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Strategic second sourcing in a vertical structure

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JEL Classification: D43 ; L13 ; O34

Key Words: Entry; Licensing; Downstream market; Second sourcing; Upstream market

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1. Introduction

If the buyers of a product need to bear specific setup costs, the seller can expropriate the returns to the buyer's specific investment by either increasing price of the product or by reducing quality of the product. This problem of opportunism in the market transaction reduces profit of the seller and it can be resolved if the monopolist seller crates a second source of supply by licensing its technology to a competitor. These issues have been addressed in Shepard (1987) and Farrell and Gallini (1988).

We show that even if there is no commitment problem about the future price or quality of the upstream product, second sourcing by an upstream monopolist is profitable if it increases competition in the downstream market. Second sourcing reduces the input price by increasing competition in the upstream market, which may increase competition in the downstream market by attracting new firms. The latter effect increases the demand for input and dominates the competition effect in the upstream market. We also show that welfare increases under second sourcing.

Our explanation of second sourcing is consistent with the empirical evidence. It has been documented in Shepard (1987) that commentary in the trade press and by industry analysts attributes second sourcing to the innovating firm's desire to expand product demand in the semiconductor industry.

This paper can also be related to works on licensing of innovation, which shows that a monopolist licenses to the competitor only if the products are imperfect substitutes (see, e.g., Faulí-Oller and Sandonis, 2002). We show that the upstream monopolist licenses technology even if the upstream products are perfect substitutes.

The remainder of the paper is organized as follows. Section 2 describes the model and derives the results. Section 3 concludes.

2. The model and the results

Let us consider an economy with the upstream and the downstream markets. Assume that there is an upstream monopolist, I_1, who has the technology to produce a critical input for the downstream firms. The average cost of input production is constant and is assumed to be 0, for simplicity. Assume that there is another upstream firm, I_2, who can produce the input if and only if it gets the technology of I_1.[1]

Assume that there is an incumbent and a potential entrant in the downstream market. We call these firms as D_1 and D_2 respectively. We consider one downstream incumbent to show our results in the simplest way. However, it is needless to say that our qualitative results hold even if there are n downstream firms. Assume that the downstream firms have the same production technology, which requires one unit of

[1] To make second sourcing feasible, it must be profitable for I_2 to enter the market. To satisfy this in the simplest way, we assume away cost of entry for I_2.

the input to produce one unit of the final goods. For simplicity, we consider that the final product requires only the critical input produced by the upstream firm(s).

Assume that the inverse market demand function for the final product is

$$P = a - q_1 - q_2, \tag{1}$$

where q_1 and q_2 are outputs of D_1 and D_2 respectively and P is price of the final good.

Assume that the firms in the upstream and the downstream markets choose outputs to maximize their profits. In case of competition in the upstream and/or in the downstream markets, the respective firms compete like Cournot duopolists with homogeneous products. So, we consider an economy with successive Cournot oligopolists like Shepard (1987).[2] Therefore, the upstream firm(s) chooses output(s) and the input price, w, is determined from the input demand function. Further, like Shepard (1987) and Farrell and Gallini (1988), we assume away vertical restraints and vertical integration between the upstream and the downstream firms.[3] We also assume that the antitrust authority prevents collusion in the final goods market, which will be justified also by our analysis.

We consider the following game. At stage 1, I_1 decides whether to license to I_2 or not. In case of licensing, it gives a take-it-or-leave-it offer to I_2, which either accepts or rejects the offer. At stage 2, the domestic entrant D_2 decides whether to enter or not. At stage 3, I_1 (I_1 and I_2) produces (produce simultaneously) if there is no licensing (licensing) at stage 1. At stage 4, D_1 (D_1 and D_2) produces (produce

[2] One may, e.g., refer to Abiru (1988), Salinger (1988) and Abiru et al. (1998) for other works with successive Cournot oligopolists.

[3] Hart and Tirole (1990) argued that vertical integration would not occur for significant cost of integration.

simultaneously) if D_2 does not enter (enters) at stage 2 and the profits are realized. We solve the game through backward induction.

2.1 No licensing

Let us consider the situation where I_1 does not license its technology to I_2. In this situation, we have two possibilities: (i) where D_2 enters the downstream market and (ii) where D_2 does not enter the downstream market.

If D_2 enters then, given the input price, both D_1 and D_2 produce $\frac{(a-w)}{3}$. So, the demand for input is

$$q_I = \frac{2(a-w)}{3}. \quad (2)$$

I_1 produces to maximize the following expression:

$$\underset{q_I^1}{Max}(a - \frac{3}{2}q_I^1)q_I^1. \quad (3)$$

Optimal input supply and the input price are respectively $\frac{a}{3}$ and $\frac{a}{2}$. Profit of I_1 is $\frac{a^2}{6}$ and profits of D_1 and D_2 are respectively $\frac{a^2}{36}$ and $\frac{a^2}{36} - E$. So, if I_1 is monopolist in the upstream market, D_2 enters provided $\frac{a^2}{36} > E$.

If $\frac{a^2}{36} < E$, D_1 is monopolist in the downstream market and the input demand is

$$q_I = \frac{(a-w)}{2}. \quad (4)$$

So, I_1 produces to maximize the following expression:

$$\underset{q_I^1}{Max}(a - 2q_I^1)q_I^1. \quad (5)$$

Optimal input supply and the input price are respectively $\frac{a}{4}$ and $\frac{a}{2}$. Profits of I_1 and D_1 are respectively $\frac{a^2}{8}$ and $\frac{a^2}{16}$.

2.2 Licensing to create second sourcing

Now assume that I_1 licenses its technology to I_2. To show our results in the simplest way, following Katz and Shapiro (1985), Marjit (1990), Mukherjee (2001) and others, we assume that, under licensing, I_1 charges an up-front fixed-fee[4] for its technology, and I_2 accepts the offer if it is not worse off under licensing than no licensing. So, under licensing, both I_1 and I_2 produce the input at zero average cost of production. We normalize the payoff of I_2 under no licensing to 0.

Again we have to consider two situations: (i) where D_2 enters the downstream market and (ii) where D_2 does not enter the downstream market.

If D_2 enters, the input demand is given by (2). The ith firm, $i = 1,2$, in the upstream market produces to maximize the following expression:

$$\underset{q_I^i}{Max}(a - \frac{3}{2}q_I^i - \frac{3}{2}q_I^j)q_I^i, \qquad i \neq j. \quad (6)$$

[4] Non-infringing imitation or 'inventing around' the licensed technology by the licensee or lack of information needed for a royalty provision might be the reason for a licensing contract with up-front fixed-fee only (see, e.g., Katz and Shapiro, 1985 and Rockett, 1990).

Both I_1 and I_2 produce $\frac{2a}{9}$. Total input supply and the input price are respectively $\frac{4a}{9}$ and $\frac{a}{3}$. Therefore, optimal profits of both I_1 and I_2 are $\frac{2a^2}{27}$ and optimal Profits of D_1 and D_2 are respectively $\frac{4a^2}{81}$ and $\frac{4a^2}{81} - E$. So, D_2 enters provided $\frac{4a^2}{81} > E$.

If $\frac{4a^2}{81} < E$ then D_1 is monopolist and the demand for input is given by (4). The ith firm, $i = 1,2$, in the upstream market produces to maximize the following expression:

$$\underset{q_I^i}{Max}(a - 2q_I^i - 2q_I^j)q_I^i, \qquad i \neq j. \tag{7}$$

Both I_1 and I_2 produce $\frac{a}{6}$. Total input supply and the input price are respectively $\frac{a}{3}$ and $\frac{a}{3}$. Profits of both I_1 and I_2 are $\frac{a^2}{18}$ and profit of D_1 is $\frac{a^2}{9}$.

2.3 Incentive for second sourcing

We have seen that D_2 enters the market under no licensing and licensing in the upstream market if $\frac{a^2}{36} > E$ and $\frac{4a^2}{81} > E$ respectively, where $\frac{4a^2}{81} > \frac{a^2}{36}$.

Proposition 1: *(i) If either $E < \frac{a^2}{36}$ or $E > \frac{4a^2}{81}$, second sourcing is mot profitable.*

(ii) Second sourcing is profitable if $E \in (\frac{a^2}{36}, \frac{4a^2}{81})$.

Proof: (i) If $\frac{a^2}{36} > E$, total profit in the upstream market under second sourcing is $\frac{4a^2}{27}$ and it is lower than the profit of I_1 when it is monopolist, which is $\frac{a^2}{6}$.

If $E > \frac{4a^2}{81}$, total profit in the upstream market under second sourcing is $\frac{a^2}{9}$ and it is lower than the profit of I_1 when it is monopolist, which is $\frac{a^2}{8}$.

(ii) If $E \in (\frac{a^2}{36}, \frac{4a^2}{81})$, total profit in the upstream market under second sourcing is $\frac{4a^2}{27}$ and it is greater than the profit of I_1 when it is monopolist, which is $\frac{a^2}{8}$. Q.E.D.

If second sourcing in the upstream market does not induce entry in the downstream market, it creates competition in the upstream market while the input demand function remains unchanged. This competition effect reduces total profit in the upstream market and makes second sourcing unprofitable. However, second sourcing reduces the input price by creating competition in the upstream market and may induce entry in the downstream market. If second sourcing increases competition in the downstream market, it increases the demand for input, for a given input price. We show that the effect of higher input demand dominates the competition effect in the upstream market and makes second sourcing profitable.

2.4 Welfare implications of second sourcing

We have seen that second sourcing occurs for $E \in (\frac{a^2}{36}, \frac{4a^2}{81})$. In this situation, welfare under monopoly in the upstream market and second sourcing are respectively

$$\frac{7a^2}{32} \quad \text{and} \quad \frac{56a^2}{162} - E. \tag{8}$$

Comparison of the welfare values in (8) gives the following proposition.

Proposition 2: *Suppose,* $E \in (\frac{a^2}{36}, \frac{4a^2}{81})$. *Second sourcing increases welfare compared to monopoly in the upstream market.*

It is straightforward to see that collusion in the downstream market reduces welfare if there is no second sourcing. Proposition 1 implies that if the upstream monopolist anticipates collusion in the downstream market, second sourcing does not occur. Then, it follows from Proposition 2 that collusion in the product market further reduces welfare by preventing second sourcing, which may encourage the antitrust authority to prevent collusion in the product market as assumed in our analysis.

3. Conclusion

We show that a monopolist input supplier has the incentive to license its technology to create a second source of input supply if second sourcing increases competition in the downstream market. So, unlike pervious work on second sourcing by the monopolist input supplier, we show that even if the upstream firm does not face any commitment problem about the future price or quality of its product, second sourcing it still profitable. We also find that second sourcing increase welfare compared to monopoly in the upstream market.

References

Abiru, M., 1988, 'Vertical integration, variable proportions and successive oligopolies', *Journal of Industrial Economics*, **36**: 315 – 25.

Abiru, M., B. Nahata, S. Raychaudhuri and M. Waterson, 1998, 'Equilibrium structures in vertical oligopoly', *Journal of Economic Behavior and Organization*, **37**: 463 – 80.

Farrell, J. and N. Gallini, 1988, 'Second-sourcing as commitment: monopoly incentives to attract competition', *The Quarterly Journal of Economics*, **103**: 673 - 94.

Fauli-Oller, R. and J. Sandonis, 2002, 'Welfare reducing licensing', *Games and Economic Behavior*, **41**: 192 – 205.

Hart, O. and J. Tirole, 1990, 'Vertical integration and market foreclosure', *Brookings Papers on Economic Activity*, 205 – 76 and 285 – 86.

Katz, M. and C. Shapiro, 1985, 'On the licensing of innovation', *Rand Journal of Economics*, **16**: 504 – 20.

Marjit, S., 1990, 'On a non-cooperative theory of technology transfer', *Economics Letters*, **33**: 293 – 98.

Mukherjee, A., 2001, 'Technology transfer with commitment', *Economic Theory*, **17**: 345 – 69.

Rockett, K., 1990, 'The quality of licensed technology, *International Journal of Industrial Organization*, **8**: 559 – 74.

Salinger, M. A., 1988, 'Vertical mergers and market foreclosure', *The Quarterly Journal of Economics*, **103**: 345 – 56.

Shepard, A., 1987, 'Licensing to enhance the demand for a new product', *Rand Journal of Economics*, **18**: 360 - 68.