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Bureaucracy-business relationship, corruption and the implications for marketization[☆]

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ABSTRACT

This paper employs a novel game-theory model to characterize the impact and the resulting welfare implications of a corrupt relationship in the marketization process in an economy with weak institutions. This relationship between a bureaucrat and a domestic firm enables the bureaucrat to share part of the domestic firm's gain generated by the bureaucrat's imposition of barriers to deter the entry of foreign firms. When the barrier has an upper bound and both the bureaucrat and the foreign firm have sufficient knowledge regarding the domestic firm's cost information, the equilibrium level of the barrier would first equal the upper bound and then decrease with the domestic firm's cost. This result is robust regardless of whether the cost of the domestic firm and the foreign firm are positively correlated or independent. The welfare loss is largest in industries where a firm's cost relies heavily on its private advantage: e.g., innovation-intensive industries, and when the domestic firm has a relatively large cost disadvantage. This paper provides novel and insightful implications for marketization in countries with weak institutions.

1. Introduction

Weak institutions create a fertile breeding ground for corruption. In such a system, the executive power of bureaucrats is not restricted effectively, and they can therefore help firms to obtain resources and to overcome market frictions. This potential "trading" opportunity between bureaucrats and firms leads to the formation of corrupt and informal relationships. Such informal relationships exist not only in developing countries like China and India, but also in developed countries like Italy.[1] While the harm caused by the relationships has been empirically identified in many studies, we investigate how such relationships react to the central government's marketization attempts, which aim to increase market efficiency and encourage competition.[2] We also examine the resulting welfare

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[1] See Li et al. (2008) about China, Lehne et al. (2018) about India, and Cingano and Pinotti (2013) and Akcigit et al. (2023) about Italy.

[2] Marketization is caused by such events as joining trading organizations or treaties, deregulation in certain areas, etc. For example, China joining the WTO in 2001, India's deregulation in the 1990s, and Italy's introduction of competing mechanisms in many government procurement projects following the requirements of the EU.

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implications. Our results not only extend the extant literature on bureaucratic corruption following the framework of Shleifer and Vishny (1994) into a new and important context, but they also yield rich policy implications for marketization and anti-corruption efforts.

We assume that a bureaucrat (female) is in charge of selecting the contractor for a publicly-financed project following marketization.[3] Prior to marketization, she had formed an informal relationship with a domestic firm, possibly through previous interactions that involved corruption. This relationship enabled the bureaucrat to have valuable knowledge about the domestic firm's cost information, and she consents to maintaining this corrupt and informal relationship after marketization. Marketization attracts an interested foreign firm to compete for the project. As part of the marketization process, the central government requires a formal procurement auction to be conducted to select the contractor. However, because of weak institutions, the bureaucrat can still hinder any interested firm by delaying its application for a bidding certificate. She can also choose any level of additional cost to deter the application as long as it does not exceed an exogenous *upper bound*, which represents the limit of her power.[4] As a partner, the bureaucrat offers the domestic firm an opportunity to sabotage the foreign firm by requesting a bribe. How this relationship can prevent a new firm's entry is analogous to how a long-term contract between a customer and a firm can prevent the entry of a more efficient new firm, as in Aghion and Bolton (1987). In that paper, the relationship between the customer and the firm is established by a long-term contract, while in our paper, the relationship is established and maintained by previous corrupt deals before marketization.

We make two important and realistic assumptions in the model. The first assumption is that the costs of both firms are positively correlated. This assumption captures a realistic feature that the costs of firms in most industries generally have a common-value part that reflects industry-specific features, and a private-value part that reflects a firm's own advantage or disadvantage. This assumption allows the model to provide rich policy implications about marketization in different industries. The second assumption is that the corrupt bureaucrat also has concerns about the well-being of local citizens and firm growth. Such concerns derive mainly from her career incentive because these two measures are of great importance for a benevolent central government. The career incentive increases her opportunity cost to engage in corruption, because preventing the entry of a competitive foreign firm may be harmful for her performance assessment.

We have three major findings. First, the bureaucrat imposes a barrier only when her bargaining power in the relationship and her concern about firm growth are greater than her concern about citizens' well-being. The optimal barrier first equals the upper bound of the barrier and then decreases with the cost of the domestic firm. Entry is completely prevented in equilibrium only when the domestic firm's cost is sufficiently small. This equilibrium property holds regardless of whether the costs of the two firms are correlated or independent. Second, the comparative statics analysis shows that the welfare loss is the largest when both the domestic firm's cost is sufficiently high and the correlation between two firms' costs is small. In this case, although the probability of entry of the foreign firm is high, the expected welfare loss from overcoming the barrier is also large. This finding yields the interesting policy implication that in innovation-intensive industries where the common-value part of a firm's cost composition is small, a domestic firm with a large cost disadvantage can cause extreme welfare loss. Third, we also study one extension which considers the possibility that, after observing the barrier, the foreign firm can bribe the bureaucrat to remove it. We show that the optimal barrier may be smaller than its counterpart in the benchmark case. Hence, the additional opportunity for corruption can reduce the welfare loss by internalizing the externality of the relationship.

This paper brings important new insights to the literature on bureaucratic corruption, especially considering the generally positive trend in marketization and globalization around the world. The extant literature focuses mainly on a static setting in which corrupt officials maximize the amount of bribes by selling entry certificates to multiple firms.[5] One exception is Choi and Thum (2003) who consider a two-stage model where firms have to purchase a business certificate in each period. We extend this strand of the literature in two dimensions. First, we examine an exclusive and more advanced relationship between the bureaucrat and the firms. This relationship is analogous to a *political connection* where politicians or senior bureaucrats provide special services only to firms that have close ties with them through previous interactions.[6] Second, we capture how the corrupt relationship would respond to positive shocks like marketization. This in turn generates insightful implications for the practice of marketization in countries with weak institutions. We also provide rich policy implications on the harm caused by bureaucratic corruption in different industries.

This paper also contributes to the literature on corrupt auctions. Empirical studies have identified various kinds of preferential treatment in procurement auctions, including the manipulation of entry, easier access to information, etc. Consistent with our assumption, preferential treatment is exclusive. Recent papers in this vein include Cai et al. (2013) about China, Schoenherr (2019) about Korea, and Coviello and Gagliarducci (2017) about Italy. While Italy and Korea are more developed than China, they suffer from weak institutions, and all three have experienced challenges during marketization. In this regard, our study provides a micro foundation to better understand issues in the practice of procurement auctions after marketization. The implications can also help predict the impact of other forms of preferential treatment in public procurements. Extant theoretical papers on corrupt auctions, on the other hand, focus more on the private sector, where the intermediary or expert cares only about monetary payoffs. The strategies used in the private sector to bias the result towards a favored bidder are also different from those in the public sector.[7]

[3] The term "bureaucrat" can be understood to be local leaders who are appointed in a hierarchical political system as in China, or local politicians in Italy or India under the electoral system.

[4] In the literature on power decentralization (e.g., Che et al., 2017), the power of local politicians is restricted by the central government.

[5] For example, Besley and Michael (2007) and Drugov (2010).

[6] Political connection has always been a hot topic in empirical studies. See studies such as Fisman (2001) and Faccio (2006).

[7] See Celentani and Ganuza (2002), Burguet and Che (2004), Compte et al. (2005) and Burguet (2017).

The remainder of the paper is organized as follows: Section 2 describes the model; Section 3 analyzes the equilibrium and its welfare implications; Section 4 investigates the extension; Section 5 discusses several assumptions that can be relaxed and concludes. All proofs are provided in Appendix.

2. The model

We develop a dynamic model with three players: A bureaucrat, a domestic firm (DF), and a foreign firm (FF). Before marketization, DF and the bureaucrat engaged in a relationship through previous interactions, which is analogous to a political connection. This relationship enables the bureaucrat to have precise information about DF, and to leave the door open for further interactions after marketization.[8]

There is an indivisible public project of social value $V \in (0,1]$, which reflects its improvement of the well-being of local citizens. The budget for this project is also V. Because the country has joined a global or regional economic organization, the domestic market is opened up, and FF is attracted to enter. The relationship between the bureaucrat and DF encounters two threats after marketization. First, the contractor for this project must be selected using a procurement auction and, to participate, any interested firm has to acquire a bidding certificate, as required by the central government. Second, the bureaucrat's power is restricted in the sense that she can only accelerate or delay the application of any interested firm, but cannot affect the bidding process.

We assume that there is an exogenous upper bound for the amount of additional cost that the bureaucrat can impose without being involved in a corruption investigation. We denote this upper bound by $\bar{c}$. The bureaucrat can choose any level of the barrier below this upper bound, i.e., $c \in (0,\bar{c})$. c captures a deadweight loss, which may come from extra waiting time or from expenditures on preparing unnecessary documents.

2.1. Firms' types

The procurement cost for DF is x, which follows the uniform distribution on $[0,1]$. For tractability, we assume that FF also knows the exact value of x after it is realized. This assumption is necessary for characterizing the equilibrium in Proposition 1. The cost for FF is y, which is FF's private information. The bureaucrat and DF only know the distribution of y.

Distribution of FF's cost: *With probability* $q \in (\frac{1}{2},1)$*,* y *is randomly drawn from the uniform distribution over* $[0,x]$*; with probability* $1-q$*,* y *is randomly drawn from the uniform distribution over* $(x,1]$.

$q \in (\frac{1}{2},1)$ captures the ex ante cost advantage of FF. The correlation between x and y is $\rho_{xy} = \frac{\sqrt{-3q^2+3q+\frac{7}{12}}}{24}$, which decreases with q. As x increases, the expected gap between x and y, which is equal to $\frac{x-(1-q)}{2}$, also increases. Hence, a larger value of x corresponds to a larger ex ante disadvantage for DF.

We assume uniform distribution to obtain a closed-form solution of the optimal barrier. The general implications of our results would carry over to other distributions.[9]

The assumption that the social value of the project may be smaller than DF's cost is made to model the possibility that DF is too weak to make the project profitable. For example, it is possible that this project requires a minimum level of technological maturity, which may not be satisfied by domestic firms in developing countries. If $V > 1$ so that $V > x$ is always satisfied, all results still hold.

The positive correlation between x and y is proper to capture industries in which the procurement cost has a *common-value* component. This component may come from exogenous factors that have a homogeneous impact on firms' costs, but cannot be controlled by firms. For example, weather conditions can influence industries that have intense outdoor operations such as infrastructure construction. Labor-intensive firms in a competitive labor supply market pay the same wage as other firms, which comprises a significant portion of their production costs.

2.2. Timeline of the game

The bureaucrat first decides whether to offer a deal (d,c) to DF or to set no barrier: if DF agrees to pay d, the bureaucrat will set an application cost of 0 for DF and $c \le \bar{c}$ for FF. If d is rejected, the bureaucrat will choose an application cost for each firm that is sequentially optimal for her.

After marketization, both firms simultaneously decide whether or not to apply for the certificate. The procurement auction begins after the application is finished. It takes the form of a reversed second-price auction with no reserve price.[10] Since the budget is V, if there is only one bidder, it wins the contract and receives a payment of V; otherwise, the firm with a lower bid wins and receives the bid submitted by the losing firm as the payment.

2.3. Utility functions

Both firms are assumed to be risk-neutral. Hence we use their monetary payoffs to represent their utilities.

[8] This assumption characterizes a key property of political connections: It is restricted to a limited number of firms, and a firm has to be acquainted with the bureaucrat first before bribing her. Hence, new firms like FF cannot usually attempt to bribe the bureaucrat immediately after marketization.

[9] For example, all the analyses in this paper qualitatively hold when x and y can be positively correlated or are independent in the following way: with probability $qx \in (0,1)$, y is randomly drawn from the uniform distribution over $[0,x]$; with probability $1-qx$, y is randomly drawn from the uniform distribution over $(x,1]$. When $q=1$, x and y are independent.

[10] This format is strategically equivalent to a reversed English auction in this model.

The bureaucrat's utility reflects both her career considerations and her incentive for corruption. We denote P to be the payment from the government to the winning contractor. $V-P$ can be interpreted as the well-being (consumer surplus) of local citizens, and $P-E$(*cost of the winning firm*) is the expectation of the producer surplus. We assume that the bureaucrat's utility function takes the following form:

$$\alpha(V-P)+\beta(P-E(cost\ of\ the\ winning\ firm))+d \tag{1}$$

where $\alpha, \beta \in (0,1)$, reflecting the bureaucrat's concern about the well-being of local citizens and the firm's growth. When $\alpha=\beta$, the term $\alpha(V-P)+\beta(P-E(cost\ of\ the\ winning\ firm)$ is α times the social welfare. The third term d is the amount of bribes she may receive.

In the utility function, we do not specify whether the weight of producer surplus is firm- specific, i.e., whether the bureaucrat's utility is higher when DF is the winner instead of FF, because attracting investments from foreign firms is also important for a benevolent central government. This concern would be reflected in the bureaucrat's performance evaluation.

2.4. The corrupt deal

Since the bureaucrat knows x, she can potentially extract all surplus from DF. To make our model realistic, we assume that the bureaucrat gets λ portion of DF's extra gain from the barrier, which is the difference in DF's payoffs with and without the barrier. The parameter $\lambda \in (0,1)$ reflects the bargaining power of the bureaucrat in this relationship. Because DF is always better off as long as a barrier is imposed and $\lambda \in (0,1)$, it always accepts the request for a bribe.

3. Equilibrium analysis

3.1. Determination of the optimal barrier

The bureaucrat's problem is to maximize her utility by selecting the entry barrier c. Using backward induction, we first consider the auction stage. Following the weakly dominant strategy of sincere bidding, we assume that bidders bid their true cost. Their expected payoffs in the procurement auction can thus be derived.

In the entry stage, because FF knows x, it only enters $x-c>0$ and $y \le x-c$. Once FF enters, it will win the project. Hence, the bureaucrat can derive her expected utility when she imposes a barrier c. Denote her utility and DF's payoff *gross of* the corrupt deal to be $u(x,c)$ and $\pi(x,c)$. Hence, the corrupt deal is $d=\lambda[\pi(x,c)-\pi(x,0)]$. The bureaucrat's utility maximization problem is the following:

$$\max_c u(x,c)+\lambda[\pi(x,c)-\pi(x,0)] \tag{2}$$
$$s.t.\ \ c \in [0,\bar{c}]$$

Because $c=0$ is also a possible choice of the bureaucrat, she cannot be worse off with the deal. The detailed expression of the objective function is provided after Eq. (9) in Appendix. Proposition 1 characterizes the optimal c and presents the equilibrium.

Proposition 1. *Denote* $\frac{(V-x)(\lambda-\alpha+\beta)}{\beta}$ *by* $\tilde{c}$, $V-\frac{\beta\bar{c}}{\lambda-\alpha+\beta}$ *by* ϕ *and* $\frac{(\lambda-\alpha+\beta)V}{\lambda-\alpha+2\beta}$ *by* ψ. *When* $\lambda-\alpha+\beta \ge 0$ *and* $x \le V$, *the optimal barrier* c^* *is*

$$c^* = \begin{cases} \bar{c}, \text{ when } x < \max\{\phi,\psi\} \\ \tilde{c}, \text{ otherwise} \end{cases} \tag{3}$$

When $\lambda-\alpha+\beta<0$ *or* $x>V$, $c^*=0$.

The following strategies and beliefs constitute a perfect Bayesian equilibrium. For any value of $x \le V$, *when* $\lambda-\alpha+\beta \ge 0$, *the bureaucrat offers the deal* $d=\lambda[\pi(x,c^*)-\pi(x,0)]$. *DF accepts. FF enters if and only if* $y \le x-c^*$, *and stays out when* $y > x-c^*$. *The beliefs of the bureaucrat and DF about FF's cost are consistent.*[11]

In the following analysis, we focus on the case where $\lambda-\alpha+\beta \ge 0$ and $x \le V$. When $\alpha=\beta$, $\lambda-\alpha+\beta \ge 0$ is automatically satisfied. The expression of c^* in (3) can be expressed in a more intuitive form:

$$c^* = \begin{cases} \bar{c}, \text{ when } \bar{c} < \psi \text{ and } x \in [0,\phi); \text{ or when } \bar{c} \ge \psi \text{ and } x \in [0,\bar{c}) \\ \tilde{c}, \text{ otherwise} \end{cases} \tag{4}$$

Hence, as x increases, c^* first equals the upper bound of the barrier $\bar{c}$, and then strictly decreases with x. The decreasing part of c^* appears to be counter-intuitive because a DF with a large cost may have a stronger incentive to prevent FF's entry and is in need of a higher c. This intuition is partly correct because when x is larger, FF is more likely to have a smaller cost than DF, which enhances DF's incentive to prevent entry. However, DF's payoff conditional on FF staying out, which is measured by $V-x$, decreases with x. Hence, a weak DF's ability to bribe is also weak. In addition, as x increases, the bureaucrat is more reluctant to impose a barrier

[11] We assume that FF does not enter when $y>x$, because it can never win. When $x \le \bar{c}$, any $c \in [x,\bar{c})$ has the same effect as $\bar{c}$ in equilibrium because FF would not enter with such c. One extreme case is $x=0$, $c \in [0,\bar{c})$. FF would not enter since it cannot win against $x=0$ regardless of c.

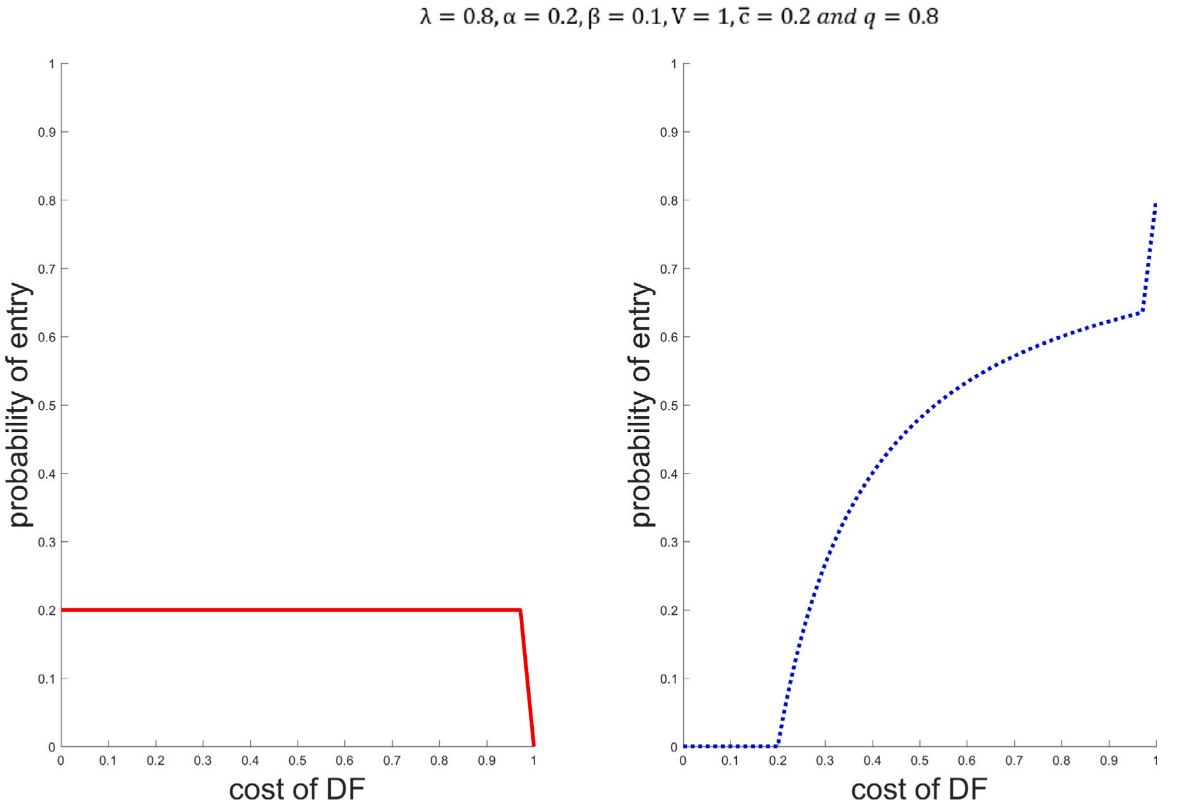

Fig. 1. Optimal entry barrier and FF's probability of entry.

because her expected utility decreases with the cost of the winning contractor, and imposing a barrier only increases the probability of DF's winning the contract. A weak DF cannot compensate the bureaucrat's loss from imposing a high barrier.[12]

The condition $\lambda-\alpha+\beta\geq 0$ is necessary and sufficient for the bureaucrat to impose a barrier. In the bureaucrat's utility function in (1), $\beta-\alpha$ is the coefficient of the expected payment to the winning contractor. When a barrier is imposed, it is effective when it prevents the entry of an FF that would have entered without the barrier, i.e., $y\in[x-c^*,x)$. In this case, V is the payment to DF and $\lambda-\alpha+\beta$ is the coefficient of V in the bureaucrat's utility, where λ comes from the amount of DF's increase in the payoff (which is $V-x$ in this case) that goes to the bureaucrat. Hence, only when $\lambda-\alpha+\beta\geq 0$ would the bureaucrat have an incentive to increase this payment by imposing a barrier. If $\lambda-\alpha+\beta<0$, both the bureaucrat's bargaining power and her concern about producer surplus are small compared with her concern about local citizens' well-being, so she prefers to impose no barrier to minimize the payment.

Fig. 1 provides an illustration of how c^* and the probability of FF's entry depend on x. This example corresponds to the case of $\bar{c}<\psi$ in Eq. (4). Because the probability of $y\leq x$ is q, the upper bound of the probability of FF's entry is $q=0.8$.

In the right panel, when x is sufficiently small so that $x<\bar{c}$, entry is completely prevented because both the probability of $y<x$ and the expected cost advantage of the FF are small. Hence, the bureaucrat maximizes her utility by completely preventing FF's entry. As x increases, although c^* still equals $\bar{c}$, the probability of FF's entry is positive. This is the case when the bureaucrat has incentive to impose a higher barrier but is restricted by $\bar{c}$. As x keeps increasing, c^* strictly decreases and the probability of FF's entry increases sharply.

We finally investigate whether marketization makes the bureaucrat better or worse off. In order to explore this issue, we introduce the possibility that marketization may not occur–it only occurs with an exogenous possibility $\mu\in(0,1)$, which is known to both the bureaucrat and DF. In this case, the deal can take a contingent form that specifies what the payment and service are conditional on whether marketization occurs or not. When marketization occurs, the result in Proposition 1 holds. When marketization does not occur, we assume that the bureaucrat assigns DF to be the contractor when $V\geq x$ and does not implement the project when $V<x$.[13] DF's gain from this deal is $V-x$ and it pays the bureaucrat $\lambda(V-x)$. Proposition 2 states how the bureaucrat's utility is affected by marketization.

[12] Lui (1985) and Choi and Thum (2003) also have the property in equilibrium that the bureaucrat can extract a smaller amount of money from a firm with a higher cost.

[13] The implicit assumption is that without marketization, the bureaucrat has to use her power to argue the necessity of implementing the project.

Proposition 2. *Marketization makes the bureaucrat worse off when $c^* = \bar{c}$ but better off when $c^* = \tilde{c}$ and x is sufficiently large. Hence, when μ increases, her expected utility decreases if $c^* = \bar{c}$ but increases if $c^* = \tilde{c}$ and x is sufficiently large.*

Proposition 2 implies that when marketization is still in progress so that $\bar{c}$ is not small, bureaucrats with weak domestic partners (large values of x) benefit from marketization. Since DF's in innovation-intensive industries usually have a sizeable cost disadvantage, Proposition 2 shows that bureaucrats will support marketization especially in innovation-intensive industries.

3.2. Comparative statics

The set of parameters includes $\bar{c}, \alpha, \beta, x, q, \lambda$ and V. We next consider how these parameters affect four measures: the probability of entry prevention, the equilibrium deal, the welfare loss, and the bureaucrat's utility in equilibrium.

The probability of entry prevention is defined by PN, which characterizes the scenario in which FF would have entered if the barrier had not been imposed.

$$PN = \Pr(y \in [x - c^*, x]) = \frac{qc^*}{x} \tag{5}$$

The equilibrium deal is defined as $d^* = \lambda[\pi(x, c^*) - \pi(x, 0)]$.

Welfare loss, which equals the difference in welfare with and without the barrier and bribe, comes from two sources. First, a barrier may prevent a more efficient FF from entry, which occurs when $y \in (x - c^*, x)$. In this case, if there is no barrier, the cost of the winning contractor would be y instead of x. Second, when $y \in (x - c^*, x)$, although FF can afford c and enters, c becomes a deadweight loss. The expected welfare loss caused by the relationship is denoted by WL:

$$\begin{aligned} WL &= \Pr(y \in (x - c^*, x))E(x - y | y \in [x - c^*, x]) + \Pr(y \in [0, x - c^*])c^* \\ &= -\frac{qc^{*2}}{2x} + qc^* \end{aligned} \tag{6}$$

We define the bureaucrat's utility in equilibrium by U_B, which is the value of the bureaucrat's utility maximization problem in Eq. (1). The following proposition provides all analytical results regarding the comparative statics.

Proposition 3.

(i) PN increases with λ, q, V and $\bar{c}$, and decreases with α and x. PN increases with β if $\lambda \le \alpha$ and decreases with β if $\lambda > \alpha$.

(ii) d^* increases with λ, q, V and $\bar{c}$, and decreases with α and x. It increases with β if $\lambda \le \alpha$ and decreases with β if $\lambda > \alpha$.

(iii) WL increases with λ, q, x, V and $\bar{c}$, and decreases with α. It increases with β if $\lambda \le \alpha$ and decreases with β if $\lambda > \alpha$.

(iv) U_B increases with α, λ, V and $\bar{c}$.

U_B increases with q when $c^* = \tilde{c}$. When $c^* = \bar{c}$, U_B increases with q when $\alpha \ge \beta$. If $\alpha < \beta$, U_B could decrease with q when $\bar{c}$ is sufficiently small and x is relatively small.

If $q(\frac{3}{2}\beta - \alpha) < \beta$, U_B decreases with x. If $q(\frac{3}{2}\beta - \alpha) \ge \beta$, when $c^* = \bar{c}$, U_B could increase with x when $\bar{c}$ is sufficiently small; when $c^* = \tilde{c}$, U_B first decreases and then increases with x.

(v) When $\alpha = \beta$, PN, d^* and WL decrease with α; U_B increases with α.

The comparative statics regarding λ, $\bar{c}$, α and V are intuitive. As the bureaucrat's bargaining power λ increases, the surplus the bureaucrat can extract from DF increases. Hence, she has a stronger incentive to prevent FF's entry, resulting in a larger value of PN, d^* and WL. U_B increases because she would be better off even if she does not change c^*.

$\bar{c}$ affects the three measures only when $c^* = \bar{c}$. Since in this case $\bar{c}$ restricts the bureaucrat's desire to prevent more entry, as $\bar{c}$ increases, PN, d^*, U_B and WL increase.

When α increases, her concern for local citizens' well-being increases and $\tilde{c}$ decreases as a result. Hence, it is easier for FF to enter, which can explain the decrease of PN, d^* and WL. U_B increases because her utility will increase even if she keeps c^* fixed. The fact that c^* decreases suggests that the gain from the increase in local citizens' well-being outweighs the loss from a smaller probability of entry deterrence and thereby a smaller amount of bribe. The intuition about the effect of α can also explain the case of $\alpha = \beta$.

When V increases, DF's potential gain from the corrupt deal also increases, which strengthens the bureaucrat's incentive to prevent entry. Hence, PN, d^* and WL increase. U_B also increases because the bureaucrat's utility from local citizens' well-being will increase regardless of which firm is the contractor.

β represents the bureaucrat's concern for the producer surplus of the winning firm. The effect of β on the above four measures is generally ambiguous unless $\alpha = \beta$, because of the conflict between citizens' well-being and producer surplus.

q cannot affect c^* and hence $x - c^*$, but it can affect the probability that FF has a lower cost than DF. When q increases, PN increases, which leads to the increase of d^* and WL. U_B generally increases with q because a more competitive FF can increase the producer surplus. However, if $\bar{c}$ is sufficiently small, the bureaucrat cannot set an interior optimal c^*. When she has a greater concern about producer surplus than the well-being of local citizens ($\alpha < \beta$), her utility decreases as q increases.

When x is small, the bureaucrat has an incentive to completely prevent entry. As x increases, PN does not change, and WL increases because the probability that a more competitive FF is prevented from entry increases. U_B decreases because while entry is completely prevented, the surplus that the bureaucrat can extract from DF decreases. When x keeps increasing so that the optimal barrier is interior, FF's ex ante cost advantage also increases, leading to a stronger incentive for the bureaucrat to lower the entry barrier. Hence, PN decreases with x. WL increases because FF's more frequent entry also increases the welfare loss from paying the unnecessary cost. This negative effect dominates the positive effect from the decrease of c^*. If $q(\frac{3}{2}\beta - \alpha) \geq \beta$, either the probability that FF has a cost advantage is relatively large, or the bureaucrat's concern about citizens' well-being is relatively small. Hence, when x is sufficiently large, the expected increase in the payment for the contract outweighs the smaller amount of the bribe the bureaucrat can extract, leading to an increase in the bureaucrat's utility.

4. Extension: requesting a bribe from FF

In the benchmark model, we implicitly assume that FF cannot bribe the bureaucrat. The main reason behind this assumption is that foreign firms investing in countries with weak institutions are generally from more developed home countries with strong regulations regarding corrupt activities.[14] However, there are frequent reports about firms from developed countries involved in bribery when they invest in developing countries.[15] In this extension, we assume that after FF has observed c, the bureaucrat can request a bribe from FF to remove the barrier. To reflect reality, we assume that the barrier can only be removed completely or not at all.[16] DF is aware that when it accepts the bureaucrat's request for a bribe, FF may also bribe the bureaucrat to remove the barrier.

Using backward induction, when FF observes c, the bureaucrat cannot ask for more than c. Otherwise, FF will be better off paying this cost. For tractability, we assume that the bureaucrat can extract all rent, implying that she requires FF to pay her c and FF will accept, even though it is indifferent. This assumption takes a realistic concern of FF into account. Normally, FF will expect to interact with the bureaucrat in other business as long as marketization continues to progress. In order to become "acquainted" with the bureaucrat, FF has an incentive to give the bureaucrat all the rent requested in their first interaction.[17]

Fixing the level of c, the incentives for DF in the benchmark model do not change in this extension, because the fact that only an FF with $y \leq c$ can enter does not change. The bureaucrat's incentive would change because the negative externality of the relationship is internalized. She solves the following problem:

$$\max_c \lambda[\pi(x,c) - \pi(x,0)] + u(x,c) + c \cdot \Pr(y \leq x - c) \quad (7)$$
$$s.t. \quad c \in [0, \bar{c}]$$

where $c \cdot \Pr(y \leq x - c)$ is the bureaucrat's expected payoff from FF's bribery.

Denote c^{**} to be the optimal barrier in this extension and $\check{c}$ to be $\frac{x+(V-x)(\lambda-\alpha+\beta)}{2+\beta}$. Denote $\frac{(\lambda-\alpha+\beta)V-(\beta+2)\bar{c}}{\lambda-\alpha+\beta-1}$ by $\check{\phi}$ and $\frac{(\lambda-\alpha+\beta)V}{\lambda-\alpha+2\beta-1}$ by $\check{\psi}$. Proposition 4 presents the equilibrium.

Proposition 4. *The following strategies and beliefs constitute a perfect Bayesian equilibrium. For any value of $x \leq V$, the bureaucrat offers the deal $d = \lambda[\pi(x,c) - \pi(x,0)]$ and imposes $c = c^{**}$ according to the structure in Eq. (8). DF accepts. FF enters when $y \leq x - c^{**}$, but stays out when $y > x - c^{**}$. When there is no barrier, FF enters when $y \leq x$. The beliefs of the bureaucrat and DF about FF's cost are consistent.*

$$c^{**} = \begin{cases} \bar{c}, \text{ when } x < \max\{\check{\phi}, \check{\psi}\} \\ \check{c}, \text{ otherwise} \end{cases} \quad (8)$$

We next investigate whether allowing FF to bribe can reduce the optimal barrier by internalizing part of the externality from imposing the barrier, i.e., whether $c^{**} < c^*$. Proposition 5 provides this analysis.

Proposition 5. *When $\bar{c} \in (\frac{(\lambda-\alpha+\beta)V}{2\lambda-2\alpha+3\beta}, \psi)$ and $x \in (\check{\phi}, \frac{2(\lambda-\alpha+\beta)V}{2\lambda-2\alpha+3\beta})$, $c^* > c^{**}$. Otherwise, $c^* \leq c^{**}$.*

When x is relatively small, the optimal barrier in both the benchmark model and this extension equals $\bar{c}$. In this case, $c^* = c^{**}$. When $\bar{c}$ has a moderate value while x is relatively large, the optimal barrier in the benchmark model is $\bar{c}$, while it is $\check{c}$ in the extension.[18] In this range, the externality of imposing a barrier is partly internalized because $\check{c}$ is reduced from $\bar{c}$, indicating that allowing the bureaucrat to take c can make up for her loss from a smaller amount of transfer from DF.

Allowing FF to bribe the bureaucrat also reduces the welfare loss through two channels. The first channel is the reduction in the deadweight loss from paying the unnecessary entry cost, which occurs whenever $c^* \geq c^{**}$. The second channel is more entry of FF, which occurs when $c^* > c^{**}$. These two positive effects originate from partially internalizing the negative externality caused by the relationship, which may increase the probability of entry, intensify the competition, and reduce the welfare loss.

A final remark is that if FF has to incur an additional cost when it engages in corruption (which captures the risk of being convicted in its home country), Proposition 4 does not change qualitatively as long as this cost does not exceed c^{**}.

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[14] For example, the Foreign Corrupt Practices Act in the United States makes it unlawful for a U.S. company to bribe any foreign official to obtain business.

[15] For example, in 2010, the U.S. Securities and Exchange Commission charged RAE Systems Inc. for illegal payments made through joint ventures to win Chinese government procurement contracts. See https://www.sec.gov/news/press/2010/2010-242.htm.

[16] In reality, it is also rare that a bureaucrat would offer a menu of services and the corresponding charges to a foreign firm that was not acquainted with her. In addition, such a service would reveal information about FF's true cost information, which it may want to avoid.

[17] Proposition 4 would not be qualitatively affected if FF can obtain a fixed proportion of c.

[18] This is the case where decreasing c a bit below c^* has only a second-order effect on the bureaucrat's utility when FF does not bribe, but has a first-order effect on increasing the probability that FF chooses to bribe, which dominates the secondary effect and benefits the bureaucrat. We thank the anonymous referee for this explanation.

5. Concluding remarks

Understanding bureaucrats' incentives is critical to understanding a number of problems in public administration. This approach is especially important for studying a transition economy experiencing improvements in a previously weak system of formal governance. In this paper, we investigate how a relationship formed before the transition responds during marketization, and examine the welfare implications. This novel approach enables us to explore policy implications for the practice of marketization, especially from the perspective of implementing industry-specific policies. Proper policies can entice more efficient foreign firms to enter, which helps accelerate the marketization process in the long run.

Our results have several policy implications for fighting corruption and enhancing welfare. For example, the central government can: lower $\bar{c}$ to limit the bureaucrat's power[19]; induce a larger value of a by emphasizing the importance of measures of citizens' well-being in the bureaucrat's performance evaluation; and increase the monitoring level of the local government's budget V for procurement contracts. Encouraging more competitive foreign firms to enter can also help to increase a bureaucrat's incentive to terminate the relationship with DF. These strategies, except for budget auditing, are more efficient than exogenous supervision when the cost of supervision is considered.[20]

The comparative statics analysis shows that the welfare loss is largest when a DF in an innovation-intensive industry has a sizeable cost disadvantage compared with the FF. In practice, this case may be more detrimental to developing countries because innovation is important for them to transition onto a sustainable path for economic growth. Since the technology and knowledge spillover from investments by foreign firms is an important source of innovation for these countries, preventing the entry of more efficient foreign firms hinders economic development in the long term. Hence, it may be necessary for the central government to implement special policies in such industries to regulate bureaucrats. For example, according to our calculations, the marginal decrease of $\bar{c}$ can lead to a greater reduction of the welfare loss in such industries.

The current model possesses a level of generality that permits the inclusion of more realistic features without altering the qualitative implications. For example, it can include the possibility of bureaucrats' rotation, multiple foreign firms and anticorruption actions that may terminate the bureaucrat's career. There are also several interesting extensions left for future research. For example, interjurisdictional competition can be introduced: if two bureaucrats in adjacent regions are potential competitors for the same position, they will be less willing to continue the corrupt relationship with their respective domestic firms because FF has the option of entering the other region when it is sabotaged in the first. This effect further increases the opportunity cost of corruption.[21] Empirical tests can also be conducted to determine the inflexibility of political connections in different industries and regions.

CRediT authorship contribution statement

Shaoqing Huang: Conceptualization, Funding acquisition, Investigation. **Weisi Xie:** Software, Writing – review & editing. **Xiaoshu Xu:** Formal analysis, Methodology, Writing – original draft.

Appendix

Proof of Proposition 1. The bureaucrat's utility gross of the corrupt deal d when she imposes no barrier and a barrier of c is equal to $u(x,0)$ and $u(x,c)$ respectively. The payoff for DF gross of the corrupt deal d when the barrier is 0 and c is equal to $\pi(x,0)$ and $\pi(x,c)$ respectively. The constraint of the bureaucrat's maximization is then $u(x,c)+\ \lambda[\pi(x,c)-\pi(x,0)]\geq u(x,0)$, where

$$u(x,c)=\alpha V+(\beta-\alpha)E(payment\ to\ the\ contractor)-\beta E(cost\ of\ the\ contractor), c\geq 0 \tag{9}$$

$E(payment\ to\ the\ contractor)=prob(y>x-c)V+prob(y\leq x-c)x$, which is equal to $(q\frac{c}{x}+1-q)V+q(x-c)$ when $x\geq c$, and is equal to V when $x<c$. $E(cost\ of\ the\ contractor)=prob(y>x-c\})x+prob(y\leq x-c)E(y|y\leq x-c)$, which is equal to $qc+(1-q)x+q\frac{(x-c)^2}{2x}$ when $x\geq c$, and is equal to x when $x<c$.

$$\pi(x,c)=prob(y>x-c)(V-x), c\geq 0 \tag{10}$$

which is equal to $(1-q\frac{x-c}{x})(V-x)$ when $x\geq c$, and is equal to $V-x$ when $x<c$.

The expression $D(x,c)=u(x,c)-u(x,0)+\ \lambda[\pi(x,c)-\pi(x,0)]$ can hence be derived as

$$D(x,c)=-\frac{q\beta}{2x}c^2+\frac{q(\lambda-\alpha+\beta)(V-x)}{x}c \tag{11}$$

[19] Marketization generally lowers $\bar{c}$. For example, after China joined the WTO in 2001, local governments enacted various measures to deter the entry of foreign firms, which was against the will of the central government (Panitchpakdi and Clifford, 2002). Subsequently, the central government removed 789 administrative approval items in 2002, 406 items in 2003 and 495 items in 2004.

[20] Acemoglu and Verdier (2000) develop a model incorporating supervision costs and conclude that the second-best intervention may involve a certain proportion of officials accepting bribes.

[21] Besley and Michael (2007), Drugov (2010) and Amir and Burr (2015) also consider the possibility of reducing corruption by introducing competition between corrupt bureaucrats. Ahlin and Bose (2007) consider the competition between honest and corrupt bureaucrats.

Because the objective function is equal to $D(x,c)+u(x,0)$, the optimal barrier to maximize $D(x,c)$ also maximizes $D(x,c)+u(x,0)$.

Without any constraint, $D(x,c)$ is maximized at the axis of symmetry: $c=\frac{(\lambda-\alpha+\beta)(V-x)}{\beta}=\tilde{c}$. When $\lambda-\alpha+\beta\le 0$, $\tilde{c}\le 0$, the optimal barrier is equal to 0 because $D(x,c)<0$ unless $c=0$. When $\lambda-\alpha+\beta>0$, the optimal barrier is $c^*=\min\{\bar{c},\tilde{c}\}$, which is strictly higher than 0. Hence, $D(x,c^*)>0$.

When $x>V$, there is obviously no gain for the bureaucrat to establish a barrier.

Proof of Proposition 3.

1. **Comparative statics of PN**

$$PN=\frac{qc^*}{x} \tag{12}$$

PN depends on α,β,λ and V only when $c^*=\tilde{c}$. Since $\tilde{c}$ increases with λ and V and decreases with α, PN increases with λ and V and decreases with α. Similarly, since $sign(\frac{d\tilde{c}}{d\beta})=sign(\alpha-\lambda)$, $sign(\frac{dPN}{d\beta})=sign(\alpha-\lambda)$.

Because c^* never contains q, $\frac{dPN}{dq}=\frac{c^*}{x}>0$.

When $c^*=\bar{c}$ and when $c^*=\tilde{c}$, $\frac{dPN}{dx}<0$.

If $\alpha=\beta,\tilde{c}=\frac{\lambda(V-x)}{\beta}$. PN decreases with α.

2. **Comparative statics of WL**

$$WL=-\frac{qc^{*2}}{2x}+qc^* \tag{13}$$

   (a) When $c^*=\bar{c}, WL=-\frac{q\bar{c}^2}{2x}+q\bar{c}$. $\frac{dWL}{dq}=-\frac{\bar{c}^2}{2x}+\bar{c}>0$ because $\bar{c}>0$. $\frac{dWL}{dx}=\frac{q\bar{c}^2}{2x^2}>0$. $\frac{dWL}{d\bar{c}}=-\frac{q\bar{c}}{x}+q\ge 0$ because $\bar{c}\le x$.

   (b) When $c^*=\tilde{c}$, WL depends on α,β,λ and V through c^*. Since $\frac{\partial WL}{\partial c^*}>0$, c^* strictly increases with λ and V and strictly decreases with α, $\frac{dWL}{d\alpha}=\frac{\partial WL}{\partial c^*}\frac{\partial c^*}{\partial\alpha}<0$, similarly, $\frac{dWL}{d\lambda}>0$, $\frac{dWL}{dV}>0, sign\{\frac{dWL}{d\beta}\}=sign\{\alpha-\lambda\}$.
   $\frac{dWL}{dq}=-\frac{c^{*2}}{2x}+c^*>0$ because $c^*>0$. $\frac{dWL}{dx}=\frac{-q(\lambda-\alpha+\beta)(\lambda-\alpha+3\beta)x^2+qV^2(\lambda-\alpha+\beta)^2}{2\beta^2x^2}=\frac{q(\lambda-\alpha+\beta)[-(\lambda-\alpha+3\beta)x^2+V^2(\lambda-\alpha+\beta)]}{2\beta^2x^2}>0$ because $x\ge\frac{(\lambda-\alpha+\beta)V}{\lambda-\alpha+2\beta}$.
   When $\alpha=\beta$, WL decreases with α.

3. **Comparative statics of d^***

$$d^*=\frac{\lambda q(V-x)}{x}c^* \tag{14}$$

   (a) When $c^*=\bar{c}, d^*=\frac{\lambda q(V-x)}{x}\bar{c}$, which increases with $\lambda,q,V,\bar{c}$ and decreases with x.

   (b) When $c^*=\tilde{c}$, $d^*=\frac{\lambda q(V-x)^2(\lambda-\alpha+\beta)}{\beta x}$, which increases with λ,q,V and decreases with x,α. $sign\{\frac{dd^*}{d\beta}\}=sign\{\alpha-\lambda\}$. When $\alpha=\beta$, d^* decreases with α.

4. **Comparative statics of U_B**

$$U_B=-\frac{\beta q}{2x}c^{*2}+\frac{q(V-x)(\lambda-\alpha+\beta)}{x}c^* \tag{15}$$

$$+\alpha V-[qx+(1-q)V](\alpha-\beta)-\beta[\frac{qx}{2}+(1-q)x] \tag{16}$$

   (a) When $c^*=\bar{c}$, $\frac{dU_B}{d\alpha}=-\frac{q(\bar{c}-x)(V-x)}{x}>0$, $\frac{dU_B}{d\lambda}=\frac{\bar{c}q(V-x)}{x}>0$, $\frac{dU_B}{dV}=\beta(1-q)+\alpha q+\frac{\bar{c}q(\lambda-\alpha+\beta)}{x}>0$. $\frac{dU_B}{dq}=\frac{-\beta\bar{c}^2+2V(\lambda-\alpha+\beta)\bar{c}+(3\beta-2\alpha)x^2+2V(\alpha-\beta)x}{2x}$. Because $-\beta\bar{c}^2+2V(\lambda-\alpha+\beta)\bar{c}$ increases when $\bar{c}\in(0,\frac{V(\lambda-\alpha+\beta)}{\beta})$, the numerator is greater than or equal to $(3\beta-2\alpha)x^2+2V(\alpha-\beta)x$, which is positive if $\alpha\ge\beta$. If $\alpha<\beta$ and $\bar{c}$ is sufficiently close to 0 while $x\in[\bar{c},\phi)$ and is relatively small, the numerator is negative.

$\frac{dU_B}{dx}=\frac{\beta q}{2x^2}\bar{c}^2-\frac{qV(\lambda-\alpha+\beta)}{x^2}\bar{c}+\frac{3\beta q}{2}-\alpha q-\beta<\frac{3\beta q}{2}-\alpha q-\beta$. Hence if $q(\frac{3\beta}{2}-\alpha)\le\beta$, $\frac{dU_B}{dx}<0$. If $q(\frac{3\beta}{2}-\alpha)>\beta$, $\frac{dU_B}{dx}>0$ when $\bar{c}$ is sufficiently close to 0. $(3\beta-2\alpha)x^2+2V(\alpha-\beta)x$

   (b) When $c^*=\tilde{c}$, $\frac{dU_B}{d\alpha}=q(V-x)[1-\frac{(V-x)(\lambda-\alpha+\beta)}{\beta x}]>0$ because $\tilde{c}<x$. $\frac{dU_B}{d\lambda}=\frac{q(V-x)^2(\lambda-\alpha+\beta)}{\beta x}>0$. $\frac{dU_B}{dV}=\alpha q+\beta(1-q)+\frac{q(V-x)(\lambda-\alpha+\beta)^2}{\beta x}>0$. $\frac{dU_B}{dq}=\frac{\beta x}{2}+(\alpha-\beta)(V-x)+\frac{(V-x)^2(\lambda-\alpha+\beta)^2}{2\beta x}$ which is strictly convex in V. Hence, $\frac{d^2U_B}{dqdV}$ increases in V, and $\frac{d^2U_B}{dqdV}\in[\alpha-\beta,\alpha-\beta+\frac{(\lambda-\alpha+\beta)^2(1-x)}{\beta x}]$. If $\alpha\ge\beta$, obviously $\frac{dU_B}{dq}$ increases in V, so $\frac{dU_B}{dq}>\frac{\beta x}{2}>0$. If $\alpha<\beta$, the minimum of $\frac{dU_B}{dq}$ is achieved at $V-x=\frac{\beta(\beta-\alpha)x}{(\lambda-\alpha+\beta)^2}$, and $\frac{dU_B}{dq}\ge\frac{\beta\lambda(\lambda-\alpha+2\beta)x}{2(\lambda-\alpha+\beta)^2}>0$. Hence, $\frac{dU_B}{dq}>0$.
   $\frac{dU_B}{dx}=\frac{3\beta q}{2}-\alpha q-\beta-\frac{q(\lambda-\alpha+\beta)^2V^2}{2\beta x^2}+\frac{q(\lambda-\alpha+\beta)^2}{2\beta}$ which increases with x. Hence, $\frac{dU_B}{dx}\in[-\beta-\lambda q,\frac{3\beta q}{2}-\alpha q-\beta]$. If $\frac{3\beta q}{2}-\alpha q-\beta<0$, $\frac{dU_B}{dx}<0$. Otherwise, $\frac{dU_B}{dx}$ is first negative and then positive.

When $\alpha = \beta$,

$$U_B = -\frac{\beta q}{2x}c^{*2} + \frac{\lambda q(V-x)}{x}c^* + \beta V - \beta[\frac{qx}{2} + (1-q)x] \tag{17}$$

$\frac{dU_B}{d\alpha} = \frac{\alpha x}{2} + \frac{\lambda^2(V-x)^2}{2\alpha x} > 0.$

Proof of Proposition 4. The bureaucrat maximizes

$$\max_c \lambda[\pi(x,c) - \pi(x,0)] + u(x,c) + c \cdot \Pr(y \le x - c) \tag{18}$$
$$s.t. \lambda[\pi(x,c) - \pi(x,0)] + u(x,c) + c \cdot \Pr(y \le x - c) \ge u(x,0)$$
$$c \le \min\{x, \bar{c}\}$$

Taking derivative with respect to c in the first constraint, we can obtain

$$-\frac{q}{2x}(2+\beta)c^2 + q[1 + \frac{(V-x)(\lambda-\alpha+\beta)}{x}]c + q[1 + \frac{(V-x)(\lambda-\alpha+\beta)}{x}] = 0 \tag{19}$$

Similarly as in the benchmark case, we can derive that the axis of this quadratic form is $c^{**}_{axis} = \frac{x+(V-x)(\lambda-\alpha+\beta)}{2+\beta}$. The optimal barrier c^{**} is

$$c^{**} = \begin{cases} \min\{x, \bar{c}\}, \text{ when } x < \max\{\frac{V(\lambda-\alpha+\beta)-(\beta+2)\bar{c}}{\lambda-\alpha+\beta-1}, \frac{V(\lambda-\alpha+\beta)}{\lambda-\alpha+2\beta-1}\} \\ \check{c}, \text{ otherwise} \end{cases} \tag{20}$$

Proof of Proposition 5. The expression of c^{**} can also be expressed in the following form which is more intuitive:

$$\text{when } \bar{c} \le \check{\psi}, c^{**} = \begin{cases} x, \text{ when } x \in [0, \bar{c}) \\ \bar{c}, \text{ when } x \in [\bar{c}, \check{\phi}) \\ \check{c}, \text{ when } x \in [\check{\phi}, V] \end{cases} \tag{21}$$
$$\text{when } \bar{c} > \check{\psi}, c^{**} = \begin{cases} x, \text{ when } x \in [0, \check{\psi}) \\ \check{c}, \text{ when } x \in [\check{\psi}, V] \end{cases}$$

Define $\frac{(\lambda-\alpha+\beta)V}{\lambda-\alpha+2\beta}$ to be φ_1 and $\frac{(\lambda-\alpha+\beta)V}{\lambda-\alpha+2\beta-1}$ to be φ_2. The region of $(0, V]$ can be divided into three regions, $(0, \varphi_1], (\varphi_1, \varphi_2]$ and $(\varphi_2, V]$. $\check{c} - \tilde{c} = \frac{(2\lambda-2\alpha+3\beta)x-2V(\lambda-\alpha+\beta)}{\beta(\beta+2)}$. Hence, when $x \ge \frac{2(\lambda-\alpha+\beta)V}{2\lambda-2\alpha+3\beta}, \check{c} \ge \tilde{c}$; otherwise, $\check{c} < \tilde{c}$.

Comparing the expressions in (4) and (21), we can conclude that

1. When $\bar{c} \in (0, \varphi_1]$
   - (a) When $x \in (0, \bar{c}], c^* = c^{**} = x$
   - (b) When $x \in (\bar{c}, \min\{\phi, \check{\phi}\}), c^* = c^{**} = \bar{c}$
   - (c) When $\bar{c} \in (0, \frac{(\lambda-\alpha+\beta)V}{2\lambda-2\alpha+3\beta}], x \in (\phi, \check{\phi}), c^* = \tilde{c}, c^{**} = \bar{c}$. Hence, $c^* < c^{**}$. When $x \in (\check{\phi}, V], c^* = \tilde{c}, c^{**} = \check{c}$. Since $\check{\phi} > \frac{2(\lambda-\alpha+\beta)V}{2\lambda-2\alpha+3\beta}$ when $\bar{c} \in (0, \frac{(\lambda-\alpha+\beta)V}{2\lambda-2\alpha+3\beta}]$, $\check{c} > \tilde{c}$.
   - (d) When $\bar{c} \in (\frac{(\lambda-\alpha+\beta)V}{2\lambda-2\alpha+3\beta}, \psi], x \in (\check{\phi}, \phi), c^* = \bar{c}, c^{**} = \check{c}$. Hence, $c^* > c^{**}$. When $x \in (\phi, V], c^* = \tilde{c}, c^{**} = \check{c}$. Because the relative magnitude between ϕ and $\frac{2(\lambda-\alpha+\beta)V}{2\lambda-2\alpha+3\beta}$ is ambiguous when $\bar{c}$ is in this region, the comparison between $\tilde{c}$ and $\check{c}$ is also ambiguous.
2. When $\bar{c} \in (\varphi_1, \varphi_2]$
   - (a) When $x \in (0, \varphi_1], c^* = c^{**} = x$
   - (b) When $x \in (\varphi_1, \bar{c}], c^* = \tilde{c}, c^{**} = x \Longrightarrow c^* < c^{**}$
   - (c) When $x \in (\bar{c}, \check{\phi}], c^* = \tilde{c}, c^{**} = \bar{c} \Longrightarrow c^* < c^{**}$
   - (d) When $x \in (\check{\phi}, V], c^* = \tilde{c}, c^{**} = \check{c}$. Because when $\bar{c} \in (\varphi_1, \varphi_2]$, $\check{\phi} \ge \frac{2(\lambda-\alpha+\beta)V}{2\lambda-2\alpha+3\beta}$, $c^* \le c^{**}$.
3. When $\bar{c} \in (\varphi_2, V]$
   - (a) When $x \in (0, \varphi_1], c^* = c^{**} = x$
   - (b) When $x \in (\varphi_1, \varphi_2], c^* = \tilde{c}, c^{**} = x \Longrightarrow c^* < c^{**}$.
   - (c) When $x \in (\varphi_2, V], c^* = \tilde{c}, c^{**} = \check{c}$. When $\bar{c}$ is in this region, $\varphi_2 > \frac{2(\lambda-\alpha+\beta)V}{2\lambda-2\alpha+3\beta}$. Hence, $\tilde{c} < \check{c}$.

Proof of Proposition 2. The proof is straightforward. When $c^* = x$, FF can never enter, and the bureaucrat's utility is strictly smaller than $(\beta+\lambda)(V-x)$, because DF's gain from the relationship is strictly smaller after marketization. Hence, the bureaucrat would get less than $\lambda(V-x)$ from DF. When $c^* = \bar{c}$, the bureaucrat's incentive to completely prevent entry by imposing $c = x$ is restricted because $\bar{c} < x$. Her utility is thereby lower than that if she can completely prevent entry, and is thereby also strictly smaller than $(\beta+\lambda)(V-x)$. When $c^* = \tilde{c}$, it can be shown that if $x = \psi$, the difference between the utility after and before marketization is $\frac{2\lambda\beta^2V^2(q-1)(\lambda-\alpha+\beta)}{(\lambda-\alpha+2\beta)^2} < 0$; if $x = V$, this difference is $q\beta^2V^2 > 0$. Hence, when x is large, marketization makes the bureaucrat better off.

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