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COMPETITION IN BUREAUCRACY AND CORRUPTION

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Competition in Bureaucracy and Corruption*

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Abstract

This paper studies the consequences of introducing competition between bureaucrats. Bureaucrats are supposed to grant licences to firms that satisfy certain requirements. Firms have to invest into satisfying these requirements. Some bureaucrats are corrupt, that is, they give the licence to any firm in exchange for a bribe. Some firms prefer to buy the licence rather than to invest and satisfy the requirements imposing negative externalities on the society. The competition regime is found to create more ex ante incentives for firms to invest while the monopoly regime is better at implementing ex post allocation, that is, distributing the licences given the firms' investment decisions. Additional results on the effects of intermediaries, staff rotation, punishments and endogenous entry to the bureaucracy are provided.

JEL Classification: D73, K42.

Keywords: Corruption, competition, bureaucracy.

1 Introduction

In India driving licence must be obtained at the police office of the local district where the applicant lives as Bertrand et al. (2007) say. In Russia it can be obtained at any road police office of the region where applicant lives. Does this institutional difference have any consequences for welfare and corruption? This is the main question of the paper.

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We study this problem in the following setup. There are firms that need a licence to produce. Firms can have either a new clean technology or an old polluting one. The legislation states that only firms with the clean technology are *qualified* for the licence. Firms with the polluting technology are *unqualified*. Production by an unqualified firm creates negative externalities. All firms have an old technology in the beginning but they can change it to the new one undertaking a costly investment. The licensing process is administered by bureaucrats. Some of them are *corrupt* and they can give the licence to any firm in exchange for a bribe. Others are *honest* and give the licence only to qualified firms with no bribe.

In the driving licence context, applicants apply for the driving licence. Initially, all applicants do not know how to drive, or at least, not enough to pass the test. They can take costly lessons to learn how to drive. Honest policemen give the licence only to those who drive well enough, while corrupt policemen try to extort a bribe from any applicant.

We will refer to the Indian case as *monopoly regime*. In this regime the licence must be obtained from a pre-specified bureaucrat, hence this bureaucrat has a monopoly power over the applicants in his district. The Russian case is *competition regime*. Any applicant can request the licence from any bureaucrat, therefore, bureaucrats compete for the applicants.^{1,2} Reapplication to the same or another bureaucrat involves some costs.

Let us first consider *ex post allocation* of licences, that is, how licences are distributed given the investment decisions of firms. In the monopoly regime unqualified firms cannot obtain the licence in the districts served by honest bureaucrats. In competition regime upon meeting an honest bureaucrat an unqualified firm can reapply to another one and reapply again until it meets a dishonest bureaucrat. In the competition regime unqualified firms get the licence more often and therefore, *competition results in a worse than monopoly ex post allocation*.

Now we turn to *ex ante incentives* of firms to invest and become qualified. Firms compare the cost of investment and the benefits of being qualified. In both regimes honest bureaucrats give the licence only to qualified firms. An unqualified firm can invest and reapply later to the bureaucrat or, only in competition regime, it can reapply to

¹We assume throughout the paper that bureaucrats are numerous enough and cannot collude.

²While it is beyond the scope of the paper, note that if one is to compare the costs of different anti-corruption instruments the competitive bureaucracy seems to be much cheaper than many others such as increasing bureaucrats' salaries, tighter monitoring of their performance, better enforcement of anti-corruption laws.

another (random) bureaucrat. This option to reapply to another bureaucrat is valuable only to firms with high investment costs, for others it is better to invest and obtain the licence for sure in the next period. For firms with low and medium investment costs (i.e., those who really think about investing) there is no difference between the two regimes in benefits of being qualified.

The difference exists if they meet a dishonest bureaucrat. In monopoly regime both qualified and unqualified firms pay the same bribe for the licence as the investment costs are sunk and their outside option is the same because they cannot reapply to another bureaucrat. In the competition regime the outside option depends on the qualification: a qualified firm will obtain the licence if the next bureaucrat turns out to be honest while an unqualified firm will not. A qualified firm pays then a lower bribe than an unqualified one. The benefits of being qualified are higher in the competition regime, and therefore, *competition provides higher ex ante incentives to invest than monopoly.*

The trade-off between competition and monopoly is now clear. Introducing competition will make more firms to invest and become qualified but the firms that still do not invest will obtain more licences. The total effect on welfare is ambiguous and depends, among other things, on the distribution of investment costs. If they are quite low for most firms, ex ante incentives to invest are important and competition is likely to be better. If they are high and firms do not invest anyway, monopoly seems to be preferred. The former case corresponds to the provision of driving licences: almost everybody is able to learn how to drive properly at relatively low cost, ex ante incentives are crucial. Provision of passports is closer to the latter case: it is difficult to become a citizen of country, therefore, ex post allocation is more important.

We study several modifications and extensions of the basic model. In the basic model firms do not know the type of the bureaucrat before they apply. If bureaucrats hold their office for years, their honesty or corruptibility becomes eventually known. In fact, rotation of bureaucrats can be viewed as a way of destroying the information about bureaucrats. In both regimes the information about bureaucrats allows firms to make their decision efficiently, that is, in the monopoly regime firms invest if and only if the bureaucrat in the district is honest, and in the competition regime firms choose the bureaucrat to apply to according to their investment decision. It speeds up obtaining the licence as firms meet the "right" bureaucrat immediately which is welfare improving when firms are qualified and welfare decreasing otherwise. The effect on incentives to invest is ambiguous: in

the monopoly regime firms do not really choose anymore whether to invest while in the competition regime both investing and not-investing become more profitable.

Future drivers do not bribe policemen directly, as Bertrand et al. (2007) and a lot of anecdotal evidence make clear. Instead, they pay fees to special "agents" that are well-connected in the police or another relevant bureaucracy. In our model these "agents" can be modelled as increasing the probability to meet the bureaucrat of the type that the firm needs in the competition regime and providing a signal of the bureaucrat's type in the monopoly regime. The effects of intermediation are then halfway towards the ones in the setup discussed above where the type of bureaucrats is known. However, in a more realistic setting where "agents" are mostly connected to the corrupt bureaucrats and therefore provide information mainly about them, their effect is welfare-decreasing as non-investing becomes relatively more attractive.

In the basic model the only cost of reapplication is the delay between applications. But there might be other costs such as application fee or the worktime spent on the application. Such costs will have effects quite similar to the ones of delay: firms will have more incentives to invest but once their decision is taken application costs tend to decrease the welfare. In the literature these costs are usually called red tape and its role is different from the one in this paper. In Banerjee (1997), Saha (2001) and Guriev (2004) red tape is used by bureaucrats to screen among different types of applicants privately known to them. In this paper there is no asymmetric information and the purpose of the red tape is to provide incentives to the applicants for the desired behavior. Of course, both here and in these papers red tape also makes it possible to extract bribes from applicants.

Corrupt activities can be discovered and participating parties can be punished. We find that it is the competition regime in which punishments have a bigger effect on incentives to invest. Also, in this regime extortion of the bribe from a qualified firm can be completely prevented. The intuition is that in the competition regime the bargaining over the bribe involves considering the non-trivial outside option of the firm to apply to other bureaucrats in future periods. This makes the bargaining outcome more sensitive to the changes in the environment, in particular, to the punishments. The corrupt relationship is more easily disrupted. Moreover, the bargaining of an unqualified firm with a bureaucrat is more sensitive than the one of a qualified firm as the former relies solely on corrupting the bureaucrat while the latter can obtain it from an honest bureaucrat. This difference adds to providing incentives for firms to invest.

People are not born bureaucrats or entrepreneurs. When they choose to become entrepreneurs or bureaucrats, the number of honest bureaucrats is endogenous. We investigate which regime leads to a higher share of honest bureaucrats. We find that there is a unique stable equilibrium in which firms do not invest. Under both regimes, for low values of the bureaucrats' bargaining power the equilibrium share is one while for high ones it is zero. There is an intermediate range in which the share of honest bureaucrats is between zero and one and is decreasing in their bargaining power. In general there is no clear cut answer which regime results in a higher share of honest bureaucrats in the equilibrium. However, there is a range of bargaining power when it is unambiguously the competition regime. There is also a unique stable equilibrium in which there is no dishonest bureaucrats and firms invest. This equilibrium is more likely to emerge under competition regime as well. Rose-Ackerman (1999) argues that competition is beneficial in the dynamic setting as it pushes down the size of bribes when there are more corrupt bureaucrats decreasing the incentives to become corrupt. Then, an intermediate equilibrium, that is, with both corrupt and honest bureaucrats, may exist. In the monopoly situation bribes do not depend on the number of corrupt bureaucrats and therefore incentives to become corrupt are the same. Total corruption will eventually prevail. We show that by including in the analysis the other side of the market, that is, firms, an intermediate equilibrium may exist in the monopoly regime as well.

The systematic economic literature on corruption has probably started with the famous book of Rose-Ackerman (1978) and by now corruption is well understood to be detrimental to investment and growth, as Mauro (1995) shows among others. However, a theoretical analysis of institutional responses to corruption is particularly scarce.^{3,4} This paper makes a step in this direction.

Competitive bureaucracy as a response to the problem of corruption was first suggested in Rose-Ackerman (1978) and then discussed in Shleifer and Vishny (1993). In the same way as competition among firms reduces prices of the goods they sell, competition among

³One reason for this is that many people agree with "moralists" or "fatalists", as Bardhan (1997) calls them. The former ones think it is all about social values and norms; the latter ones attribute it to being in a "bad" equilibrium in a multiple-equilibria world. In either case, not much can be done about corruption.

⁴An exception is quite a large literature on the optimal hierarchical structure in the presence of collusion starting with Tirole (1986). See a survey by Mishra (2006) for simple models and references on the hierarchies in the corruption context.

bureaucrats reduces prices they charge for their services, i.e. bribes. Shleifer and Vishny (1993) say (p. 607):

"A citizen can obtain a U.S. passport without paying a bribe. The likely reason for this is that if an official asks him for a bribe, he will go to another window or another city. Because collusion between several agents is difficult, bribe competition between the providers will drive the level of bribes down to zero."

As this paper, they also distinguish between corruption involving qualified and unqualified firms. The former type is corruption *without theft*, or extortion, as it only distributes the surplus between the applicant and the bureaucrat. The latter type is corruption *with theft*, or collusion, since it creates negative externalities on the rest of the society. Introducing competition is good under corruption without theft since its only effect is to reduce the level of corrupt payments.⁵ It is less so when corruption is with theft because by reducing the level of payments it allows more unqualified firms to buy the bureaucrats' service imposing larger negative externalities on the rest of the society.⁶ This observation has been made by Rose-Ackerman (1978, 1999) and Shleifer and Vishny (1993). However, they do not study the *incentives* of the firms to become qualified in the two regimes and this is the novelty of this paper.

No other paper, to the best of our knowledge, compares the two regimes. From the modelling point of view, the bargaining between a firm and a corrupt bureaucrat is close to the one in Cadot (1987). He considers only the competition regime and is interested in how information structure of the game (that is, whether the bureaucrat and applicant himself know if the applicant is qualified). Also, he gives the bureaucrat full bargaining power while we consider a more general case when bureaucrat's bargaining power can be any between zero and one. Mookherjee and Png (1995) and Acemoglu and Verdier (2000) study models in which firms decide on their behavior, there is, as we call it,

⁵We consider bribes as transfers and do not include them in the welfare function. In a more extended setup the size of bribes will matter for "ex ex ante" incentives to enter into the industry. We abstract from this effect and from other possible reasons why bribes may be bad. As this paper, the literature often focuses on some real impacts of corruption and not on the size of the bribes. See, for example, Bliss and Di Tella (1997) and Acemoglu and Verdier (2000).

⁶Strangely enough, Shleifer and Vishny (1993) do not speak about the possibility that a *non-citizen* can obtain the US passport without or with a low bribe.

endogenous qualification. In these models, firms may be inspected by a bureaucrat with a certain probability, once a firm is inspected it has to deal with a given bureaucrat.⁷ Thus, both papers have the monopoly regime; it is quite difficult to think about the competition regime there. Acemoglu and Verdier (2000) study a general equilibrium model in which agents choose whether to become entrepreneurs or bureaucrats as in one of our extensions. Their model is richer in that the government decides on the number and salary of bureaucrats and on the taxes/subsidies on the firms affecting the gain from the corrupt transactions. Finally, the papers that look at corruption and competition study, in fact, the effect of competition in the regulated market and not in the bureaucracy, the most cited being arguably Ades and Di Tella (1999) and Laffont and N'Guessan (1999).

The rest of the paper is organized as follows. The model is introduced in Section 2 and the equilibrium outcomes are found for both monopoly and competition regimes. Section 3 compares the two regimes and Proposition 3 presents the two main results discussed above. Section 4 concludes the comparison of two regimes when firms are heterogeneous in their investment costs. Section 5 contains modifications and small extensions of the basic model of Section 2. In Section 5.1 types of bureaucrats are known; in Section 5.2 firms cannot reapply to the same bureaucrat (in the competition regime); in Section 5.3 firms can invest only in the first period; in Section 5.4 there are intermediaries between firms and bureaucrats; in Section 5.5 bureaucrats have general bargaining power (it is $\frac{1}{2}$ in the basic model). Section 6 studies the effect of reapplication fee. Section 7 introduces punishments for giving and accepting bribes. In Section 8 the model is put into a dynamic framework: we analyze equilibria where agents can choose whether they become entrepreneurs or bureaucrats. Section 9 concludes.

2 The model

There is an industry in which production process involves negative externalities in terms of pollution, hygienic risk, etc. There are identical firms that can invest a certain amount $c \leq 1$ to improve the production process, for example, they can recycle their wastes or

⁷In Mookherjee and Png (1995) the probability of inspection is chosen by the bureaucrat and it is costly.

switch to a better technology.^{8,9} If a firm produces without investing it imposes a negative externality of size $1 + lc$, $l > 0$, on the rest of the society. This industry is regulated in the following way: there are bureaucrats that grant licences to the firms and only licensed firms can produce. We say that a firm is *qualified* (for the licence) if it has invested into a better technology, otherwise, it is *unqualified*. Denote with superscripts q and u the variables relevant for qualified and unqualified firms, respectively. Firms produce at zero marginal costs and earn profits normalized to one. A producing qualified firm generates welfare equal to $1 - c$, a producing unqualified firm generates welfare equal to $-lc$.

The bureaucrats are supposed to grant licences if and only if the firm applying for the licence is qualified. A share h of bureaucrats do precisely this, they are *honest*. Moreover, they do not ask for bribes. The remaining bureaucrats, of share $1 - h$, are *dishonest*: they give a licence in exchange for a bribe irrespectively of the firm's qualification. There is a unit mass of bureaucrats.

We study two regimes of the bureaucracy: monopoly and competition. Under monopoly regime, each firm can apply for a licence only to a certain bureaucrat, for example, the firms are in different districts and there is a single bureaucrat in each district. Under competition regime, each firm chooses randomly the bureaucrat to apply and then it can reapply to the same bureaucrat or to another random one.¹⁰ The firms do not know the honesty of a given bureaucrat until they apply. In both regimes, a firm that faces a dishonest official bargains about bribe b . The bargaining ends with no delay and the two parties split equally the surplus from the relationship.¹¹ Denote with subscripts m and c the variables relevant for monopoly and competition regimes, respectively.

The timing of the game is the following. In the beginning of each period the firm decides whether to invest into a better technology or not (if it has not invested before). Then, it applies to a bureaucrat. If the licence is granted, the firm produces, earns 1 and

⁸We consider heterogenous firms in Section 4.

⁹The assumption that $c \leq 1$ is done only to simplify exposition. If $c > 1$ the firm never invests which complicates a bit expressions for the monopoly regime. See Section 4.

¹⁰In Section 5.2 in the competition regime firms cannot reapply to the same bureaucrat. This is the case when a firm applies not to a specific bureaucrat but to a department that assigns it randomly to some bureaucrat. For example, reapplying for visa and repassing the interview you cannot be sure to meet the same interviewer as the first time.

¹¹In Section 5.5 we show that the results of this Section and Section 3 (in particular, Proposition 3) do not depend qualitatively on the distribution of the surplus, i.e., on the bargaining power of the two parties.

quits the game. Otherwise, the firm enters the next period. Under monopoly regime the firm always reapplies to the same bureaucrat. Under competition regime, the firm can reapply to the same bureaucrat or another random bureaucrat. Since there is a continuum of them, in every period the firm meets a honest bureaucrat with probability h . There is a common discount factor δ .¹²

In the welfare calculation we do not include bribes, they are considered as pure transfers. There are many reasons to believe that bribes do enter (negatively) the welfare function. For instance, part of the bribes may be wasted because of the secret and non-enforceable nature of these contracts, as it is often assumed in the hierarchical (principal-supervisor-agent) models of collusion (e.g. Laffont and N'Guessan (1999));¹³ higher bribes and/or higher prevalence of corruption create tolerance to the corruption in the society which makes anti-corruption policies less effective. However, it is important to disentangle the two issues, welfare and amount of bribes, aiming to understand the exact effects of introducing competitive bureaucracy.

Let us now consider the two regimes in more detail.

2.1 Monopoly regime

Under monopoly regime, the firm cannot switch to another bureaucrat. The surplus of their relationship is firm's profits 1 *independently* of whether the firm is qualified or not. Then, any firm facing a dishonest official will have to pay half of its profits as a bribe to obtain the licence¹⁴

$$b_m^a = b_m^u = b_m = \frac{1}{2}.$$

Consider the firm's decision to improve its technology. When the firm improves it, it will obtain the licence in the same period from any bureaucrat; but it will have to pay

¹²The profit of the firm is treated as if it occurs only in the period when production takes place. It can be also interpreted as a discounted stream of all future profits, that is, once a firm gets the licence it produces for all future periods. Then, its per period value will be $1 - \delta$. The same applies to the externality $1 + lc$.

¹³It was first shown in Laffont and Tirole (1991) in the framework of interest-group politics and then developed for different setups in the subsequent literature.

¹⁴We assume that bureaucrats can commit not to renegotiate the bribe in future periods. If they could not, there would be no difference between competition among different bureaucrats and competition between a bureaucrat today and his future selves.

the bribe b_m if the bureaucrat is dishonest:

$$\Pi_m^q = h + (1 - h)\frac{1}{2} - c. \quad (1)$$

If the firm decides not to improve, it will still obtain the licence from a dishonest bureaucrat in exchange for a bribe. If the bureaucrat is honest, the firm will have to invest in the next period:

$$\Pi_m^u = \delta h(1 - c) + (1 - h)\frac{1}{2}. \quad (2)$$

Comparing (1) and (2) we see that there is a threshold level of investment costs c_m^{q*}

$$c_m^{q*} = \frac{(1 - \delta)h}{1 - \delta h} \quad (3)$$

such that the firm improves its technology if and only if its costs are lower than c_m^{q*} . It increases in h from 0 to 1 as we would expect: when more bureaucrats become honest, chances to "buy" the licence decrease while chances to get the licence without a bribe increase so that the investment into a better technology is justified for higher costs. It decreases with the discount factor δ as the cost of delay which occurs when an unqualified firm meets an honest bureaucrat become smaller.

Once we know if the firm invests or not, we can easily compute the welfare. Proposition 1 summarizes the main results of this Section.

Proposition 1 *Under monopoly regime, there exists the threshold $c_m^{q*} \in [0, 1]$ given by (3) such that if the investment costs c are lower than c_m^{q*} the firm invests and the resulting welfare is*

$$W_m^q = 1 - c. \quad (4)$$

If the investment costs c are higher than c_m^{q} the firm does not invest and the resulting welfare is*

$$W_m^u = \delta h(1 - c) - (1 - h)lc. \quad (5)$$

2.2 Competition regime

Under competition regime the analysis becomes more complicated. When an unqualified firm meets an honest bureaucrat, it may invest and reapply to him in the next period

or may not invest and reapply to a random bureaucrat. When a firm meets a dishonest bureaucrat and bargains about the bribe, its outside option depends on whether it is qualified or not, and if it is unqualified, whether it will invest having met an honest bureaucrat.

As there is a continuum of bureaucrats, the outcome of reapplication to a random bureaucrat depends only on the type of the firm and not on its history, the environment is stationary. Lemma 1 shows that there are three possible strategies for the firm.¹⁵

Lemma 1 *The firm uses one of the following three strategies:*

- *Invest in the first period;*
- *Never invest;*
- *Invest as soon as meet an honest bureaucrat.*

Proof. See Appendix. ■

Remark 1 *In the monopoly regime the firm also has three strategies. When it does not invest in the first period, its further choice depends on whether the district bureaucrat is honest or not. As this choice is trivial, we did not make these two strategies explicit.*

Consider the three strategies in turn.

Invest in the first period. Let us first derive the expected profits of the firm that decides to invest in the first period. It will always obtain the licence but if the bureaucrat is dishonest, it will have to pay the bribe b_c^q :

$$\Pi_c^q = h + (1 - h)(1 - b_c^q) - c.$$

The bribe is determined through a bargaining process.¹⁶ The value of the relationship between the firm and dishonest bureaucrat is $1 - \delta(\Pi_c^q + c)$ as the firm may leave the

¹⁵In Section 5.2 firms cannot reapply to the same bureaucrat. The third strategy does not exist then.

¹⁶We use Nash bargaining solution despite the game being non-cooperative. If the bargaining breaks down the firm can still reapply to another bureaucrat, that is, to use its outside option and in this case Nash solution is valid. Alternatively, one could interpret a breakdown in negotiations as some corruption investigation and that if a firm is caught negotiating a bribe it cannot have the licence anymore. In this case the outside option does not affect the outcome of the bargaining unless it binds. Qualitative results of the model will still be the same as the outside option may bind for a qualified firm but not for others. I thank Meg Meyer and David Myatt for drawing my attention to this issue. See Binmore, Rubinstein and Wolinsky (1986) for the original paper.

bureaucrat and reapply in which case it will earn $\delta [h + (1 - h)(1 - b_c^q)]$. The equilibrium bribe splits this value equally, that is,

$$b_c^q = 1 - \delta(\Pi_c^q + c) - b_c^q.$$

It equals

$$b_c^q = \frac{1 - \delta}{2 - \delta + \delta h}. \quad (6)$$

Note that b_c^q is decreasing in the share of honest bureaucrats h and in the discount factor δ because both of them increase the firm's outside option. In particular, a higher h means higher chances to obtain the licence without a bribe.

The qualified firm expected profits are

$$\Pi_c^q = \frac{1 + h}{2 - \delta + \delta h} - c. \quad (7)$$

Never invest. Let us now turn to the firm that decides not to invest. It can get the licence only from a dishonest bureaucrat; if it meets an honest one, it has to reapply in the next period. Its expected profits are

$$\Pi_c^u = \delta h \Pi_c^u + (1 - h)(1 - b_c^u).$$

The equal split condition

$$b_c^u = 1 - \delta \Pi_c^u - b_c^u$$

yields the equilibrium bribe b_c^u

$$b_c^u = \frac{1 - \delta}{2 - \delta - \delta h}. \quad (8)$$

The most important thing to note is that $b_c^u > b_c^q$, given by (6), as the consequence of a lower outside option of the unqualified firm. The bribe b_c^u is decreasing in the discount factor δ as it is the case of the bribe for qualified firms. However, it increases with the share of honest bureaucrats h since a higher h decreases the firm's chances to meet a dishonest bureaucrat, the only source of the licence for an unqualified firm.

The unqualified firm profits are

$$\Pi_c^u = \frac{1 - h}{2 - \delta - \delta h}. \quad (9)$$

Invest only if meet an honest bureaucrat. Finally, consider the third possible strategy. Denote the relevant variables by superscript uq . If the firm meets an honest bureaucrat, it invests and reapplies to him in the next period. If it meets a dishonest one, it pays the bribe as the other two types. The profits are

$$\Pi_c^{uq} = \delta h(1 - c) + (1 - h)(1 - b_c^{uq}).$$

Sharing the surplus equally with the dishonest bureaucrat

$$b_c^{uq} = 1 - \delta \Pi_c^{uq} - b_c^{uq}$$

the firm pays the bribe b_c^{qu}

$$b_c^{uq} = \frac{1 - \delta^2 h(1 - c) - \delta(1 - h)}{2 - \delta + \delta h}. \quad (10)$$

This bribe falls with the discount factor and the share of honest bureaucrats, as b_c^q does, since both increase the firm's outside option. A higher cost c increases the bribe as investing becomes less attractive. The profits are

$$\Pi_c^{uq} = \frac{1 - h + 2\delta h(1 - c)}{2 - \delta + \delta h}. \quad (11)$$

Optimal strategy. We can now find the optimal strategy for a firm that has investment costs c .

The comparison of (7) and (11) yields the threshold level of costs c_c^{q*} below which the firm invests in the first period

$$c_c^{q*} = \frac{2h(1 - \delta)}{2 - \delta - \delta h}. \quad (12)$$

Comparing (9) and (11) we obtain the threshold level of costs c_c^{u*} above which the firm never invests

$$c_c^{u*} = \frac{(1 + h)(1 - \delta)}{2 - \delta - \delta h}. \quad (13)$$

Both c_c^{q*} and c_c^{u*} increase with h from 0 to 1 as c_m^{q*} does: when h is higher, it pays more to be qualified and it pays less to be unqualified. Both decrease with the discount factor δ since though a higher δ benefits both the qualified firm and the unqualified, the impact on the latter one is bigger than on the former one.

We can write Proposition 2 summarizing the results of this Section.

Proposition 2 *Under competition regime, there exist two thresholds $c_c^{q*} < c_c^{u*} \in [0, 1]$ given by (12) and (13) such that if the investment costs c are lower than c_c^{q*} the firm invests in the first period and the resulting welfare is*

$$W_c^q = 1 - c. \quad (14)$$

If the investment costs c are between c_c^{q} and c_c^{u*} the firm invests only when it meets an honest bureaucrat and the resulting welfare is*

$$W_c^{uq} = \delta h(1 - c) - (1 - h)lc. \quad (15)$$

If the investment costs c are higher than c_c^{u} the firm never invests and the resulting welfare is*

$$W_c^u = -\frac{1 - h}{1 - \delta h}lc. \quad (16)$$

The expression for W_c^u may need some comment. When the firm never invests, it can obtain the licence only if it meets a dishonest bureaucrat. This event occurs with probability $1 - h$ in the first period, with probability $h(1 - h)$ in the second period, with probability $h^2(1 - h)$ in the third period, etc. The expected social value of production is $-lc(1 - h)(1 + \delta h + \delta^2 h^2 + \dots)$ which gives (16).

Note that $W_c^{uq} = W_m^u$. In both cases the firm does not invest in the first period but if the first bureaucrat it meets is honest it stays with him and invests. In fact, the threshold c_c^{q*} corresponds to c_m^{q*} in the monopoly regime and c_c^{u*} corresponds to one: all firms invest if they meet an honest bureaucrat.

3 Comparison of the two regimes

The comparison of the monopoly and competition regimes proceeds in two steps. First, we find out which regime is better if the firm behavior is the same in the two regimes. That is, we compare the welfare of the two regimes if the firm invests and if it does not. Second, we find out which regime gives more *incentives* for firms to invest into a better

technology, that is, we compare the investment thresholds in the two regimes.¹⁷

Proposition 3 *Ex post allocation.* *If the first-period investment decision is the same under the two regimes, the monopoly regime is (weakly) better, that is, $W_m^u = W_c^{uq} > W_c^u$ and $W_m^q = W_c^q$.*

Ex ante incentives. *The firm has more first-period investment incentives under the competition regime, that is, $c_c^{q*} > c_m^{q*}$.*

Proof. Direct comparison. ■

Remark 2 *In the monopoly regime all the firms invest if they meet an honest bureaucrat, that is, $c_m^{u*} = 1 > c_c^{u*}$. The monopoly regime gives more ex post incentives to invest. We place it under "ex post allocation" to make the comparison more clear. Moreover, it is not crucial for comparing ex post allocation. The monopoly regime is still better than the competition one when unqualified firms do not invest having met an honest bureaucrat (for example, if firms have investment costs higher than one). The welfare is $-(1-h)lc$ which is higher than $W_c^u = -\frac{1-h}{1-\delta h}lc$.*

Let us explain the intuition of these results. Start with the simplest one, the one showing that if the firm invests, the welfare is the same, $W_m^q = W_c^q$. If the firm is qualified, it will get the licence from any bureaucrat under any regime. The only difference is the bribe it will have to pay. As the bribes do not affect the welfare, the welfare is the same under both regimes.

If the firm never invests in the competition regime, the monopoly regime turns out to be better, $W_m^u > W_c^u$, for two reasons. First, the unqualified firm gets the licence with probability $1-h$ in the monopoly regime and with (discounted) probability $\frac{1-h}{1-\delta h}$ in the competition regime. The latter is higher than the former, that is, the unqualified firm obtains the licence more likely under the competition regime. Second, in the monopoly regime the unqualified firm invests if it meets an honest bureaucrat creating welfare of $\delta h(1-c)$. In the competition regime the unqualified firm reapplies until it encounters a dishonest bureaucrat.

¹⁷In the comparisons of the two regimes we always assume, unless explicitly stated otherwise, that $0 < h < 1$ to avoid non-strict inequalities and explanations that the equality is reached only at $h = 0$ or 1.

Finally, if the firm invests only after having met an honest bureaucrat, it behaves exactly as an unqualified firm in the monopoly regime. The two regimes result in the same welfare, $W_m^u = W_c^{uq}$.

Now, why does the competition regime provide more incentives for the investment? The difference comes from the case when the firm applies to a dishonest bureaucrat. It has to pay the same bribe $b_m^q = b_m^u = \frac{1}{2}$ under monopoly regime independently of whether it is qualified or not. Under competition regime, a qualified firm has a higher outside option than an unqualified one. Bargaining over the bribe the qualified firm ends up paying a smaller bribe, $b_c^q < b_c^{uq}$. Thus, the difference in profits between a qualified firm and unqualified firm is higher under competition regime.

A word should be said about the size of bribes. Bribe b_c^{uq} is always higher than b_c^q and for $c < c_c^{u*}$ it is lower than b_c^u which is always lower than one half. Thus, competition reduces the size of the bribes in the equilibrium:

$$b_c^q < b_c^{uq} < b_c^u < b_m. \quad (17)$$

The comparison of the welfare confirms the earlier literature: both Rose-Ackerman (1978, 1999) and Shleifer and Vishny (1993) argue that the competition regime is not so good when the firms are unqualified as there are more licences issued illegally imposing higher social costs. They also argue that competition is good when the firms are qualified as it reduces the bribe level. We do have this feature in our model (see (17)) but since bribes do not enter the welfare function we do not observe this effect in Proposition 3.

4 Heterogeneous firms and inefficient firms

In the analysis before the firms were identical, that is, they all had the same investment costs c , and the production was efficient if the firm has invested, that is, $1 - c > 0$. We relax these assumptions in this Section.

Suppose that the firms are heterogeneous. A firm i has investment costs c_i which is distributed on $[0, \bar{c}]$, $\bar{c} > 1$, according to a cumulative distribution function F . Firms are therefore different and there are *inefficient* firms with $c_i > 1$ that never invest.

Given a certain share of honest bureaucrats h , the thresholds of investment c_m^{q*} , c_c^{q*} and c_c^{u*} are (3), (12) and (13), respectively. Every firm compares its costs c_i with the threshold(s) of the appropriate regime and chooses the optimal strategy. In the market

both qualified and unqualified firms coexist. In the language of Shleifer and Vishny (1993) there is corruption with theft and without theft at the same time. The welfare in the monopoly regime is

$$W_m = \int_0^{c_m^{q*}} W_m^q f(c) dc + \int_{c_m^{q*}}^1 W_m^u f(c) dc + \int_1^{\bar{c}} [-(1-h)lc] f(c) dc, \quad (18)$$

where W_m^q is (4) and W_m^u is (5). The last term is the welfare generated by an unqualified firm with costs higher than one. As it never invests, it produces only if it meets a dishonest bureaucrat.

In the competition regime it is

$$W_c = \int_0^{c_c^{q*}} W_c^q f(c) dc + \int_{c_c^{q*}}^{c_c^{u*}} W_c^{uq} f(c) dc + \int_{c_c^{u*}}^{\bar{c}} W_c^u f(c) dc, \quad (19)$$

where W_c^q is (14), W_c^{uq} is (15) and W_c^u is (16).

The difference in welfare $\Delta W = W_c - W_m$ equals

$$\Delta W = \int_{c_m^{q*}}^{c_c^{q*}} [W_c^q - W_m^u] f(c) dc + \left[\int_{c_c^{u*}}^1 [W_c^u - W_m^u] f(c) dc + \int_1^{\bar{c}} [W_c^u + (1-h)lc] f(c) dc \right]. \quad (20)$$

From Proposition 3, $c_c^{q*} > c_m^{q*}$ and $W_m^u > W_c^u$, by an easy inspection $W_c^q > W_m^u$ and $-(1-h)lc > W_c^u$. Then, the first term in (20) is positive and the second term is negative. Introducing competition has two opposing effects: the first, positive, one is that more firms invest into a better technology; the second, negative, effect is that the firms that still do not invest decrease the welfare. The total effect is therefore ambiguous.

Suppose that there are more firms with costs c_i . This is good for the competition regime as compared to the monopoly regime if $c_m^{q*} < c_i < c_c^{q*}$ and bad if $c_i > c_c^{u*}$. As all the thresholds depend on the share of honest bureaucrats h , it can be good for some h and bad for others. However, if these firms are inefficient, $c_i > 1$, they never invest and so they are always bad for the competition regime. Proposition 4 makes a formal statement. For the sake of exposition it assumes a uniform distribution but nothing qualitatively depends on this assumption.

Proposition 4 *Assume $c_i \rightsquigarrow U[0, \bar{c}]$. For any positive share of dishonest bureaucrats, $h < 1$, there exists \bar{c} high enough so that the monopoly regime is better than the competition regime.*

Proof. Rewrite (20) as

$$\Delta W = \frac{1}{\bar{c}} \left[\int_{c_m^{q*}}^{c_c^{q*}} [W_c^q - W_m^u] dc + \int_{c_c^{u*}}^1 [W_c^u - W_m^u] dc - \frac{(1-h)\delta hl}{2(1-\delta h)} (\bar{c}^2 - 1) \right].$$

The first two terms in the square brackets do not depend on \bar{c} . For any $h < 1$ the expression in brackets is a decreasing quadratic function of \bar{c} . The difference in welfare ΔW is negative if and only if

$$\bar{c}^2 > 1 + \left[\int_{c_m^{q*}}^{c_c^{q*}} [W_c^q - W_m^u] dc + \int_{c_c^{u*}}^1 [W_c^u - W_m^u] dc \right] \frac{2(1-\delta h)}{(1-h)\delta hl}.$$

■

As ex ante incentives become less important when firms are less efficient, competition regime becomes relatively less attractive when the distribution of costs shifts towards more high cost types. Therefore, if new technology is a minor improvement over the old one and it is relatively cheap to switch, the competition regime is likely to be superior. When the new technology is a leap forward and it requires a lot of investment, monopoly regime is likely to be better. Other examples can be easily thought of. Learning how to drive is probably not very costly for most people and then competition regime is preferred. Obtaining nationality (legally) is usually quite difficult, and so decisions to give it, or provision of passports should be done in the monopoly system.

5 Extensions

5.1 Known types of bureaucrats

In many instances the bureaucrats are known for their honesty or corruption. They might hold the office for many years and eventually people learn their type. In the competition regime corrupt bureaucrats have incentives actually to advertise themselves as corrupt to attract unqualified firms. Rotation of bureaucrats is usually proposed as a way of

destroying cosy relationships in the public sector (see Das-Gupta and Mookherjee (1998) for the case of tax authorities in India and Rose-Ackerman (1999) for more references and examples) but it can also be thought as a way of making types of bureaucrats unknown to the public. In this Section we explore whether rotation is a good policy in our setup.

As in Section 4 we take investment costs c_i distributed on $[0, \bar{c}]$, $\bar{c} > 1$, according to a cumulative distribution function F .

In the monopoly regime, firms invest if and only if the bureaucrat of their district is honest (and their investment costs are smaller than 1). There is no threshold of investment as before, even very efficient firms do not invest if their district bureaucrat is dishonest and very inefficient firms invest if their bureaucrat is honest. The total welfare is

$$W_m = h \int_0^1 (1 - c) f(c) dc - (1 - h)l \int_0^{\bar{c}} cf(c) dc. \quad (21)$$

Comparing (21) with (18) we see that the information about bureaucrats' honesty has two opposing effects. The positive one is that in the districts served by honest bureaucrats all the firms invest in the first period. Without the information, firms with costs between c_m^{q*} and 1 invest in the second period when they find out that their bureaucrat is honest. The negative effect is that no firm invests in the districts with corrupt bureaucrats while without the information firms with costs lower than c_m^{q*} invest. Also note that the discount factor δ does not enter (21) since all the licences are obtained in the first period, with the bribe or without.

In the competition regime a firm may invest in the first period and then apply to an honest bureaucrat or it may not invest and apply to a corrupt bureaucrat. As the firm does not learn anything when applying there are no other strategies, for example, like the one before "invest as soon as meet an honest bureaucrat". Computing the threshold level of investment costs yields

$$c_c^* = \frac{1 - \delta}{2 - \delta}. \quad (22)$$

It can be seen that $c_c^* \leq c_c^{u*}$ given by (13) (equality is reached at $h = 0$).

The total welfare in the competition regime is

$$W_c = \int_0^{c_c^*} (1-c) f(c) dc - l \int_{c_c^*}^{\bar{c}} c f(c) dc. \quad (23)$$

Comparing it to (19) we should distinguish two cases. First, $c_c^* < c_c^{q*} < c_c^{u*}$ which holds for h high enough. The consequences of the information about honesty of bureaucrats are unambiguously bad. Firms with costs between c_c^* and c_c^{u*} do not invest anymore. Also, unqualified firms get their licence faster as they go to the corrupt bureaucrats immediately. The second case is when h is low and $c_c^{q*} < c_c^* < c_c^{u*}$. The negative effects of the information are the same as in the first case but there is a positive effect: firms with costs between c_c^{q*} and c_c^* invest in the first period and not in the second as without the information. Also note that the share of honest bureaucrats h does not enter (23) as firms meet the bureaucrats they want with probability one.¹⁸

Now let us compare the two regimes when the types of the bureaucrats are known. Monopoly regime is still better at ex post implementation. Unqualified firms cannot get the licence unless there are in the districts with corrupt bureaucrats while in the competition regime they get it with probability one. Ex ante incentives are not directly comparable as before. But Proposition 4 is still valid. The welfare in the monopoly regime, (21), does not depend on the distribution of costs while the one in the competition regime, (23), does. A shift in the distribution towards more high cost firms will result in more unqualified firms and thus will decrease the welfare in the competition regime.

We can also compare the two regimes as a function of the share of honest bureaucrats. In the competition regime the welfare does not depend on it while in the monopoly regime it is increasing in it. When $h = 0$ nobody invests in the monopoly regime while everybody does when $h = 1$. There is a threshold value of h such that if the share of honest bureaucrats is lower, competition regime is better, and if it is higher, the competition regime is worse than the monopoly regime.

The effect of information of types of bureaucrats, or the effect of non-rotating the staff, is therefore two-fold. First, information makes it faster to obtain the licence. This is beneficial for the welfare if the licence is obtained by a qualified firm and it is not otherwise. The second effect is on the incentives to invest. Both investing and not-investing strategies become more attractive as firms can go to the bureaucrat that suits

¹⁸This is also a consequence of our assumption that bureaucrats have an unlimited capacity of serving firms.

them best. Which strategy becomes relatively more attractive is not clear.¹⁹

5.2 Reapplication to a random bureaucrat

We assumed before that the applicant can reapply to the same bureaucrat in the competition regime. In some cases this assumption may not be plausible. For example, repassing the driving test the applicant cannot be sure that the policeman that will be sitting in the car will be the same as in the previous attempt even if the test is taken at the same police station. Reapplying for visa the applicant cannot be sure to be interviewed by the same embassy worker. It can be also thought as a policy question since nothing prevents, for example, an embassy to have a rule that repeated applications cannot be considered by the same person. In this Section we explore the consequences of making it impossible to reapply to the same bureaucrat.

This modification of the setup concerns only the competition regime. The results of Section 2.1 for the monopoly regime are unchanged. In the competition regime, the firm's problem is now stationary. Having to reapply to a random bureaucrat the firm learns nothing by the current application. The strategy "invest as soon as meet an honest bureaucrat" employed before does not make sense anymore. The firm either invests in the first period or does not invest at all. By a similar analysis to the one of Section 2.2 a qualified firm earns

$$\Pi_c^q = \frac{1+h}{2-\delta+\delta h} - c$$

and an unqualified firm earns

$$\Pi_c^u = \frac{1-h}{2-\delta-\delta h}.$$

The investment threshold becomes

$$c_c^* = \frac{4(1-\delta)h}{(2-\delta)^2 - \delta^2 h^2} \quad (24)$$

and it lies between c_c^{q*} and c_c^{u*} in (12) and (13), respectively. Firms with the costs between c_c^{q*} and c_c^* switch to investing in the first period while the ones with the costs between c_c^*

¹⁹The last point is even more clear when the reapplication to the same bureaucrat is impossible as in Section 5.2. The firm has only two strategies, invest in the first period or never invest, and the investment threshold (24) (only one in this case) can be either higher or lower than (22).

and c_c^{u*} switch to not investing at all. Thus, the benefits of not allowing to reapply to the same bureaucrat depend on the relative size and importance of the two groups.

When comparing the two regimes, Proposition 3 holds.

Proposition 5 *Proposition 3 holds. That is, monopoly regime is (weakly) better at ex post implementation while it is worse at ex ante incentives, $c_m^{q*} < c_c^*$ given by (3) and (24), respectively.*

5.3 Unique investment opportunity

In the basic model of Section 2 firms may invest in any period. This allows them to have a strategy to invest if and only if they meet an honest bureaucrat. In some cases, however, the investment opportunity may arise only once. For example, the cost of the new technology may be above one and the government may partly subsidize the switch to the new technology for a limited time. The firm that has not used the government subsidy will never invest as the costs are too high. Another example with a similar flavour would be a tax amnesty.

Assume that the firm can invest only in the first period. In the monopoly regime a firm that has not invested and finds itself with an honest bureaucrat has to leave the market. The investment threshold (3) becomes

$$c_m^* = h \tag{25}$$

since with probability h the bureaucrat is honest and a qualified firm obtains the licence of value one while an unqualified firm does not.

In the competition regime the analysis is the same as in Section 5.2 where the firm cannot reapply to the same bureaucrat. There, a firm can invest in any period but it is optimal either to do it in the first period or not to do it at all. The investment threshold is then given by (24).

Now it is the monopoly regime that gives more incentives to invest as $c_m^* > c_c^*$. The welfare when the firm is qualified and not is the same as before. We obtain the following proposition.

Proposition 6 *If firms can invest only in the first period, the monopoly regime is better in both ex post allocation and ex ante incentives, that is, $c_m^* > c_c^*$ given by (25) and (24), respectively.*

Firms that do not invest in the monopoly regime face a very high risk because they will have to leave the market if the bureaucrat turns out to be honest. This case can be also thought of as the one in which the discount factor is zero, that is, the firm cannot reapply at all. In fact, (25) is (3) for $\delta = 0$. This risk creates more incentives to invest than the difference in bribes in the competition regime. Note that for $\delta = 0$ the competition regime becomes identical to the monopoly one since reapplication is impossible, and $c_c^* = h$ as well.

5.4 Intermediaries

Bertrand et al. (2007) report that applicants for the driving licence do not bribe the policemen directly. Instead, they pay fees to special "agents" that help them to get the licence. The same is also true in Russia where these "agents" are often found through driving schools, sometimes they are driving instructors. Many companies in developing countries often use and even hire "consultants" that are well connected in the government.

Such "agents" or "consultants" may be able to get things solved because they have personal relations with the bureaucrats, as in the case of former government officials, relatives, etc. However, their role is also informational: they simply know who and how can be approached with a delicate issue. In our model such intermediation can be viewed as decreasing the probability of meeting the honest bureaucrat from h to h' in the competition regime. Symmetrically, the same or another intermediary may know which bureaucrats are honest and so they can increase the probability of meeting the honest bureaucrat from h to h'' .

The overall effect of the intermediaries is in between our basic setup where the type of the bureaucrat is not known before the firm apply and the setup of Section 5.1 when it is known. However, intermediaries that provide services of honest bureaucrat are not very common in practice. The effect of intermediaries is then biased: there is more information about corrupt bureaucrats than about honest ones which clearly makes non-investing a more attractive strategy.

More specifically, in the competition regime an unqualified firm will address the intermediary that connects it with a corrupt bureaucrat with probability $1 - h'$, while a qualified firm will meet an honest bureaucrat with probability h'' . The investment thresholds (12) and (13) become

$$c_c^{q*} = \frac{2(1-\delta)(h'' + h' - \delta h' + \delta h' h'')}{(2-\delta + \delta h'')(2-\delta - \delta h')} \text{ and}$$

$$c_c^{u*} = \frac{(1+h')(1-\delta)}{2-\delta - \delta h'}.$$

Both thresholds are increasing in h' and h'' . As $h' < h < h''$, c_c^{q*} may be higher or lower than its value without intermediaries while c_c^{u*} is certainly lower. Thus, more firms never invest. If intermediaries that connect with honest bureaucrat are not very common, the probability h'' is close or equal to h . In this case, c_c^{q*} decreases as well and less firms invest in the first period. Intermediation negatively affects incentives to invest. It also speeds up obtaining the licence but it only matters for unqualified firms and then it is detrimental for the welfare.

In the monopoly regime the only possible role of intermediaries is informational as they cannot use different bureaucrats. Employing such an intermediary the firm gets a signal about the honesty of the bureaucrat in its district. The effect of intermediaries is along the lines of Section 5.1 where the types of bureaucrats are known: less firms invest in the districts of corrupt bureaucrats and firms invest faster in the districts served by honest bureaucrats.

5.5 Arbitrary bargaining power

Until now we have assumed that the corrupt bureaucrat and the firm split equally the surplus of their relationship, that is, they have equal bargaining power. The distribution of bargaining power affects, obviously, bribes and the profits of the firm. Therefore, it will change the incentives of the firm to invest. In this Section we show that Proposition 3 that compares the two regimes holds for any distribution of bargaining power. Denote the bargaining power of the bureaucrat σ , i.e., the bureaucrat obtains share σ of the surplus.

Proposition 7 *Proposition 3 holds for any positive bargaining power of the bureaucrat $\sigma > 0$. That is, if the firm's decision to invest is the same under the two regimes, the monopoly regime is (weakly) better, that is, $W_m^u = W_c^{u\sigma} > W_c^u$ and $W_m^q = W_c^q$. The firm has more incentives to invest under the competition regime, $c_c^{q*} > c_m^{q*}$. Moreover, the difference $c_c^{q*} - c_m^{q*}$ is increasing in σ .*

Proof. See Appendix. ■

The intuition for $c_c^{q*} - c_m^{q*}$ increasing in σ is that in the competition regime a higher bargaining power of bureaucrats makes the firm's outside option more important in the bargaining and it increases the difference in bribes paid by qualified and unqualified firms creating more incentives to invest ex ante. In the monopoly regime this effect is absent as all the firms pay the same bribes.

In the literature the usual case is when the bureaucrat has full bargaining power, that is, $\sigma = 1$ (e.g. Cadot (1987) and Banerjee (1997)). It is therefore a nice feature of our model that it incorporates this case. However, an intermediate bargaining power, first, is more realistic, second, allows us to analyze how changes in both firm's and bureaucrat's outside options affect the equilibrium level of bribes and the welfare by changing the firm's investment decision. Indeed, if the bureaucrat appropriates the whole surplus of the relationship a change in his outside option, for example, a higher punishment, does not influence the bribe unless the punishment is so high that he stops accepting bribes. See Section 7 in which we introduce a punishment for corrupt transactions for both the firm and the bureaucrat.

6 Reapplication costs

In the model so far the only reapplication costs have been the delay that has to occur between the two applications and the associated discount factor δ . Another kind of costs might be direct costs of reapplication r that the applicant has to bear every time he or she reapplies.²⁰ These costs may be (re)application fee or they may be wasteful from the social point of view, like time spent by firm's personnel filling in the application or queuing for the appointment with the bureaucrat.

The investment threshold (3) in the monopoly regime becomes

$$c_m^{q*} = \frac{(1 - \delta + \delta r) h}{1 - \delta h}.$$

In the basic model c_m^{u*} is one and we did not really speak about it as the choice of the firm whether to invest after meeting an honest bureaucrat was trivial. Now it is

²⁰The applicant does not pay r for the first application. Therefore, the bureaucracy has to track the history of applications to distinguish the first one from subsequent ones which might not be plausible in some cases. This assumption is only for simplicity, nothing will change qualitatively if the applicant has to pay for the first application as well.

$$c_m^{u*} = 1 - r$$

as the firm compares the profits of investing $1 - c - r$ with zero, what it gets withdrawing from the application process.

In the competition regime the thresholds (12) and (13) become

$$c_c^{q*} = \frac{2h(1 - \delta + \delta r)}{2 - \delta - \delta h} \text{ and}$$

$$c_c^{u*} = \frac{(1 + h)(1 - \delta + \delta r)}{2 - \delta - \delta h}.$$

The thresholds c_m^{q*} and c_c^{q*} increase in r since higher reapplication costs give more incentives not to reapply and therefore to invest in the first period. When the firm has not invested in the monopoly regime, higher r obviously decreases the profits from investment while leaving the application process results in zero profits anyway, and so c_m^{q*} decreases with r . In the competition regime both investing and non-investing become less attractive, but it is non-investing that falls more with r . Besides the immediate next period effect higher r also decreases the outside option in the future bargaining and leads to a higher bribe. As a result, c_c^{u*} increases in r .

Thus, reapplication costs r decrease the number of unqualified firms that apply and get their licences. Comparing their effect to the one of delay we see that both reapplication costs and delay (and any other obstacle to reapplication) improve incentives to invest. But their effect on ex post allocation is different. Independently of the type of the firm, reapplication costs either worsen ex post allocation if they are wasteful activities or leave it unchanged if they are monetary payments to the government, i.e., transfers.²¹ The effect of delay depends on the type of the firm that receives the licence: ex post allocation is improved when unqualified firms reapply and worsened when qualified firms do so.

The analysis and the expressions above hold true if the application costs r are not too high. When r is high enough, some firms prefer not to reapply.²² Firms that never invest suffer the most from reapplication costs as potentially they have to reapply more

²¹When policy makers want to attract more firms into the activity all payments done by firms such as bribes and application fees cannot be considered as transfers; they have to enter negatively the welfare function.

²²If reapplication costs are born for the first application as well, firms with high investment costs will not enter the market at all.

than other types. Reapplication costs also increase the bribe as they decrease the outside option in the bargaining. For $r > \frac{1-h}{2}$ firms that never invest do not reapply since their expected profits are negative. They try their luck only once and if the bureaucrat is honest (or bargaining breaks down), they do not reapply.

Conditional (monetary) application costs which are paid only when the application is unsuccessful may seem beneficial in the light of the discussion above.²³ Such application costs will be born directly only by unqualified firms as only they get rejected in the equilibrium. They do give more power to the bureaucrats increasing the size of the bribes but, as any other bargaining friction, this will hurt first of all firms that never invest. More than unconditional application costs, they increase the difference between outside options of qualified and unqualified firms increasing the difference between the bribes paid by these firms. When application costs are unconditional firm's outside option in the bargaining is at least zero as it always can leave the market getting zero. With conditional application costs the outside option may become negative which increases the maximum possible bribe. Again, unqualified firms will suffer more than qualified ones.

7 Punishments

Corrupt transactions may be discovered, participating parties may be punished. We do not model the discovery and/or punishment technology. Taking it as given, assume that a bureaucrat accepting a bribe for the licence faces an expected punishment p_b and a firm paying a bribe faces an expected punishment p_f . It is convenient to think about these punishments as the probability with which the bribing is found out times the fine imposed on the respective party. We distinguish punishments when the firm is qualified and when it is not, that is, for extortion and collusion. Different societies may have different considerations which kind of corruption is more serious and should be punished more severely. Thus, there are four expected punishments p_b^u , p_b^q , p_f^u and p_f^q .

Denote *total* punishments as the sum of punishments of the bureaucrat and the firm, $p^q = p_b^q + p_f^q$ and $p^u = p_b^u + p_f^u$. The following observation simplifies the analysis.

Lemma 2 *For the firm's profits (and therefore, for its incentives to invest) only total punishments p^q and p^u matter.*

²³The enforcement of such payments can be problematic, though.

Proof. Since the bargaining is efficient, it is the total surplus generated by the relationship that determines the outcome of the bargaining. The total surplus is the value of the licence 1 minus the punishments of the two parties and minus their outside options. The distribution of the punishment between the bureaucrat and the firm does not affect the outcome of the bargaining, and therefore, firm's profits. ■

For the rest of this Section, we use only total punishments p^q and p^u . We assume that

Assumption 1 $0 \leq p^q, p^u \leq P < 1$.

Corruption is never encouraged and there is some maximal available level of punishment P which is smaller than the value of the licence. Otherwise, corruption is trivially deterred by setting both p^q and p^u higher than one.

Our further analysis will proceed in three steps. First, we derive the investment thresholds when the punishments are relatively low and firms and bureaucrats behave similarly to the case of no punishments. Second, for each regime and for each type of firm we find the punishment necessary to deter corruption. Third, we will find *optimal* punishments. In all the analysis the costs of punishments are ignored.

7.1 Investment thresholds

We can now compute firm's profits when it invests and when it does not under monopoly and competition regimes as we did in Section 2. In order to isolate the effect of punishments we can write profits Π and the investment thresholds c^* as a sum of two terms. The first term is the relevant expression when there are no punishments (that we found before); the second term is the effect of punishments. To save on notation, denote the first term by an upper bar, for example, $\bar{\Pi}_m^q$ stands for Π_m^q in (1).

In the monopoly regime, the firm's profits are

$$\Pi_m^q = \bar{\Pi}_m^q - \frac{1}{2}(1-h)p^q \text{ and}$$

$$\Pi_m^u = \bar{\Pi}_m^u - \frac{1}{2}(1-h)p^u.$$

The firm pays the bribe with probability $1-h$ and it bears one half of the decrease in the total surplus brought in by the punishment.

The threshold c_m^{q*} becomes

$$c_m^{q*} = \bar{c}_m^{q*} + \frac{1-h}{2(1-\delta h)}(p^u - p^q). \quad (26)$$

Qualified and unqualified firms pay the bribe with the same probability. Then, only the difference in punishments, $p^u - p^q$, matters. Their effect is positive if $p^u > p^q$, that is, collusion is considered to be a more serious offence than extortion. If punishments are the same irrespectively the case, they are useless for providing incentives for the firms to invest.

In the competition regime, the profits are

$$\begin{aligned} \Pi_c^q &= \bar{\Pi}_c^q - \frac{1-h}{2-\delta+\delta h}p^q, \\ \Pi_c^u &= \bar{\Pi}_c^u - \frac{1-h}{2-\delta-\delta h}p^u \text{ and} \\ \Pi_c^{uq} &= \bar{\Pi}_c^{uq} - \frac{1-h}{2-\delta+\delta h}p^u. \end{aligned} \quad (27)$$

The punishment when the firm is qualified has the same effect as when the firm is not qualified but invests if it meets an honest bureaucrat. The effect of the punishment depends on how often the firm pays the bribe, and these two types pay the bribe with the same probability. A firm that never invests pays the bribe with a higher probability, and thus, the effect of the punishment is stronger.

The investment thresholds are

$$c_c^{q*} = \bar{c}_c^{q*} + \frac{1-h}{2-\delta-\delta h}(p^u - p^q) \text{ and} \quad (28)$$

$$c_c^{u*} = \bar{c}_c^{u*} + \frac{1-h}{2-\delta-\delta h}p^u. \quad (29)$$

For both qualified firms and firms that invest only when they meet an honest official the probability to pay the bribe is the same. Like in the monopoly regime, it is the difference in the two punishments $p^u - p^q$ that matters for the threshold c_c^{q*} . When a firm is not qualified and decides whether to invest if the official is honest, it will never pay a bribe being qualified. Punishment p^q is then irrelevant for threshold c_c^{u*} .

Comparing the two investment thresholds (26) and (28),

$$c_c^{q*} - c_m^{q*} = \bar{c}_c^{q*} - \bar{c}_m^{q*} + \frac{\delta(1-h)^2}{2(1-\delta h)(2-\delta-\delta h)}(p^u - p^q). \quad (30)$$

This difference $c_c^{q*} - c_m^{q*}$ is increasing in $p^u - p^q$. Also, c_c^{u*} is increasing in p^u and becomes closer to one which is its monopoly analogue. Provided that $p^u > p^q$, that is, corruption with theft is punished more severely than corruption without theft, the same punishments have a bigger effect in the competition regime. The reason is that in the competition regime the punishments affect the outside option of the firm in the bargaining while in the monopoly regime the outside option is always zero. Then, the profits of the firm are more sensitive to the punishments as future periods (and future punishments) count as well.

7.2 Deterring corruption

Until now we have assumed that dishonest bureaucrats do not change their behavior. The punishment affected only the size of the bribes. However, if the punishment is high enough, the corrupt activity becomes unprofitable. For example, in the monopoly regime the bureaucrat and the firm share the surplus of the value of licence minus the punishment $1 - p$. If $p \geq 1$, then the bureaucrat and the firm do not want to engage in a corrupt transaction. Since the bureaucrat cannot extract any bribe from the firm we assume that in this case dishonest bureaucrats behave as if they were honest.

Next Proposition describes the behavior of dishonest officials in the two regimes.

Proposition 8 *Dishonest bureaucrats stop asking for a bribe if and only if the punishment is higher than the threshold \hat{p} . In the monopoly regime it equals one, $\hat{p}_m = 1$. In the competition regime*

- *When the firm is qualified $\hat{p}_c^q = \frac{1-\delta}{1-\delta+\delta h}$.*
- *When the firm is unqualified and never invests $\hat{p}_c^u = 1$.*
- *When the firm is unqualified but invests when it meets an honest bureaucrat and has investment costs c*

$$\hat{p}_c^{uq} = \frac{1 - \delta + \delta h - \delta^2 h(1 - c)}{1 - \delta + \delta h}. \quad (31)$$

Proof. In the monopoly regime the surplus from a corrupt transaction is $1 - p$. It is negative when $p \geq 1$. In the competition regime when a qualified firm bribes the surplus is $1 - \delta(\Pi_c^q + c) - p^q$. Equating it to zero and solving for p^q gives the result. Two other cases are solved similarly. ■

The punishment that is equal to the value of the licence is a very high punishment (remember, this is an expected punishment). If the maximal available punishment P were so high, the problem of corruption would not exist. All what is needed is to introduce this high punishment. This case is not very interesting from the practical point of view.

The result for deterring corruption when the firm is qualified or potentially qualified in the competition regime is more encouraging. The punishment can be lower than the value of the licence and it will still deter corruption. A higher punishment has two effects on the surplus of the corrupt transaction: a direct negative effect (as the punishment is directly subtracted in the expression of the surplus) and an indirect positive one. The indirect effect acts through the outside option of the firm. A higher punishment decreases the gains of the firm in dealing with dishonest bureaucrats in the future, then, the surplus of dealing with a current bureaucrat increases. When the firm is unqualified, the indirect effect is strong as such a firm will certainly deal with a corrupt bureaucrat. The surplus becomes zero only at $\hat{p}_c^u = 1$.²⁴ When the firm is (potentially) qualified the indirect effect is weaker as such a firm may not pay a bribe in the future. Then, the surplus is destroyed at a lower punishment, both \hat{p}_c^q and \hat{p}_c^{uq} are lower than one.

Firms that invest as soon as they meet an honest bureaucrat receive different treatment by a dishonest bureaucrat because the threshold punishment \hat{p}_c^{uq} depends on costs c . If they do not buy the licence anyway, they are better off by becoming qualified in the first period.

Proposition 9 *The threshold c_c^{q*} that separates firms that invest in the first period and firms that invest only if they meet an honest bureaucrat equals*

$$c_c^{q*} = \max\left\{\frac{2h(1-\delta) + (1-h)(p^u - p^q)}{2-\delta-\delta h}, 1 - \frac{1-\delta+\delta h}{\delta^2 h}(1-p^u)\right\}.$$

Proof. The first term is the "usual" threshold (28) when all firms that invest only when they meet an honest bureaucrat pay bribes to dishonest bureaucrats. The second term is rewritten (31), that is, it is function $c(p^u)$ such that given punishment p^u firms of this type with the costs lower than $c(p^u)$ choose not to pay the bribe to a dishonest bureaucrat

²⁴Rewrite firm's profits (27) as

$$\Pi_c^u = \frac{1-h}{2-\delta-\delta h}(1-p^u).$$

and reapply. Then, these firms are better off by investing in the first period since they do not get the licence from dishonest bureaucrats.²⁵ ■

7.3 Optimal punishments

The fact that extortion from qualified firms can be prevented by a high enough punishment (but not excessively high) implies that the optimal punishment for corruption without theft is either zero to provide firms as much incentives to invest as possible or very high to deter extortion.

Proposition 10 *If all the corruption cannot be prevented, that is, $P < 1$, then the optimal punishment is*

- *When an unqualified firm bribes, $p^{u*} = P$ in both regimes.*
- *When a qualified firm bribes, $p_m^{q*} = 0$ in the monopoly regime. In the competition regime $p_c^{q*} = 0$ if $P < \frac{1-\delta}{1-\delta+\delta h}$ and p_c^{q*} is any number in $[\frac{1-\delta}{1-\delta+\delta h}, P]$ otherwise.²⁶*

Punishing corruption without theft, that is, bureaucrats extorting bribes from qualified firms, has a positive effect only if it deters this type of corruption, otherwise, it is optimal not to punish. Then, when available punishment is high enough, corruption without theft is completely deterred in the competition regime while it is not in the monopoly regime. Corruption with theft should be always punished at the maximal available level.

If dishonest bureaucrats start to give licences to the qualified firms without the bribe, firms have more incentives to invest. The investment threshold c_c^{q*} will be even higher than in (28). Then, the competition regime becomes even more attractive than the monopoly one.

We can conclude this section with a broad remark. In the competition regime when bargaining over a bribe the firm has a non-trivial outside option. This outside option is a quite complicated object, it is an expected utility of applying to a bureaucrat in the next period, possibly randomly, bargaining with him, possibly reapplying, etc. Therefore,

²⁵It can be verified that c_c^{q*} is still always lower than c_c^{u*} .

²⁶In a dynamic framework where agents decide on their entry to bureaucracy (see Section 8) setting $p^{q*} = 0$ may not be optimal as it increases the revenues of the dishonest bureaucrats as compared to a positive punishment. The optimal punishment will then trade-off static incentives for firms to invest and dynamic incentives of agents to become dishonest bureaucrats.

it is likely to be sensitive to the changes in the environment. The bargaining itself is then more sensitive to the changes in the setup than in the monopoly regime where the outside option of the firm is simply zero. When policy makers try to disrupt the corrupt activity, the one in the competition regime seems to be more vulnerable. In the particular case considered here the bargaining was more sensitive to the punishments. Probably, similar results will hold for other frictions in the corrupt transactions. For example, we can consider the possibility that the bureaucrat and the firm can denounce each other or that they have asymmetric information about the surplus they share as in Cadot (1987).

8 Dynamics

Preliminary

Let us now turn to a dynamic, or long-term, perspective similar to the one of Acemoglu and Verdier (2000). Agents in the economy can choose whether they become entrepreneurs or bureaucrats. All agents have the same entrepreneurial talent, that is, they all have the same investment cost c if they choose to become entrepreneurs. However, some agents are honest while others are dishonest and they turn, if the wish, into bureaucrats of the respective type.²⁷

For simplicity we take the setup of Section 5.2 where firms cannot reapply to the same bureaucrat. When agents decide whom to become, the level of their income (profits for entrepreneurs, bribes for dishonest bureaucrats) is important and so the distribution of bargaining power. As in Section 5.5 we use arbitrary bargaining power σ . The investment threshold (24) becomes

$$c_c^* = \frac{(1 - \delta)h}{(1 - \delta\sigma + \delta h\sigma)(1 - \delta\sigma + \delta h\sigma - \delta h)}. \quad (32)$$

We make a simplifying assumption that bureaucrats do not receive any salary.²⁸ Honest agents do not receive any income if they become entrepreneurs. As we need some

²⁷In Acemoglu and Verdier (2000) the agents do not know whether they will be honest or dishonest bureaucrats. They claim that this assumption does not affect the general insights of their model.

²⁸Introducing a salary would require taxes on the firms to balance the government budget as in Acemoglu and Verdier (2000). The government then has an instrument that changes the relative income of bureaucrats and entrepreneurs and therefore influences the agents' decision about their career. We leave this for future research.

of them still entering the bureaucracy, we assume that there are some honest "enthusiasts" or "patriots" that always want to become entrepreneurs. Dishonest agents will derive their income from bribes. Choosing their career they compare their expected bribe income and their expected profits if they become entrepreneurs.

We also assume that the number of both entrepreneurs and bureaucrats is of unit mass each.²⁹ If dishonest agents find it worthwhile to become bureaucrats they enter into bureaucracy until either all bureaucrats are dishonest or their share is such that the dishonest bureaucrats' expected income equals entrepreneurs' profits. A dynamic equilibrium is thus characterized only by the share of honest bureaucrats.

8.1 Profits and income from bribes

Denote the expected bribe income B and the expected firm profits Π . As we are interested in how they depend on the share of honest bureaucrats h we write $B(h)$ and $\Pi(h)$.

Definition 1 *A dynamic equilibrium is characterized by the share of the honest bureaucrats h^{eq} such that $h^{eq} = 0$ if and only if $B(0) \geq \Pi(0)$; $0 < h^{eq} < 1$ if and only if $B(h) = \Pi(h)$ and $h^{eq} = 1$ if and only if $B(1) \leq \Pi(1)$.*

In each of the two regimes we now need to find how the bribe income and profits depend on h . This is done in Lemmas 3 and 4 for the monopoly and competition regimes, respectively.

Lemma 3 *Under monopoly regime, the bribe income is constant*

$$B_m = \sigma.$$

If $h < h_m^*$

$$h_m^* = \frac{c}{1 - \delta + \delta c}, \tag{33}$$

the profits are Π_m^u given by (36) and decreasing in h if

$$\delta c + 1 - \delta \geq \sigma \tag{34}$$

²⁹This can be another instrument of the government as in Acemoglu and Verdier (2000). We plan to investigate it in the future.

and increasing otherwise.

If $h > h_m^*$ the profits are Π_m^q given by (35) and increasing in h .

Proof. Any firm pays the bribe $b_m = \sigma$ if it meets a dishonest bureaucrat. As there is unit mass of both firms and bureaucrats, the dishonest bureaucrat bribe income is σ . Putting $c = c_m^*$ in (3) we find the threshold level h_m^* such that the firms invest if and only if $h > h_m^*$. Differentiating relevant profits with respect to h gives the result. ■

Looking for the equilibria below, we find the intersection of the profits and the bribe income. Despite the bribe income being constant as a function of h , there still might be an intermediate equilibrium since the profits of the firm are not constant. Therefore, it is crucial to consider both sides of the market. Omitting the demand for the corrupt deals, one could conclude that the constant bribe income always results in a corner equilibrium where either all or none of the bureaucrats are corrupt depending on whether this constant income is higher or lower than bureaucrats' outside option like being honest or engaging in some other activity.

If the firm invests, its profits increase in the share of honest bureaucrats as it has higher chances to meet an honest bureaucrat. When the firm does not invest its profits might either decrease or increase in h . The former case is intuitive as such a firm seems to prefer a dishonest bureaucrat. The latter case is, however, also possible when the bureaucrats' bargaining power is high enough; then, the firm prefers to wait one period, invest and obtain the license from a honest bureaucrat.

Lemma 4 *Under the competition regime, if $h < h_c^*$ implicitly given by (32) at $c_c^* = c$, the bribe income is³⁰*

$$B_c^u = \frac{1}{1 - \delta h} b_c^u,$$

where b_c^u is given by (38), and increasing in h . The profits are Π_c^u given by (40) and decreasing in h .

If $h > h_c^*$ the bribe income is

30

$$h_c^* = \frac{1}{2} \frac{1}{c\delta^2\sigma(1-\sigma)} (\delta c(1-\sigma\delta)(2\sigma-1) - (1-\delta) + \sqrt{2\delta c - 4c\sigma\delta + 4c\sigma^2\delta^2 + 2\delta^2 c\sigma - 4\delta^3 c\sigma^2 + 1 + c^2\delta^4\sigma^2 - 2c\delta^2 - 2c^2\delta^3\sigma + 2\delta^3 c\sigma + c^2\delta^2 + \delta^2 - 2\delta}).$$

$$B_c^q = b_c^q,$$

where b_c^q is given by (37), and decreasing in h . The profits are Π_c^q given by (39) and increasing in h .

Proof. Putting $c = c_c^*$ in (32) we find the threshold level h_c^* such that the firms invest if and only if $h > h_m^*$. Differentiating relevant profits with respect to h gives the result. The bribe income is the expected discounted bribe of the firm divided by the the number of dishonest bureaucrats $1 - h$. When the firm is qualified, the expected bribe is $(1 - h)b_c^q$. When the firm is unqualified the expected bribe is $\frac{1-h}{1-\delta h}b_c^u$. ■

If the firm invests, the bureaucrats' income decreases with the share of honest bureaucrats as more honest bureaucrats increase the outside option of the qualified firm in its bargaining over the bribe. The profits of the qualified firm increase with h as it meets an honest bureaucrat more often and it pays a lower bribe if it meets a dishonest one. If the firm does not invest, a higher share of honest bureaucrats is bad news for it as it has to pay a higher bribe and reapplication is more likely. Note that unlike the monopoly regime the profits are never increasing in h since meeting an honest bureaucrat in the current period provides no information about the bureaucrat to which it will reapply in the next period. The bureaucrats' income is increasing in h for two reasons. First, each firm pays a higher bribe when there are more honest bureaucrats; second, each dishonest bureaucrats faces on average more firms.

Profits and bribe income in the two regimes are drawn in Fig. 1. The competition regime, as we have seen before, decreases bribes. The firms' profits are unambiguously higher than in the monopoly regime. The corrupt bureaucrats' income also tends to decrease. However, if firms do not invest, they reapply to different bureaucrats until they meet a dishonest one. Thus, as compared to the monopoly regime, dishonest bureaucrats face on average more applicants. Despite lower bribes, that is, lower per applicant revenue, total revenues may be higher. A higher share of honest bureaucrats increases both the bribe and the average number of applicants. And it might be, as in Fig. 1, that bureaucrats' income increases with the introduction of the competition regime when the competition is weak, that is, when there is a lot of honest bureaucrats.

This effect of more applicants is absent when firms invest because they do not reapply after meeting an honest official. It is weak when dishonest bureaucrats compete intensely,

that is, when there is few honest ones. In these cases the introduction of competition does decrease the income of bribe-takers.

8.2 Equilibria

Let us now find the equilibria. Lemmas 3 and 4 assert that in the two regimes if the firms choose not to invest, the bribe income is increasing (or constant) in h and the profits are decreasing in h (in the monopoly regime under condition (34)). Consider an equilibrium with an intermediate $h^{eq} \in (0, 1)$ (if it exists). In such an equilibrium bribe income equals the profits. If there are more dishonest agents that enter into bureaucracy, the share of honest bureaucrats falls. The bribe income falls (or does not change) and the firms' profits increase. Dishonest agents will not enter any more and honest "enthusiasts" will eventually move the share of honest bureaucrats back to h^{eq} in future periods. Thus, this equilibrium is *stable*. Moreover, it is a unique equilibrium in which firms do not invest.

If firms decide to invest, the profits are increasing in h while the bribe income is either constant (under monopoly regime) or declining in h (under competition regime). Then, an intermediate equilibrium (if it exists) is unique and unstable.

If firms do not invest there might a stable corner equilibrium $h^{eq} = 0$ if $B(0) \geq \Pi(0)$. Similarly, if firms invest, there might a stable corner equilibrium $h^{eq} = 1$. This is summarized in next Lemma. The proof is omitted as it is straightforward given Lemmas 3 and 4.

Call an equilibrium in which firms invest *investment equilibrium* and the one in which the firms do not invest *non-investment equilibrium*.

Lemma 5 *Under any regime, there is at most one non-investment equilibrium which is stable. There are at most two investment equilibria, one stable with $h^{eq} = 1$ and one unstable with $0 < h^{eq} < 1$. Under monopoly regime there is at most one unstable non-investment equilibrium if (34) does not hold.*

See Fig. 1 that presents a case when there are three equilibria under monopoly regime and two equilibria under competition regime (the unstable investment equilibrium does not exist).

In what follows we focus only on the stable equilibria. In Proposition 11 we characterize equilibria in monopoly and competition regimes.

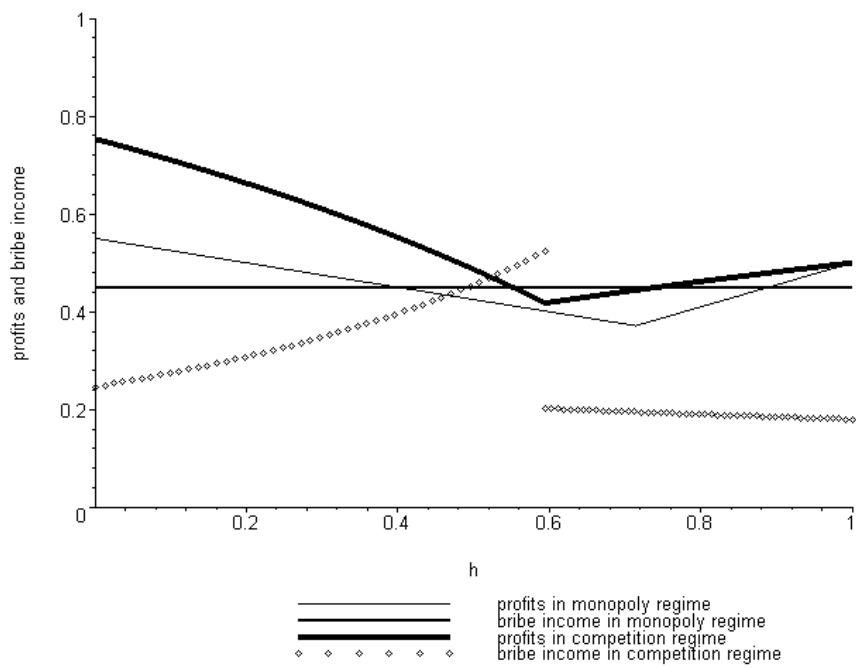


Figure 1: Profits and bribe incomes under two regimes when $\sigma = 0.45$, $c = 0.5$, $\delta = 0.6$. There are three equilibria under monopoly regime and two equilibria under competition regime.

Proposition 11 ³¹ Under monopoly regime, the equilibria are the following:

- If $\sigma < 1 - c$ there is an investment equilibrium with $h_m^{eq} = 1$.
- If $\sigma > \sigma_m^*$ there is a non-investment equilibrium with h_m^{eq} equal

$$h_m^{eq} = \begin{cases} h_m^{eq-int}, & \text{if } \sigma_m^* < \sigma \leq \frac{1}{2}, \\ 0, & \text{if } \sigma > \frac{1}{2}, \end{cases}$$

where

$$h_m^{eq-int} = \frac{1 - 2\sigma}{1 - \sigma - \delta(1 - c)}$$

and $\sigma_m^* < 1 - c$ is such that $\frac{1 - 2\sigma_m^*}{1 - \sigma_m^* - \delta(1 - c)} = h_m^*$ in (33).³²

Under competition regime, the equilibria are the following:

- If $\sigma < \frac{1-c}{1-\delta}$ there is an investment equilibrium with $h_c^{eq} = 1$.
- If $\sigma > \sigma_c^*$ there is a non-investment equilibrium with h_c^{eq} equal

$$h_c^{eq} = \begin{cases} h_c^{eq-int}, & \text{if } \sigma_c^* < \sigma \leq \frac{1}{2-\delta}, \\ 0, & \text{if } \sigma > \frac{1}{2-\delta}, \end{cases}$$

where h_c^{eq-int} is such that $\Pi_c^u(h_c^{eq-int}) = B_c^u(h_c^{eq-int})$ and $\sigma_c^* < \frac{1-c}{1-\delta}$ is such that $h_c^{eq-int} = h_c^*$ defined in Lemma 4.³³

Both h_m^{eq-int} and h_c^{eq-int} decrease in σ .

Remark 3 As $\sigma_m^* < 1 - c$ and $\sigma_c^* < \frac{1-c}{1-\delta}$, in both regimes there is a range of parameter values for which there are both investment and non-investment equilibria.

³¹The proof will be put in Appendix, for the moment it is available from the author upon request.

³²

$$\sigma_m^* = \frac{(1-c)(1-\delta+c\delta)}{2-2\delta+2c\delta-c}.$$

³³

$$h_c^{eq-int} = \frac{1}{2} \frac{(1+\delta)(1-\sigma) - \sqrt{\delta^2 - 2\delta - 6\sigma\delta^2 + 8\sigma\delta + 1 - 2\sigma + 5\sigma^2\delta^2 - 6\sigma^2\delta + \sigma^2}}{\delta(1-\sigma)}.$$

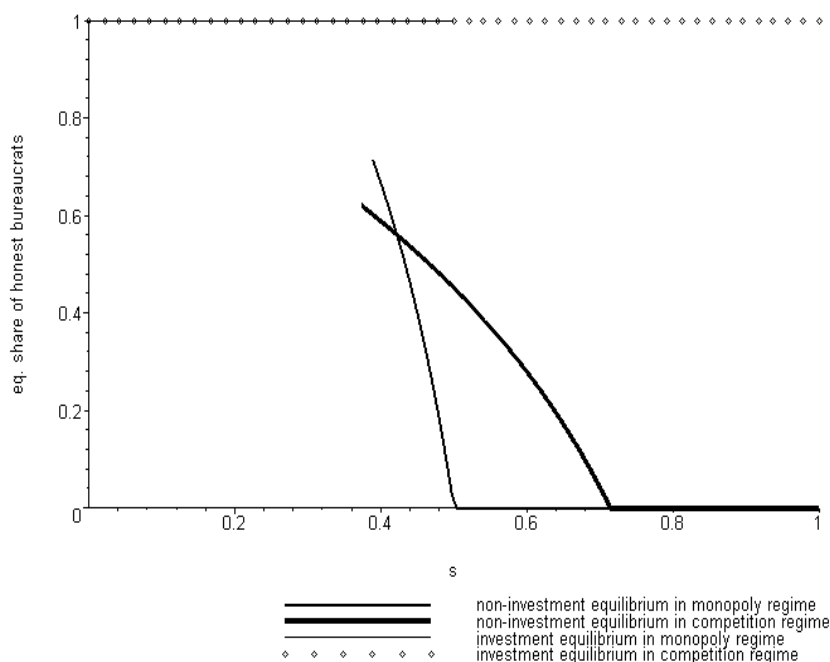


Figure 2: The equilibrium shares of honest bureaucrats h^{eq} when $c = 0.5$, $\delta = 0.6$.

Considering either regime, for low bargaining power of bureaucrats the only equilibrium is the investment one and all bureaucrats are honest. When the bargaining power increases, the investment equilibrium still exists but a non-investment equilibrium appears, that is, there are multiple equilibria. Initially, the share on honest bureaucrats in this non-investment equilibrium is positive but it gradually decreases with the bureaucrats' bargaining power until it reaches zero, that is, all bureaucrats become dishonest. In the monopoly regime for high enough bargaining power the investment equilibrium does not exist while it may still exist in the competition regime provided a sufficiently large discount factor.

In Fig. 2 the equilibrium share of honest officials is drawn. The parameter values are taken such that the equilibrium shares under monopoly, h_m^{eq-int} , and competition regime, h_c^{eq-int} , intersect. Thus, if we focus on non-investment equilibrium with a positive share of honest bureaucrats the monopoly regime has a higher share of honest bureaucrats for lower values of bargaining power but then, for higher values, it is the competition regime. In particular, there is a region $\sigma \in [\frac{1}{2}, \frac{1}{2-\delta})$ where there is no honest bureaucrats in the monopoly regime, $h_m^{eq} = 0$, while there are some in the competition regime, $h_c^{eq} > 0$.

The situation depicted in Figure 2 does not hold always. In particular, h_c^{eq-int} and

$h_m^{eq_int}$ may not intersect. In this case, the competition regime results in a higher share of honest bureaucrats for any bargaining power. This is likely to be the case if the investment costs c are low. This is because with lower c the two thresholds σ_m^* and σ_c^* increase so that the intersection of $h_c^{eq_int}$ and $h_m^{eq_int}$ happens to the left from them when it is irrelevant as both h_c^{eq} and h_m^{eq} are one in that interval. Next Proposition which is a simple corollary of Proposition 11 compares the two regimes.

Proposition 12 *The investment equilibrium exists for a larger set of parameter values under competition regime than under monopoly regime. It exists for $\sigma < \frac{1-c}{1-\delta}$ in the former regime and for $\sigma < 1 - c$ in the latter.*

For $\sigma \in [\frac{1}{2}, \frac{1}{2-\delta})$ in the non-investment equilibrium the share of honest bureaucrats is zero under monopoly regime and strictly positive under competition regime.

Our ultimate goal is the comparison of the welfare in the two regimes. In an investment equilibrium the welfare comparison is trivial. From Proposition 3, $W_m^q = W_c^q$ given the same share of honest bureaucrats. In the investment equilibria under both regimes all bureaucrats are honest, therefore, they result in the same welfare. The competition regime is then better as the investment equilibrium exists there for a larger set of parameter values.

The case of a non-investment equilibrium is more complicated. From Proposition 3, $W_m^u > W_c^u$ given the same share of honest bureaucrats (if $h = 0$ there is an equality). Then, for any positive share of honest bureaucrats in the monopoly regime there should be a higher share in the competition regime so that the welfare in the two regimes is the same. Looking at the equilibrium shares of honest bureaucrats we bias the welfare comparison in favour of the competition regime.

However, when the equilibrium share of honest bureaucrats in the monopoly regime is zero the picture is different. The welfare in this case is $W_m^u = -lc$. In the competition regime for a positive share of honest bureaucrats the welfare is $W_c = -\frac{1-h}{1-\delta h}lc$. Honest bureaucrats delay the implementation of the polluting project (we are in a non-investment equilibrium). This delay is good for welfare and therefore the welfare is higher in the competition regime. We can conclude that for $\sigma \in [\frac{1}{2}, \frac{1}{2-\delta})$ the welfare is lower in the monopoly regime.

9 Conclusion

This paper studied the effects of the competitive bureaucracy. It confirmed the intuition of informal discussions in the literature that it is good (neutral) when corrupt transactions are only about redistributing surplus and bad when they impose negative externalities on the rest of the society. The new finding of the paper is that the competitive bureaucracy creates more incentives for the firms to invest into eliminating these negative externalities.

It may seem that the competitive bureaucracy is an arrangement rarely seen in the real world. However, firms usually can re-register in another region if they are unhappy with the bureaucracy of their current region. Even if in a given region there is only one bureaucrat firms can choose the bureaucrat by choosing the region.

Several directions seem promising for future research. Analyzing the dynamic entry into bureaucracy we found that competitive bureaucracy results in more honest bureaucrats in the equilibrium in some cases. However, our analysis was very basic. Enriching it à la Acemoglu and Verdier (2000) seems to be promising. The government may introduce a price of the licence and it may impose a fine on unqualified applicants. The size of bureaucracy can also be adjusted, as well as salaries paid to bureaucrats.

Another direction is to introduce imperfect information about applicants' type as in Cadot (1987), Banerjee (1997) and others. Applicants, and more importantly, bureaucrats often do not know whether the applicants satisfy the requirements for the licence, or service, they ask for. Bureaucrats may take a costly action to find out as in Mookherjee and Png (1995). For example, a bureaucrat may visit the firm's site to see the technology it uses, or he can give or refuse the licence without visiting saving the time and the effort. It is an open question which regime will result in more bureaucrats' efforts. Bureaucrats can also use red tape to find out which applicants are qualified for the licence as in Banerjee (1997), Saha (2001) and Guriev (2004). Red tape will then serve a double goal: it will create incentives to invest and once investment decision are taken, it will allow to screen the applicants.

Finally, optimal policy in licence administration should be also looked for. Besides choosing the regime, monopoly or competition, policy makers also choose the minimum delay between applications and other costs of applications, that is, they choose red tape. The optimal red tape is likely to be different in the two regimes which might have important policy implications if this paper has any practical relevance.

Appendix

Proof of Lemma 1. Denote decision to invest as a binary function of the history of meetings $I(\#h, \#d)$, where $\#h$ is the number of times the firm has met an honest bureaucrat and $\#d$ is the number of times the firm has met a dishonest bureaucrat: $I(\#h, \#d) = 1$ when the firm invests and $I(\#h, \#d) = 0$ otherwise. Note that if $I(\#h, \#d) = 1$ then $I(\#h + i, \#d + j) = 1 \forall i, j \geq 0$. We need to prove that $I(\#h, \#d)$ takes one of the three forms: $I(\#0, \#0) = 1$ (invest in the first period), $I(\#h, \#d) = 0 \forall h, d$ (never invest), $I(\#1, \#d) = 1 \forall d$ (invest as soon as meet an honest bureaucrat).

Take a candidate strategy $I(\#0, \#d) = 1$ for some $d > 0$. Having invested, the firm is better off by applying randomly than to the dishonest bureaucrat. But then $I(\#0, \#0) = 1$ dominates the candidate strategy because of discounting. Take another candidate strategy $I(\#h, \#d) = 1$ for $h \geq 2 \forall d$. It is dominated by $I(\#1, \#d) = 1 \forall d$ as if the firm finds it optimal to invest after having met two honest bureaucrats it is even better to invest after having met the first one. There are no other strategies. ■

Proof of Proposition 7. The distribution of bargaining power σ affects the bribes. However, it does not affect the welfare if the firm's decision to invest is unchanged. So, $W_m^q, W_c^q, W_m^u, W_c^{uq}, W_c^u$ are still given by (4), (14), (5), (15),(16), respectively.

To prove that $c_c^{q*} > c_m^{q*}$ we have to compute them explicitly. Under monopoly regime, (1) and (2) become

$$\Pi_m^q = h + (1 - h)(1 - \sigma) - c \text{ and} \quad (35)$$

$$\Pi_m^u = \delta h(1 - c) + (1 - h)(1 - \sigma). \quad (36)$$

The threshold c_m^{q*} does not depend on σ and is given by (3).

Under competition regime, bribes (6), (8) and (10) become

$$b_c^q = \frac{1 - \delta}{1 - \delta\sigma + \delta h\sigma}\sigma, \quad (37)$$

$$b_c^u = \frac{1 - \delta}{1 - \delta\sigma + \delta h\sigma - \delta h}\sigma \text{ and} \quad (38)$$

$$b_c^{uq} = \frac{1 - \delta^2 h(1 - c) - \delta(1 - h)}{1 - \sigma\delta + \sigma\delta h}\sigma.$$

The profits (7), (9) and (11) are now

$$\Pi_c^q = \frac{1 - \sigma + \sigma h}{1 - \delta\sigma + \delta h\sigma} - c, \quad (39)$$

$$\Pi_c^u = \frac{(1 - \sigma)(1 - h)}{1 - \delta\sigma + \delta h\sigma - \delta h} \text{ and} \quad (40)$$

$$\Pi_c^{uq} = \frac{(1 - \sigma)(1 - h) + \delta h(1 - c)}{1 - \sigma\delta + \sigma\delta h}.$$

The thresholds c_c^{q*} and c_c^{u*} given before by (12) and (13) are now

$$c_c^{q*} = \frac{(1 - \delta)h}{(1 - \delta\sigma + \sigma\delta h - \delta h)} \text{ and}$$

$$c_c^{u*} = \frac{(\sigma + h - \sigma h)(1 - \delta)}{(1 - \delta\sigma + \sigma\delta h - \delta h)}.$$

The difference $c_c^{q*} - c_c^{u*}$ is positive³⁴

$$c_c^{q*} - c_c^{u*} = \frac{\sigma\delta h(1 - \delta)(1 - h)}{(1 - \delta\sigma + \sigma\delta h - \delta h)(1 - \delta h)} > 0.$$

Noting that c_c^{q*} is increasing in σ completes the proof. ■

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³⁴The difference $c_c^{u*} - c_c^{q*}$ is also positive as before.

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