pp. 145–159.

[76] Muralidharan, K. and V. Sundararaman (2011), "Teacher performance pay: experimental evidence from India," *Journal of Political Economy,* Vol. 119, pp 39–77.

[77] Olken, BA. (2006), "Corruption and the costs of redistribution: micro evidence from Indonesia," *Journal of Public Economics*, Vol. 90, pp 853–70.

[78] Olken, BA. (2007), "Monitoring corruption: evidence from a field experiment in Indonesia," *Journal of Political Economy,* Vol. 115, pp 200–49.

[79] Olken, BA. (2009), "Corruption perceptions vs. corruption reality,". *Journal of Public Economics,* Vol. 93, pp 950–64.

[80] Olken, BA. and P. Barron (2009), "The simple economics of extortion: evidence from trucking in Aceh," *Journal of Political Economy,* Vol. 117, pp 417–52.

[81] Olken, B. and R. Pande (2011) "Corruption in Developing Countries", *Annual Review of Economics*, Vol. 4, pp 479-509.

[82] Pechlivanos, L (2005) "Self-Enforcing Corruption: Information Transmission and Organizational Response", in The New Institutional Economics of Corruption, J. Graf Lambsdorff, M. Taube and, M. Schramm (eds), pp. 93-111, London: Routledge.

[83] Rauch, JE. and PB. Evans (2000), "Bureaucratic structure and bureaucratic performance in less developed countries". *Journal of Public Economics,* Vol 75, pp 49–71.

[84] Reinikka, R. and J. Svensson (2004), "Local capture: evidence from a central government transfer program in Uganda," *Quarterly Journal of Economics*, Vol. 119, pp 679–706.

[85] Reinikka, R. and J. Svensson (2005), "Fighting corruption to improve schooling: evidence from a newspaper campaign in Uganda". *Journal of the European Economic Association*, Vol 3, pp 259–67.

[86] Rose-Ackerman, S. (1978), *Corruption: A study of political economy.* New York: Academic Press.

[87] Rose-Ackerman, S. (1996), "Redesigning the state to fight corruption," Public Policy for Private Sector, World Bank. Note No. 75.

[88] Schickora, J. T. (2011b) "Bringing good and bad whistle-blowers to the lab." Munich discussion paper.

[89] Sequeira, S. (2012) "Advances in Measuring Corruption in the Field." In D. Serra and L. Wantchekon (eds.) New Advances in Experimental Research on Corruption, Research in Experimental Economics Volume 15. Emerald Group Publishing.

[90] Sequeira, S. and S. Djankov (2010) "An Empirical Study of Corruption in Ports." Working Paper, London School of Economics.

[91] Serra, D. (2011) "Combining top-down and bottom-up accountability: Evidence from a bribery game," Journal of Law, Economics and Organization, forthcoming.

[92] Serra, D. (2006), "Empirical determinants of corruption: a sensitivity analysis," *Public Choice*, Vol. 126, No 1-2, pp 225-256.

[93] Shleifer, R and R. W. Vishny (1993), "Corruption," *Quarterly Journal of Economics,* Vol 108, No 3, pp 599-617.

[94] Shleifer, A., and R. W. Vishny (1994), "Politicians and Firms," *Quarterly Journal of Economics*, Vol. 109, No. 4, pp. 995-1025.

[95] Svensson J. (2003), "Who must pay bribes and how much? Evidence from a cross section of firms," *Quarterly Journal of Economics*, Vol 118, pp 207–30.

[96] Svensson J. (2005), "Eight questions about corruption," *Journal of Economic Perspectives*, Vol 19, No 5, pp 19–42.

[97] Tirole, J. (1986), "Hierarchies and Bureaucracies: On the Role of Collusion in Organizations," *Journal of Law, Economics & Organization*, Vol. 2, No. 2, pp. 181–214.

[98] Transparency International (2006) *Handbook For Curbing Corruption In Public Procurement*, Edited by K. Kostyo, Transparency International.

[99] Treisman D. (2000), The causes of corruption: a cross-national study. *Journal of Public Economics,* Vol. 76, pp. 399–457

[100] Van Rijckeghem C, Weder B. (2001), Bureaucratic corruption and the rate of temptation: Do wages in the civil service affect corruption, and by how much? *Journal of Development Economics*, Vol. 65, pp. 307–31

[101] Van Veldhuizen, R. (2013), "The influence of wages on public officials' corruptibility: a laboratory investigation," *Journal of Economic Psychology*, Vol. 32, pp 341-356.