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Profit raising entry in a vertical structure*

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Abstract: In contrast to the usual belief, we show that entry in the final goods market increases profits of the incumbent final goods producers if there is free entry in the input market and the final goods are sufficiently differentiated. Thus, we extend Matsushima (2006, Industry profits and free entry in input markets, *Economics Letters*, 93: 329-336).

Key Words: Entry; Final goods; Input; Profit

JEL Classification: D43; L11; L13

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1. Introduction

It is generally believed that entry of new firms reduces profits of the incumbent firms and encourages the incumbents to adopt entry deterring strategies. In contrast, we show that, if there is free entry in the input markets, entry in the final goods market increases profits of the incumbent final goods producers if the final goods are sufficiently differentiated. This holds under both Cournot and Bertrand competition in the final goods market.

The reason for our result is as follows. For a given input price, entry in the final goods market reduces the profits of the incumbent final goods producers by increasing competition. However, entry in the final goods market induces entry in the input market and reduces the input price, which tends to increase the profits of the incumbent final goods producers. If the final goods are sufficiently differentiated, entry does not increase competition in the final goods market significantly, but it helps to reduce the input price, thus creating profit raising entry.

There are empirical evidences supporting the mechanism underlying our result. Friedson and Li (2015) show that more hospitals (the downstream agents) in an area attract more local independent medical labs (the upstream agents) providing intermediate services, like testing physical samples, to the hospitals (i.e., increased "input sharing") and reduces prices of the intermediate services. Holmes (1999), Fee and Thomas (2004)[1], and Li (2013) also provide evidences of increased input sharing.

Considering free entry in the input market, Matsushima (2006) showed that entry in the final goods market increases industry profit but reduces profits of the

[1] I thank Shantanu Banerjee for providing me this evidence.

incumbent final goods producers.[2] We show that his result is due to the assumption of homogeneous final goods. If the final goods are sufficiently differentiated, entry increases the profits of the incumbents.

Considering a monopolist input supplier and quantity competition in the final goods market, Tyagi (1999) shows that profit raising entry in the final goods market occurs if the demand function is sufficiently convex. Like our paper, entry in his paper creates the competition effect and the input-price effect, but the input-price effect in his paper is different from ours. Due to the competition effect, for a given input price, entry reduces the outputs of the incumbents, increases total final goods production, and reduces the profits of the incumbents. However, entry increases input demand and the monopolist input supplier increases the input price if the derived input demand is generated from a highly convex final goods demand.[3] The higher input price tends to reduce the output of each final goods producer and total final goods production. Since total final goods production is higher under oligopoly compared to industry-profit maximising output, the input-price effect tends to increase the profits of the incumbents by contracting total final goods production. On the balance, the total-output dampening effect resulting from a higher input price dominates the total-output enhancing competition effect and creates profit raising entry. Hence, unlike our paper, entry in Tyagi (1999) increases the input price and reduces total final goods production, which makes the consumers worse off when profit raising entry occurs. Further, unlike Tyagi (1999), we consider competition in the input market and show our results under both quantity and price competition in the final goods market.

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[2] Naylor (2002a) also shows the possibility of *industry-profit* raising entry in a vertical structure.

[3] If the demand curve is highly convex, increased total final goods production following entry reduces price of the final goods significantly, which affects rent extraction by the input supplier and encourages it to increase the input price to contract total output in the final goods market.

Naylor (2002b) and Mukherjee et al. (2009) also show profit raising entry in a vertical structure. Considering firm-union bargaining, Naylor (2002b) shows that profit raising entry may occur if the labour unions care sufficiently about wages, but it does not happen if the upstream agents give the same weights on price and output, like firms.[4] In a successive oligopoly, Mukherjee et al. (2009) show profit raising entry in the presence of asymmetric final goods producers. In contrast, we show profit raising entry when the input suppliers put the same weights on price and output, and with symmetric final goods producers.

Profit raising entry may occur due to other factors, such as Stackelberg leader-follower (Pal and Sarkar, 2001 and Mukherjee and Zhao, 2009), vertical product differentiation and heterogeneous consumer groups (Ishibashi and Matsushima, 2009), innovation by asymmetric cost firms (Ishida et al., 2011), and network externality with corporate social responsibility (Fanti and Buccella, 2017). In contrast, we show the implications of horizontally differentiated final goods and free entry in the input market.

2. The model and the results

Consider a successive oligopoly model like Matsushima (2006) with the exception that the final goods are horizontally differentiated. There are n final goods producers producing horizontally differentiated products by using a critical input produced in an oligopolistic input market. Assume that each final goods producer requires one unit of input to produce one unit of the final goods.

While the number of final goods producers are given exogenously, there are many input suppliers and free entry in the input market determines the number of active input suppliers. If an input supplier enters the market, it incurs a fixed entry cost, K. For

[4] Fanti (2014) shows similar results by measuring competition through product differentiation.

simplicity, we normalise the marginal cost of input production to 0. There are no other costs for input production. We also assume for simplicity that the only cost faced by the final goods producers is the price of the input.

Assume that the ith final goods producer faces the inverse market demand function $P_i = 1 - q_i - g\sum_{\substack{j=1 \\ i \neq j}}^{n} q_j$, where $g \in [0,1]$ is the degree of product differentiation. The products are perfect substitutes (isolated) if $g = 1$ ($g = 0$).

Consider a three-stage game. At stage 1, the input suppliers take the entry decision. At stage 2, the input suppliers who entered the market determine their outputs like Cournot oligopolists, and the input price, *w*, is determined. At stage 3, the final goods producers determine their outputs like Cournot oligopolists and the profits are realised. We solve the game through backward induction.

If *m* input suppliers enter the market, the ith final goods producer determines its output by maximising the following expression:

$$\underset{q_i}{Max}(1 - q_i - g\sum_{\substack{j=1 \\ i \neq j}}^{n} q_j - w)q_i. \qquad (1)$$

The equilibrium output is

$$q_i^* = \frac{1-w}{2-g+gn}. \qquad (2)$$

The total input demand is $nq_i^* = I = \frac{n(1-w)}{2-g+gn}$, which gives $w = \left(1 - gI - \frac{(2-g)I}{n}\right)$. The kth input supplier determines its output by maximising the following expression:

$$\underset{I_k}{Max}\left(1-g(I_k+\sum_{\substack{s=1\\k\neq s}}^{m}I_s)-\frac{(2-g)(I_k+\sum_{\substack{s=1\\k\neq s}}^{m}I_s)}{n}\right)I_k . \tag{3}$$

The equilibrium input production is

$$I_k^* = \frac{n}{(1+m)(2+g(-1+n))} . \tag{4}$$

The equilibrium profit of the kth input supplier who entered the market is $\pi_{I_k} = \frac{n}{(1+m)^2(2+g(-1+n))} - K$.

The free entry equilibrium number of input supplier is given by $\pi_{I_k} = \frac{n}{(1+m)^2(2+g(-1+n))} - K = 0$ or

$$m^* = -1 + \frac{n}{\sqrt{K(2+g(-1+n))n}} . \tag{5}$$

Assume $K < \frac{1}{8}$ so that at least one input supplier enters the market for any values of n and g.

Given (5), the equilibrium input price is

$$w^* = \frac{\sqrt{K(2+g(-1+n))n}}{n} . \tag{6}$$

Proposition 1: *Higher competition in the final goods market reduces the equilibrium input price.*

Proof: We get that $\frac{\partial w^*}{\partial n} = \frac{-(2-g)K}{2n\sqrt{K(2+g(-1+n))n}} < 0$. ■

Given the input price, entry in the final goods market increases the total input demand and the profits of the input suppliers, thus encouraging more input suppliers to enter the market. Hence, competition in the input market increases and the input price falls.

From (1), (2) and (6), the equilibrium profit of the ith final goods producer is

$$\pi_i^* = \frac{\left(-1+\frac{\sqrt{K\left(2+g\left(-1+n\right)\right)n}}{n}\right)^2}{\left(2+g\left(-1+n\right)\right)^2}. \tag{7}$$

We get that

$$\frac{\partial \pi_i^*}{\partial n} = \frac{\left(-n+\sqrt{K\left(2+g\left(-1+n\right)\right)n}\right)\begin{pmatrix} 2gn\sqrt{K\left(2+g\left(-1+n\right)\right)n} \\ -K\left(2+g\left(-1+n\right)\right)\left(2+g\left(-1+2n\right)\right)\end{pmatrix}}{\left(2+g\left(-1+n\right)\right)^3 n^2 \sqrt{K\left(2+g\left(-1+n\right)\right)n}}. \tag{8}$$

If $g=0$, we get $\left.\frac{\partial \pi_i^*}{\partial n}\right|_{g=0} = \frac{\sqrt{2K}(\sqrt{n}-\sqrt{2K})}{4n^2} > 0$, since the minimum value of $\sqrt{n}=1$ is greater than the maximum value of $\sqrt{2K} = \sqrt{2\left(\frac{1}{8}\right)} = \frac{1}{2}$, as $K < \frac{1}{8}$. Since the right-hand side of (8) is continuous in *g*, it suggests that if the final goods are sufficiently differentiated, entry in the final goods market increases profits of the incumbent final goods producers.

However, if $g=1$, we get $\left.\frac{\partial \pi_i^*}{\partial n}\right|_{g=1} = \frac{-2n^2 - K(1+n) - \sqrt{Kn\left(1+n\right)}\left[2\sqrt{Kn\left(1+n\right)}-1-4n\right]}{n^2\left(1+n\right)^3} < 0$, since $\left[2\sqrt{Kn\left(1+n\right)}-1-4n\right] < 0$. This is like Matsushima (2006), suggesting that if the final goods are close substitutes, entry in the final goods market decreases profits of the incumbent final goods producers.

The following proposition summarise the above discussion.

Proposition 2: *If the final goods are sufficiently differentiated (close substitutes), entry in the final goods market increases (decreases) the profits of the incumbent final goods producers.*

If the final goods are isolated, entry of a new final goods producer encourages entry in the input market, which reduces the input price and increases profits of the final goods producers. Since the profits of the final goods producers are continuous on product differentiation, the continuity argument suggests that entry of a new final goods producer increases profits of the incumbent final goods producers if the final goods are sufficiently differentiated. However, if the final goods are close substitutes, higher competition following entry dominates the beneficial input-price effect, and entry reduces profits of the incumbents.

As an example, compare the profits of a final goods producers under a monopoly and a duopoly final goods market structure. If there is a monopolist final goods producer, its profit is $\pi_{mo}^{*}=\frac{1}{4}\left(1-\sqrt{2}\sqrt{K}\right)^{2}$. If there are two final goods producers, the profit of the ith final goods producer is $\pi_{i}^{*}=\frac{\left(1-\frac{\sqrt{(2+g)K}}{\sqrt{2}}\right)^{2}}{(2+g)^{2}}$, *i* = *1*, *2*. If $K<\frac{1}{8}$, at least one input supplier enters the market for n = *1* and n = *2*. Assuming $K=\frac{1}{10}$, we plot the difference $(\pi_{i}^{*}-\pi_{mo}^{*})$ in Figure 1, which shows that

$(\pi_i^* - \pi_{mo}^*) > (<) 0$ for low (high) values of g, suggesting that profit raising entry occurs if the final goods are sufficiently differentiated (close substitutes).

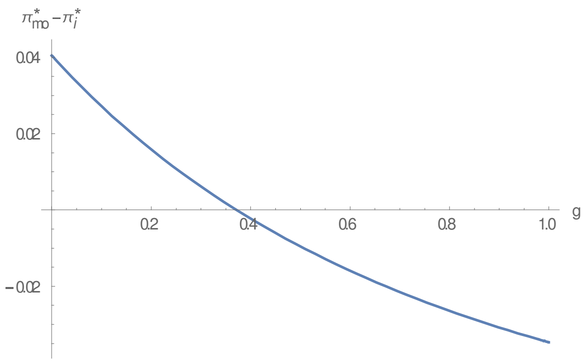

Figure 1: $(\pi_i^* - \pi_{mo}^*)$ for $K = \frac{1}{10}$ and $g \in [0,1]$

Successive Cournot oligopoly is criticised on the grounds that the outputs of the final goods producers are effectively determined by the input market. However, Proposition 2 holds even if the final goods market is characterised by Bertrand competition. The analysis under Bertrand competition in the final goods market is in the Appendix.

3. Conclusion

We show that entry in the final goods market increases profits of the incumbent final goods producers if there is free entry in the input market and the final goods are sufficiently differentiated. The mechanism for our result may have a broader applicability. If there are related markets (e.g., the markets for complementary goods), entry in one market may affect a related market, which, in turn, may create a beneficial effect in the former market.[5] Our consideration of a vertical structure is one such case.

[5] We thank an anonymous referee for highlighting this point.

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