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# Auctions vs. negotiations in vertically related markets<sup>☆</sup>

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## ABSTRACT

In a two-tier industry with bottleneck upstream and two downstream firms producing vertically differentiated goods, we identify conditions under which the upstream supplier chooses exclusive or non-exclusive negotiations, or an English auction to sell its essential input. Auctioning off a two-part tariff contract is optimal for the supplier when its bargaining power is low and the final goods are not too differentiated. Otherwise, the supplier enters into exclusive or non-exclusive negotiations with the downstream firm(s). Finally, in contrast to previous findings, an auction is never welfare superior to negotiations.

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## 1. Introduction

There is widespread evidence that both auctions and negotiations are broadly used in the procurement processes in the private sector. [Bajari et al. \(2009\)](#) report that from 1995–2000, 43% of private construction contracts in Northern California have been awarded via negotiations, while the remaining contracts have been awarded via auctions with open competitive tendering or among a restricted group of bidders. [Leffler et al. \(2003\)](#), exploring private company sales of timber tracts in North Carolina, find that roughly 50% of the contracts are awarded via bilateral negotiations. [Bonaccorsi et al. \(2003\)](#) report that both auctions and bargaining are used as procurement mechanisms in Italian hospitals.

The comparison of auctions and negotiations has been of great interest to economic theorists, practitioners and policymakers. Theoretical studies (e.g. [Goldberg, 1977](#); [Bulow and Klemperer, 1996, 2009](#); [Manelli and Vincent, 1995](#); [Herweg and Schmidt, 2017](#)), experimental studies (e.g. [Thomas and Wilson, 2002, 2005](#); [Gerke and Stiller, 2006](#); [Gattiker et al., 2007](#)), as well field studies

(e.g. [Bajari et al., 2009](#); [Kaufmann and Carter, 2004](#); [Wu and Kersten, 2017](#)) compare auctions with negotiations in terms of profitability and efficiency. These studies analyze conditions under which auctions outperform negotiations in terms of efficiency and profitability for buyers and sellers.

Within this vivid debate, our paper addresses the following questions. Do quality differences of final goods affect an upstream supplier's choice among different input selling mechanisms? How does its bargaining power affect this choice? Are consumers and the society benefited by the supplier's optimal choice?

We consider a two-tier industry with an upstream monopolist selling an essential input to two downstream firms that are using it to produce vertically differentiated goods. In a three stage game, the upstream supplier first decides whether to sell the input via exclusive or non-exclusive negotiations, or auction exclusivity off via an English auction. Two-part tariff contracts are used in all cases. In the second stage, the selected input selling mechanism is implemented. Under negotiations, bargaining power is exogenously distributed among involved parties and non-exclusive negotiations are simultaneous and separate over contingent contracts. Finally, downstream firms set their prices.

The upstream monopolist opts for an auction if final goods are not too differentiated. Moreover, the lower its bargaining power, the more likely it selects an auction. The upstream supplier prefers exclusive negotiations only if its bargaining power is high. Otherwise, it opts for non-exclusive negotiations that, despite resulting in above-marginal-cost input pricing, yield higher

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consumer surplus and social welfare. In this case, the low quality downstream firm is not foreclosed and total output and industry profits increase. Interestingly, an auction does not lead to an efficient outcome and should be scrutinized by antitrust authorities.

Our paper relates to the literature comparing auctions and negotiations. Bulow and Klemperer (1996, 2009) show that auctions outperform negotiations.<sup>1</sup> Goldberg (1977) and Manelli and Vincent (1995) point out that negotiations may be preferable to auctions when quality is non-contractible and information exchange is crucial for the design of the good. Herweg and Schmidt (2017) confirm these views under costly renegotiations on design improvements and identify conditions under which negotiations are welfare-superior.<sup>2</sup> We depart from this literature by assuming that the qualities of final goods are known. The driving force that makes negotiations outperform an auction in our context is the higher fixed fees that a powerful supplier can extract from downstream firm(s). Moreover, non-exclusive negotiations allow for the production of the low quality good and are, thus, welfare superior to an auction.

Our paper is also related to the vast literature on the performance and welfare effects of various forms of vertical contracts. The paper mostly related to ours is Bacchiega et al. (2018) that, in a similar setup, identifies the conditions under which an upstream monopolist chooses exclusive, or contingent or non-contingent non-exclusive contracts and evaluates welfare effects. In the present paper we allow an auction to be an alternative selling mechanism and show that auctions are (almost) equally used as negotiations (see Fig. 1). Our latter finding seems to be consistent with the empirical literature mentioned above.

## 2. Model

### 2.1. Firms

An upstream monopolist  $\mathcal{U}$  produces at no cost an essential input that sells to two downstream firms,  $\mathcal{D}_h$  and  $\mathcal{D}_l$ . The latter transform the input in a “1–1” proportion into variants of a vertically differentiated good.  $\mathcal{U}$  can choose among two different input selling mechanisms: (i) exclusive or non-exclusive simultaneous negotiations with downstream firm(s); or (ii) an auction for contract exclusivity.<sup>3</sup>

### 2.2. Demand

A continuum of heterogeneous consumers of unit mass is uniformly distributed with unitary density over the interval  $[0, 1]$ . A consumer  $\theta \in [0, 1]$ , is characterized by the indirect utility function,

$$U(\theta, u_i) = \begin{cases} \theta u_i - p_i & \text{when buying one unit of variant } i, \\ 0 & \text{otherwise,} \end{cases} \quad (1)$$

where  $u_i > 0$  is the (exogenous) quality level of good  $i = h, l$  sold by  $\mathcal{D}_i$  and  $p_i$  is its price, with  $u_h > u_l > 0$ .

With an exclusive contract one variant of the good only is available in the market. Its demand is determined through the marginal consumer approach and writes  $D_m(p_m) = 1 - \frac{p_m}{u_i}$ ,

<sup>1</sup> Yet, under costly participation, the auction is less desirable from a welfare point of view to sequential negotiations (Bulow and Klemperer, 2009).

<sup>2</sup> In the context of takeovers, Pagnozzi and Rosato (2016) show that the auction's negative externalities on other incumbents may lead the entrant to choose negotiations.

<sup>3</sup> Obviously, auctioning off two contracts to the two downstream firms is a strictly dominated strategy as it would eliminate competition for the input thus leading to zero profits for  $\mathcal{U}$ .

where the subscript  $m$  indicates “downstream monopoly”, and  $i = h, l$ , depending on which downstream firm obtains the supply contract. Consumer surplus is then  $CS_m(p_m) = \int_{\frac{p_m}{u_i}}^1 (\theta u_i - p_m) d\theta$ .

With non-exclusive contracts, two goods are available in the market. Using the marginal consumer approach, their demands are  $D_h(p_h, p_l) = 1 - \frac{p_h - p_l}{u_h - u_l}$  and  $D_l(p_h, p_l) = \frac{p_h - p_l}{u_h - u_l} - \frac{p_l}{u_l}$ . The consumers surplus is  $CS(p_h, p_l) = \int_{\frac{p_l}{u_l}}^{\frac{p_h - p_l}{u_h - u_l}} (\theta u_l - p_l) d\theta + \int_{\frac{p_h - p_l}{u_h - u_l}}^1 (\theta u_h - p_h) d\theta$ .

### 2.3. Timing

We consider a three-stage game with *observable* actions. In stage 1,  $\mathcal{U}$  decides whether to negotiate – either exclusively with one downstream firm or non-exclusively with both of them – over two-part tariff contract terms, or to set-up an auction for the exclusivity two-part tariff contract rights.<sup>4</sup> In stage 2, in the case of negotiations,  $\mathcal{U}$  bargains with one or both downstream firms over their contract terms, with the bargaining power distribution being exogenous:  $\mu \in [0, 1]$  for  $\mathcal{U}$  and  $(1 - \mu)$  for  $\mathcal{D}_i$ . In the case of auction, downstream firms make their observable bids in an open absolute English auction. In stage 3 prices are simultaneously set.

We use subgame perfectness to solve the game. In case of non-exclusive contracts, we evoke the Nash-in-Nash solution concept to solve the simultaneous and separate negotiations between each of  $\mathcal{D}_h$  and  $\mathcal{D}_l$  and  $\mathcal{U}$ .<sup>5</sup> We assume that non-exclusive contracts are *contingent*: in case of disagreement between  $\mathcal{U}$  and  $\mathcal{D}_i$ , negotiations start anew between  $\mathcal{U}$  and  $\mathcal{D}_j$ .<sup>6</sup>

## 3. Selling mechanisms and market outcomes

### 3.1. Negotiation(s)

Let  $T_i \equiv (w_i, t_i)$  be the two-part tariff contract negotiated by  $\mathcal{U}$  and  $\mathcal{D}_i$ ,  $i = h, l$ , where  $w_i$  is the per-unit input price and  $t_i$  is the fixed fee. From Bacchiega et al. (2018), we know that if  $\mathcal{U}$  opts for an exclusive negotiation, it selects  $\mathcal{D}_h$  as trading partner and the resulting contract is:

$$T_m^e = (0, \frac{u_h}{4} \mu). \quad (2)$$

If instead  $\mathcal{U}$  enters non-exclusive simultaneous and separate negotiations with downstream firms, the equilibrium contracts are:

$$T_h^n = (w_h^n, t_h^n) = \left( \frac{u_l}{4}, \frac{4\mu(2 - \mu)u_h - (3 + \mu)u_l}{16(2 - \mu)} \right), \quad (3)$$

$$T_l^n = (w_l^n, t_l^n) = \left( \frac{u_l^2}{4u_h}, \frac{u_l[(-1 + 6\mu - 4\mu^2)u_h - (2 - \mu)u_l]}{16(2 - \mu)u_h} \right). \quad (4)$$

The following Lemma summarizes the optimal choices of  $\mathcal{U}$  in the case of negotiations, and the corresponding market outcomes.

<sup>4</sup> Our results remain (to a major extent) qualitatively similar under linear wholesale contracts. Although the case of non-exclusive negotiations cannot be solved analytically, our simulations indicate a similar pattern of selling mechanism choices to those under two-part tariffs. In addition, our simulations point out that  $\mathcal{U}$  is better off using two-part tariffs.

<sup>5</sup> Quoting (Collard-Wexler et al., 2019, p. 165), “[...] this solution can be cast as a “Nash equilibrium in Nash bargains” that is, separate bilateral Nash bargaining problems within a Nash equilibrium to a game played among all pairs of firms”.

<sup>6</sup> This implicitly assumes that a breakdown in the negotiations between  $\mathcal{U}$  and  $\mathcal{D}_i$  is permanent and irrevocable (Milliou and Petrakis, 2007). Notice also that contracts are *interim observable*, i.e., contract terms are known during the pricing stage (see O'Brien and Shaffer, 1992).

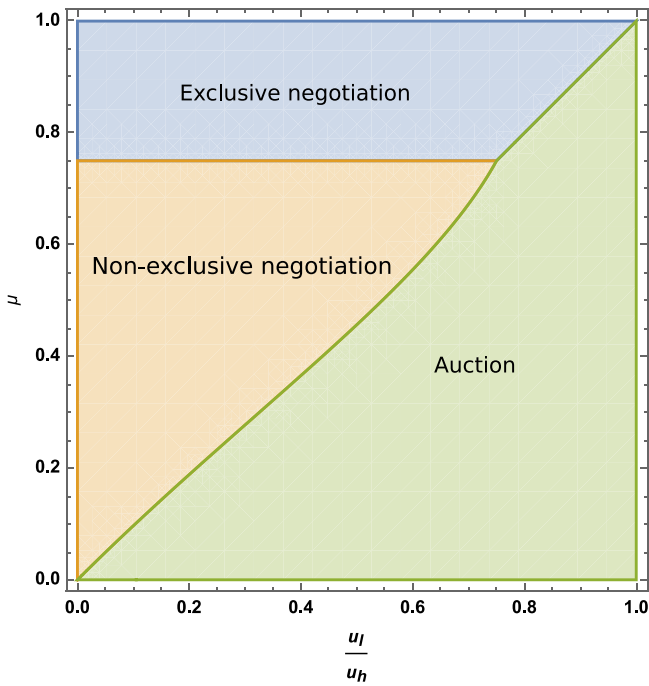


Fig. 1. Optimal mechanism selection.

**Lemma 1.** *The upstream supplier:*

- (i) Enters non-exclusive negotiations if  $0 \leq \mu \leq \frac{3}{4}$ . The equilibrium contract terms are given by (3) and (4). The equilibrium prices are  $p_h^n = \frac{2u_h - u_l}{4}$ ,  $p_l^n = \frac{u_l}{4}$ , and the equilibrium demands are  $D_h^n = \frac{1}{2}$ ,  $D_l^n = \frac{1}{4}$ . The equilibrium profits of  $\mathcal{U}$ ,  $\mathcal{D}_h$  and  $\mathcal{D}_l$  are, respectively,  $\Pi^n = \frac{\mu[4u_h - u_l + 4(1-\mu)(u_h + u_l)]}{16(2-\mu)}$ ,  $\pi_h^n = \frac{(1-\mu)[4u_h(2-\mu) - 5u_l]}{16(2-\mu)}$  and  $\pi_l^n = \frac{u_l(1-\mu)(3-4\mu)}{16(2-\mu)}$ . Consumer surplus and social welfare are:  $CS^n = \frac{4u_h + 5u_l}{32}$  and  $TW^n = \frac{3(4u_h + u_l)}{32}$ .
- (ii) Enters an exclusive negotiation with firm  $\mathcal{D}_h$  if  $\frac{3}{4} < \mu \leq 1$ . The equilibrium contract terms are  $w_m^e = 0$  and  $t_m^e = \frac{u_h}{4}\mu$ . The equilibrium price is  $p_m^e = \frac{u_h}{2}$ , the equilibrium demand is  $D_m^e = \frac{1}{2}$ , and the equilibrium profits of  $\mathcal{U}$  and  $\mathcal{D}_h$  are, respectively,  $\Pi_m^e = \frac{u_h}{4}\mu$  and  $\pi_m^e = \frac{u_h}{4}(1-\mu)$ . Consumer surplus and social welfare are:  $CS_m^e = \frac{u_h}{8}$  and  $TW_m^e = \frac{3u_h}{8}$ .

**Proof.** See Bacchiega et al. (2018) for a formal proof. ■

In any negotiation, the amount of producer surplus appropriated by  $\mathcal{U}$  increases both with  $\mu$  and the value of its outside option(s). Exclusivity avoids industry profit-eroding downstream competition, leading to higher producer surplus, yet it makes  $\mathcal{U}$ 's outside options nil. Under non-exclusivity  $\mathcal{U}$  has positive outside options in both negotiations, but reduced producer surplus due to downstream competition and its own commitment problem. For large  $\mu$ ,  $\mathcal{U}$  extracts most of the high-quality producer surplus under exclusivity and opts for it. For small  $\mu$ ,  $\mathcal{U}$  prefers non-exclusivity to enjoy positive outside options.

3.2. Auction

$\mathcal{U}$  sets up an open absolute English auction over two-part tariff terms. A bid is a pair  $(w_m, t_m)$ , with  $w_m$  the unitary input price and  $t_m$  the fixed fee to be paid to  $\mathcal{U}$  by the auction winner. The winning bid is the one giving  $\mathcal{U}$  the largest profits upon execution of its contractual terms. Downstream firms submit

bids to maximize profits conditional on winning the auction. The following Lemma summarizes:

**Lemma 2.** *If  $\mathcal{U}$  auctions off the terms of an exclusive two-part tariff contract,  $\mathcal{D}_h$  wins the auction bidding ( $w_m^a = 0$ ,  $t_m^a = \frac{u_l}{4}$ ). The equilibrium price is  $p_m^a = \frac{u_h}{2}$ , the equilibrium demand is  $D_m^a = \frac{1}{2}$ , and the equilibrium profits of  $\mathcal{U}$  and  $\mathcal{D}_h$  are, respectively,  $\Pi_m^a = \frac{u_l}{4}$  and  $\pi_m^a = \frac{u_h - u_l}{4}$ . Consumer surplus and social welfare are:  $CS_m^a = \frac{u_h}{8}$  and  $TW_m^a = \frac{3u_h}{8}$ .*

**Proof.** For any  $(w_m, t_m)$ , the winner  $\mathcal{D}_i$  optimally sets  $p_m(w_m) = \frac{u_i + w_m}{2}$  in the last stage and obtains profits  $\pi_m(w_m, t_m) = \frac{(u_i - w_m)^2}{4u_i} - t_m$ . For any  $t_m$ ,  $\pi_m(w_m, t_m)$  is maximized at  $w_m = 0$ , i.e., any bid maximizing  $\mathcal{D}_i$ 's profits has the form  $(0, t_m)$ , which we label *optimal bid*. Each  $\mathcal{D}_i$  will bid up to the difference between the value of winning the auction with the optimal bid ( $\frac{u_i}{4} - t_m$ ) and losing it (zero).  $\mathcal{D}_i$ 's maximum optimal bid is  $(0, \frac{u_i}{4})$  which is outmatched by  $\mathcal{D}_h$  submitting a bid  $(0, \frac{u_l}{4} + \epsilon)$ , with  $\epsilon > 0$  but arbitrarily small. The equilibrium bids of  $\mathcal{D}_l$  and  $\mathcal{D}_h$  are, respectively,  $(0, \frac{u_l}{4})$  and  $(0, \frac{u_l}{4} + \epsilon)$ . Plugging back the winning bid into the relevant expressions completes the proof. ■

Clearly, the equilibrium bids are unique, because any optimal bid must have  $w_m = 0$ , and the maximum profit of any  $\mathcal{D}_i$  for  $w_m = 0$  is unique too. Moreover, the outcomes of the exclusive negotiation and the auction only differ in the apportioning of the producer surplus between  $\mathcal{U}$  and  $\mathcal{D}_h$ . Defining  $r \equiv \frac{u_l}{u_h} \in (0, 1)$ ,  $r$  measures the products' homogeneity degree. If  $r \rightarrow 0$ , they are (infinitely) differentiated, while if  $r \rightarrow 1$  products are (almost) homogeneous. Notice that, for any  $u_h$ , the value of the auction for  $\mathcal{U}$ , namely the amount of producer surplus it appropriates, is larger the closer  $u_l$  to  $u_h$ :  $\Pi_m^a = \frac{u_l}{4} = \frac{u_h}{4}r$  increases in  $r$ .

**Remark 1.** The value of the auction for  $\mathcal{U}$  is larger the less differentiated the products are.

3.3. Auction vs. negotiations

The following Proposition states our main results.

**Proposition 1.** Letting  $\mu_1(r) \equiv \frac{(8+7r) - \sqrt{64-16r-79r^2}}{8(1+r)}$ ,

- (i) if  $0 \leq \mu \leq \frac{3}{4}$ ,  $\mathcal{U}$  selects non-exclusive negotiations if  $\mu > \mu_1(r)$  and an auction otherwise.
- (ii) if  $\frac{3}{4} < \mu \leq 1$ ,  $\mathcal{U}$  selects an exclusive negotiation if  $\mu > r$  and an auction otherwise.

**Proof.** Comparing  $\Pi_m^n$  and  $\Pi_m^a$ , and  $\Pi_m^e$  and  $\Pi_m^a$ , we get (i) and (ii), respectively. ■

Fig. 1 depicts Proposition 1. Intuitively, for high  $\mu$ ,  $\mathcal{U}$  opts for an auction only if its value of the auction (as determined by  $r$ , see Remark 1) is larger than the share  $\mu$  of the producer surplus it appropriates from exclusive negotiations. For low  $\mu$ ,  $\mathcal{U}$  prefers non-exclusive negotiations to an auction but only if its bargaining power is high enough, and in particular, for all  $\mu > \mu_1(r)$ , with  $\mu_1(r) < r$  for  $\frac{3}{4} < \mu \leq 1$ . That is, the minimum bargaining power needed for  $\mathcal{U}$  to opt for an auction is lower than the degree of product homogeneity  $r$ . The reason is that under non-exclusive negotiations,  $\mathcal{U}$  enjoys an outside option in each negotiation which increases the producer surplus it can extract from the downstream firms. This should be contrasted

with the case of high  $\mu$ , where surplus extraction by  $\mathcal{U}$  from  $\mathcal{D}_h$  only depends on its bargaining power.

Finally, non-exclusive negotiations lead to higher consumer surplus and social welfare than both exclusive negotiations and an auction. In contrast to the bulk of the literature, an auction results in a welfare inferior outcome, since it leads to the foreclosure of the low quality downstream firm, thus reducing consumer surplus and industry profits.

#### 4. Concluding remarks

Bulow and Klemperer (1996) show that auctions dominate negotiations in a wide class of situations where an essential input is sold to symmetric buyers because they involve bidders competing simultaneously. In the present paper, buyers compete for the input as well, but sell vertically differentiated products. The winning bid equals the profit of the low-quality firm, which is lower than that of the high-quality one, thus leaving the high-quality winner with a positive surplus. This surplus is larger the more differentiated the products are. The ultimate consequence is that, for a given distribution of bargaining power, the seller prefers negotiations (exclusive or non-exclusive) to auctions if the final products are (vertically) differentiated enough.<sup>7</sup>

We have obtained our results under interim observable contracts. A legitimate question is whether our results are robust under secret contracts. Under the latter, input prices equal marginal cost, which increases the profitability of an exclusive negotiation relative to non-exclusive ones, leaving the roles of countervailing buyer power and product differentiation unaffected.<sup>8</sup>

#### Appendix A. Supplementary data

Supplementary material related to this article can be found online at <https://doi.org/10.1016/j.econlet.2020.109198>.

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<sup>7</sup> From another standpoint, it should be noticed that in the present paper a negotiation with  $\mathcal{D}_h$  alone may be preferred to an auction with two participants even if the seller does not have all the bargaining power. Although our setup is rather different, this should be contrasted with (Bulow and Klemperer, 1996), where an English auction with  $N+1$  bidders is always preferred to a negotiation with  $N$  firms when the seller has all the bargaining power.

<sup>8</sup> The detailed analysis is available from the authors upon request.