Incentive to encourage downstream competition under bilateral oligopoly

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Abstract

Consider the contracting problem of an input supplier dealing with several firms that compete in an output market. We show that, contrary to the key result of the previous literature, an input supplier's profit can increase with the number of downstream firms if the upstream firm is not a monopolist but instead 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 so 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 profits at that firm's expense. This opportunistic behaviour 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. In particular, it is well-known that the upstream firm's profit will decrease as the number of downstream firms competing in the output market increases.[1] 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 good or service suppliers. In the presence of another competitor, an upstream firm faces both the previous commitment problem and a threat of losing sales to a 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 upstream competition is strong, 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 non-integrated downstream firm. They have shown that, the lower the cost of the second supplier, the larger the supply of the vertically integrated firm to the non-integrated downstream firm. They have not focused on the relationship between the dominant upstream firm's profit and the number of downstream firms. Chemla (2003) has investigated this relationship in a related framework but has assumed a specific upstream cost and a different range of bargaining power between upstream and downstream firms. When 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). Since upstream firms are rarely pure monopolists, there is at least one situation, more simple and more usual, in which a dominant upstream firm has a private incentive to preserve downstream competition.

The rest of this paper is organised 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 analyse a non co-operative 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

[1] See Rey and Tirole (2005) for a survey of the literature.

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) and 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[2]: $\{w_i, F_i\}$, $i = 1,...,n$ 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[3] (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:

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

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):

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

Under the Cournot-Nash assumption, differentiation of Eq. (2) with respect to q_i yields the first-order condition for profit maximisation 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:

$$q_i^{BR}\left(w_i, \sum_{j \neq i} q_j\right) = \frac{1}{2}\left(a - w_i - \sum_{j \neq i} q_j\right),\ \pi_i^{BR}\left(w_i, \sum_{j \neq i} q_j\right) = \frac{1}{4}\left(a - w_i - \sum_{j \neq i} q_j\right)^2 , \tag{3}$$

and when it refuses the contract as:

$$q_i^{BR}\left(c', \sum_{j \neq i} q_j\right) = \frac{1}{2}\left(a - c' - \sum_{j \neq i} q_j\right),\ \pi_i^{BR}\left(c', \sum_{j \neq i} q_j\right) = \frac{1}{4}\left(a - c' - \sum_{j \neq i} q_j\right)^2 . \tag{4}$$

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 on multilateral vertical contracting[4], we assume that downstream firms have "passive beliefs": a

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[2] Since the two-part tariff is a simple way to approximate non linear tariffs, we focus on two-part tariffs.
[3] Following McAfee and Schwartz (1994), this framework is related to the "unobservability game".
[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, see McAfee and Schwartz (1995) and, Rey and Vergé (2004). Since we require 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).

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*. The dominant upstream firm faces the constraint that firm *i* earns nonnegative profits, that is, $\pi_i^{BR}\left(w_i, \sum_{j\neq i} q_j^*\right) - F_i \geq \pi_i^{BR}\left(c', \sum_{j\neq i} q_j^*\right)$. This constraint holds with equality. Since the conjectures are passive and the upstream marginal cost of production is constant, the relevant objective of the dominant upstream firm is:

$$Max_{w_i}\ (w_i - c)\, q_i^{BR}\left(w_i, \sum_{j\neq i} q_j^*\right) + \pi_i^{BR}\left(w_i, \sum_{j\neq i} q_j^*\right) - \pi_i^{BR}\left(c', \sum_{j\neq i} q_j^*\right). \tag{5}$$

The first-order condition in w_i can be written as:

$$(w_i - c)\frac{\partial q_i^{BR}\left(w_i, \sum_{j\neq i} q_j^*\right)}{\partial w_i} = 0, \tag{6}$$

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

Let $\pi_i(c,n)$ and $\pi_i(c',n)$ be the equilibrium gross profit of firm *i* when it accepts the contract of the dominant firm and when it refuses it, respectively:

$$\pi_i(c,n) = \pi_i^{BR}\left(c, \sum_{j\neq i} q_j^*\right) \text{ and } \pi_i(c',n) = \pi_i^{BR}\left(c', \sum_{j\neq i} q_j^*\right). \tag{7}$$

Equilibrium profit for the dominant upstream firm is given as:

$$\pi_U = n\left[\pi_i(c,n) - \pi_i(c',n)\right] = \frac{n(c'-c)\left(4(a-c)-(n+1)(c'-c)\right)}{4(n+1)}. \tag{8}$$

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. Differentiating (8) with respect to *n*, we obtain:

$$\frac{(c'-c)}{4(n+1)^2}\left[4(a-c)-(c'-c)(n+1)^2\right], \tag{9}$$

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

$$4(a-c)-(c'-c)(n+1)^2 > 0 \iff n < -1 + 2\sqrt{\frac{a-c}{c'-c}}. \tag{10}$$

The intuition for the result is straightforward. Decompose differentiating (8) with respect to *n* into two parts:

$$\left[\pi_i(c,n) + n\frac{\partial \pi_i(c,n)}{\partial n}\right] - \left[\pi_i(c',n) + n\frac{\partial \pi_i(c',n)}{\partial n}\right] \tag{11}$$

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 a point at which the standard profit-reducing effect 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 of *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 $c' = 0.25$).

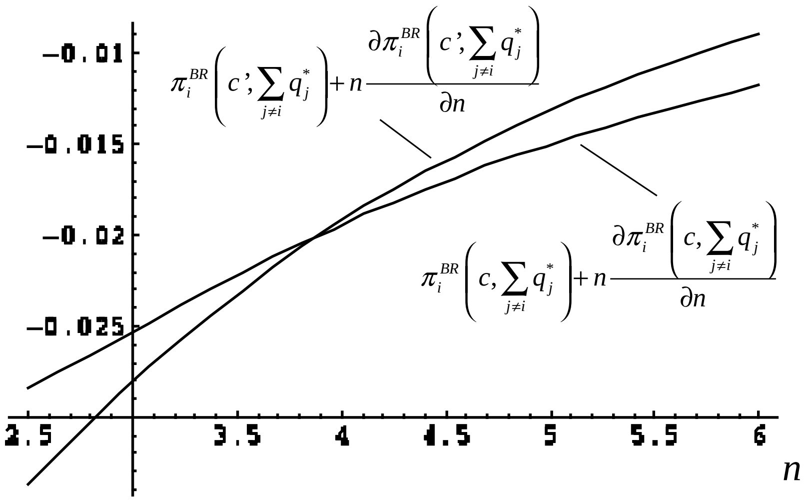

Fig. 1: profit-reducing and rent-shifting effects

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 similar to Hart and Tirole (1990), a dominant input supplier's profit is initially increasing in the number of downstream firms, if the alternative supplier is competitive enough. The standard result found in the previous literature is amended 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 from an increase in *n* dominates.

This analysis has some 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 is and/or the larger the size of the demand in final market, the larger the incentive to promote competition. The threshold number of downstream firms becomes larger as the upstream competition strengthens and/or downstream demand increases.

References

Chemla, G. (2003) "Downstream competition, foreclosure, and vertical integration" *Journal of Economics and Management Strategy* **12(2)**, 261-289.

Hart, O., and J. Tirole (1990) "Vertical integration and market foreclosure" *Brookings Papers on Economic Activity*, 205-276.

McAfee, R.P., and M. Schwartz (1994) "Opportunism in multilateral vertical contracting: nondiscrimination, exclusivity and uniformity" *American Economic Review* **84(1)**, 210-230.

McAfee, R.P., and M. Schwartz (1995) "The non-existence of pairwise-proof equilibrium" *Economics Letters* **49**, 251-259.

Rey, P., and J. Tirole (2005) "A primer of foreclosure" in *Handbook of Industrial Organization III*, Ed. Armstrong, M. and R. Porter, Elsevier (North Holland, Amsterdam).

Rey, P., and T. Vergé (2004) "Bilateral control with vertical contract" forthcoming *RAND Journal of Economics* **35(4)**.

Segal, I., and M. Whinston (2003) "Robust predictions for bilateral contracting with externalities" *Econometrica* **71(3)**, 757-791.

[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.