A Strategic Entry Game by an Independent Downstream Firm: Independent Subsidiary vs. Integration

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Abstract

This paper studies a strategic input market entry by an independent downstream firm with a successive oligopoly model. When an independent downstream firm enters into the input market, it decides between internal supplier (= integration) and outside supplier (= independent subsidiary). Independent subsidiary entry does not have any influence on the input and output markets. However, the input market entry strategy depends on the number of downstream firms. If the number of downstream firms exceeds the threshold level, the independent downstream firm moves towards having an outside supplier. However, if the number of downstream firms is sufficiently small, it chooses inside supplier.

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1 Introduction

Many downstream industries purchase inputs from upstream industries which are also organized oligopolistically. Vertical integrations raise antitrust concerns for two set of reasons, exclusive effects and collusive effects. However, recent developments have adopted conventional oligopoly models to explore the incentives to merge and the consequences of mergers.[2] Vertical integration of successive monopolists with fixed coefficient technology has been well known to provide merging monopolists with greater profits and their consumers with lower prices. The transaction cost theory is, in particular, a theory of vertical integration.[3] When repeated transactions involve the investment of relation-specific assets by sellers and buyers, what was initially the selection of one among many potential suppliers is transformed into a bilateral monopolistic situation. Given the expectation of opportunistic behavior by the supplier, there is an incentive for the buyer to integrate the seller into the firm.[4]

Salinger (1988) illustrates three effects of vertical mergers in quantity settings of a successive oligopoly. One is that the merging firm increases its output based on cost saving. The second is that the

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[2] See McElroy (1991) for a survey.

[3] See Williamson (1985, chapter 4 and 5, 1986) for details.

[4] See, however, Bonanno and Vickers (1988), who develop model in which it is profitable for manufacturer to sell the goods through independent distributors.

separated firm decreases its intermediate goods demand. Market structure plays an important role in equilibrium. Under some conditions, the effects on resource allocation of a merger can be negative. McBride (1983) shows evidence that vertical mergers in the cement and concrete industry drops cement prices as well as concrete prices.

Lee & Han (2011) showed an input market entry game by vertically integrated firms, whereas this paper analyzes an input market entry game by an independent downstream firm. They showed that the number of downstream firms plays an important role in equilibrium. If the number of downstream firms is less than a threshold level, integrated firms choose direct entry, whereas, if the number of downstream firms exceeds the threshold level, integrated firms spin off their input divisions.

Lin (2006) showed that a vertically integrated firm can make a spin-off of its input division. It confers a strategic advantage on the spin-off unit. In particular, a spin-off enables the input division to credibly expand upstream by freeing it from having to worry about its parent business.

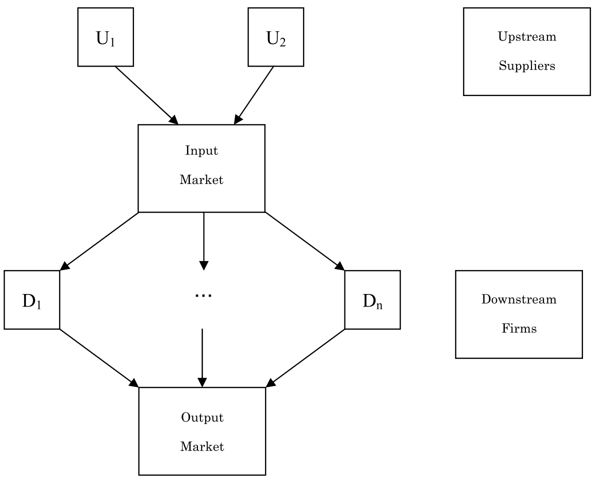
The key result of this model is that the input market entry strategy depends on the number of downstream firms. If the number of downstream firms exceeds the threshold level, the independent downstream firm will have an outside supplier. However, if the number of downstream firms is sufficiently small, it chooses an inside supplier. This paper is organized as follows: in the next section we set up the model. In section 3, we examine two entry strategies: independent subsidiary versus internal supplier. Section 4 contains the conclusion.

2 The model

We follow Salinger's model (1988). There are initially two independent suppliers indexed by U_1 and U_2, and n independent downstream firms indexed by D_1, D_2, ..., and D_n, $n \geq 2$.

All downstream firms purchase a key input from the upstream suppliers and then transform it into a final product. Technologically, one unit of final product requires one unit of input. The marginal cost of producing the input is c for all suppliers. For simplicity, both the marginal cost for the input and the cost

Figure 1. Vertically Related Market



of transforming the input into the final product are normalized to zero. Throughout this paper, we assume that both input and final product are homogeneous. The inverse demand function for the final product is given by:

$$p = a - Q_D. \tag{1}$$

where p is the price of the final product, and $Q_D = q_1 + \cdots + q_i + \cdots + q_n$ is the total output of the final product, and a is a positive parameter.

In the next section, we will study a strategic input market entry game by an independent downstream firm.[5] The timing of the game is as follows;

1. An active downstream firm chooses the input market entry: independent subsidiary versus integration.
2. Each upstream supplier produces a homogeneous input and competes in Cournot fashion with the derived demand.
3. Each downstream firm produces a homogeneous final product and makes its decision about output simultaneously a la Cournot.

3 Analysis

3.1 Independent Subsidiary

In stage three, given the input price w determined in upstream market, downstream firms compete in Cournot fashion. Thus, downstream firm i's maximization problem is

$$\max_{q_i} \qquad \pi_i = (p - w) q_i = (a - Q_D - w) q_i. \tag{2}$$

We now focus on a symmetric case. Cournot equilibrium output for the final product is given as follows:

$$q_i = \frac{a - w}{n + 1}, \qquad i = 1, \ ..., \ n. \tag{3}$$

The derived demand for input is:

$$Q_U = Q_1 + Q_2 = q_1 + \cdots + q_n = \frac{n(a - w)}{(n + 1)}.$$

where Q_U and Q_j, $j = 1, 2$, respectively, denote the total input quantity and supplier j's input quantity. Thus, the derived demand curve is:

$$w = a - \frac{(n + 1)}{n} Q_U. \tag{4}$$

In stage two, upstream supplier j's maximization problem is[6]:

$$\max_{Q_j} \qquad y_j = wQ_j = \left(a - \frac{(n + 1)}{n} Q_U \right) Q_j \qquad j = 1, \ 2. \tag{5}$$

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[5] See Lee and Han (2011) and Lin (2006) for an input market entry game.

[6] Note that the marginal cost for input is zero.

Table 1. Subsidiary Equilibrium

	Equilibrium
p^{S*}	$\frac{a(n+3)}{3(n+1)}$
q_i^{S*}	$\frac{2a}{3(n+1)}$
w^{S*}	$\frac{a}{3}$
Q_j^{S*}	$\frac{an}{3(n+1)}$
π_i^{S*}	$\frac{4a^2}{9(n+1)^2}$
y_j^{S*}	$\frac{a^2n}{9(n+1)}$
$\pi_i^{S*}+y_j^{S*}$	$\frac{a^2(n^2+n+4)}{9(n+1)^2}$

From the FOC, we have:

$$Q_j=\frac{an}{3(n+1)}, \qquad j=1,\ 2. \tag{6}$$

Lemma 1. Given Eq. (1), the equilibrium is characterized as follows.

(1) Each upstream supplier decides the input quantity $Q_j^{S*}=\frac{an}{3(n+1)}$.

(2) Each downstream sets the final product quantity. $q_i^{S*}=\frac{2a}{3(n+1)}$.

(3) Firm i's and Supplier j's payoffs are respectively;

$$\pi_i^{S*}=\frac{4a^2}{9(n+1)^2}, \quad \text{and} \quad y_j^{S*}=\frac{a^2n}{9(n+1)}.$$

where the superscript S denotes independent subsidiary entry by a downstream firm.

3.2 Integration

Next, we examine vertical integration by an active downstream firm. Figure 2 shows the case in which a downstream firm integrates with an upstream supplier and enters into the input market.

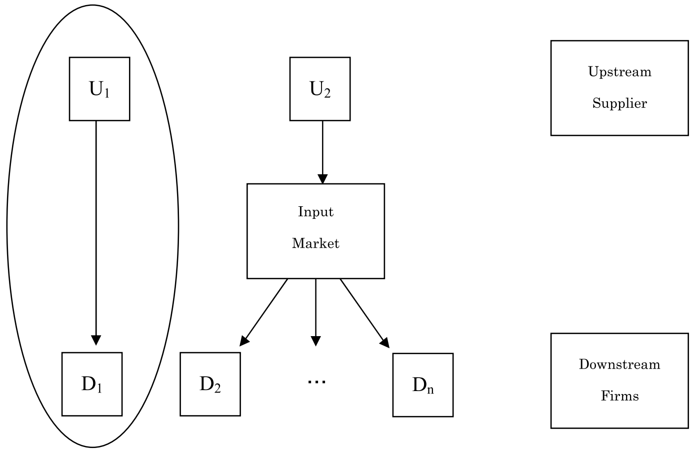
Given the input price w, vertically integrated downstream firm 1's maximization problem is:

$$\max_{q_1} \qquad \pi_1=pq_1=(a-Q_D)q_1.^{7} \tag{7-1}$$

On the other hand, vertically separated firm i's maximization problem is also given by

[7] Note that the marginal cost for a vertically integrated downstream firm is zero.

Figure 2. Vertically Related Market with Integration



$$\max_{q_i} \quad \pi_i = (p - w)q_i = (a - Q_D - w)q_i, \qquad i = 2, \ldots, n. \tag{7-2}$$

From the FOC, we have

$$\frac{\partial \pi_1}{\partial q_1} = a - q_1 - Q_D = 0, \tag{8-1}$$

$$\frac{\partial \pi_i}{\partial q_i} = a - q_i - Q_D - w = 0 \qquad i = 2, \ldots, n. \tag{8-2}$$

Eq. (8-1) and Eq. (8-2) are a set of n simultaneous equations, which can be solved for equilibrium final product output as functions of the input price w.

$$q_1 = \frac{1}{n+1}[a + (n-1)w] \tag{9-1}$$

$$q_i = \frac{1}{n+1}[a - 2w], \qquad i = 2, \ldots, n. \tag{9-2}$$

Substituting Eq. (9-1) and (9-2) into Eq. (1), (7-1), and (7-2) gives us the price for final product and each downstream producer's profit.

$$p = \frac{1}{n+1}(a + (n+1)w) \tag{10-1}$$

$$\pi_1 = \frac{[a + (n-1)w]^2}{(n+1)^2} \tag{10-2}$$

$$\pi_i = \frac{[a - 2w]^2}{(n+1)^2} \tag{10-3}$$

The derived demand for input is[8]:

$$Q_U = Q_2 = q_2 + \cdots + q_n = \frac{(n-1)(a-2w)}{(n+1)}$$

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[8] See Lin (2006) about direct entry. He showed why direct entry into the input market by a vertically integrated firm will not occur. Consult Lee and Han (2011) about direct entry into the input market.

where Q_U and Q_2, respectively, denote the total input quantity and supplier 2's input quantity.[9] Therefore, aggregating and rearranging Eq. (9−2) gives an inverse demand curve for the input:[10]

$$w = \frac{1}{2}\left[a - \frac{(n+1)}{(n-1)}Q_2\right]. \tag{11}$$

The separated supplier 2's maximization problem is[11]:

$$\max_{Q_2} \quad y_2 = wQ_2 = \frac{1}{2}\left(a - \frac{(n+1)}{(n-1)}Q_2\right)Q_2. \tag{12}$$

From the FOC, we have:

$$\frac{\partial y_2}{\partial Q_2} = \frac{a}{2} - \frac{(n+1)}{(n-1)}Q_2 = 0. \tag{13}$$

The equilibrium input quantity for the supplier is:

$$Q_2 = \frac{(n-1)a}{2(n+1)}. \tag{14}$$

Lemma 2. Given Eq. (1), the equilibrium is characterized as follows.

(1) Supplier 2 decides the input quantity $Q_2^{I*} = \frac{(n-1)a}{2(n+1)}$.

(2) Firm 1's and firm i's output is respectively;

$$q_1^{I*} = \frac{(n+3)a}{4(n+1)} \quad \text{and} \quad q_i^{I*} = \frac{a}{2(n+1)}.$$

(3) Firm 1's and Supplier 2's payoffs are respectively:

$$\pi_i^{I*} = \frac{a^2(n+3)^2}{16(n+1)^2} \quad \text{and} \quad y_j^{I*} = \frac{a^2(n-1)}{8(n+1)}$$

where the superscript I denotes the case in which firm 1 integrates an upstream supplier.

Proposition 1. Given Eq. (1), an active downstream firm decides

(1) if $n > 5$, the active downstream firm has the outside supplier.

(2) if $n \leq 5$, it will choose the internal supplier.

Proposition 1 implies that the number of downstream firms plays an important role in the input market entry strategy. In other words, an outside supplier will be chosen when the downstream market is large and an internal supplier will be used when downstream market is small. The intuition is as follows. The active downstream firm is inclined to earn more profit in a less competitive market. Therefore, if downstream market competition becomes worse, the active firm chooses the outside supplier in order to earn more profit in the input market. On the other hand, if the downstream market is less competitive, the firm procures the input through the internal supplier.

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9 In this case, supplier 2 has a monopoly power in the input market.

10 We assume that the vertically integrated firm purchases the input from its input division. Thus, the total output for the input market is equal to the total output produced by the separated downstream firms.

11 See Lin (2006) for direct entry. He showed that direct entry by an integrated firm into the input market never occurs in the double Cournot model with the linear demand curve and one integrated firm. Thus, we follow his assumption.

Table 2. Integration equilibrium

	Equilibrium	
p^{I*}	$\frac{a(n+3)}{4(n+1)}$	
q^{I*}	q_1^{I*}	$\frac{a(n+3)}{4(n+1)}$
	q_i^{I*}	$\frac{a}{2(n+1)}$
w^{I*}	$\frac{a}{4}$	
Q_2^{I*}	$\frac{a(n-1)}{2(n+1)}$	
π^{I*}	π_1^{I*}	$\frac{a^2(n+3)^2}{16(n+1)}$
	π_i^{I*}	$\frac{a^2}{4(n+1)^2}$
y_2^{I*}	$\frac{a^2(n-1)^2}{4(n+1)^2}$	

4 Conclusion

This paper examined a strategic game about input market entry by an independent downstream firm with a successive oligopoly model. We showed that the number of downstream firms plays an important role in the entry game. If the number of downstream firms exceeds the threshold level, the independent downstream firm will have an outside supplier. However, if the number of downstream firms is sufficiently small, it tends to choose an inside supplier.

Interesting Issues not discussed in this paper are as follows. Efficiency may be linked not to vertical integration itself but to firm size in a downstream market. The other is analyzing the relationship between efficiency and integration in a successive oligopolistic market. Will more efficient firms tend to be vertically integrated or not?

Reference

[1] Abiru, Masahiro (1988), "Vertical Integration, variable proportion and successive oligopolists," *Journal of Industrial Economics*, Vol.36, pp.315–325.

[2] Bettignies, J. (2006), "Product Market Competition and Boundaries of the Firm," *Canadian Journal of Economics*, Vol.39, pp.948–970.

[3] Bonanno, G. and J. Vickers, (1988), "Vertical Separation," *Journal of Industrial Economics*, Vol.36, pp.257–265.

[4] Chen, YongMin (2005), "Vertical Disintegration," *Journal of Economics & Management Strategy*, Vol.14, pp.209–229.

[5] Farrell, J. and C. Shapiro (1990), "Horizontal Merger: An equilibrium analysis," *American Economic Review*, Vol. 80, pp.107–126.

[6] Lee, DongJoon and S. H. Han (2011), "Market Entry Strategy by Vertically Integrated Firms: Direct Entry vs. Spin-off," Scientiae Mathematicae Japonicae, Vol.73, 2011–6.

[7] Lin, Ping. (2006), "Strategic spin-offs of input divisions," *European Economic Review*, Vol.50, pp.977–993.

[8] Marris, Robin (1963), "A Model of the Managerial Enterprise," *Quarterly Journal of Economics*, Vol.77, pp.185–209.

[9] McBride, Mark E. (1983), "Spatial Competition and Vertical Integration: Cement and Concrete Revisited," *American Economic Review*, Vol.73, pp.1011–1022.

[10] McElroy, F. William (1991), "Price and welfare effects of oligopolistic mergers," *Bulletin of Economic Research*, Vol.43, pp.331–354.

[11] M. L. Greenhut and H. Ohta (1979), "Vertical Integration of Successive Oligopolists," *American Economic Review*, Vol.69, pp.137–141.

[12] Mueller, Dennis C. (1972), "A Life Cycle Theory of the Firm," *Journal of Industrial Economics*, Vol.20, pp.199–219.

[13] Quirmbach, Herman C (1986), "Vertical Integration: Scale Distortions, Partial Integration, and the Direction of Price Change," *Quarterly Journal of Economics*, Vol.101, pp.131–147.

[14] Rey, P. and J. Stiglitz (1988), "Vertical Restraints and Producer's Competition," *European Economic Journal*, Vol. 32, pp.561–568.

[15] Salinger, M. (1988), "Vertical Mergers and Market Foreclosure," Quarterly Journal of Economics, Vol.103, pp.345–356.

[16] Salinger, M. (1989), "The Meaning of Upstream and Downstream and the Implications for Modeling Vertical Mergers," *Journal of Industrial Economics*, Vol.37, pp.373－387.

[17] Westfield, Fred M. (1981), "Vertical Integration: Does product price rise or fall?" *American Economic Review*, Vol. 71, pp.334–346.

[18] Williamson, O. E. (1985), *The Economic Institutional of Capitalism*, New York: Free Press.

[19] Williamson, O. E. (1986), Vertical Integration and Related Variations on a Transaction-cost Economics Theme. In Joseph E. Stiglitz and G. Frank Mathewson (eds), *New Developments in Analysis of Market Structure*, Cambridge, MA: MIT Press, pp.149–174.