MARKET ENTRY STRATEGY BY VERTICALLY INTEGRATED FIRMS: DIRECT ENTRY VS. SPIN-OFF

DongJoon Lee*, SangHeon Han**

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Abstract. This paper analyzes a strategic entry game by vertically integrated firms in a successive Cournot model. When a vertically integrated firm enters backward into the input market, it chooses one between two; direct entry or spin-off. Such an entry makes the input market be more competitive than before. It also benefits all separated downstream firms, whereas it deteriorates all integrated downstream firms. 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.

1 Introduction Many downstream industries use inputs from upstream industries. Some firms produce a key input in house, while others purchase it from the independent suppliers. Vertically integrated firms commonly supply the key input to their rival downstream competitors. For example, cereal manufacturers, soft-drink producers, and gasoline refiners have long supplied the key input both to their downstream divisions or affiliates and to their rival retail competitors. Recently, the rapid increase in online commerce has brought manufacturer into direct competition in the downstream market. Such trend is widely spread in the insurance industry.

More so, large enterprises often spin off their key input divisions. For example, in the auto industry, General Motors Corp. spun off its Delphi auto parts in 1999. Delphi was to pursue supply contracts with automakers besides GM. In 2000, Ford Motor Co. spun off of its Visteon unit, one of the biggest players in the auto parts business. It was partly in response to the GM-Delphi spin-off.

This paper analyzes a strategic entry game by vertically integrated firms in a successive Cournot model. When a vertically integrated firm enters backward into the input market, it chooses one between two; direct entry or spin-off. Such an entry makes the input market be more competitive than before. It also benefits all separated downstream firms, whereas it deteriorates all integrated downstream firms. The number of downstream firms plays an important role in equilibrium. If the number of downstream firms is sufficiently small, integrated firms choose direct entry, whereas, if the number of downstream firms is sufficiently large, integrated firms spin off their input divisions.

This paper is mainly related to the literature on a strategic input market entry or vertical separation in vertically related markets. A pricing inefficiency in vertically related markets stems from the double marginalization problem.[1] Vertical mergers raise antitrust concerns for two set of reasons, exclusionary effects and collusive effects.[2] Recently, Lin (2006) analyzed the incentive of a self-sufficient producer in a two-tier industry to enter backward

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[1]The double marginalization problem was first addressed by Spengler(1950).

[2]Consult Riordan (2008) on overviews of vertical mergers.

into the input market. Lin's paper focused on the strategic game between no-entry and spin-off, whereas the present paper draws attention to the strategic game between direct entry and spin-off.

Chen (2005) showed that vertical separation can help realize the economies of scale in upstream production. While Chen focused on the strategic effect of vertical separation on purchasing behavior of downstream producers, the present paper draws attention on the strategic effect of input market entry on upstream suppliers. Bonanno and Vickers (1988) analyzed vertical separation in a model with two pairs of upstream and downstream firms. They showed that it is profitable for manufacturer to sell the goods through independent distributors since vertical separation induces the downstream competition to soften. Vertical separation in Bonanno and Vickers (1988) requires a producer not to supply the retailer of the rival producer, which is to remove "the helping effect and the deteriorating effect".

The helping effect by the input market entry in this model is opposite to vertical foreclosure. In a successive Cournot model, Salinger (1988) showed that vertical integration causes the price of the final good to increase.[3] In the model, the merged firms will not participate in the input market under three assumptions.[4]

The new insight of our paper is that strategic entries, direct entry or spin-off, free the entry firms from helping the separated downstream firms. Our model deals with how vertically integrated firms enter into the input market: direct entry or spin-off.

This paper is organized as follows: in section 2, we set up the model; Section 3 examines the effect of the input market entry on integrated and separated firms of downstream market; Section 4 studies the strategic entry game between direct entry and spin-off; Finally, section 5 contains conclusion.

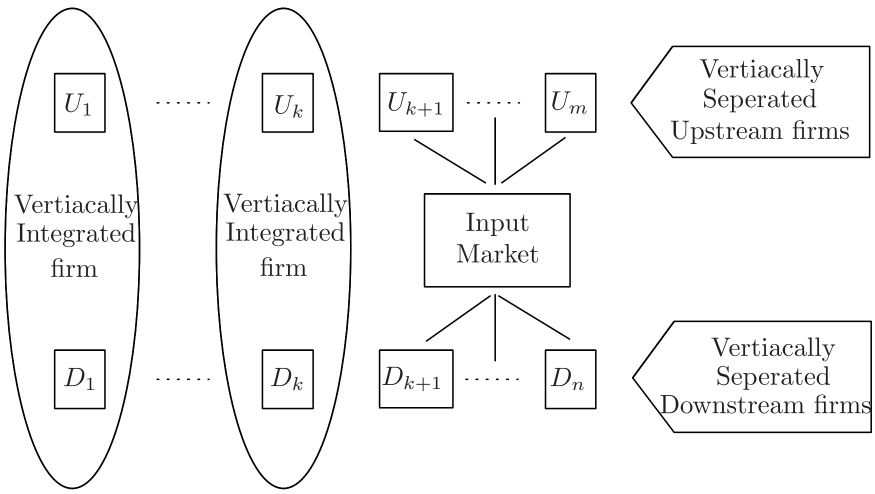

Figure 1: Vertically Related market

[3]Consult Ordover et al (1990) on vertical foreclosure.

[4]See Salinger (1988) for details. Throughout the paper, he assumes three plausible assumptions to induce for merged firms not to enter into the input market. First, if a vertically integrated firm sells an extra unit of the intermediate goods, it conjectures that other intermediate good producers maintain their outputs and that a final goods producer increases its output by one unit. Second, if a vertically integrated firm buys an extra unit of the intermediate goods, it assumes that an intermediate good producer expands its output by one unit and other final goods producers maintain their output. Third, $MC_I < P_I < MC_F < P_F$, where MC_I, P_I, MC_F, and P_F denote the marginal cost of the intermediate goods, the price of the intermediate goods, the marginal cost of the final goods, and the price of the final goods, respectively.

2 The Model There are initially n downstream firms indexed by $D_1, D_2, \cdots, D_n$, $n \geq 3$ and $(m-k)$ upstream suppliers indexed by $U_{k+1}, \cdots, U_m$, $m \geq 3$. All downstream firms, except D_i, $i = 1, \cdots, k$, $k \geq 2$, purchase a key input from the upstream suppliers and then transform it into final product. Each vertically integrated downstream firm D_i is capable of producing the key input itself. There are also $(m-k)$ incumbent upstream suppliers, indexed by $U_{k+1}, \cdots, U_m$, $(m-k) \geq 1$.

One unit of final product requires one unit of input. The marginal cost of producing the input is c for D_i and $U_{k+1}, \cdots, U_m$. For simplicity, both the marginal cost c and the cost of transforming the input into the final product are normalized to zero. The inverse demand function for the final product is given by:

$$p = p(Q_D). \tag{1}$$

where $Q_D = q_1 + q_2 + \cdots + q_i + \cdots + q_n$.

In the next section, we will consider whether direct entry by a vertically integrated firm into the input market occurs or not.[5]

The timing of the game is as follows:

1. All integrated firms and incumbent upstream suppliers, U_1, $U_2, \cdots$, U_m produces a homogeneous input. Each incumbent upstream supplier competes in Cournot fashion with the derived demand.

2. All downstream firms, D_1, $D_2, \cdots$, D_n produce a homogeneous final product. They make their decision about outputs $(q_1, q_2, \cdots, q_n)$ simultaneously a la Cournot which leads to the derived demand for input.

3 Analysis Given the input price w determined in upstream market, downstream firms compete in Cournot fashion. Let $q_i(w)$, $q_j(w)$, $\pi_{Di}(w)$, and $\pi_{Dj}(w)$ denote, respectively, the equilibrium quantity and profit of $D_i(w)$ and $D_j(w)$, $i = 1, \cdots, k$ and $j = k+1, \cdots, n$, in the downstream market.

3.1 Lemma *Under direct entry, both output and profit of D_i increase with the cost w of its separated rival firms, whereas D_j's output and profit decrease with the input price w.*

Since D_i produces the input q_i it needs in house, the derived demand for input is $Q_U(w) \equiv q_{k+1}(w) + \cdots + q_n(w)$. Facing this derived demand, each upstream producer chooses the output level in order to maximize its profit simultaneously. Let $Q_J \equiv Q_{k+1} + \cdots + Q_m$ and $Q_I \equiv Q_1 + \cdots + Q_k$ denote, respectively, the output levels of incumbent input suppliers and new direct entry firms in the input market. The derived demand for input can be written as $w = w(Q_U)$, where $Q_U = Q_I + Q_J$.[6]

Note that, under direct entry, the input division of D_i, namely U_i, is under the control of D_i. Therefore, the input division U_i of vertically integrated firm i maximizes its total profit $\pi_{Ui}(Q_i, Q_{-I}, Q_J) + \pi_{Di}(w)$, where $Q_J = Q_{k+1} + \cdots + Q_m$ and $Q_{-I} = Q_1 + \cdots + Q_{i-1} + Q_{i+1} + \cdots + Q_k$. For given Q_{-I} and Q_J, the best response of U_i is determined by the F.O.C.

$$\frac{\partial \pi_{Ui}(Q_i, Q_{-I}, Q_J)}{\partial Q_i} + \frac{\partial \pi_{Di}(w)}{\partial w}\frac{\partial w}{\partial Q_i} = 0. \tag{2}$$

[5] See Lin (2006), Salinger (1988) on a backward entry into an input market. The former shows that direct entry by a vertically integrated firm into the input market never occurs in the double Cournot model with linear demand. The latter sets three assumptions for integrated firms not to enter into the input market.

[6] Note that the total input production is thus $\sum_{i=1}^{k} q_i + Q_I + Q_J$.

The second term on the LHS of Eq. (2) captures the "helping effect" to all separated downstream firms and the "deteriorating effect" to all integrated downstream firms: an increase in Q_i lowers the input price w, which, of course, hurts payoffs of all integrated downstream firms, i (i=1,⋯,k), because the payoff of D_i increases with the input price w. Eq. (2) also implies that for given Q_{-I} and Q_J, the optimal Q_i of U_i lies in the range where $\frac{\partial \pi_{Ui}(Q_i,Q_{-I},Q_J)}{\partial Q_i} > 0$.

For given other rival integrated firms' decision on the direct entry into the input market, therefore, each integrated firm will enter into the input market if and only if the profit generating from the input market entry is larger than the loss of the downstream market due to the input market entry. Lin (2006) 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.[7] Easily explaining, consider a downstream market that consists of one integrated firm and other separated downstream firms. When the integrated firm enters into the input market, it lowers the input price w. All loss generating from the input market entry will be transferred to the integrated firm. However, consider the downstream market consisting of multiple integrated firms and separated firms. Suppose that an integrated firm enters into the downstream market.[8]

On the other hand, the separated incumbent upstream firm U_j maximizes its own profit only. Its best response to Q_I and Q_{-J} is determined by

$$\frac{\partial \pi_{Uj}(Q_I, Q_j, Q_{-J})}{\partial Q_j} = 0 \tag{3}$$

where Q_{-J}=Q_{k+1}+⋯+Q_{j-1}+Q_{j+1}+⋯+Q_m. Eq.(2) and Eq.(3) means that the output level of the separated incumbent upstream firm is larger than that of the integrated upstream division in the input market.

Entry into the input market by U_i, of course, hurts the downstream business of the vertically integrated firms. However, whether or not a direct entry depends on the benefits and costs it generates. Next, we consider the case with linear demand: $p = a - Q$.

We focus on symmetric case. Note that, under direct entry, the marginal cost is 0 for D_i, $i = 1,\cdots,k$, $(k \geq 2)$, and w for D_j, $j = k+1,\cdots,n$. Cournot equilibrium quantities for the final product are given as follows:

$$q_1(w) = \cdots = q_k(w) = \frac{a + (n-k)w}{n+1}$$

and

$$q_{k+1}(w) = \cdots = q_n(w) = \frac{a - (k+1)w}{n+1}.$$

The derived demand for input is

$$Q_U = Q_I + Q_J = q_{k+1}(w) + \cdots + q_n(w) = \frac{(n-k)\left[a - (k+1)w\right]}{n+1}.$$

[7]Suppose that only one integrated firm exists in the downstream market. If the firm sells an input to a rival downstream firm, its profit is w. On the other hand, when the firm sells a final product, it receives p. Therefore, if $p > w$, direct entry by the integrated firm into the input market never occurs in the successive Cournot model.

[8]Direct entry into the input market will hurt the final producer business, as it increases input market competition. See Lin (2006) for a "helping the rivals effect". However, we show, in the behindhand section, that the integrated producer enjoys more profit by selling its own input to its rival producers, even if there exists a "helping the rivals effect".

where Q_I and Q_J, respectively, denote the total input quantities of integrated firms and separated incumbent suppliers.

or equivalently

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

Facing this demand for input, the upstream firms choose quantities, Q_I and Q_J, simultaneously. In choosing Q_i, U_i must take into account the effect on the total profits of U_i and D_i. Writing q_i as a function of Q_U by substituting Eq.(4) into $q_i(w)$, we have

$$q_i = \frac{a}{k+1} - \frac{Q_U}{k+1} \tag{5}$$

Therefore

$$\pi_{Ui} = wQ_i = \left[\frac{a}{k+1} - \frac{(n+1)(Q_i + Q_{-i})}{(n-k)(k+1)}\right] Q_i \tag{6a}$$

and

$$\pi_{Di} = pq_i = \left[\frac{a}{k+1} - \frac{Q_i + Q_{-i}}{k+1}\right]^2 \tag{6b}$$

Straightforward derivations yield that

$$\begin{aligned} \frac{\partial \pi_{Ui}}{\partial Q_i} + \frac{\partial \pi_{Di}}{\partial Q_i} &= \left(1 - \frac{2}{k+1}\right)\frac{a}{k+1} - \frac{1}{k+1}\left[\frac{nk - n + 3k + 1}{(n-k)(k+1)}\right] Q_{-i} \\ &\quad - \frac{2}{k+1}\left[\frac{nk + 2k + 1}{(n-k)(k+1)}\right] Q_i = 0^9 \end{aligned} \tag{7}$$

3.1 Proposition *Assume that $p = a - Q$. If $k \geq 2$ and a is sufficiently large, direct entry by D_i into input market may occur in the successive Cournot model.*

4 Competing Game We so far focus on direct entry by k integrated firms. However, entry decisions are independently decided by all vertically integrated firms. Like any other decision in oligopoly, entry decisions are also available to all vertically integrated firms. Our focus here is on the interaction of entry decisions by D_1 and D_2. For simplicity, assume that initially there are n downstream firms, D_1, D_2, D_3,$\cdots$, D_n, including D_1, D_2, and D_3, which are all vertically integrated firms, but D_3 is non-active integrated firm.[10] There is only one incumbent supplier, U_4, in upstream market. As before, the unit cost of input production is normalized to zero for all upstream firms. We also consider the case with linear demand: $p = a - Q$.

There are three possible cases: (1) two symmetric cases: direct entry, spin-off; (2) an asymmetric case: direct entry vs. spin-off.

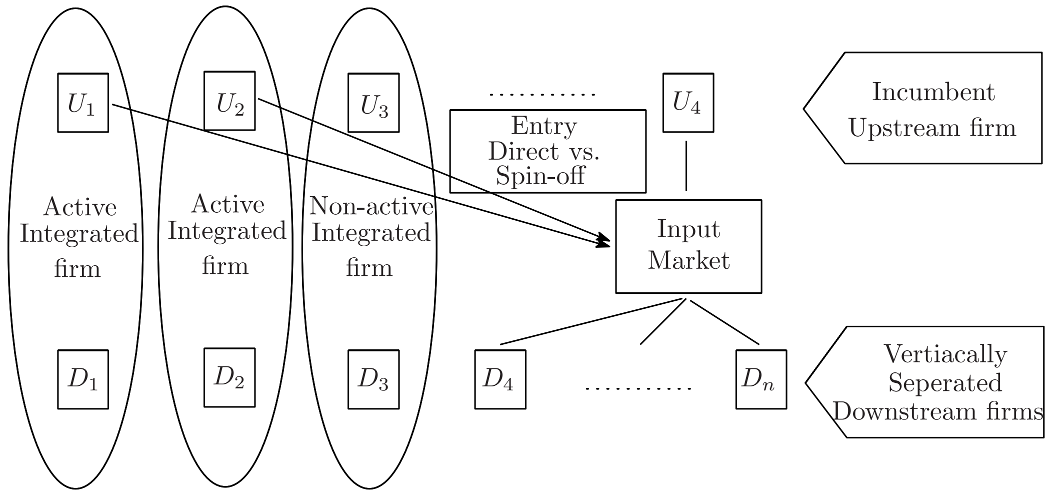

Figure 2: Strategic Entry by Vertically Integrated Firms

(1) Direct entry by both D_1 and D_2:

In the stage two, vertically integrated downstream firm i chooses output in order to maximize its profit given the outputs of all other downstream firms. Note that the marginal cost is zero for integrated rival firms and w for separated rival firms.

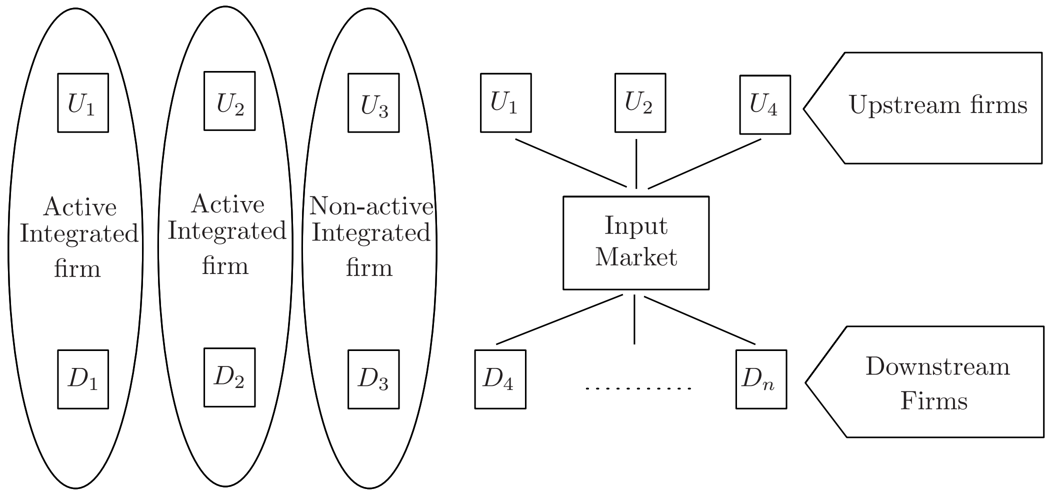

Figure 3: Direct Entry by both Integrated Firms

[9]From the Eq.(7), the second-order condition can be easily checked.

[10]Comparing an asymmetric case in which one integrated firm enters into the input market directly and the other enters into the input market through spin-off, it is necessary for one non-active integrated firm to exist. If not so, the asymmetric case between direct entry and spin-off never occurs. To escape it, our model includes a non-active integrated firm. See Lin (2006) for details. He proved that a direct entry by one vertically integrated firm into the input market never occurs in the double Cournot model with a vertically integrated firm.

Then, vertically integrated firm i's maximization problem is

$$Max \quad \pi_{Di} = pq_i = \{a - (q_1 + \cdots + q_n)\}\, q_i \quad w.r.t \quad q_i, i = 1, 2, 3.$$

Vertically separated firm j's maximization problem is also given by

$$Max \quad \pi_{Dj} = (p - w)q_j = \{a - w - (q_1 + \cdots + q_n)\}\, q_j \quad w.r.t \quad q_j, j = 4, ..., n.$$

A Nash-Cournot equilibrium must satisfy n pieces of the first-order conditions:

$$\text{(8a)} \qquad \frac{\partial \pi_{Di}}{\partial q_i} = a - (q_1 + \cdots + q_n) - q_i = 0, \quad i = 1, 2, 3.$$

$$\text{(8b)} \qquad \frac{\partial \pi_{Dj}}{\partial q_j} = a - w - (q_1 + \cdots + q_n) - q_j = 0, \quad j = 4, ..., n.$$ [11]

By solving Eq. (8-a) and Eq. (8-b), equilibrium quantities in the downstream market given wholesale price w are:

$$\text{(9a)} \qquad q_i(w) = \frac{a + (n-3)w}{n+1} \quad i = 1, 2, 3$$

$$\text{(9b)} \qquad q_j(w) = \frac{a - 4w}{n+1} \quad j = 4, ..., n.$$

The derived demand for input is thus

$$Q_U = q_4(w) + \cdots + q_n(w) = \frac{(n-3)(a-4w)}{n+1}$$

or

$$\text{(10)} \qquad w = \frac{a}{4} - \frac{(n+1)}{4(n-3)} Q_U$$

where $Q_U = Q_1 + Q_2 + Q_4$ and Q_U denotes total input output level.

Facing Eq. (10) for input demand, vertically integrated upstream firm U_i chooses quantity Q_i in order to maximize its profit simultaneously. In choosing Q_i, however, U_i must take account the effect on the total profits of U_i and D_i. Thus, firm U_i's maximization problem is

$$Max \quad \pi_{Di} + \pi_{Ui} = \frac{(a - Q_U)^2}{16} + \left(\frac{a}{4} - \frac{(n+1)Q_U}{4(n-3)}\right) Q_i \quad w.r.t \quad Q_i,\ i = 1, 2$$

On the other hand, incumbent upstream firm U_4's maximization problem is given by

$$Max \quad \pi_{U4} = wQ_4 = \left(\frac{a}{4} - \frac{(n+1)Q_U}{4(n-3)}\right) Q_4 \quad w.r.t \quad Q_4$$

From the F.O.C., we have equilibrium output level:

[11] We also have the second-order conditionsthat take the form $\frac{\partial^2 \pi_{Di}}{\partial {q_i}^2} = -2q_i < 0$ and $\frac{\partial^2 \pi_{Dj}}{\partial {q_j}^2} = -2q_j < 0$.

$$Q_i{}^{DD}* = \frac{a(n-3)^2}{2(n+1)(3n+7)}, \quad i = 1,2 \tag{11a}$$

$$Q_4{}^{DD}* = \frac{a(n-3)(n+5)}{(n+1)(3n+7)} \tag{11b}$$

where the superscript DD denotes direct entry by both D_1 and D_2.
The Cournot equilibrium input price, output price, final product quantity and payoff for each player are given by:

$$w^{DD}* = \frac{a(n+5)}{4(3n+7)} \tag{12a}$$

$$p^{DD}* = \frac{a(n+13)}{4(3n+7)} \tag{12b}$$

$$q_i{}^{DD}* = \frac{a(n+13)}{4(3n+7)} \quad i = 1,2,3 \tag{12c}$$

$$q_j{}^{DD}* = \frac{2a}{(3n+7)} \quad j = 4,...,n \tag{12d}$$

$$Q_D{}^{DD}* = \frac{a(11n+15)}{4(3n+7)} \tag{12e}$$

$$\pi_{D_1}{}^{DD}* = \pi_{D_2}{}^{DD}* = \frac{a^2(n+13)^2}{16(3n+7)^2} \tag{12f}$$

$$\pi_{U_1}{}^{DD}* = \pi_{U2}{}^{DD}* = \frac{a^2(n-3)^2(n+5)}{8(n+1)(3n+7)^2} \tag{12g}$$

(2) Spin-off by both D_1 and D_2:
In the stage two, vertically separated downstream firm i chooses output in order to maximize its profit given the outputs of all other downstream firms.

Then, vertically separated firm i's maximization problem is

$$Max \quad \pi_{Di} = (p-w)q_i = \{a - w - (q_1 + \cdots + q_n)\}\, q_i \quad w.r.t \quad q_i,\ i = 1,2,4,...,n.$$

Non-active integrated downstream firm D_3's maximization problem is also given by

$$Max \quad \pi_{D3} = pq_i = \{a - (q_1 + \cdots + q_n)\}\, q_3 \quad w.r.t \quad q_3.$$

A Nash-Cournot equilibrium must satisfy n pieces of the first-order conditions:

$$\frac{\partial \pi_{Di}}{\partial q_i} = a - w - (q_1 + \cdots + q_n) - q_i = 0, \quad i = 1,2,4,...,n \tag{13a}$$

$$\frac{\partial \pi_{D3}}{\partial q_3} = a - (q_1 + \cdots + q_n) - q_3 = 0. \tag{13b}$$

By solving Eq.(13-a) and Eq.(13-b), equilibrium quantities in the downstream market given wholesale price w are:

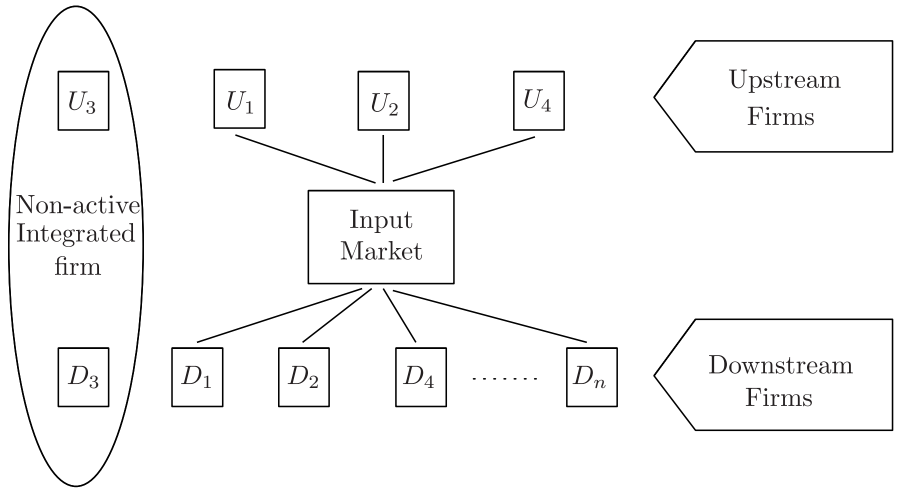

Figure 4: Spin-offs by both Integrated Firms

$$q_i = \frac{a-2w}{n+1} \tag{14a}$$

$$q_3 = \frac{a+(n-1)w}{n+1} \tag{14b}$$

The derived demand for input is thus

$$Q_U = q_1 + q_2 + q_4 + \cdots q_n = \frac{(n-1)(a-2w)}{n+1}$$

or

$$w = \frac{a}{2} - \frac{(n+1)}{2(n-1)} Q_U \tag{15}$$

where $Q_U = Q_1 + Q_2 + Q_4$.

Under Eq. (15), the equilibrium output price, total output level, and each downstream firm's profit are given by

$$p = \frac{a+(n-1)w}{n+1} \tag{16a}$$

$$Q_D = \frac{na-(n-1)w}{n+1} \tag{16b}$$

$$\pi_{Di} = \left[\frac{a-2w}{n+1}\right]^2 = \frac{{Q_U}^2}{(n+1)^2} \tag{16c}$$

Facing Eq.(15) for input demand, each upstream firm U_i chooses quantity Q_i in order to maximize its profit. Thus, firm U_i's maximization problem is

$$Max \quad \pi_{Ui} = wQ_i = \left(\frac{a}{2} - \frac{(n+1)Q_U}{2(n-1)}\right) Q_i \quad w.r.t \quad Q_i,\ i = 1,2,4$$

From the F.O.C., we have equilibrium output level:

(17) $$Q_i{}^{SS}* = \frac{a(n-1)}{4(n+1)}$$

where the superscript SS denotes spin-off by both D_1 and D_2. The Cournot equilibrium input price, output price, final product quantity and payoff for each player are given by:

(18a) $$w^{SS}* = \frac{a}{8}$$

(18b) $$p^{SS}* = \frac{a(n+7)}{8(n+1)}$$

(18c) $$q_i{}^{SS}* = \frac{3a}{4(n+1)} \quad i = 1,2,4,...,n$$

(18d) $$q_3{}^{SS}* = \frac{a(n+7)}{8(n+1)}$$

(18e) $$Q_D{}^{SS}* = \frac{a(7n+1)}{8(n+1)}$$

(18f) $$\pi_{Di}{}^{SS}* = \frac{9a^2}{16(n+1)^2}$$

(18g) $$\pi_{Ui}{}^{SS}* = \frac{a^2(n-1)}{32(n+1)}$$

(3) Direct entry by D_1 and Spin-off by D_2 (the case of spin-off by D_1 and direct entry by D_2 only is symmetric):

In the stage two, vertically integrated downstream firm i chooses output in order to maximize its profit given the outputs of all other downstream firms.

Then, vertically integrated firm i's maximization problem is

$$Max \quad \pi_{Di} = pq_i = \{a - (q_1 + \cdots + q_n)\}\, q_i \quad w.r.t \quad q_i, i = 1,3$$

Vertically separated firm j's maximization problem is also given by

$$Max \quad \pi_{Dj} = (p-w)q_j = \{a - w - (q_1 + \cdots + q_n)\}\, q_j \quad w.r.t \quad q_j, j = 2,4,...,n$$

From the F.O.C., we have equilibrium output level:

(19a) $$q_i = \frac{a + w(n-2)}{n+1}, \quad i = 1,3$$

(19b) $$q_j = \frac{a - 3w}{n+1}, \quad j = 2,4,...,n$$

The derived demand for input is thus

$$Q_U = q_2 + q_4 + q_5 + \cdots q_n = \frac{(n-2)(a-3w)}{n+1}$$

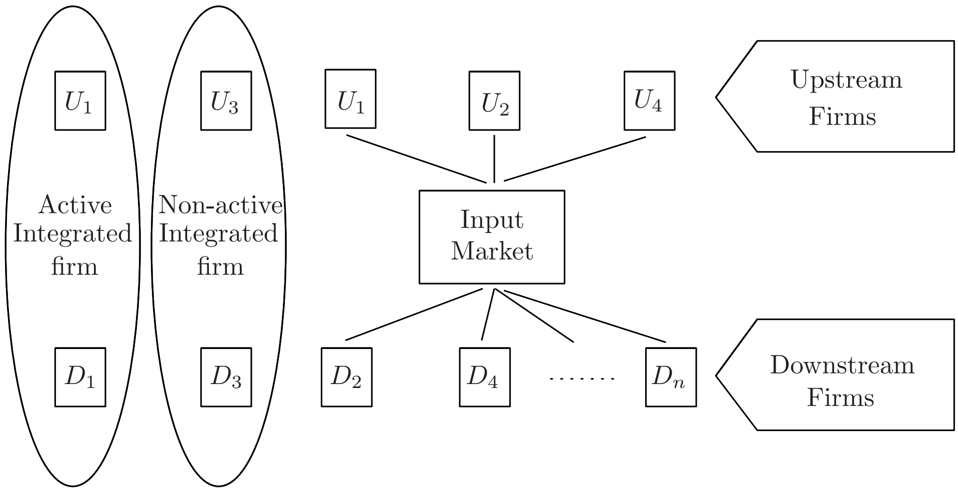

Figure 5: Asymmetric Case: Direct Entry by D_1 and Spin-off by D_2

or

$$w = \frac{a}{3} - \frac{(n+1)}{3(n-2)} Q_U \tag{20}$$

where $Q_U = Q_1 + Q_2 + Q_4$ and Q_U denote total input output level.

Facing Eq.(20) for input demand, vertically integrated upstream firm U_1 chooses quantity Q_1 in order to maximize its profit. In choosing Q_1, U_1 must take account the effect on the total profits of U_1 and D_1. Thus, firm U_1's maximization problem is

$$Max \quad \pi_{D1} + \pi_{U1} = \frac{(a - Q_U)^2}{9} + \left(\frac{a}{3} - \frac{(n+1)Q_U}{3(n-2)} \right) Q_1 \quad w.r.t \quad Q_1$$

On the other hand, vertically separated upstream firm j's maximization problem is given by

$$Max \quad \pi_{Uj} = wQ_j = \left(\frac{a}{3} - \frac{(n+1)Q_U}{3(n-2)} \right) Q_j \quad w.r.t \quad Q_j, \ j = 2, 4$$

From the F.O.C., we have equilibrium output level:

$$Q_1{}^{DS}* = \frac{a(n-2)(n-11)}{2(n+1)(5n+8)} \tag{21a}$$

$$Q_2{}^{DS}* = \frac{3a(n-2)(n+3)}{2(n+1)(5n+8)} \tag{21b}$$

where the superscript DS denotes the case of both direct entry by D_1 and spin-off by D_2. The Cournot equilibrium input price, output price, final product quantity and payoff for each player are given by:

Table 1: Payoff Matrix

		Firm 2	
		Direct Entry	Spin - off
Firm 1	Direct Entry	$\left(\frac{a^2(n^2+6n+37)}{8(n+1)(3n+7)}, \frac{a^2(n^2+6n+37)}{8(n+1)(3n+7)}\right)$	$\left(\frac{a^2(2n^3+11n^2+103n+166)}{4(n+1)(5n+8)^2}, \frac{a^2(3n^3+12n^2+40n-5)}{4(n+1)(5n+8)^2}\right)$
	Spin - off	$\left(\frac{a^2(3n^3+12n^2+40n-5)}{4(n+1)(5n+8)^2}, \frac{a^2(2n^3+11n^2+103n+166)}{4(n+1)(5n+8)^2}\right)$	$\left(\frac{a^2(n^2+17)}{32(n+1)^2}, \frac{a^2(n^2+17)}{32(n+1)^2}\right)$

(22a) $$w^{DS}* = \frac{a(n+3)}{2(5n+8)}$$

(22b) $$p^{DS}* = \frac{a(n+10)}{2(5n+8)}$$

(22c) $$q_i{}^{DS}* = \frac{a(n+10)}{2(5n+8)}$$

(22d) $$q_j{}^{DS}* = \frac{7a}{2(5n+8)}$$

(22e) $$Q_D{}^{DS}* = \frac{a(n^2+8n-6)}{2(5n+8)}$$

(22f) $$\pi_{D_1}{}^{DS}* = \frac{a^2(n+10)^2}{4(5n+8)^2} \quad and \quad \pi_{U_1}{}^{DS}* = \frac{a^2(n-2)(n-11)(n+3)}{4(n+1)(5n+8)^2}$$

(22g) $$\pi_{D_2}{}^{DS}* = \frac{49a^2}{4(5n+8)^2} \quad and \quad \pi_{U_2}{}^{DS}* = \frac{3a^2(n-2)(n+3)^2}{4(n+1)(5n+8)^2}$$

The total payoffs of firm 1 and 2 are given in Table 1:

First, the stand-alone incentive for spin-off, which equals the gain in profit if a firm switches to spin-off while the other firm does not, is thus

$$\Delta_1 \equiv \left(\pi_{D2}^{DS*} + \pi_{U2}^{DS*}\right) - \pi_{D2}^{DD*} = \frac{a^2(11n^4 - 2n^3 - 653n^2 - 2284n - 2508)}{16(n+1)(3n+7)(5n+8)^2}$$

Second, the competitive incentives for spin-off, which equals the gain in profit if a firm switches to direct entry given that the other firm has chosen spin-off, is given by

$$\Delta_2 \equiv \left(\pi_{D1}^{SS*} + \pi_{U1}^{SS*}\right) - \left(\pi_{D1}^{DS*} + \pi_{U1}^{DS*}\right) = \frac{3a^2(n+4)(3n^3 - 20n^2 - 61n - 20)}{32(n+1)^2(5n+8)^2}$$

Neither firm choosing spin-off is a Nash equilibrium if and only if$\Delta_1 < 0$. Then, both firms choose spin-off if and only of $\Delta_2 > 0$. It is easy to show that Δ_1 and Δ_2 have the following properties; (1) Δ_1 and Δ_2 are increasing function of n for $n \geq 4$; (2) Δ_1 =0 if n = 9.278 and Δ_2 =0 if n=9.006; and (3) $\Delta_1 < \Delta_2$ for all $n \geq 4$. We have the following results regarding the Nash equilibrium of the entry game between D_1 and D_2:

4.1 Proposition *Assume that p=a-Q. Then,*
(1) if $4 \leq n \leq 9$*, both firms choose direct entry;*
(2) if $n \geq 10$*, both* D_1 *and* D_2 *spin off their input divisions.*

Proposition 4.1 implies that the number of downstream firms plays an important role. In other words, spin-offs do not occur if n is small and will occur if n is large. The intuition of Proposition 4.1 is as follows. Each active integrated firm can participate in both markets; upstream and downstream market. Therefore, each integrated firm can earn more profit in less competitive market. If competition in downstream market becomes worse, each integrated firm chooses spin-off to earn more profit in upstream market. Note that the equilibrium quantity in spin-off is larger than that of direct entry.

5 Conclusion When a self-sufficient producer enters backward into the upstream input market, a "helping effect" for separated downstream firms and a "deteriorating effect" for integrated downstream firms coexist. Such an entry increases the degree of competition in the input market. This negative effect hurts the traditional downstream business of the integrated firm. Therefore, it may limit its expansion in the input market.

We show, however, that entry into the input market confer a strategic advantage on the firm. This paper also analyzes a strategic entry game by vertically integrated firms in a successive Cournot model. Lin has already addressed a similar entry game, no-entry versus spin-off, in a successive Cournot model. He also showed that the direct entry by an integrated firm into the input market never occurs in the successive Cournot model. However, this paper shows that if there are multiple integrated firms, each integrated firm has an incentive to enter into the input market. The new insight of our paper is that a strategic entry enables the vertically integrated firms to credibly expand their input business. Our model deals with a strategic entry game: direct entry versus spin-off.

Issues not discussed in this paper are as follows. One is to build up a model that incorporates product differentiation into a two-tier vertical model. The other is also to build a model of successive oligopolies with endogenous entry, allowing for entry costs in both markets. Intuitively, the downstream conditions dominate the overall profitability of the two-tier structure while the upstream conditions mainly affect the distribution of profits.

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*Department of Management Administration Nagoya University of Commerce & Business 4-4 Sagamine, Komenoki-cho, Nisshin-shi, Aichi-ken, Japan 470-0193, Phone: +81-(0)561-73-2111, E-mail: dongjoon@nucba.ac.jp

**Department of Management Administration Nagoya University of Commerce & Business 4-4 Sagamine, Komenoki-cho, Nisshin-shi, Aichi-ken, Japan 470-0193, Phone: +81-(0)561-73-2111, E-mail: hansangheon@gmail.com