Incentive to encourage downstream competition under bilateral oligopoly

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Abstract:
We show that, contrary to the key result of the previous literature, input supplier’s profit can increase with the number of downstream firms if the upstream firm is not a monopolist but competes with an alternative inferior supplier.

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1. Introduction

Consider the contracting problem of an input supplier dealing with several firms that compete in an output market. As the upstream firm’s customers compete with one another, their input demands are interdependent and each downstream firm cares about the terms that the input supplier offers to all. Once the upstream firm has contracted with a downstream firm, it has an incentive to renegotiate other contracts to increase its profit at the first one downstream firm’s expense. This opportunistic behavior reduces the upstream firm’s profit since downstream firms will pay less for access to the input. Facing such a commitment problem, it is then not surprising that the upstream firm’s profit is smaller, the more competitive the downstream segment. It is a well-known result of the previous literature that the upstream firm’s profit will decrease as the number of downstream firms competing in the output market increases. The nature of this relationship influences the incentives of firms both to vertically merge and foreclose other firms: it is a key determinant of market structure.

Upstream firms are rarely pure monopolists. They most often compete with other goods or services suppliers. In the presence of another competitor, an upstream firm faces both the previous commitment problem and a threat of losing sales to rival supplier. In this paper, we show that, under an upstream duopoly, where a dominant upstream firm competes with an alternative inferior (less efficient) supplier, the relationship between dominant upstream firm’s profit and the number of firms competing in the downstream market depends on the strength of upstream competition (related to the cost of the second supplier). If the latter is an effective alternative opportunity, then it is possible that the dominant upstream firm’s profit increases with the number of downstream firms.

As far as we are aware, this is a new result. Hart and Tirole (1990) have considered a close bilateral oligopoly model in which two firms competed in the downstream market. Introducing a less efficient second source, the incentive to vertically merge was unchanged but, under vertical integration, this did not lead to the complete exclusion of the nonintegrated downstream firm. They have shown that, the lower the cost of the second supplier, the larger the supply of the vertically integrated.

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1 See Rey and Tirole (2003) for a survey of the literature.
firm to nonintegrated downstream firm. They have not focused on the relationship between dominant upstream firm’s profit and the number of downstream firms. Chemla (2003) has investigated this relationship in a related framework but has assumed specific upstream cost and a different range of bargaining power between upstream and downstream firms. When both an upstream firm had convex costs and downstream firms had non-negligible bargaining power there was a range over which dominant upstream firm’s profit increased with the number of downstream firms. We examine this relationship in a simpler setting close to Hart and Tirole (1990). Hence, there is at least one situation, more simple and more usual, since upstream firms are rarely pure monopolists, in which a dominant upstream firm has private incentive to preserve downstream competition.

The rest of this paper is organized as follows. In section 2, we outline the basic model and in section 3 we draw out the implications of the model for the relationship between the dominant upstream firm’s profit and the number of downstream competitors. Section 4 concludes.

2. The model

We analyze a non-cooperative two-stage game in which at the upstream level we have a dominant input supplier $U$ and a less efficient second source $U'$, which we model as a competitive fringe. The latter sells at a cost of $c'$ while the former has a constant marginal cost of production $c$ ($c < c'$). They face $n$ identical firms that use the input to produce homogeneous products, on a one-for-one basis and at zero marginal cost. We follow Hart and Tirole (1990) or McAfee and Schwartz (1994) in supposing that contracts are secret. In the first stage (the contract stage), $U$ offers secret contracts, one for each firm; we confine attention to contracting in two-part tariffs: $\{w_i, F_i\}$, $i=1,...,n$ where $F_i$ is a fixed fee and $w_i$ is the marginal price per unit of the input. Downstream firms accept and pay the fixed fee or reject offers simultaneously. In the second stage (the product market stage), downstream firms set their outputs (and purchase the necessary amounts of input). A downstream firm never learns others’ contracts (and hence marginal costs).

We proceed by backward induction.

2.1 Stage 2: the product market stage

Let linear product market demand be written as:

$$P(Q) = a - Q \quad \text{where} \quad Q = q_i + \sum_{j \neq i} q_j. \quad (1)$$

Gross profit for the representative firm $i$ when it accepts a contract of the dominant upstream firm can be written as (franchise fee is not relevant at this stage):

$$\pi_i\left(w_i, q_i, \sum_{j \neq i} q_j\right) = \left[a - q_i - \sum_{j \neq i} q_j\right] - w_i q_i. \quad (2)$$

Under the Cournot-Nash assumption, differentiation of Eq. (2) with respect to $q_i$ yields the first-order condition for profit maximization by firm $i$, from which it is straightforward to derive both firm $i$’s best reply in output space and related gross profit when it accepts the contract of the dominant upstream firm as:

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2 To simplify the exposition we focus on two-part tariffs, but our results are unchanged with more general pricing-schemes. Because curbing retailers’ disagreement payoffs imposes contracts to be contingent on others’ contracts, it is not possible to have such a mechanism when offers in contracts are made secretly.

3 Following McAfee and Schwartz (1994), this framework is related to the “unobservability game”.

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\[ q_i^{BR} \left( w_i, \sum_{j \neq i} q_j \right) = \frac{1}{2} \left( a - w_i - \sum_{j \neq i} q_j \right), \quad \pi_i^{BR} \left( w_i, \sum_{j \neq i} q_j \right) = \frac{1}{4} \left( a - w_i - \sum_{j \neq i} q_j \right)^2, \]  
and when it refuses the contract as:

\[ q_i^{BR} \left( c^*, \sum_{j \neq i} q_j \right) = \frac{1}{2} \left( a - c^* - \sum_{j \neq i} q_j \right), \quad \pi_i^{BR} \left( c^*, \sum_{j \neq i} q_j \right) = \frac{1}{4} \left( a - c^* - \sum_{j \neq i} q_j \right)^2. \]

2.2 Stage 1: the contract stage

The contracts actually offered by \( U \) in equilibrium, as well as the responses from downstream firms, will depend on the nature of each downstream firm’s conjectures about contracts offered to its rivals. Following the previous literature multilateral contracting\(^4\), we assume that downstream firms have “passive beliefs”: a downstream firm, regardless of the contract offer it receives from \( U \), expects rivals to produce the candidate equilibrium quantities, \( \sum_{j \neq i} q_j \).

Consider the negotiation with firm \( i \).

In stage 1, if  \( \pi_i^{BR} \left( w_i, \sum_{j \neq i} q_j^* \right) - F_i \geq \pi_i^{BR} \left( c^*, \sum_{j \neq i} q_j^* \right) \), firm \( i \) then accepts its contract and the dominant upstream firm sets \( F_i = \pi_i^{BR} \left( w_i, \sum_{j \neq i} q_j^* \right) - \pi_i^{BR} \left( c^*, \sum_{j \neq i} q_j^* \right) \). Since both the conjectures are passive and the upstream marginal cost of production is constant, the relevant objective is:

\[ \text{Max}_{w_i} \left( w_i - c \right) q_i^{BR} \left( w_i, \sum_{j \neq i} q_j^* \right) + \pi_i^{BR} \left( w_i, \sum_{j \neq i} q_j^* \right) - \pi_i^{BR} \left( c^*, \sum_{j \neq i} q_j^* \right). \]  

The first order condition in \( w_i \) can be written as:

\[ \left( w_i - c \right) \frac{\partial q_i^{BR} \left( w_i, \sum_{j \neq i} q_j^* \right)}{\partial w_i} = 0. \]  

From which it follows that, in symmetric sub-game perfect equilibrium, \( w_i \) equals the marginal cost of production.

Equilibrium dominant upstream firm’s profit is given as:

\[ \pi_U = n \left[ \pi_i^{BR} \left( c^*, \sum_{j \neq i} q_j^* \right) - \pi_i^{BR} \left( \sum_{j \neq i} q_j^* \right) \right] = \frac{n(c^* - c)(4(a - c) - (n + 1)(c^* - c))}{4(n + 1)}. \]

3. Dominant upstream firm’s profit and downstream competition

We now investigate how the dominant upstream firm’s profit varies with the number of firms in the downstream market.

\(^4\) For a detailed presentation of different sets of beliefs, see McAfee and Schwartz (1994). Passive beliefs are often used because they are very simple. However, non-existence of equilibrium may arise, even if this is not the case in our framework. For full details in very close settings, see McAfee and Schwartz (1995) and, Rey and Vergé (2004); since we have required both, that downstream firms compete in quantities and that each firm never learns others’ contracts, an equilibrium always exists.

For a more general discussion of these issues, see Segal and Whinston (2003).
Differentiating (7) with respect to $n$, we obtain:

$$
\frac{(c - c')}{4(n+1)^2} \left[ 4(a-c) - (c - c')(n+1)^2 \right]
$$

(8)

which is positive (implying that dominant upstream firm’s profit is non-decreasing in the number of firms) if the following condition is satisfied:

$$
4(a-c) - (c - c')(n+1)^2 > 0 \iff n < -1 + 2\sqrt{\frac{d-c}{c - c'}}.
$$

(9)

The intuition for the result is straightforward. Decompose differentiating (7) with respect to $n$ into two parts:

$$
\left[ \pi_i^{br}(c, \sum_{j \neq i} q_j^*) + n \frac{\partial \pi_i^{br}}{\partial n} \left( c' \sum_{j \neq i} q_j^* \right) \right] - \left[ \pi_i^{br}(c, c', \sum_{j \neq i} q_j^*) + n \frac{\partial \pi_i^{br}}{\partial n} \left( c' \sum_{j \neq i} q_j^* \right) \right]
$$

(10)

the first part is related to the “profit-reducing effect” while the second one to the “rent-shifting effect”. The profit-reducing effect operates in the standard model (without an alternative source); an increase in the number of firms unambiguously reduces upstream firm’s profit through the increased product market competition because the supplier faces a lack of commitment on contracts. For the bilateral oligopoly case developed in the current paper, this profit-reducing effect still works, but is offset by a rent-shifting effect. The retailer’s disagreement payoff is a decreasing function in the number of downstream rivals. The larger this number, the lower the retailer’s disagreement payoff and then the less concessions the dominant upstream firm should make. With a larger number of downstream firms, the dominant upstream firm extracts more rents from the downstream level up to the standard profit-reducing effect resulting of an increase in $n$ dominates. The magnitude of the rent-shifting effect, through retailers’ disagreement payoffs is larger when the price $c'$ at which each retailer can buy from the alternative supplier is lower and/or the output demand $a$ is bigger. The threshold value in $n$, under which the dominant upstream firm’s profit is non-decreasing in $n$, is thus decreasing in $c'$ and increasing in $a$.

Fig. 1 depicts both the profit-reducing effect and the rent-shifting effect for the case $(a = 1, c = 0.1$ and $c' = 0.25)$.

From Fig. 1, we can see that, up to a given value of $n$, an increase in $n$ induces a reduction in retailers’ disagreement payoffs of sufficient magnitude to more than offset the profit reducing effect related to larger product market competition.
4. Conclusion

We have shown that in a bilateral oligopoly model close to Hart and Tirole (1990), dominant input supplier’s profit is initially increasing in the number of downstream firms, if the alternative supplier is competitive enough. The usual result of the previous literature is turned round because there exists a rent-shifting effect that initially dominates the standard profit-reducing effect resulting of an increase in \( n \). Consider the dominant upstream firm that negotiates with a retailer. The retailer’s disagreement payoff is a decreasing function in the price at which it can buy from the alternative supplier, but also an increasing function of the number of downstream rivals. The larger this number, the lower the retailer’s disagreement payoff (assuming downstream firms are substitute) and then the less concessions the dominant upstream firm should make. Thus, the dominant upstream firm can extract more rents from the downstream level up to the point where the standard profit-reducing effect resulting of an increase in \( n \) dominates.

In practice, it is a fundamental result since examples of such vertical relationships include manufacturers selling to retailers, patent-holders licensing several producers, and franchisors with several franchisees.

So, our analysis has policy implications. We have shown that the incentive to exclude downstream firms is more limited that the previous literature has suggested. However, the dominant upstream firm’s incentive to encourage competition is lower than that of a social planner\(^5\). But, the more competitive the upstream oligopoly (the inferior supplier) and/or the larger the size of the demand in final market, the larger the incentive to promote competition; the threshold value, up to that the dominant upstream firm’s profit increases in the number of downstream firms, becomes larger in the strength of upstream competition and/or the size of the downstream demand.

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References


\(^5\) From a social point of view, an increase in competition always has a positive effect in our framework since both an increase in the number of downstream firms on consumer surplus is positive and upstream marginal cost of production is constant.