ISSN 2282-6483

Alma Mater Studiorum - Università di Bologna
DEPARTMENT OF ECONOMICS

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Quaderni - Working Paper DSE N°1145

Auctions vs. negotiations in vertically related markets*

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April 3, 2020

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.

Keywords: Vertical relationships, exclusive vs. non-exclusive relationships, auctions.
JEL classification: D43, L13, L14.

*We wish to thank Paolo Garella and Vincenzo Denicolò for extremely useful comments and discussions. The usual disclaimer applies. E. Bacchiega aknowledges financial support under PRIN 20157NH5TP-SH1.

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Non-technical summary

Auctions and negotiations are two common selling mechanisms for production factors. A lively debate has taken place in the last decades about their relative pros and cons. In the absence of issues due to asymmetric information among the parties, auctions usually outperform negotiations, yet this balance may be reversed if informational exchange is necessary for designing the good, or if the design itself can be costly improved. Inspired by this debate, in this paper we argue that if the traded input is necessary for the production of vertically differentiated variants of a good, neither mechanism is absolutely superior to the other.

In a setup of perfect and complete information, where a necessary input is needed to produce vertically differentiated variants of a final good, we assume that a monopolist input supplier chooses whether to sell the input to two downstream firms either through an auction or –possibly exclusive– negotiation(s). We show that the optimal mechanism depends upon the interaction between the distribution of bargaining power if negotiations take place and the degree of product differentiation. The upstream monopolist opts for an auction as long as final goods are not too differentiated; moreover, the lower its bargaining power is, the more likely is that it uses an auction. The upstream supplier prefers exclusive negotiations but only if its bargaining power is high. We finally claim, contrary to the acquired wisdom, that non-exclusive negotiations may be welfare-superior to auctions, because, in our setup, they increase product variety.

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 K.B. and Munn (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), using data on the procurement of medical devices by Italian hospitals, report that both auctions and bargaining are used as procurement mechanisms.

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 to negotiations in terms of their profitability and efficiency. These studies identify and discuss conditions under which auctions may outperform negotiations in terms of their profitability for buyers and sellers as well as their efficiency.

Our paper contributes to this vivid debate by addressing the following questions. Do quality differences of final goods affect the choice of an upstream supplier to use alternative selling mechanisms for selling its input? How does its relative bargaining power affect the supplier's decision? Does the optimal for the supplier selling mechanism benefit consumers and the society too?

We consider a two-tier industry with an upstream monopolist selling an essential input and two downstream firms that use it in a one-to-one proportion to produce their vertically differentiated final goods. The upstream supplier decides in the first stage of the game whether to sell the input via exclusive or non-exclusive negotiations over two-part tariff contracts, or auction off the two-part tariff contract via an English auction. In the second stage, the selected selling mechanism is implemented. Under negotiations, there is an exogenous distribution of bargaining power between the bargaining parties. Moreover, non-exclusive negotiations take place simultaneously and separately and are over contingent two-part tariff contracts. In the last stage, downstream firms compete by setting their prices.

We show that the upstream monopolist opts for an auction as long as final goods are not

too differentiated. Moreover, the lower its bargaining power is, the more likely is that it uses an auction. The upstream supplier prefers exclusive negotiations but only if its bargaining power is high. Otherwise, it opts for non-exclusive negotiations that, in contrast to the previous selling mechanisms, lead to above marginal cost input pricing. Nevertheless, non-exclusive negotiations result in higher consumer surplus and social welfare. In this case, the low quality downstream firm is not excluded from the market and total output and industry profits increase. Interestingly, in our context, an auction does not lead to an efficient outcome and should go under the scrutiny of antitrust authorities.

Our paper is related to the theoretical literature that compares auctions to negotiations. Bulow and Klemperer (1996, 2009)) show that auctions outperform negotiations.[1] Goldberg (1977) and Manelli and Vincent (1995) point out that negotiations may be preferable to auctions when quality is non-contractible and information exchange between contractors 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.[2] We depart from this literature by assuming that the qualities of final goods are known. We dentify as driving force that negotiations outperform an auction the higher fixed fees that a powerful supplier can extract from downstream firm(s). Finally, non-exclusive negotiations are welfare superior than auctions because they allow for the production and consumption of the low quality good.

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

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

[2] Pagnozzi and Rosato (2016) compare auctions and bilateral negotiations in the context of takeovers: A potential entrant either bargains with a target incumbent firm or sets up an auction in which other incumbents can bid too. They identify the auction's negative externalities on other incumbents as the reason that entrant will often choose negotiations.

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. The upstream monopolist is entitled to choose among two different selling mechanisms to sell the input: (i) exclusive or non-exclusive simultaneous negotiations with downstream firm(s); or (ii) an auction for contract exclusivity.

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,

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

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

Under an exclusive contract there is only one variant of the good available in the market, whose demand is determined through the standard marginal consumer approach and writes $D_m(p_m) = 1 - \frac{p_m}{u_i}$, where the subscript m indicates "downstream monopoly", and $i = h, l$, depending on which downstream firm the supply contract is signed with. In this case, the consumer surplus is $CS_m(p_m) = \int_{\frac{p_m}{u_i}}^{1} (\theta u_i - p_m) d\theta$.

Under non-exclusive contracts, two goods are available in the market. Using again the marginal consumer approach, their demands are $D_h(p_h, p_l) = 1 - \frac{p_h - p_l}{u_h - u_l}$ and $D_l(p_h, p_l) = \frac{p_h - p_l}{u_h - u_l} - \frac{p_l}{u_l}$ with $u_h > u_l > 0$ being the quality levels of the two goods. The consumers surplus is $CS(p_h, p_l) \equiv \int_{\frac{p_l}{u_l}}^{\frac{p_h - p_l}{u_h - u_l}} (\theta u_l - p_l) d\theta + \int_{\frac{p_h - p_l}{u_h - u_l}}^{1} (\theta u_h - p_h) d\theta$.

2.3 Timing

We consider a three-stage game with *observable* actions. In stage 1, the upstream supplier decides whether to negotiate – either exclusively with one downstream firm or non-exclusively with both downstream firms – over two-part tariff contract terms, or to set-up an auction for the exclusivity two-part tariff contract rights. In the case of negotiations, in stage 2, the upstream supplier 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 English auction. Stage 3 is the price setting stage.

As is standard, we use subgame perfection to solve the entire game. To solve for the simultaneous and separate negotiations between $\mathcal{U}$ and each of $\mathcal{D}_h$ and $\mathcal{D}_l$ in case of non-exclusive contracts, we evoke the Nash-in-Nash solution concept.[3] Moreover, those contracts are assumed to be *contingent*, i.e. in case of disagreement between $\mathcal{U}$ and $\mathcal{D}_i$, negotiations start anew between $\mathcal{U}$ and $\mathcal{D}_j$.[4]

3 Selling mechanisms and market outcomes

We start by analyzing the case of negotiation(s) and then move on to the auction.

3.1 Negotiation(s)

Let $T_i \equiv (w_i, t_i)$ be the two-part tariff contract signed by the upstream supplier and the downstream firm $i = h, l$, 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:

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

On the other hand, if $\mathcal{U}$ enters into non-exclusive simultaneous negotiations with both downstream firms, the equilibrium contracts are:

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

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

In following Lemma we summarize the optimal choices of the upstream supplier in the case of negotiations, and the corresponding market outcomes.

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*

[3] See, e.g. Collard-Wexler *et al.*, 2019.

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

the equilibrium demands are $D_h^n = \frac{1}{2}$, $D_l^n = \frac{1}{4}$. *The equilibrium profit of the upstream supplier is* $\Pi^n = \frac{\mu[4u_h - u_l + 4(1-\mu)(u_h+u_l)]}{16(2-\mu)}$ *and those of the downstream firms are* $\pi_h^n = \frac{(1-\mu)[4u_h(2-\mu)-5u_l]}{16(2-\mu)}$ *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 the upstream and downstream firm 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.

3.2 Auction

In the case of auction, $\mathcal{U}$ sets up an open English auction over the two-part tariff terms. As information in our model is complete, both downstream firms are willing to bid up to the difference between the value of winning the auction and losing it. For both downstream firms, the value of losing the auction is zero. The winning firm, for any bid it made at the auction stage, maximizes its profit by setting $\hat{p}_m(w_m) = \frac{u_i+w_m}{2}$ and reaping a profit equal to $\frac{(u_i-w_m)^2}{4u_i} - t_m$. Accordingly, the maximum bid each firm can submit is $(w_m, \frac{(u_i-w_m)^2}{4u_i})$. In particular, the maximum bid $\mathcal{D}_l$ can submit is $(w_l = 0, t_l = \frac{u_l}{4})$, which corresponds to the maximum profit (gross of the bid itself) this firm can obtain if it wins the auction, with the input price set to the vertical integration level $w_l = 0$. Clearly, $\mathcal{D}_h$ can match this bid as its profit, if it wins the auction, strictly exceeds the value of the bid itself. This is stated in the following Lemma.

Lemma 2. *If the upstream supplier auctions the terms of an exclusive contract, the high-quality downstream firm wins the auction with the bid* $(w_m^a = 0, t_m^a = \frac{u_l}{4})$. *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 the upstream and downstream firms 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* $TW_m^a = \frac{3u_h}{8}$.

It is evident that the outcomes resulting from the exclusive negotiation and the auction only differ in the apportioning of the producer surplus between $\mathcal{U}$ and $\mathcal{D}_h$. Furthermore, it is worth noticing that, for any u_h, the value of the auction for $\mathcal{U}$, namely the amount of overall producer surplus this firm can appropriate, is larger the closer is u_l to u_h, i.e. the less differentiated the products are. This observation is summarized in the following Remark.

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

It will prove useful here to define $r \equiv \frac{u_l}{u_h} \in (0,1)$, the *homogeneity degree* of the products. When $r \to 0$, they are (infinitely) differentiated, whereas when $r \to 1$ products are (almost) homogeneous.

3.3 Auction vs. negotiations

The following Proposition states our main results.

Proposition 1. *Let* $\mu_1(r) \equiv \frac{(8+7r)-\sqrt{64-16r-79r^2}}{8(1+r)}$. *The upstream supplier:*

(i) in the region $0 \leq \mu \leq \frac{3}{4}$ *selects non-exclusive negotiations if* $\mu > \mu_1(r)$ *and an auction otherwise.*

(ii) in the region $\frac{3}{4} < \mu \leq 1$ *selects an exclusive negotiation if* $\mu > r$ *and an auction otherwise.*

Proof. (i) It follows form a direct comparison between Π_m^n and Π_m^a and (ii) it follows from a direct comparison between Π_m^e and Π_m^a.

Figure 1 depicts Proposition 1, which is explained as follows. For clarity, we shall start by case (ii). There, $\mathcal{U}$ compares its profit from entering an exclusive negotiation with $\mathcal{D}_h$, $\mu\frac{u_h}{4}$, and auctioning off the exclusive contract, reaping $\frac{u_l}{4}$. The first option is preferred to the second one if $r < \mu$, i.e. if the bargaining power in the negotiation exceeds the product homogeneity degree (which determines the value of the auction, see Remark 1). The opposite it true if r is larger than μ. In case (i) the same reasoning applies: non-exclusive negotiations are preferred to an auction if the bargaining power is larger than *a function* of the homogeneity degree ($\mu > \mu_1(r)$). It is instructive that $\mu_1(r) < r$, for all $\mu \in [0, \frac{3}{4}]$. That is, for any given r, the minimum bargaining power needed for $\mathcal{U}$ to switch from an auction to negotiations is *lower* than the degree of product homogeneity itself. The reason is that in the case of non-exclusive negotiations, the profit $\mathcal{U}$ reaps in each negotiation constitutes the outside option in the other negotiation, which increases the surplus firm $\mathcal{U}$ can extract from the downstream firms $\mathcal{D}_i, i = h, l$ for any $\mu \leq \frac{3}{4}$. This should be contrasted with case (ii), where surplus extraction by $\mathcal{U}$ from $\mathcal{D}_h$ only depends on the exogenous bargaining power μ.

Notice that 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 to an inefficient outcome. This is because an auction leads to the exclusion of the low quality downstream firm from the market and reduces, thus, both consumer surplus and industry profits.

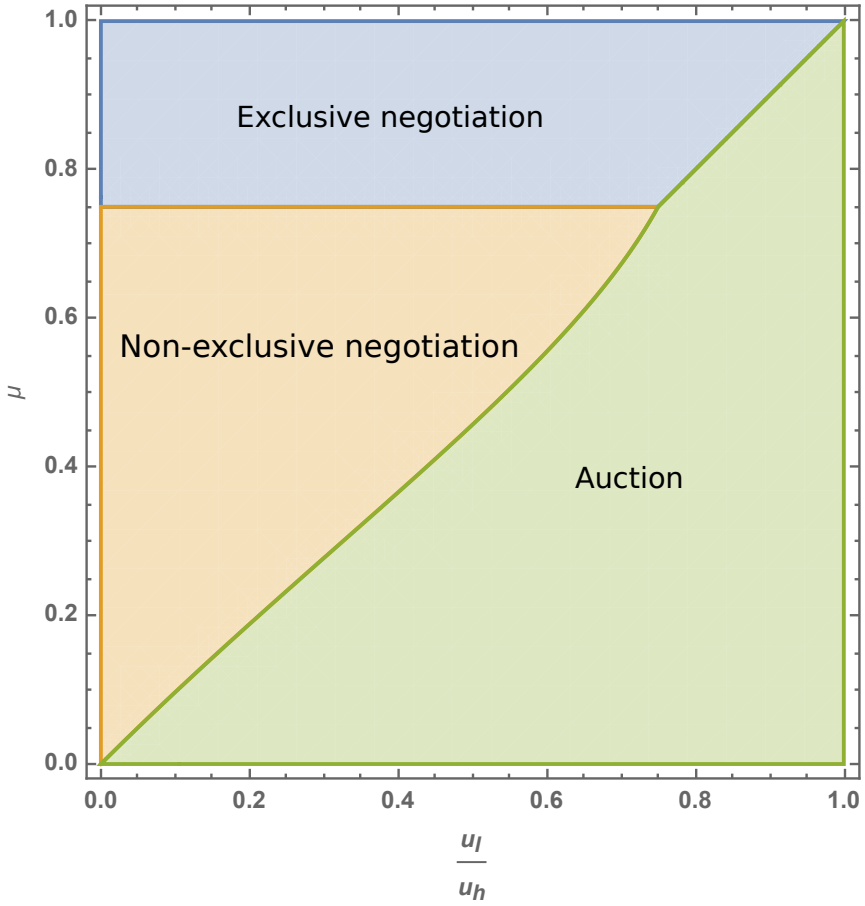

Figure 1: Optimal mechanism selection.

4 Concluding Remarks

We have investigated the optimal selling mechanism for an upstream monopolist supplying an essential input to two downstream firms producing vertically differentiated goods and competing in prices. The upstream supplier decides whether to enter exclusive or non-exclusive simultaneous negotiations with the downstream firms, or to setup an auction for the exclusivity contract rights. Our results show that the degrees of countervailing buyer power and of product differentiation determine the optimal choice of the upstream supplier. In particular, the auction is its optimal choice when buyer power is high and the products are homogeneous enough. The crucial point in our analysis is that, because of vertical product differentiation, more differentiated products result in larger profit differences between the high- and low-quality downstream firms. In the case of an auction, the winning bid is the minimum of these profits, which implies that the value of the auction for the upstream supplier is larger the more homogeneous the goods are.

Our results have been obtained under interim observable contracts, thus a legitimate question concerns the robustness of our findings to alternative information structures. Interim unobservability or secrecy of contracts does not qualitatively alter our results. Under secrecy, there is marginal cost input pricing, which increases the profitability of an exclusive negotiation relative to non-exclusive ones, leaving the roles of countervailing buyer power and product differentiation unaffected.[5]

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[5]The detailed analysis is available from the authors upon request.

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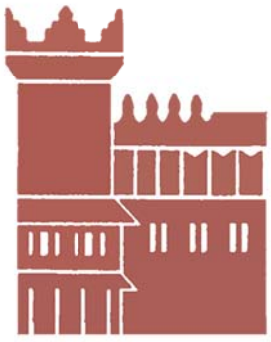

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