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Abstract

In order to make competition open, fair and transparent, procurement regulations often require equal treatment for all bidders. This paper shows how a favorite supplier can be treated preferentially (opening the door to *home bias* and *corruption*) even when explicit discrimination is not allowed. We analyze a procurement setting in which the optimal design of the project to be contracted is unknown. The sponsor has to invest in specifying the project. The larger the investment, the higher the probability that the initial design is optimal. When it is not, a bargaining process between the winning firm and the sponsor takes place. Profits from bargaining are larger for the favorite supplier than for its rivals. Given this comparative advantage, the favored firm bids more aggressively and then, it wins more often than standard firms. Finally, we show that the sponsor invests less in specifying the initial design, when favoritism is stronger. Underinvestment in design specification is a tool for providing a comparative advantage to the favored firm.

Keywords: Auctions, Favoritism, Auction Design, Renegotiation, Corruption.

JEL classification: C72, D44, D82.

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1 Introduction

Governments and state-owned enterprises around the world spend substantial sums to purchase goods, services and infrastructure projects. Public procurement, excluding public corporations, represents about 13% of GDP in OECD countries.[1] Naturally, then, how that spending is carried out is a major issue. Governments, supranational entities and international organizations choose and recommend procurement procedures intended to foster competition among suppliers and allow the public sector to receive more value for the money.

Those procedures are usually designed to make competition open, fair and transparent. In particular, they try to prevent procurement authorities from favoring a specific set of bidders over others. Local authorities, for example, may prefer that contracts be awarded to local suppliers. This home bias, though, is detrimental to competition. Since the mid-1990s, the European Union has been actively promoting equal treatment for all European suppliers not only by creating a single public-procurement market with uniform procedures, but also by eliminating differences in standards or technical regulations set by national governments for health and safety reasons, which may act as entry barriers for some suppliers. Similarly, a number of WTO members have signed the Government Procurement Agreement, which requires that suppliers from all signatory countries be treated equally. In general terms, the main objective is to promote the use of symmetric –or *anonymous*– procurement auctions, i.e. those that treat all bidders equally, irrespective of their nationality or other specific characteristics.[2]

In spite of all these efforts to level the playing field, there is evidence that home bias in procurement is still a prominent phenomenon. Herz and Varela-Irimia (2020) uses data from from 1.8 million European public procurement contracts awarded between 2010 and 2014 to estimate a gravity model of bilateral procurement flows. It concludes that firms

[1]See *stats.oecd.org* and Bosio et al. (2020), which reports that procurement accounts for 12 percent of global GDP -i.e. around $11 trillion.

[2]Other justifications for favoring some bidders over others are sometimes used –e.g. promoting SMEs, treating minority-owned business preferentially– but they are unrelated to our focus in this paper.

located in the home region of the tendering authority are about 900 times more likely to be awarded a contract than foreign firms.

In this paper, we highlight the role of contract renegotiation as a key limiting factor to equal treatment in procurement auctions. Independently of how transparent and anonymous the procurement auction may be, once the contract has been awarded to the winner, Williamson's "fundamental transformation" occurs. If the original contract has to be renegotiated later on, such renegotiation is, by construction, not anonymous. If procurement authorities value some suppliers higher than others, they will tend to treat the former more favorably when renegotiating.

Furthermore, such unequal treatment will impact the procurement process as a whole. If renegotiation is likely, those bidders that expect better renegotiation terms will anticipate their future larger surplus and bid more aggressively in the initial procurement auction. Favored bidders will win more often, capturing a larger share of the procurement market. Even though the auction itself may be anonymous, the procurement process as a whole is not.

If the procurement authority wants to favor a specific set of bidders, then, renegotiation provides scope for doing so. The authority might be tempted to specify the contract to be auctioned off in such a way that renegotiation is more likely. We show below that this may indeed be the case. The original contract may be less complete than it could be, so that renegotiation becomes more probable. Needless to say, this enhances the advantage that any favored bidder may hold over her rivals.

We provide a simple model that allows us to incorporate these issues into our analysis of the procurement process. A project has to be carried out, and the sponsor, i.e. the public institution in charge of it, will manage it so as to maximize her utility. She cares about the surplus the project will generate to the public sector, but she also cares about the profits of a specific bidder –in fact, her objective function is a weighted sum of her own and the favored bidder's surplus. First, the sponsor invests in specifying the contract that will be awarded to a supplier. That contract determines what the winning supplier should do for a given set of contingencies, which may be larger or smaller according to the sponsor's initial investment choice. Possible contractors then compete in a second-price auction. After the winner has been determined, if a contingency that has not been anticipated in the contract arises, renegotiation follows. We provide a specific form for the renegotiation game. When renegotiating, naturally, the sponsor will act according to her own objectives. Renegotiation efforts for reducing firm's rents are costly, and the sponsor will select a lower effort level when renegotiating with her favorite firm (since its rents are also part of sponsor's objective function) than when doing so with another potential supplier. In equilibrium, this will yield a larger surplus from renegotiation if the contractor involved is the favorite. Then, that supplier will be more aggresive in the bidding stage, since her expected profits when winning are larger. Given that the favored firm's comparative advantage is larger at the bidding stage, when the probability of renegotiation is higher, this may affect the sponsor's incentives when specifying the initial design. Furthermore, we show that, under certain conditions, the set of contingencies for which the contract is specified is smaller when the weight given to the favorite's utility in the sponsor's objective function is larger.

There are at least two possibly related phenomena where renegotiation may act as a channel to discriminate among bidders. The first, following our examples above, is what is sometimes called *favoritism*: the procurement authority may care about the welfare of a specific set of bidders. These may be local firms, pay more local taxes and generate more local employment, which could be particularly valued by local authorities. In general, favoritism leads to the use of procurement auctions that are not anonymous. Favored bidders are given some advantage over their rivals, e.g. price preferences or quotas. When discrimination is prohibited by higher-level regulations, as in the EU example, the renegotiation channel we focus on could be key.

In addition, renegotiation may be the way in which a procurement authority and a subset of bidders implement a *corrupt* agreement. In exchange for a bribe, the authority may promise a larger surplus from renegotiation to a specific bidder. This allows that bidder to be more aggressive and win with a larger probability. This is not just a theoretical possibility. Campos at al. (2021) describes the Odebrecht case, one of the largest corruption scandals in recent history –government officials in twelve countries in Latin America and Africa were involved. Odebrecht, an infrastructure company, systematically bribed officials to receive better treatment in the renegotiation process, thereby holding an advantage at the auction stage. This case shows that corruption may take place even though the auction stage is symmetric and difficult to manipulate. Below, we include a specific section where we explicitly analyze the possibility of corruption –i.e. endogenous favoritism– and show how the impact of anonymous procurement auctions to ensure equal treatment for all bidders can be rather limited.[3]

Our work is connected to a few different strands in the literature. First, it is related to the literature on renegotiation and cost overruns in procurement. We borrow from Bajari and Tadelis (2001) and Ganuza (2007) the setting where the sponsor does not know the optimal design of the project ex ante. She invests in reducing the likelihood that the design fails and renegotiation follows, which would generate additional costs. Their focus, though, is different. Bajari and Tadelis (2001) are mainly interested in the choice between fixed-price contracts (better for cost-reduction incentives) and cost-sharing contracts (better for reducing ex-post transaction costs). We ignore this dimension, and concentrate on fixed-price contracts, the most widely used used contractual arrangement in public procurement.[4] Ganuza (2007) analyzes a competitive procurement setting with horizontally differentiated suppliers. His main result is that systematic cost overruns may arise, since the sponsor optimally underinvests in the specification of the initial design in order to promote competition (reducing suppliers' rents). While we do not consider horizontally differentiated suppliers, it is also important in our model that bidders foresee expected contract renegotiation and bid more aggressively when anticipating profits if renegotiation occurs.

[3]In addition, we provide an analysis of how corruption may impact the very first stage of the procurement process, where the exact specification of the project is selected. The study of corruption at that early stage has been absent in the literature. See Burguet, Ganuza and Montalvo (2018) for a survey.

[4]In 2009, Obama's white house memorandum declared that the USA Administration has a strict preference for fixed price contracts over the cost-plus ones. See Lewis and Bajari (2011) for a discussion of contractual procedures in USA.

Our analysis is connected as well to the literature on favoritism, i.e. the possibility that the sponsor values positively the profits obtained by some suppliers. Laffont and Tirole (1991) and Vagstad (1995) study the case of multidimensional auctions, where favoritism may appear when the auctioneer assesses product quality. McAfee and McMillan (1989), Branco (1994), and Naegelen and Mougeot (1998) examine single-dimensional auctions, where price-preferences may be used. In all these papers, the procurement authority may resort to mechanisms that are not anonymous. Arozamena and Weinschelbaum (2011) extend the analysis of the single-dimensional case to a situation where the number of bidders is endogenous, and conclude that the optimal auction in that setting is anonymous. Arozamena, Shunda and Weinschelbaum (2014) characterize the optimal auction under favoritism when the number of bidders is fixed and the buyer is constrained to use a symmetric mechanism, in a setting without renegotiation. Here, we add two stages to the analysis of the procurement process. First, we describe how the sponsor decides to what extent to specify the contract to be allocated in the auction, and we consider the possibility that renegotiation may happen after the winner has been chosen. As we describe below, favoritism will have an impact on both of those added stages.

Corruption may be another explanation for the procurement authority's biased behavior. Our work, then, relates to the literature on corruption in procurement, and in particular to Campos et al. (2020). The model in that paper points at renegotiation as a way in which the bribing firm may be favored. That model may be viewed as a possible interpretation of the last part of our analysis. We provide here a more complete analysis, by adding a description of how renegotiation itself may endogenously become more relevant, since the procurement authority may actually make it more probable when designing the contract.

The rest of the paper proceeds as follows. Section 2 below lays out our model, describing how the procurement contract is designed, how the auction is carried out and how renegotiation, if necessary, may proceed. Section 3 describes the equilibrium behavior that follows. Section 4 discusses a few possible extensions, as well as some applications. Given that our model is somewhat specific, Section 5 examines how relaxing some of our assumptions would alter our results. Finally, Section 6 concludes.

2 The Model

A sponsor wants to undertake a single, indivisible project. There are $N \geq 3$ potential contractors[5] that are willing to complete the project according to the sponsor's specifications. The sponsor values the project at v if it is completed – we normalize her utility at zero if it is not. She procures the services of one of the potential contractors using a symmetric auction mechanism. For simplicity, we assume she uses a second-price auction. All parties are risk-neutral, and all the information described below is common knowledge.

The optimal design of the project is uncertain. Specifically, we assume that there is a set W of all contingencies that may arise during the project's construction. The optimal design depends on which of those contingencies actually occurs. Before the auction, the sponsor must provide potential contractors with a design, which we model as a contract that specifies what to do for a set of contingencies/states of nature. Let $e \in [0, 1]$ be the sponsor's effort in specifying the contract, and let $W^C(e) \subset W$ be the set of contingencies that are covered in the contract as a result. The sponsor's effort entails a cost $k(e)$, with $k'(e) > 0$, $k''(e) > 0$, $k'(0) = 0$ and $k'(e)$ growing fast enough so that interior solutions always obtain. A larger value of e means that the contract includes specifications that cover a larger set of states of nature, so that $W^C(e') \subset W^C(e'')$ whenever $e' < e''$.

After the auction, and before the construction of the project, the state of nature that determines the optimal design is realized. Let that state be $w^* \in W$. If $w^* \in W^C(e)$, then following the initial contract yields the full value v to the sponsor. So as to simplify notation, we assume that $\Pr\{w^* \in W^C(e)\} = e$. If $w^* \notin W^C(e)$ (which happens with probability $1 - e$), the sponsor needs to modify the original contract to obtain v. In order to keep the model as simple as possible, we assume, as in Bajari and Tadelis (2001), that if $w^* \notin W^C(e)$, completing the project according to the original contract gives the sponsor

[5] In Section 5 we explore the case where there may be just two potential contractors.

zero utility. In that case, the sponsor engages in a renegotiation game with the firm that won the auction, so as to adapt the project to state of nature w^* in the contract and thus obtain the full value v.

Before moving on to the renegotiation process, we describe the potential contractors' cost functions. We assume that for every possible contract $W^C(e)$, firm 1's (later labeled as the "favored firm") cost of undertaking the project is $c_1(e) = c(e) + \Delta$, where Δ is distributed according to a c.d.f. F which is symmetric around zero. In particular, for simplicity, we assume here that F is the uniform distribution on the interval $[-B, B]$ and $B > 0$. For any $i \geq 2$, firm i's cost is $c_i(e) = c(e)$. Then, all firms have the same expected cost ex ante, and Δ reflects firm 1's cost advantage/disadvantage. To avoid complications that will not alter our main results, we take the case where the expected cost of completing the project is independent of the contract's specifications, so that $c(e) = c$ for all e. In addition, as we will detail below, in our setup it will always be the case that $v > c + B$.

Given an effort choice e by the sponsor and the corresponding contract covering contingencies in $W^C(e)$, firm 1 learns its cost (i.e. Δ is realized) and the second-price auction takes place. Then, the winning firm and the sponsor learn w^*. If $w^* \in W^C(e)$, the initial contract is implemented. If $w^* \notin W^C(e)$, as we mentioned, the contract has to be renegotiated –since we are assuming that the initial design yields zero utility to the sponsor. In order to accomodate state of nature w^* in the previous project, the firm has to incur an additional cost $c_{w^*} < v$, and this applies equally to any of the potential contractors. We take a renegotiation setup that follows Bajari and Tadelis (2001). We model the renegotiation stage as a reduced-form game: with probability $\lambda > 0$ the sponsor makes a take-it-or-leave-it (TIOLI) offer to the contractor, and with probability $1 - \lambda > 0$ the firm makes a TIOLI offer to the sponsor. Clearly, the party making the offer will capture all surplus from renegotiation. We depart from Bajari and Tadelis (2001), though, in considering that λ is endogenous and that it is chosen by the sponsor at some cost during the renegotiation process. In particular, the sponsor bears a renegotiation cost $\beta\lambda^2/2$, where β is a parameter capturing the sponsor's relative efficiency in the renegotiation process. As $v > c_{w^*}$, it is always profitable to renegotiate the contract if $w^* \notin W^C(e)$. Even more, we assume that $v \geq c + B + c_{w^*}$, which means that it is optimal to procure the project even if it is necessary to renegotiate with the winner with probability one.

Finally, we add favoritism to the setup described so far. We assume that the sponsor cares about the welfare of firm 1, the "favored firm." Specifically, the sponsor maximizes the weighted sum of her own, "private" utility –i.e. the value she receives from the project if completed minus any cost she has to pay– and the favored contractor's expected profit.[6] Then, the sponsor's welfare, Π_F^S, is given by

$$\Pi_F^S = \Pi^S + \alpha \Pi_1,$$

where Π^S is the sponsor's "private" expected utility and Π_1 is the favored firm's expected profit. The parameter α measures the intensity of favoritism. We assume that $\alpha \in [0, 1)$, so that the sponsor values the favored bidder's profit less than her own, "private" utility.

Summarizing, the timing in the model is as follows:

1. *Contract specification:*

   - The sponsor chooses e and thereby specifies the initial contract $W^C(e)$.

2. *Procurement:*

   - *G*iven $W^C(e)$, each firm learns its cost of undertaking the project (i.e. Δ is realized).

   - The second price auction takes place and the project is awarded.

3. *Renegotiation:*

   - The winning firm and the sponsor learn w^*. Two cases may occur:

     (a) If $w^* \in W^C(e)$, the initial contract is implemented.

[6] The way favoritism enters in the sponsor's utility function is as in Arozamena and Weinschelbaum (2011) and Arozamena, Shunda and Weinschelbaum (2014). It is a special case of the setup in Naegelen and Mougeot (1998). Still, the favored contractor's profits may enter that utility function in a different way, and our qualitative results would remain valid.

(b) If $w^* \notin W^C(e)$ the renegotiation process take place.

i. The sponsor chooses λ at a cost equal to $\beta\lambda^2/2$.

ii. The TIOLI offer takes place according to λ, and a new contract is signed for implementing w^*.

4. *The project is completed.*

We have made a number of assumptions in order to simplify the analysis. We postpone to Section 5 below a discussion of the exact role these assumptions play and to what extent our results will hold in more general cases. Now, we characterize the equilibrium in the model we have just laid out.

3 Equilibrium

3.1 Renegotiation

To start solving the model backwards, we focus first on the renegotiation stage. Suppose that $w^* \notin W^C(e)$, so that the sponsor and the winning firm need to renegotiate the contract. Given our assumptions, the renegotiation process is always successful and the optimal design for state of nature w^* is implemented. The surplus from renegotiation, $v - c_{w^*}$, is thus always generated, but how it is split depends on which of the parties makes a TIOLI offer, and on whether the winning firm is the favored one or not.

Let us start with the case where the favored firm, contractor 1, won the initial auction. Assume that the sponsor already chose a specific value of λ. If the sponsor makes the offer, which happens with probability λ, the firm will gain nothing from renegotiation, since the sponsor will set a price[7] that just compensates the adaptation cost, c_{w^*}. The sponsor thus appropriates the whole surplus. If, as happens with probability $(1-\lambda)$, it is the firm that makes the offer, the sponsor's "private" utility from renegotiation will be zero: the firm sets a price that equals v and obtains a profit of $v - c_{w^*}$. Then, the sponsor's "private" expected

[7]This is the price the sponsor will pay in addition to the price set in the initial, second-price auction.

utility from renegotiation (for a given value of λ) is $\lambda(v - c_w^*)$, whereas the contractor's expected profit is $(1 - \lambda)(v - c_w^*)$.

Anticipating these outcomes, and considering renegotiation costs, the sponsor chooses her renegotiation effort λ. Her problem is

$$\max_{\lambda \in [0,1]} \quad \lambda(v - c_w^*) + \alpha(1 - \lambda)(v - c_w^*) - \beta\frac{\lambda^2}{2}.$$

The sponsor's objective function is, then, the weighted sum of her own "private" expected utility, $\lambda(v - c_w^*) - \beta\frac{\lambda^2}{2}$, and the firm's expected profit, $(1 - \lambda)(v - c_w^*)$.

Under favoritism, the sponsor considers the favorite contractor's profits when choosing how hard to renegotiate. Then, the optimal renegotiation effort for the sponsor, $\lambda^*(\alpha)$, will be such that

$$\lambda^*(\alpha) = \arg\max_{\lambda} \left[v - c_w^* - (1 - \alpha)(1 - \lambda)(v - c_w^*) - \beta\frac{\lambda^2}{2} \right],$$

which yields

$$\lambda^*(\alpha) = \frac{1 - \alpha}{\beta}(v - c_w^*). \tag{1}$$

The sponsor's effort when renegotiating falls with the intensity of favoritism, α.

Let $\pi^R(\alpha)$ be the expected net profit a contractor obtains if there is renegotiation (which happens with probability $(1-e)$) and it is favored with coefficient α. This profit includes any additional adaptation costs the contractor may have to pay due to changes in the project. Given the sponsor's optimal renegotiation effort choice, we have

$$\pi^R(\alpha) = (1 - \lambda^*(\alpha))(v - c_{w^*}), \tag{2}$$

where $\pi^R(\alpha)$ is increasing in α. If the sponsor becomes less efficient in the renegotiation process (i.e. if β grows) $\lambda^*(\alpha)$ falls and the firm's profit, $\pi^R(\alpha)$ rises.

The total expected renegotiation cost that the sponsor will face will then be

$$c^R(\alpha) = \lambda^*(\alpha)c_{w^*} + (1 - \lambda^*(\alpha))v + \beta\frac{\lambda^*(\alpha)^2}{2} = c_{w^*} + \pi^R(\alpha) + \beta\frac{\lambda^*(\alpha)^2}{2}$$

Naturally, if firm $i \geq 2$ won the auction and is involved in the renegotiation process, the same reasoning as above applies, except for the fact that $\alpha = 0$. The sponsor will then choose a larger probability of herself making a TIOLI offer,

$$\lambda^*(0) = \frac{v - c_w^*}{\beta}. \tag{3}$$

The firm's profit will thus be

$$\pi^R(0) = (1 - \lambda^*(0))(v - c_{w^*}) \tag{4}$$

and the total renegotiation cost for the sponsor will be

$$c^R(0) = c_{w^*} + \pi^R(0) + \beta\frac{\lambda^*(0)^2}{2}.$$

We summarize our key results at this stage in the following Lemma

Lemma 1 *The sponsor's optimal renegotiation effort, $\lambda^*(\alpha)$, is decreasing in α, and the expected renegotiation profit for the favored bidder, $\pi^R(\alpha)$ is increasing in α. In particular, the sponsor renegotiates harder with unfavored bidders, and the latter obtain a lower expected profit from renegotiation than the favorite –i.e. $\lambda^*(\alpha) < \lambda^*(0)$ and $\pi^R(\alpha) > \pi^R(0)$ for any $\alpha > 0$.*

Clearly, then, the sponsor treats the favorite bidder better. She chooses a lower effort and thereby allows contractor 1, if it won the auction, to capture a larger portion of the renegotiation surplus. This asymmetric treatment of contractors at the renegotiation stage will be key in what follows. It turns the original symmetric mechanism into an asymmetric one.

3.1.1 Procurement Stage

After the sponsor has specified the project, $W^C(e)$, the relative efficiency parameter Δ is realized, and firms take part in the second price auction. It is a weakly dominant strategy for each contractor to bid a sum equal to the minimum price for which it would be willing to undertake the project. That is, each contractor i bids the price P_i^* that would make its expected profit from the project –including any potential profits from renegotiation– equal to zero. In the case of firm 1, then, we have

$$P_1^* - c - \Delta + (1-e)\pi^R(\alpha) = 0,$$

so that.

$$P_1^* = c + \Delta + (1-e)\pi^R(\alpha).$$

For firm $i \geq 2$,

$$P_i^* - c + (1-e)\pi^R(0) = 0.$$

so

$$P_i^* = c + (1-e)\pi^R(0).$$

All bidders anticipate their expected profits from renegotiation *and discount them in their initial bids.* But contractor 1's discount is more aggressive, since it has a renegotiation advantage.

To emphasize this point, let us compare firm 1's situation with that of any firm $i > 1$. The bidding behavior described above implies that firm 1's bid will be lower that firm i's when

$$c + \Delta - (1-e)\pi^R(\alpha) < c - (1-e)\pi^R(0),$$

or

$$\Delta < (1-e)[\pi^R(\alpha) - \pi^R(0)] \equiv \Gamma(e, \alpha)$$

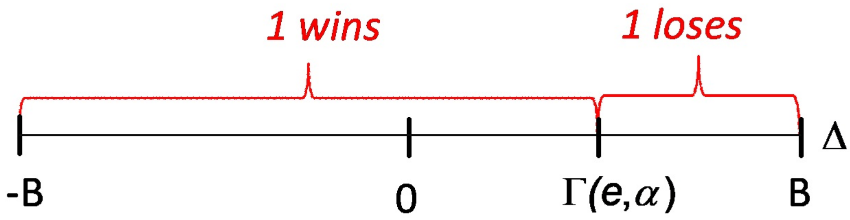

Figure 1 : Project allocation.

As shown in Figure 1, $\Gamma(e,\alpha)$ is the effective cost advantage that favoritism conveys to contractor 1 due to preferential treatment when renegotiating the original contract. This advantage does not follow from the existence of renegotiation, but from the fact that the renegotiation outcome is conditional on the original winner's identity. In fact, $\Gamma(e,0) = 0$ for any value of e. If renegotiation were anonymous, firm 1 would bid lower than its rivals and win when $\Delta < 0$, as in a second-price auction without renegotiation.

From (1), (2), (3) and (4) above, we have

$$\Gamma(e,\alpha) = (1-e)(\lambda^*(0) - \lambda^*(\alpha))(v - c_{w^*}) = (1-e)\frac{\alpha}{\beta}(v - c_{w^*})^2 > 0$$

As we would expect, firm 1's advantage is increasing in α. Note as well that, since the channel through which favoritism generates that advantage is renegotiation, $\Gamma(e,\alpha)$ is decreasing in e. When the sponsor selects a lower effort in covering contingencies contractually, renegotiation is more likely, which in turn makes firm 1's advantage more relevant and valuable.

Naturally, firm 1's market share –i.e. its probability of winning– is also increasing in α and decreasing in e:[8]

$$\Pr[\Delta < \Gamma(e,\alpha)] = \frac{\Gamma(e,\alpha) + B}{2B}.$$

Given our distributional assumptions, we may interpret B as a measure of cost dispersion. A smaller value of B, for example, means that the firm 1's cost distribution is more similar to its rivals'. Interestingly, the impact of favoritism on firm 1's market share is larger when

[8] We are implicitly assuming that $(1-e)\frac{\alpha}{\beta}(v - c_{w^*})^2 < B$, otherwise firm 1 will always win.

B is smaller. The advantage that favoritism generates has a greater impact when potential contractors are more homogeneous.

Given that $N \geq 3$, for any realized value of Δ, the second-lowest bid is always made by a nonfavored contractor. Thus, our simplifying assumptions eliminate any effect favoritism may have on the price resulting from the auction, which is always

$$P^*(e) = c - (1-e)\pi^R(0).$$

In Section 5 below we discuss what may happen in cases where the price that follows from the second-price auction may also change as a result of favoritism.

3.1.2 Specification Stage

The sponsor's goal at the specification stage is to choose the contract that maximizes her ex-ante utility, given by the weighted sum of her own, "private" utility and the favored firm's profit. Anticipating equilibrium behavior in the auction, the sponsor's "private" expected utility is

$$v - P^*(e) - (1-e)C^R(e, \alpha), \tag{5}$$

where $C^R(e, \alpha)$ is the expected renegotiation cost

$$C^R(e, \alpha) = \Pr[\Delta < \Gamma(e, \alpha)]\ c^R(\alpha) + (\Pr[\Delta > \Gamma(e, \alpha)])\ c^R(0).$$

Firm 1's expected profit is given by the sum of its expected profit from the second-price auction and expected renegotiation profits.

$$\begin{aligned}\Pi_1(e, \alpha) &= \Pr[\Delta < \Gamma(e, \alpha)][-E\{\Delta|\Delta \leq \Gamma(e, \alpha)\} + (1-e)(\pi^R(\alpha) - \pi^R(0))] \\ &= \Pr[\Delta < \Gamma(e, \alpha)][-E\{\Delta|\Delta \leq \Gamma(e, \alpha)\} + \Gamma(e, \alpha)]. \end{aligned} \tag{6}$$

As $\Gamma(e, \alpha)$ is decreasing in e and increasing in α, so is $\Pi_1(e, \alpha)$.

Combining (5) and (6), the sponsor's problem is

$$\max_{e} \quad \Pi_F^S(e,\alpha) = v - P^*(e) - (1-e)C^R(e,\alpha) + \alpha\Pi_1(e,\alpha) - k(e), \tag{7}$$

Given our assumptions –namely, that Δ is uniformly distributed and that the cost of renegotiating for the sponsor is quadratic– we can compute the first-order condition for (7),

$$c_w^* + \frac{(v-c_w^*)^2(2-\alpha^2)}{4\beta} - k'(e) = 0 \tag{8}$$

and the corresponding second-order sufficient condition holds as well.

Let $e^*(\alpha)$ be the optimal specification level for the sponsor. In what follows, we try to establish how the optimal specification level varies with the intensity of favoritism.

3.1.3 Optimal specification selection and favoritism

How does favoritism impact the sponsor's initial effort choice in specifying the contract? As a more incomplete contract makes renegotiation more likely, we may expect that e^* would fall with α: given that the competitive advantage that the favored contractor holds is tied to the possibility that the original contract be renegotiated, with more intense favoritism the sponsor may lower e so as to make renegotiation more likely. Proposition 1 formalizes this intuition by stating that the sponsor´s objective function is strictly submodular.

Proposition 2 $e^*(\alpha)$ *is strictly decreasing*

Proof. Take the first-order condition (7) as implicitly defining $e^*(\alpha)$. Then, using the implicit function theorem, we would have

$$\frac{de^*}{d\alpha} = -\frac{\frac{\partial^2}{\partial e \partial \alpha}\Pi_F^S(e,\alpha)}{\frac{\partial^2}{\partial e^2}\Pi_F^S(e,\alpha)}$$

By the second-order condition of (7), we know the denominator of this expression is negative.

Then, the sign of $de^*/d\alpha$ will coincide with the sign of $\frac{\partial^2}{\partial e \partial \alpha}\Pi_F^S(e,\alpha)$. We can then compute

$$\frac{\partial^2}{\partial e \partial \alpha}\Pi_F^S(e,\alpha) = -\frac{\alpha}{2\beta}(v - c_w^*)^2 < 0$$

and our result follows. ■

Then, more favoritism implies a contract covering fewer states of nature, and thus makes renegotiation more likely. We provide an example of this negative relationship below.

Example 1: *Suppose* $v = 6$, $c = 2, c_w^* = 3, \beta = 5$, $B = 1$ *and* $k(e) = 5e^2/2$. *Then,*

$$e^*(\alpha) = \frac{3}{100}(26 - 3\alpha^2)$$

which is depicted in Figure 2 below.

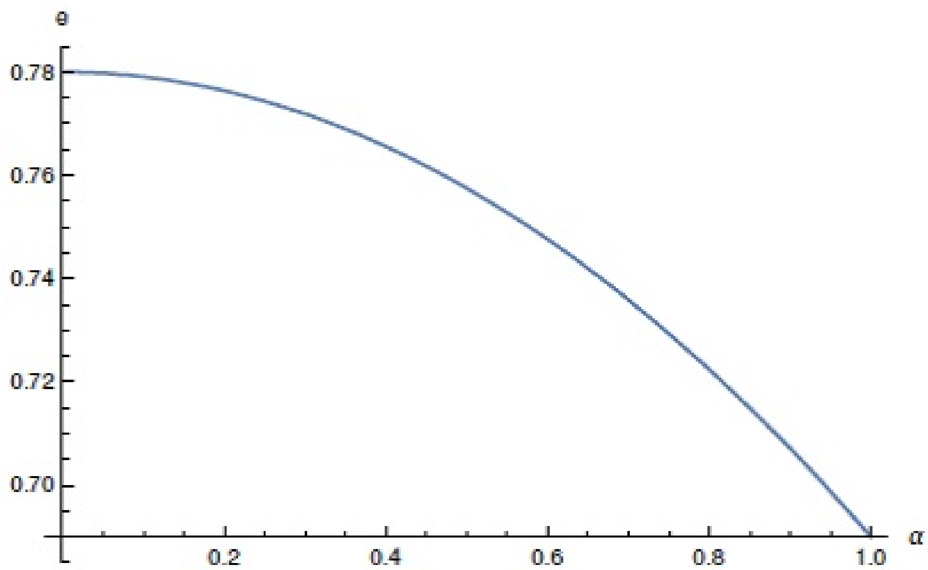

Figure 2 : Project specification and favoritism.

Therefore, we have shown not only that the favored contractor in the renegotiation process may have a competitive advantage in the bidding competition, but also that the sponsor may increase such advantage by underinvesting in specifying the initial contract, making renegotiation more likely. Finally, more favoritism leads to lower incentives to invest in contract specification.

4 Applications and extensions

In this section, we use and extend our model to examine a few policy issues. First, we show how favoritism can be endogenized if there is corruption in the procurement process. We then move on to analyze how our results would change if the sponsor could commit to renegotiating anonymously. Finally, we use our model to study the impact of policies intended to limit cost overruns in procurement.

4.1 Endogenous Favoritism and Corruption.

Until now, we have taken the fact that firm 1 was the sponsor's favorite contractor as exogenously given. In this subsection, we analyze "endogenous favoritism." We focus on a setting in which the sponsor is not biased in favor of firm 1, but she delegates the procurement process to an agent. The procurement agent is corruptible. She may behave according to the sponsor's preferences but, in exchange for a bribe, she may also collude with firm 1. In order to introduce this bureaucratic corruption in our model, we consider an initial stage in which the procurement agent and firm 1 engage in a bribing negotiation game. There, firm 1 offers a bribe b, and, if she accepts, the agent commits to a continuation strategy that is summarized by a specification effort and a level of favoritism during the renegotiation process, (e_c, α_c).[9] If the corrupt deal is reached, the agent incurs a cost τ that is likely to include expected penalties but also idiosyncratic factors related to moral cost and career concerns –in other words, we are assuming that procurement agents are heterogenous, so that some agents are more prone to be involved in corruption than others. The idiosyncratic cost τ is distributed according to a c.d.f. $G(.)$. We remain agnostic about the exact negotiation procedure, but we assume that it is efficient, so that corruption takes place whenever the

[9]Note that, as we mentioned above, corruption influences the exact specification of the project.

additional firm's profits from corruption compensate the agent's cost. That is, whenever

$$\Pi_1(e_c, \alpha_c) - \Pi_1(e^*(0), 0) > \tau$$

The bribe b determines how the corruption surplus, $\Pi_1(e_c, \alpha_c) - \Pi_1(e^*(0), 0) - \tau$, is divided between both parties. Its exact value depends on the parties' bargaining power. However, whether corruption takes place or not only depends on the corruption surplus being positive. Then, the ex-ante probability of corruption is $\gamma = G(\overline{\tau})$, where the cut-off cost $\overline{\tau}$, is given by

$$\begin{aligned} \overline{\tau} &= \Pi_1(e_c, \alpha_c) - \Pi_1(e^*(0), 0) \\ &= \frac{\Gamma(e_c, \alpha_c)}{2} + \frac{\Gamma(e_c, \alpha_c)^2}{4B}. \end{aligned}$$

The last equality follows from (6). $\Gamma(e_c, \alpha_c)$ is decreasing in e_c and increasing in α_c. The choice of (e_c, α_c) may depend on institutional constraints, such as the probability of detecting corruption. For example, if we consider the case where e is observable but the renegotiation effort λ, is not (only the renegotiation outcome is observable), then we may expect $e_c = e^*(0)$ and $\alpha_c = 1$. Independently of (e_c, α_c), we can state an interesting comparative statics result

Proposition 3 *Corruption is more likely to arise if cost dispersion is low.*

This is a direct implication of the fact that $\overline{\tau}$ is decreasing in B, which in our setting measures the costs dispersion. The intuition for this insight, which may go beyond the specific details of our model, is the following. The corrupt firm's comparative advantage in the bidding process is bounded by renegotiation rules and limits. In a way, it is a fixed amount. Then, the lower is dispersion in cost distributions, the higher will be the probability that such an advantage will make the corrupt firm win.

This result is interesting for the corruption literature. Cost dispersion is, in general, directly related to firms' rents and, then, inversely related to the level of competition in a particular industry. Therefore, we can read our result as stating that more competitive markets with low firm profits are more vulnerable to corruption when it takes place through this procurement renegotiation channel. This goes against the traditional view that relates corruption to lack of market competition, which generates rents that can be illegally appropriated.[10]

This form of "competitive corruption" fits well with the Odebrecht corruption case described in Campos et al.(2021). In that case, corruption emerged in a construction sector characterized by its competitiveness and low firm profits. During the period 2001-2016, Odebrecht –the largest engineering and construction company in Latin America– bribed about 600 politicians and public servants in 10 Latin American countries. According to the US Department of Justice (2016), this corruption case was the largest foreign bribery case in history, accounting for 788 millions of dollars in bribes.

Although, in exchange for the bribes, Odebrecht asked for several ways to be favored, the most prominent one was obtaining higher prices during the renegotiation process. Campos et al.(2021) shows that renegotiation revenues in Odebrecht's projects for which there is evidence of corruption were higher than in the regular projects. As the theoretical discussion of the case in Campos et al.(2020) and our model predict, this renegotiation advantage translated into an advantage at the bidding stage. Odebrecht multiplied its contracts by a factor higher than 8 times between 2003 and 2016 due to its corrupt practices.

4.2 Commitment to renegotiating anonymously: more frequent cost overruns?

In Section 3, we have shown that favoritism may lead to lower specification and more cost overruns than a situation in which the sponsor treats firms equally. In this subsection, we provide an alternative benchmark. Here, the sponsor treats all firms equally, has commitment power and can set a renegotiation effort $\lambda = \lambda_c$ before the auction takes place. Beyond its role as a benchmark, this assumption may be relevant, for example, if the sponsor is a

[10]Rose-Ackerman was one of the first scholars promoting the idea that as competition reduces rents, it also leads to lower corruption. In her book, Rose-Ackerman (1996), she states: "In general any reform that increases the competitiveness of the economy helps reduce corrupt incentives." We provide an additional argument to the literature on competition and corruption that challenges the Rose-Ackerman' principle –see for example Bliss and Di Tella(1997), Celentani and Ganuza (2002) and Laffont and N'Guessan (1999).

long term player that may be interested in building a reputation. In that case, the sponsor would exert the same effort level at the renegotiation stage whichever contractor has won the auction.

How does this impact the procurement process? Naturally, since in our original setting it was unequal treatment at the renegotiation stage that acted as a channel for favoritism, such a channel now disappears. Without the incentive provided by favoritism, we may expect that renegotiation, and cost overruns, will occur less frequently. We show now that this may not be the case.

When the sponsor can commit to a renegotiation effort $\lambda = \lambda_c$, we have $\pi^R(\alpha) = \overline{\pi}^R = (1-\lambda_c)(v-c_{w^*})$ for all α, and $\Gamma(e,\alpha) = 0$ for all e, α. At the same time, $C^R(e,\alpha)$ and $\Pi_1(e,\alpha)$ is constant in e, α. In addition, we know that $P^*(e)$ does not depend on α. Intuitively, whichever extra expected profits from renegotiation the sponsor generated by lowering e, they would be equal for all bidders. Then, they would all discount those extra profits equally in their initial bids.

With commitment, which value of λ_c would the sponsor choose? Following our previous arguments, the expected price would be $P^*(e) = c - (1-e)\overline{\pi}^R$. At the initial stage, the sponsor would choose not only the specification level e but also her bargaining effort λ_c. She would then solve

$$\max_{e,\lambda_c} \quad -\left[c - (1-e)\overline{\pi}^R\right] - (1-e)\left[c_{w^*} + \overline{\pi}^R + \beta\frac{\lambda_c^2}{2}\right] - k(e).$$

Which simplifies to

$$\max_{e,\lambda_c} \quad -c - (1-e)c_{w^*} - (1-e)\beta\frac{\lambda_c^2}{2} - k(e).$$

Notice that the objective function is decreasing in λ_c. Then, it would be optimal to select $\lambda_c = 0$, and the sponsor's optimal specification choice would be

$$e_c^* \in \arg\min\{(1-e)c_{w^*} + k(e)\}.$$

Intuitively, as any renegotiation surplus bidders may have is discounted in their original bids, the sponsor has incentives to eliminate any inefficiencies associated to renegotiation. In our model, then, she reduces her effort to zero. This, in turn, leads to lower investment in specification, since $e_c^* < e^*(\alpha)$ for all $\alpha \in (0,1)$. Cost overruns are then more likely as a result of commitment.

4.3 Limiting cost overruns

In order to prevent the form of discrimination analyzed in our original setup, we could device a policy that limits cost overruns in the project. In fact, it is common in public procurement regulations to set such a limit. Typically, if cost overruns are above the limit the project is not longer under the sponsor's control and any renegotiation of the original contract has to be approved by a higher authority. We can incorporate this policy into our model by imposing a minimum renegotiation effort to the sponsor, $\overline{\lambda} > \lambda^*(0)$, that removes the possibility of discrimination. The sponsor then solves

$$\max_e \quad \Pi_F^S(e,\alpha,\overline{\lambda}) = v - c - (1-e)c_{w^*} - (1-e)\beta\frac{\overline{\lambda}^2}{2} - k(e).$$

The next proposition establishes the relationship between project specification and $\overline{\lambda}$.

Proposition 4 *Project specification is increasing in* $\overline{\lambda}$.

The proof of the proposition is a direct implication of the first order condition

$$c_w^* + \beta\frac{\overline{\lambda}^2}{2} - k'(e) = 0 \tag{9}$$

Then, this policy leads to more specification and lower cost overruns, since renegotiation takes place less often and firms seize lower rents through renegotiation.

5 Relaxing assumptions

As mentioned above, we made a number of specific assumptions, simplifying the model in a way that allowed us to highlight how favoritism influences the whole procurement process, from contract specification to renegotiation. In this section, we discuss how relaxing those assumptions may or may not change our results.

Once the initial contract has been awarded, we took a very specific form for the renegotiation game. That form allowed us to simplify substantially the equilibrium in earlier stages of the game. However, what is key to our results is that renegotiation yields a larger profit to the favorite than to its rivals, and that such profit (in our notation, $\pi^R(\alpha)$) grows with α. Independently of the exact renegotiation game, then, the favorite contractor will have a cost advantage $\Gamma(e, \alpha) > 0$ in the original auction, as described in our model, and that advantage will result in a lower bid in the initial auction.

Given that cost advantage, we can examine the impact of favoritism in the auction's result in different settings, so as to understand the role our assumptions play. For example, assume momentarily that $N = 2$, and also that both firms' cost distributions have a common support, $[\underline{c}, \overline{c}]$. Figure 3 below helps compare outcomes with and without favoritism.

Without favoritism (i.e. when $\alpha = 0$), firm 1 wins if $c_1 < c_2$ (region I), so the auction's result is efficient, whereas with favoritism it wins when $c_1 - \Gamma(\alpha) < c_2$ (I and II). Then, favoritism has no impact on price or the initial contract allocation in region I. In region II, it changes contract allocation (firm 1 wins instead of firm 2) and reduces the price set in the auction. In region III, finally, it only lowers the resulting price. Naturally, since $\Gamma(\alpha)$ grows with α, region II is larger (and region III smaller) when favoritism is more intense. Expected renegotiation costs also change with favoritism. They go from $c^R(0)$ to $c^R(\alpha)$ in regions I and II, and stay the same in region III.

This extends to cases where $N \geq 2$. Then, favoritism has a three-fold impact on the outcome of the procurement process for a given project. It influences (i) the resulting allocation, (ii) the price set in the initial auction, and (iii) contractor profits and sponsor

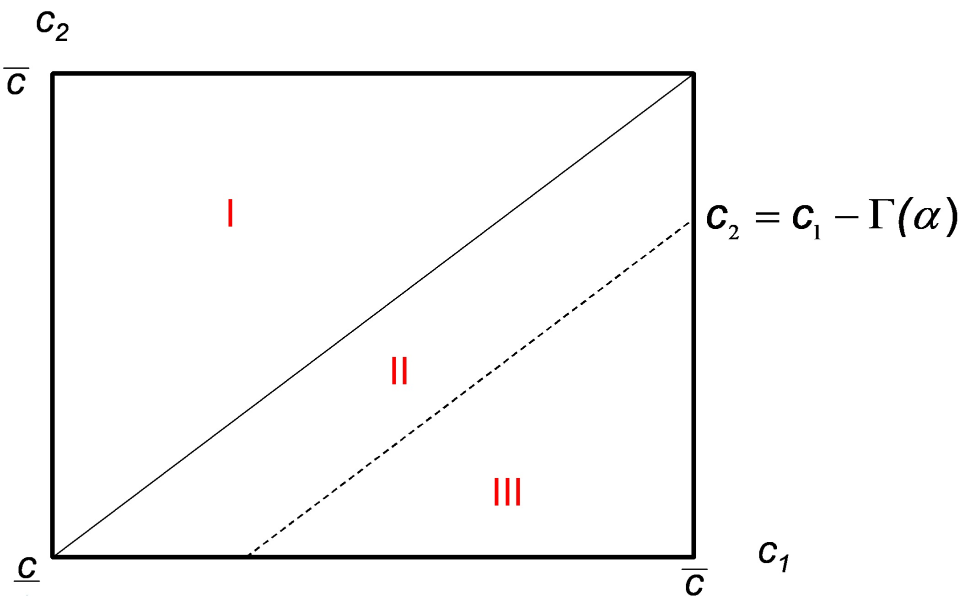

Figure 3 : Project allocation with and without favoritism.

costs from renegotiation.

Our specific model simplified the analysis by taking a setting where the second effect listed above is absent. In Section 2, by assuming $N \geq 3$ under our specific cost distributions we eliminated any possible impact of favoritism on the auction's price. In essence, the favorite firm's bid can never be the second lowest, and favoritism can only impact the resulting allocation. Naturally, in a more general setting both contract allocation and price can change with favoritism.

To consider a simple case where favoritism may have pricing effects, let us modify our model from Section 2 only by assuming that there is just one nonfavored firm, so $N = 2$. There are now three cases, analogous to the three regions in Figure 3. Favoritism changes neither the allocation nor the auction's price when $\Delta < 0$. When $\Delta \in (0, \Gamma(e, \alpha))$, it changes contract allocation (firm 1 wins instead of firm 2) and reduces the price set in the auction. Finally, if $\Delta > \Gamma(e, \alpha)$, it only lowers the resulting price, since firm 1 still loses, but does so while bidding lower.

Then, our analysis in Section 2 changes only in that the expected price resulting from the auction is now a function of e and α. The expected value of the losing bid is now

$$\begin{aligned}P^*(e,\alpha) &= E_\Delta\left[\max\{c-(1-e)\pi^R(0), c+\Delta-(1-e)\pi^R(\alpha)]\right] \\ &= c+\Pr[\Delta>\Gamma(e,\alpha)]\ \{E\left[\Delta|\Delta\geq\Gamma(e,\alpha)\right]-(1-e)\pi^R(\alpha)\} \\ &- \Pr[\Delta<\Gamma(e,\alpha)]\ (1-e)\pi^R(0)\end{aligned}$$

Moving back to the specification stage, in our original setting an increase in α made reducing e more attractive to the sponsor. There is a new effect now, though, since the price that follows from the second-price auction varies as well. And the joint impact of e and α on that price is less clear. If α becomes larger, then contractor 1 bids lower. Reducing e will make him lower his bid even more. This further reduction is not so attractive in the second of the three possible cases, i.e. when $\Delta\in(0,\Gamma(e,\alpha))$, since the price falls from contractor 1's bid to her rival's bid -and the latter is independent of α. It is attractive in the third case, for $\Delta>\Gamma(e,\alpha)$, where firm 1's bid becomes the auction's resulting price. If the second case is more relevant we may have a significant countervailing effect. This happens, for example, when the initial value of α is large. The favorite contractor is winning with a large probability, so the price reduction obtained in an unlikely third case is not attractive.

We would then expect results to be less precise than before. Solving the sponsor's optimal specification problem,

$$\max_e \quad \Pi_F^S(e,\alpha)=v-P^*(e,\alpha)-(1-e)C^R(e,\alpha)+\alpha\Pi_1(e,\alpha)-k(e),$$

the corresponding FOC is

$$c_w^*+\frac{(v-c_w^*)^2}{2\beta}\left[\frac{(1-e)\alpha^2(v-c_w^*)^2}{B\beta}-\frac{(2+\alpha)\alpha-2}{2}\right]-k'(e)=0$$

As before, let $e^*(\alpha)$ be the optimal specification effort for the sponsor. We provide a sufficient condition for strict submodularity of the sponsor's objective function. Note that this condition is easier to satisfy for lower values of α.

Proposition 5 *If* $\beta > \frac{2\alpha(v-c_w^*)^2}{(1+\alpha)B}$, *then* e^* *is strictly decreasing in* α.

Proof. Proceeding exactly as in the proof of Proposition 1, and computing the cross derivative, we get

$$\frac{\partial^2}{\partial e \partial \alpha}\Pi_F^S(e,\alpha) = \frac{(v-c_w^*)^2}{2B\beta^2}\left[2(1-e)\alpha(v-c_w^*)^2 - (1+\alpha)B\beta\right].$$

Then, if $\beta > \frac{2\alpha(v-c_w^*)^2}{(1+\alpha)B}$, this expression is negative for any value of e. ■

The following two examples provide cases where our sufficient condition does and does not hold.

Example 2: *Suppose* $v = 6$, $c = 3$, $c_w^* = 2, \beta = 24$, $B = 1$ *and* $k(e) = 5e^2/2$. The sufficient condition in the Proposition applies, and $e^*(\alpha)$ is strictly decreasing, as shown in Figure 4.

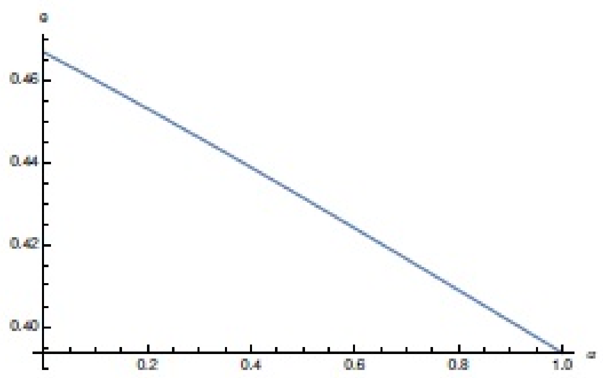

Figure 4 : Project specification in Example 2

As in the main model in which we ignore pricing effects, if the condition of Proposition 2 holds, the higher the favoritism, the lower the incentives of the sponsor to specify the initial contract. The next example shows that if the sufficient condition does not hold, the pricing

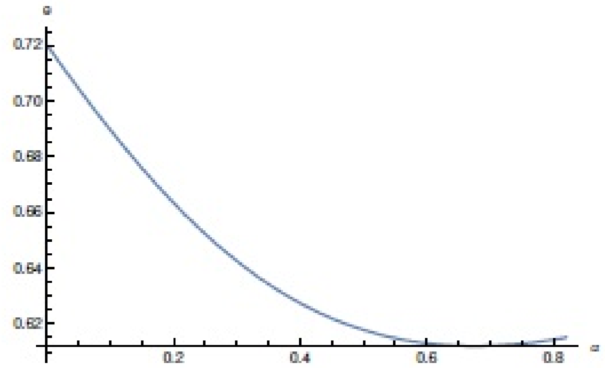

Figure 5 : Project specification in Example 3

effects may make the relation between favoritism and the incentives to specify the initial contract not monotonic.

Example 3: *Now* $v = 6$, $c = 3, c_w^* = 2, \beta = 5$ $B = 1$ *and* $k(e) = 5e^2/2$

6 Conclusion

Procurement auctions are frequently regulated in a way that imposes equal treatment for all bidders. In this paper, we have argued that whenever contracts can be renegotiated, there is a channel through which a favorite contractor can be granted better treatment: renegotiation is not anonymous, and this in turn makes the whole procurement process asymmetric as well. The core idea is that, given that the favorite firm will be better treated in contract renegotiation, it will be more aggressive in the initial, anonymous bidding process, and therefore win more often. Furthermore, making renegotiation more likely by underinvesting in design specification enhances the favorite firm's comparative advantage, thereby increasing its probability of winning and its profits. Under certain conditions, the initial contract will be less specified the more the sponsor cares about the favored firm's profits. Renegotiation is much harder to regulate than the procurement auction itself, so ensuring that the whole procurement process satisfies equal treatment for all bidders is equally difficult.

We have shown that this channel exist, but also that: i) it does not increase cost overruns beyond their level at the optimal solution with commitment; ii) policies targeted to limit cost overruns reduce or eliminate discrimination but they may increase total costs; and iii) pricing effects may lead to a nonmonotonic relationship between design specification and favoritism.

The setting we have analyzed is complex since it involves a procurement process with heterogeneous bidders and renegotiation. We have illustrated potential supplier discrimination due to biased renegotiation using the simplest possible specification of such setting. Further research is needed for understanding the interaction between biased renegotiation, pricing effects and incentives to specify the initial contract. We have theoretically shown the existence of the channel but we hope that future empirical research will explore how the bidding behaviour of firms is determined by contract renegotiation, whether or not local firms are favored in renegotiation, and how these effects change the sponsor's incentives to invest in specifying the initial contract.

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