Direct Marketing in Duopolistic Wholesale Market

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Abstract

Many manufacturers sell their products directly to consumers using catalogues, the internet, or their own stores. Since direct marketing is the method of selling products not through retailers, we expect a relationship between direct marketing and competition in a retail market. This paper studies a manufacturer's choice whether to sell directly in the presence of a rival manufacturer that has the same choice. We consider a game where manufacturers decide whether to set up sites (e.g., websites or physical stores) where consumers can buy their products directly. After the decision, manufacturers also choose the amount to sell to retailers. Retailers and the manufacturers that have direct-sales sites then choose the amount to sell to consumers. We show that competition in the retail market may prevent direct marketing. Then, an increase in the number of retailers raises the profit of retailers, but reduces social welfare. Notably, social welfare is larger when a retail market is monopoly than when a perfectly competitive market. Therefore, we provide a justification for regulation of retail markets.

JEL classification numbers: L13, L20

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1 Introduction

Nowadays, manufacturers sell many products (for instance, personal computers, furniture and clothes) not only to retailers but also to consumers using the internet or their own stores. That is, manufacturers encroach on the retail market by using direct marketing.[1] Examples can be found in food industries.[2] During the period from 1997 to 2002, the value of agricultural products sold directly to individuals for human consumption increases from \$591,820,000 to \$812,204,000 (U.S. Department of Agriculture, 2004).

Since direct marketing connects manufacturers to consumers directly, a decision of whether to use direct marketing depends on a competition among retailers. If there are few retailers, the retailers resell good at a high markup. Then, since the gain from the wholesale market is small, manufacturers will sell their products to consumer directly. On the other hand, if the retail market is perfectly competitive, the manufacturers will not sell directly.

When the the marginal cost of direct sales is zero, the monopolistic manufacturer certainly encroaches on the retail market, since it gains monopoly profit. However, if there are two manufacturers, it is not necessarilly the case that the manufacturers certainly encroach on the retail market. Since encroaching manufacturers also care about the profit from the retail market, to make the retailers' share small and obtain large share in the retail market, the encroaching manufacturers have an incentive to increase wholesale price. Then, the encroaching manufacturers sell a small amount of the product. In other words, the decision not to encroach on the retail market makes the non-encroaching manufacturer sell the larger amount of product to the retailers. Then, the non-encroaching manufacturer gains the larger profit from the wholesale market than the encroaching manufacturer, but losses the profit from the retail market. Hence, there is a trade-off between encroaching on the retail market and non-encroaching.

The present paper studies this issue by using the following model (see Figure 1). There are two manufacturers and multiple retailers. Each manufacturer chooses whether to sell to both retailers and consumers or to sell only to retailers. Given a sales channel, manufacturers choose the amount of products to sell to the wholesale market. The wholesale price is determined

[1] For impacts of e-commerce on food marketing, see Baourakis et al. (2002).

[2] For the food market structure, see Barkema et al. (1991), Rogers (2001), Sexton (2000), and Wrigley (2001).

to clear the market. Then, manufacturers and retailers choose the amount of products sold to consumers. The manufacturer's marginal costs of direct and indirect sales are zero. The retailers buy the product from the wholesale market, and sell it to consumers with no additional cost.

We show that when there are six retailers, one manufacturer sells only through the indirect sales channel, while the other sells only through the direct sales channel. When the number of retailers exceeds 7, no manufacturers sells directly even though the marginal cost of direct sales is zero. If an increase in the number of retailers decreases the number of encroaching manufacturers, the profit of retailers increases. When there are five retailers, social welfare is maximized. Especially, social welfare in the case in which the retail market is monopoly is larger than that in the case in which the retail market is perfectly competitive. We also consider that the retailers can create their divisions, and show that manufacturers' encroachment is always deterred. By extending the model to include many manufacturers, we provide the number of retailers such that social welfare is maximized given the number of manufacturers.

Arya et al. (2007) investigate a monopolistic manufacturer's encroachment by using direct marketing. When the manufacturer decides whether to sell its product directly, it compare the cost of direct marketing with that of double marginalization. If the marginal cost of direct sales is small, the monopolistic manufacturer encroaches. Since the manufacturer's encroachment makes the retail marke more competitive, it reduces the wholesale price in order not to decrease the sales in the wholesale market. Then, the encroachment may be beneficial for retailers. According to Arya et al. (2007), when encroachment arises, the manufacturer and consumers both benefit from encroachment. If the marginal cost of direct sales in some range, the retailers also gain from the encroachment. That is, social welfare may increase by manufacturer's encroachment.

Lahiri and Ono (1988) show if less efficient firms enter the market, social welfare may decrease. When a less efficient firm enters the market, efficient firms' production decreases and the inefficient firm' production increases. Hence, since the average efficiency of production decreases, social welfare may decrease. In our model, when encroaching manufacturers exit the retail market, sales through retailers increase. That is, good is sold through the channel with double marginalization but through without it. The channel through retailers is socially costly. Hence, since encroaching manufacturers may exit, an increase in the number of retailers may decrease social welfare.

While Lahiri and Ono (1988) focus on firms' technologies, we look into logistics (direct and indirect sales channels). We show that even if there are no differences of technology among firms, an increase in the number of retailers reduces social welfare. The driving force of this result is a vertical relationship that is not considered in Lahiri and Ono (1988).

There are some papers that consider direct marketing. Sibley and Weisman (1998) consider the entry of an upstream monopolist into downstream markets and show that the upstream monopolist has an incentive to reduce the costs of its downstream competitors.[3] Chiang et al. (2003) use a quality differentiation model (see Gabszewicz and Thisse, 1979, 1980 and Shaked and Sutton, 1982, 1983) and show that direct marketing may not always be harmful for retailers. However, these studies do not treat imperfect competition among manufacturers.

Over the past two decades, several papers have been devoted to successive oligopoly. Salinger (1988) considers vertical integration in a successive Cournot market. Salinger (1988) shows that the vertically merged firm increases its final good output and withdraws from the wholesale market. However, Salinger (1988) does not consider supplier encroachments. Following Salinger (1988), some papers discuss successive oligopoly markets but do not consider supplier encroachments.[4]

In the literature of successive oligopoly, Buehler and Schmutzler (2005) consider vertical integration in successive oligopoly and show that only some of the firms integrate. Lin (2006) considers spin-offs of input divisions and shows that spin-offs occur if and only if the number of downstream firms exceeds a threshold level. However, these papers do not consider supplier encroachments.

The remainder of this paper is organized as follows. Section 2 presents the model. Section 3 calculates the equilibrium. Section 4 studies the effect of the number of the retailers on the equilibrium outcomes. Section 5 considers divisionalization problem. Section 6 allows that there

[3] For raising rivals' costs, also see Salop and Scheffman (1983).

[4] Ziss (2005) analyzes a horizontal merger in successive oligopoly and shows that a merger at the merging and non-merging stages reduces social welfare and the size of the reduction depends on the level of concentration of industries. Matsushima (2006) considers industry profits in a vertical relationship and shows that the industry profits may increase with the number of downstream firms. Like Salinger (1988) and Matsushima (2006), this present study analyzes a successive Cournot model; however, unlike this study, they do not consider supplier encroachments.

are many manufacturers. Section 7 concludes.

2 Model

This paper considers a vertical relationship in a homogeneous good market along with a three-stage game. There exist $n(\geq 1)$ retailers and two manufacturers. At stage one, each manufacturer simultaneously decides to encroach on the retail market (E) or not (N). At stage two, each manufacturer simultaneously produces a homogeneous good at zero marginal cost and sells it to the retailers. We call these sales *indirect sales.* This paper assumes Cournot competition in the wholesale market. Let w denote the equilibrium wholesale price. The price w is determined so that the aggregate amount of the good produced by manufacturers is equal to the aggregate amount of the products sold to consumers by retailers (Salinger, 1988). At stage three, each retailer simultaneously purchases the good from manufacturers and sells them to consumers at zero marginal cost, given the equilibrium wholesale price. In the same way, each manufacturer simultaneously sells the homogeneous products to the consumers at zero marginal cost. That is, in the stage three, each retailer and manufacturer simultaneously decides the amount of sales. We call the manufacturer's sales to consumers *direct sales.* This study assumes Cournot competition also in the retail market. To summarize, this study considers the following model.

Stage 1: Each manufacturer simultaneously chooses encroachment on the retail market (E) or no-encroachment (N).

Stage 2: Each manufacturer simultaneously chooses the amount of the indirect sales. Given the aggregate supply of the products, the wholesale price w is determined by the derived inverse demand function for the product.

Stage 3: All retailers and manufacturers observe the wholesale price, and each retailer and manufacturer simultaneously chooses the amount of the product sold to consumers.

The market inverse demand function is given by $P = a - bX$, where a is constant and $a > 0$. Let P be the price at which the retailers sell the product. Let X be the aggregate amount of the product sold to consumers. Let q_j be the amount of the product produced by manufacturer j at stage two. Then, the aggregate supply of the products produced by manufacturers to retailers is $Q = q_1 + q_2$. Let x_i be the amount of the product sold by retailer i to consumers. Let d_j be the amount of the product sold directly by manufacturer j to consumers. Then, the aggregate amount of the product sold to consumers is $X = d_1 + d_2 + \sum_{i=1}^{n} x_i$. The profit of manufacturer j is

$$\pi_{Mj} = \left[a - b\left(d_1 + d_2 + \sum_{i=1}^{n} x_i\right)\right] d_j + wq_j. \tag{1}$$

The profit of retailer i is

$$\pi_{Ri} = \left[a - b\left(d_1 + d_2 + \sum_{i=1}^{n} x_i\right) - w\right] x_i. \tag{2}$$

This study assumes the complete information. The model is solved by backward induction. Only pure strategies are considered throughout this paper.

3 Calculating Equilibrium

3.1 The no-encroachment setting

First, we consider the no-encroachment setting in which all manufacturers cannot directly sell products to consumers. That is, in stage one, all manufacturers choose not to encroach on the retail market. In other words, all manufacturers choose zero direct sales: $d_1 = d_2 = 0$. Then, in stage three, retailer i's profit is

$$\pi_{Ri} = \left(a - b\sum_{i=1}^{n} x_i\right) x_i. \tag{3}$$

Then, the first-order condition leads to

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

Adding up the quations ($i = 1, \ldots, n$) and putting $\sum_{i=1}^{n} x_i = Q(= q_1 + q_2)$ into it, we obtain the derived demand for input:

$$w = a - \frac{b(1 + n)(q_1 + q_2)}{n}. \tag{5}$$

Substituting (5) and $d_j = 0$ into (24), the profit of manufacturer j can be rewritten as follows:

$$\pi_{Mj} = \left[a - \frac{b(1+n)(q_1+q_2)}{n}\right] q_j. \tag{6}$$

Then, the first-order condition leads to

$$x_i^{NN} = \frac{2a}{3b(1+n)}, \quad X^{NN} = \frac{2an}{3b(1+n)}, \quad P^{NN} = \frac{a(3+n)}{3(1+n)}, \quad q_j^{NN} = \frac{an}{3b(1+n)}, \quad w^{NN} = \frac{a}{3}, \tag{7}$$

$$\pi_{Mj}^{NN} = \frac{a^2 n}{9b(1+n)}, \quad \pi_{Ri}^{NN} = \frac{4a^2}{9b(1+n)^2}, \tag{8}$$

where the superscript NN denotes the no-encroachment setting.

3.2 One firm's encroachment setting

Here, we consider the case where only one manufacturer can directly sell the products to consumers, that is, in stage one, one manufacturer decides to encroach on the retail market, but the other chooses no-encroachment. Without loss of generality, we assume that manufacturer 1 chooses encroachment (E) and manufacturer 2 chooses no-encroachment (N). Then, $d_2 = 0$. From (24) and (25), the first-order conditions in stage three lead to

$$x_i = \frac{a-2w}{b(2+n)}, \quad d_1 = \frac{a+nw}{b(2+n)}. \tag{9}$$

Adding up the first equations ($i = 1, \ldots, n$) in (9) and putting $\sum_{i=1}^{n} x_i = Q$ into it, we obtain the derived demand for input:

$$w = \frac{a}{2} - \frac{b(2+n)(q_1+q_2)}{2n}. \tag{10}$$

We substitute $d_2 = 0$, (9), and (10) into the manufacturer 1's profit (24), and then differentiate with respect to q_1. We obtain

$$\frac{\partial \pi_{Mj}}{\partial q_1} = -\frac{b}{2n}\left(4q_1 + nq_1 + 2q_2\right). \tag{11}$$

Hence, the encroaching manufacturer 1 produces zero output for the retailers ($q_1 = 0$). We substitute $d_2 = 0$, $q_1 = 0$, (9), and (10) into manufacturer 2's profit (24), then the first-order condition for manufacturer 2 in stage two leads to

$$x_i^{EN} = x_i^{NE} = \frac{a}{2b(2+n)}, \quad d_1^{EN} = d_2^{NE} = \frac{a(4+n)}{4b(2+n)}, \tag{12}$$

$$q_1^{EN} = q_2^{NE} = 0, \quad q_2^{EN} = q_1^{NE} = \frac{an}{2b(2+n)}, \tag{13}$$

$$X^{EN} = X^{NE} = \frac{a(4+3n)}{4b(2+n)}, \quad w^{EN} = w^{NE} = \frac{a}{4}, \quad P^{EN} = P^{NE} = \frac{a(4+n)}{4(2+n)}, \tag{14}$$

$$\pi_{M1}^{EN} = \pi_{M2}^{NE} = \frac{a^2(4+n)^2}{16b(2+n)^2}, \quad \pi_{M2}^{EN} = \pi_{M1}^{NE} = \frac{a^2 n}{8b(2+n)}, \quad \pi_{Ri}^{EN} = \pi_{Ri}^{NE} = \frac{a^2}{4b(2+n)^2}, \tag{15}$$

where the superscript EN denotes that manufacturer 1 encroaches on the retail market, but manufacturer 2 does not. Similarly, when manufacturer 2 encroaches on the retail market, but manufacturer 1 does not, we use the superscript NE.

3.3 Full encroachment setting

Here, we consider the case where all manufacturers can directly sell the products to consumers. That is, in stage one, all manufacturers decide to encroach on the retail market. From (24) and (25), the first-order conditions in stage three lead to

$$x_i = \frac{a-3w}{b(3+n)}, \quad d_j = \frac{a+nw}{b(3+n)}. \tag{16}$$

Adding up the first equation in (16) and putting $\sum_{i=1}^{n} x_i = Q$ into it, we obtain the derived demand for input:

$$w = \frac{a}{3} - \frac{b(3+n)(q_1+q_2)}{3n}. \tag{17}$$

We substitute (16) and (17) into (24), then the first-order condition for manufacturer j in stage 2 leads to

$$x_i^{EE} = \frac{2a}{b(27+5n)}, \quad q_j^{EE} = \frac{an}{b(27+5n)}, \quad d_i^{EE} = \frac{a(9+n)}{b(27+5n)}, \tag{18}$$

$$X^{EE} = \frac{2a(9+2n)}{b(27+5n)}, \quad P^{EE} = \frac{a(9+n)}{27+5n}, \quad w^{EE} \frac{a(7+n)}{27+5n}, \tag{19}$$

$$\pi_{Mj}^{EE} = \frac{a^2(81+25n+2n^2)}{b(27+5n)^2}, \quad \pi_{Ri}^{EE} = \frac{4a^2}{b(27+5n)^2}, \tag{20}$$

where the superscript EE denotes the encroachment setting. If $c/a \geq (9+n)/(9+7n)$, then

$d_j^{EE} = 0$. Hence, the outcomes are the same as that in the no-encroachment setting.

3.4 Encroachment decisions

Here, to derive equilibrium strategies in stage one, we compare the equilibrium profits in stage two. See the following 2×2 matrix (Table 1). The payoff in each cell is depicted as follows:

- $\pi_{M1}^{NN} = \pi_{M2}^{NN}$ is in (8)
- $\pi_{M1}^{EN} = \pi_{M2}^{NE}$ is in (15)
- $\pi_{M1}^{NE} = \pi_{M2}^{EN}$ is in (15)
- $\pi_{M1}^{EE} = \pi_{M2}^{EE}$ is in (20)

Table 1 is here.

Since manufacturers are symmetric, it is sufficient to consider the signs of $\pi_{M1}^{EE} - \pi_{M1}^{NE}$ and $\pi_{M1}^{EN} - \pi_{M1}^{NN}$. After tedious calculations, we have the following result:

Proposition 1 *The first-stage outcome is* (E, E) *if* $n < 5.906$*;* (N, E) *and* (E, N) *if* $5.906 \geq n \geq 6.355$*;* (N, N) *if* $n > 6.355$.

Proof. See Appendix.

From Proposition 1, for $n \geq 7$, encroachment does not arise. This result differs from Arya et al. (2007), who show that for any number of retailers, monopolistic manufacturer's encroachment does arise, if the marginal cost of direct sales is sufficiently small. The difference arises for the following reason. When the wholesale market is monopoly, the monopolistic manufacturer should sell to consumers directly since the manufacturer can gain the monopoly profit. When the wholesale market is duopoly, the commitment not to sell to consumers directly has a benefit. Even if the marginal cost of direct sale is zero, the manufacturers decide not to encroach, when the benefit from the commitment exceeds the cost.

To obtain the intuition behind Proposition 1, we explain the benefit of the commitment not to encroach on the retail market. From (24), the first-order condition in stage two is

$$\frac{\partial \pi_{Mj}}{\partial q_j} = (a - bX)\frac{\partial d_j}{\partial w}\frac{\partial w}{\partial q_j} - bd_j\frac{\partial X}{\partial w}\frac{\partial w}{\partial q_j} + q_j\frac{\partial w}{\partial q_j} + w = 0. \tag{21}$$

In (21), the first and second terms represent the effect on the profit from the retail market. The third and forth terms represent the effect on the profit from the wholesale market.

An increasing the output decreases the equilibrium whoelsale price. The more competitive the retail market is, the more elastic the retail demand. Hence, from (5), (10), and (17), we have $\partial w^{NN}/\partial q_j < w^{EN}/\partial q_j < w^{EE}/\partial q_j < 0$. In our setting, from (5), (10), and (17), $\partial w^{NN}/\partial q_j$, $w^{EN}/\partial q_j$ and $w^{EE}/\partial q_j$ are constant. From (12) and (18), since an increase in the wholesale price increases the retailers' marginal cost, retailers' sales decrease ($\partial x_i/\partial w < 0$) and manufacturers' direct sales increase ($\partial d_j/\partial w > 0$). Since an increase in the retailer's marginal cost w leads the retail market to become less competitive, the aggregate output in the retail market X decreases. That is, $\partial X/\partial w < 0$. Therefore, the first, second and third terms are negative.

When manufacturers do not encroach on the retail market, the first and second term in (21) is zero, since $d_j = 0$. Hence, the encroaching manufacturer's output for the wholesale market q_j is smaller than the non-encroaching manufacturer's output, since the first and second terms are negative. We call the effect on the equilibrium output the *commitment effect*. Since $\partial w^{NN}/\partial q_j < w^{EN}/\partial q_j < w^{EE}/\partial q_j < 0$, the third term in (21) makes the non-encroaching manufacturer's output for the wholesale market small. We call this effect on the equilibrium output the *competition effect*. In our model, the commitment effect dominates the competition effect. Therefore, the decision not to encroach means a commitment to produce larger output in the wholesale market.

When a manufacturer changes the action from encroaching (E) to no encroaching (N), the cost is loss of profit from the retail market and the benefit is larger sales in the wholesale market. When the competitor encroaches, the benefit is larger and the cost is smaller than when it does not. The benefit increases with the number of retailers (n) since the retailers' demand for the product is larger. The cost decreases with n, since direct sales are smaller when there are many competitors in the retail market. Figure 2 summarizes the above discussion.

Figure 2 is here.

In Figure 2, there are four solid lines. When the competitor's action is k ($k \in \{E, N\}$), the line $Benefit^k$ means the benefit from changing the action from E to N, and the line $Cost^k$ means the cost from the change. We divide the set n into three ranges: $[0, 5.906)$, $[5.906, 6.355]$, and $(6.355, \infty)$. First, if n is small, that is $n \in [0, 5.906)$, regardless of the competitor's action (E or N), the costs are larger than the benefits. Thus, manufacturers do not change their action from E to N. Hence, the equilibrium action is (E, E). Second, if n is large, that is $n \in (6.355, \infty)$, regardless of the competitor's action, the benefits are larger than the costs. Hence, the equilibrium action is (N, N). Therefore, when $n \geq 7$, no manufacturers encroach on the retail market, even if marginal cost c is zero. Finally, if n is not so large, that is $n \in [5.906, 6.355]$, $Benefit^E$ is larger than $Cost^E$, but $Benefit^N$ is smaller than $Cost^N$. Hence, the manufacturer encroaches if the competitor does not encroach, but not otherwise. Therefore, the equilibrium actions are (E, N) and (N, E).

4 Comparative Statics

4.1 The profit of retailers

Ordinary, an increase in the number of retailers decrease each retailer's profit. In this subsection, we show that the retailer's profit is not maximized when the retail market is monopoly.

We describe a relationship between the number of retailers and the profit of retailer. From Proposition 1, and (8), (15) and (20), $b\pi^*_{Ri}/a^2$ is drawn in Figure 3, where the superscript $*$ denotes the equilibrium outcome in stage one.

Figure 3 is here.

In Figure 3, there are three intervals, that is, $[0, 5.906)$, $[5.906, 6.355]$, and $(6.355, \infty)$. If the number of retailers increase from 5 to 6 or from 6 to 7, the retailer's profit increases. This is because when the number of retailers increases from 5 to 6 or from 6 to 7, the number of encroaching manufacturers decreases by 1. Then, in the retail market, the encroaching manufacturer which has zero marginal cost is replaced by the retailer which has an input cost of w. Hence, the retail market becomes less competitive. It implies that when an increase in the number of retailers decreases the number of encroaching manufacturers, the profit of retailers could rise. Proposition 2 summarizes the above result.

Proposition 2 *If the number of retailers increases from* 5 *to* 6 *or from* 6 *to* 7*, the retailer's profit increases. The profit of retailers is maximized when the number of retailers is* 7*.*

4.2 The profit of manufacturers

Ordinarily, the tougher the competition in the retail market is, the larger the profit of manufacturers, since the double marginalization problem is diminished. In this subsection, we obtain the reverse result.

We consider the relationship between the number of retailers and the manufacturers' profit. From proposition 1, and (8), (15), and (20), $b\pi^*_{Mj}/a^2$ is drawn in Figure 4.

Figure 4 is here.

An increase in the number of retailers (n) makes the retail market more competitive. Then, it has two effects on the encroaching manufacturer's profit. First, the negative effect is a decrease in the profit from retail market, since the manufacturer's share in the retail market shrinks. Second, the positive effect is an increase in the profit from wholesale market, since an increase in competition between retailers decreases the double marginalization. In Figurer 4, for $n \in [0, 6.355]$, the profit of encroaching manufacturer (π^{EN}_{M1} and π^{EE}_{Mj}) decreases, since the negative effect dominates the positive effect. If the manufacturer does not encroach on the retail market, there is no negative effect. Hence, for $n \in [5.906, \infty)$, the non-encroaching manufacturer's profit (π^{EN}_{M2} and π^{NN}_{Mj}) increases.

When there is one retailer in the retail market, the profit of manufacturer is $\pi^{EE}_{Mj} = 27a^2/(256b)$. Solving $27a^2/(256b) = a^2n/[9b(1+n)]$ $(= \pi^{NN}_{Mj})$ for n yields $n = 18.6923$. Hence, if there are less than 19 retailers in the market, the profit of manufacturers is larger under the monopolistic retail market than the oligopolistic retail market. Proposition 3 summarizes the above result.

Proposition 3 *For $n \geq 6$, an increase in the number of retailers (n) may decrease the encroaching manufacturer's profit. The manufacturer's profit is larger at $n = 1$ than at $2 < n < 18$.*

4.3 Social welfare

In this subsection, we show that social welfare is not maximized when the retail market is perfectly competitive. Then, we consider the relationship between the number of retailers and social welfare. In our setting, the larger social welfare is, the larger the aggregate amount of the product sold to consumers (X^*) is. Thus, we consider only the equilibrium output X^*. From proposition 1, and (7), (14), and (19), bX^*/a is drawn in Figure 5.

Figure 5 is here.

Given the decisions on encroachment in stage one, the larger the number of retailers is, the larger the equilibrium output is, since manufacturers and retailers compete in quantity. From Proposition 1, we compare the equilibrium outputs in the cases of $n = 5$, $n = 6$, and $n \to \infty$.

From Proposition 1, if $n = 5$, there are two encroaching manufacturers and five retailers in stage three. If $n = 6$, there are one encroaching manufacturer and six retailers in stage three. The case of $n = 6$ is obtained from the case of $n = 5$ by replacing an encroaching manufacturer, whose marginal cost is zero, with a retailer, whose marginal cost is $w(> 0)$. Then, the case of $n = 5$ is more competitive than the case of $n = 6$. Hence, social welfare is larger when $n = 5$.

From Proposition 1, if $n \geq 7$, no manufacturers encroach on the retail market. Then, when the number of retailers n diverges to infinity, the margin in the retail market (retail price P minus wholesale price w) converges to zero. Hence, from (5), the inverse demand function of the wholesale market is

$$\lim_{n\to\infty}\left[a - \frac{b(1+n)(q_1+q_2)}{n}\right] = a - b(q_1+q_2). \tag{22}$$

The above equation implies that the equilibrium retail price is equal to the equilibrium wholesale price. Hence, when $n \to \infty$, the equilibrium output X^* converges to the total output in the two-firm Cournot equilibrium with zero marginal cost. When there are no retailers, in the retail market, there are two encroaching manufacturers. Hence, from (7) and (19), we obtain $\lim_{n\to\infty} X^{NN} = X^{EE}|_{n=0} < X^{EE}|_{n=1} < X^{EE}|_{n=5}$. The inequalities are hold, because given the decisions on encroachment, increases in the number of retailers lead to larger the equilibrium output. Therefore, the monopolistic retail market gives a higher social welfare than the perfectly competitive market. Proposition 4 summarizes the above result.

Proposition 4 *Social welfare is maximized when $n = 5$. Social welfare in the case of $n = 1$ is larger than that in the case as $n \to \infty$.*

The existence of retailers causes a double marginalization problem. Thus, the non-existence of retailers is usually desired. However, if the number of retailers is small enough to cause manufacturers to encroach on the retail market, the existence of retailers is desirable for society. Even if the retail market is monopoly, social welfare in the market is larger than the market which includes no retailers. Therefore, we should not eliminate middleman.

5 Endogenous Number of Retailers: Divisionaliztion Problem

In the former section, we show that the number of retailers significantly affects on the equilibrium outcomes. Actually, firms (especially retailers) can create their stores (e.g., supermarkets and convenience stores). For example, to control the number of stores, retailers create division by selling franchises without exclusive territories. Hence, it is important to consider the retail market with endogenous number of retailers.

In our model, from Proposition 2, the retailer's profit under 7 retailers is larger than under monopolistic retail market. Then, retailers may have an incentive to create divisions. In this section, we discuss the divisionalization problem in the retail market.

We assume that retailers cannot sell the product to consumer directly, and the divisions created with no cost by retailers buy the product from manufacturers and sell it to consumers. For simplicity, we assume that the retailer can only make a 'take it or leave it' offer for the divisions. Thus, the profit of retailer is the sum of the divisions' profit. That is, we consider the former stage in which retailers simultaneously choose the number of divisions. Then, the following stage is the same as former section.

We assume that divisions can be created with no cost. First, we consider that there is one retailer in the market. Then, from the second equation in (8), the monopolistic retailer's profit is $n\pi_{Ri}^{NN}$, where n is the number of divisions created by the retailer. Differentiating $n\pi_{Ri}^{NN}$ with respect to n yields $-4a^2(n-1)/[9b(1+n)^3]$ which is negative in $n \geq 7$. From Proposition 2, for $n \leq 6$, the profit of division is smaller than $n = 7$. Hence, the monopolistic retailer creates 7 divisions in retail market. Then, from Proposition 1, manufacturers do not encroach on the retail market. Corollary 1 summarizes the above argument.

Corollary 1 *If a monopolistic retailer can create its division with no cost, it sells* 7 *franchises. Then, manufacturers' encroachment is deterred.*

Next, we consider that the retail market is oligopoly. From Proposition 2, the aggregate number of divisions created by retailers is not less than 7. Thus, manufacturers do not encroach on the retail market. Let n_i (*resp.* n_k) be the number of the divisions created by retailer i (*resp.* k), and $n_{-i} = \sum_{k \neq i} n_k$. Then, from (8), the profit of retailer i is

$$\pi_{Ri}^{NN} = \frac{4a^2 n_i}{9b\,(1 + n_i + n_{-i})}. \tag{23}$$

The first-order condition for retailer i leads to the best response for the retailer i: $n_i = 1 + n_{-i}$. Hence, perfect competition is the equilibrium outcome, since all retailer want to set up one more divisions than the aggregate number of divisions created by other retailers.

Corollary 2 *When the retail market is oligopoly, perfect competition is the equilibrium outcome in the divisionalization stage.*

This result is the same as Corchón (1991). He does not consider vertical relationships and show that divisionalization with no cost leads to perfect competition. Mizuno (forthcoming) consider costly divisionalization in a vertical relationship, but does not consider manufacturer's encroachment. He shows that costly divisionalization does not lead to perfect competition. In our model, manufacturers do not encroach on the retail market with the large number of retailers. Thus, when divisionalization is costly, our result is the same as result in Mizuno (forthcoming).

6 Oligopolistic Wholesale Market

In this section, we suppose the number of manufacturer $m \geq 2$. The other settings are same as in the section 2. Then, we show that if there are few retailers, all manufacturers encroach on the retail market , but there are many retailers, they do not. This property is similar to it in the former section. Hence, we find that our result is robust. At the end of this section, we provide the number of retailers such that social welfare is maximized given the number of manufacturers.

The profit of manufacturer j is

$$\pi_{Mj} = \left[a - b\left(\sum_{j=1}^{m} d_j + \sum_{i=1}^{n} x_i\right)\right] d_j + wq_j. \tag{24}$$

The profit of retailer i is

$$\pi_{Ri} = \left[a - b\left(\sum_{j=1}^{m} d_j + \sum_{i=1}^{n} x_i\right) - w\right] x_i. \tag{25}$$

This model can be solved in the similar way as in the section 3. We denote m_E as the number of encroaching manufacturers. Let $\hat{m}_E$ be

$$\hat{m}_E = \frac{-2 + 2m - n + \sqrt{16 + 16m + 4m^2 + 16n - 4mn + n^2}}{6}. \tag{26}$$

If $m_E \leq \hat{m}_E$, the equilibrium profit of encroaching manufacturers in stage two is

$$\pi_M^E = \frac{a^2(1 + m + n + mm_E - m_E{}^2)^2}{(1 + m_E)^2(-1 - m + m_E)^2(1 + n + m_E)^2}, \tag{27}$$

where the superscript E denotes that the manufacturer encroaches on the retail market. The profit of non-encroaching manufacturers in stage two is

$$\pi_M^N = \frac{a^2 n}{(1 + m_E)(-1 - m + m_E)^2(1 + n + m_E)}, \tag{28}$$

where the superscript N denotes that the manufacturer does not encroach on the retail market.

If $m_E > \hat{m}_E$, the equilibrium profit of encroaching manufacturers in stage two is

$$\pi_M^E = \frac{a^2}{\Omega}\left(\begin{array}{c} 1+2m+m^2+2n+2mn+m^2n+n^2+3m_E+6mm_E \\ +3m^2m_E+5nm_E+2m^2nm_E+3n^2m_E+n^3m_E+3{m_E}^2 \\ +6m{m_E}^2+3m^2{m_E}^2+12n{m_E}^2-2mn{m_E}^2+m^2n{m_E}^2 \\ +6n^2{m_E}^2+{m_E}^3+2m{m_E}^3+m^2{m_E}^3+9n{m_E}^3 \end{array}\right), \tag{29}$$

where $\Omega = (1+n+m_E)(1+m+n+mn+2m_E+2mm_E-nm_E+mnm_E+{m_E}^2+m{m_E}^2)^2$. The profit of non-encroaching manufacturers is

$$\pi_M^N = \frac{a^2 n(1+m_E)(1+n+3m_E)^2}{\Omega}. \tag{30}$$

Figure 6 is here.

By numerical calculation, we obtain the ratio of the number of manufacturers encroaching on the retail market in the equilibrium (See Figure 6). In Figure 6, s denotes the ratio of the number of manufacturers, that is $s = m_E/m$. If $s = 1$, all manufacturers encroach on the retail market, and if $s = 0$, no manufacturers encroach. In the only 10 cases, some manufacturers encroach on the retail market, and the others do not. There are multiple equilibria in which all firms encroach and no firms encroach at some pair (m, n). Given the number of manufacturer (m), all manufacturers encroach if there are few retailers, and no manufacturers encroach if there are many retailers. Hence, we obtain the similar result in the former section.

Table 2 is here.

Table 2 shows the maximum number of retailers such that all manufacturers encroach $n^{\max}$. Since when all manufacturers encroach, social welfare increase with the number of retailers, the social welfare is maximized at $n^{\max}$. For example, when there are 10 manufacturers, $n^{\max} = 21$ if the equilibrium must be unique, and $n^{\max} = 57$ if the equilibria can be multiple. Then, social welfare is maximized at $n = 21$ if the equilibrium must be unique, and at $n = 57$ if the equilibria can be multiple. In Table 2, the larger the number of manufacturer is, the larger $n^{\max}$ is. Since $n^{\max}$ progressively increases with the number of manufacturers under the multiple equilibria, if the wholesale market is competitive, government should not regulate the retail market.

7 Conclusions

This paper analyzed supplier encroachment in successive oligopoly. We show that , social welfare is larger when there are direct marketing manufacturers than when there are not. The following constitute the main findings of this research. When there are six retailers, one manufacturer sells only through the indirect sales channel, while the other sells only through the direct sales channel. When the number of retailers exceeds 7, no manufacturers sells directly even if the marginal cost of direct sales is zero. When an increase in the number of retailers decreases the number of encroaching manufacturers, the profit of retailers could increases. When there are five retailers, social welfare is maximized. When the retailers can create their divisions, manufacturers' encroachment is deterred. Even if there are $m \geq 2$ manufacturers, the property of the result in duopolistic wholesale market is held. We provide the number of retailers such that social welfare is maximized given the number of manufacturer.

In our paper, we assume homogeneous products. However, some firms sell differentiated products through direct and indirect sales channels. In the apparel industry, The Gap sells clothes at company stores, that is, The Gap directly sells the clothes to consumer. Calvin Klein sells clothes at department stores, that is, Calvin Klein indirectly sells the clothes.[5] Therefore, a study of relationship between product differentiation and direct marketing is also future research.

[5] For apparel industry, see Gertner and Stillman (2001).

Appendix

Proof of Proposition 1.

To identify the equilibrium in stage one, we consider the signs of $\pi_{M1}^{EE} - \pi_{M1}^{NE}$ and $\pi_{M1}^{EN} - \pi_{M1}^{NN}$, since the sign of $\pi_{M1}^{EE} - \pi_{M1}^{NE}$ (*resp.* $\pi_{M1}^{EN} - \pi_{M1}^{NN}$) is equal to $\pi_{M2}^{EE} - \pi_{M2}^{EN}$ (*resp.* $\pi_{M2}^{NE} - \pi_{M2}^{NN}$). First, we consider the sign of $\pi_{M1}^{EE} - \pi_{M1}^{NE}$. From (20) and (15), the sign of $\pi_{M1}^{EE} - \pi_{M1}^{NE}$ is

$$\text{Sign}\left[\pi_{M1}^{EE} - \pi_{M1}^{NE}\right] = \text{Sign}\left[1296 + 319n - 38n^2 - 9n^3\right]. \tag{31}$$

Solving $1296+319n-38n^2-9n^3 = 0$ for $n(\geq 0)$ yields $n = 5.90645$. Hence, for $n \in [0, 5.90645)$, $\pi_{M1}^{EE} - \pi_{M1}^{NE} > 0$.

Next, we consider the sign of $\pi_{M1}^{EN} - \pi_{M1}^{NN}$. From (8) and (14), the sign of $\pi_{M1}^{EN} - \pi_{M1}^{NN}$ is

$$\text{Sign}\left[\pi_{M1}^{EN} - \pi_{M1}^{NN}\right] = \text{Sign}\left[144 + 152n + 17n^2 - 7n^3\right]. \tag{32}$$

Solving $144 + 152n + 17n^2 - 7n^3 = 0$ for $n(\geq 0)$ yields $n = 6.3549$. Hence, for $n \in [0, 6.3549)$, $\pi_{M1}^{EN} - \pi_{M1}^{NN} > 0$.

By summarizing the above results, the equilibrium action in stage one is (E, E) if $n \in [0, 5.90645)$; (E, N) and (N, E) if $n \in [5.90645, 6.3549]$; (N, N) if $n \in (6.3549, \infty)$.

Q.E.D.

References

[1] Arya, A., Mittendorf, B., and Sappington, D. E. M. (2007). "The bright side of supplier encroachment", Marketing Science, Vol. 26, No. 5, pp. 651–659.

[2] Baourakis, G., Kourgiantakis, M., and Migdalas, A. (2002). "The impact of e-commerce on agro-food marketing. The case of agricultural cooperatives, firms and consumers in Crete", British Food Journal, Vol. 104, No. 8, pp. 508–590.

[3] Barkema, A., Drabenstott, M., and Welch, K. (1991). "The quiet revolution in the U.S. food market", Economic Review, Vol. 76, No. 3, pp. 25–41.

[4] Buehler, S. and Schmutzler, A. (2005). "Asymmetric vertical integration", Advances in Theoretical Economics, Vol. 5, No. 1, Art. 1.

Available at: http://www.bepress.com/bejte/advances/vol5/iss1/art1

[5] Chiang, W. K., Chhajed, D., and Hess, J. D. (2003). "Direct marketing, indirect profits: A strategic analysis of dual-channel supply-chain design", Management Science, Vol. 49, No. 1, pp. 1–20.

[6] Corchón, L. C. (1991). "Oligopolistic competition among groups", Economics Letters, Vol. 36, No. 1, pp. 1–3.

[7] Gabszewicz, J. J. and Thisse, J. F. (1979). "Price competition, quality and income disparities", Journal of Economic Theory, Vol. 20, No. 3, pp. 340–359.

[8] Gabszewicz, J. J. and Thisse, J. F. (1980) "Entry (and exit) in a differentiated industry", Journal of Economic Theory, Vol. 22, No. 2, pp. 327–338.

[9] Gertner, R. H. and Stillman, R. S. (2001) "Vertical integration and internet strategies in the apparel industry", Journal of Industrial Economics, Vol. 49, No. 4, pp. 417–440.

[10] Lahiri, Sajal and Ono, Yoshiyasu. (1988) "Helping minor firms reduces welfare", Economic Journal, Vol. 98, No. 393, pp. 1199–1202.

[11] Lin, P. (2006). "Strategic spin-offs of input divisions", European Economic Review, Vol. 50, No. 4, pp. 977–993.

[12] Matsushima, N. (2006). "Industry profits and free entry in input markets", Economics Letters, Vol. 93, No. 3, pp. 329–336.

[13] Mizuno, T. "Divisionalization and horizontal mergers in a vertical relationship", forthcoming in Manchester School.

[14] Rogers, R. T. (2001). " Structural change in U.S. food manufacturing, 1958-1997", Agribusiness, Vol. 17, No. 1, pp. 3–32.

[15] Salinger, M. A. (1988). "Vertical mergers and market foreclosure", Quarterly Journal of Economics, Vol. 103, No. 2, pp. 345–356.

[16] Salop, S. C. and Scheffman, D. T. (1983). "Raising rivals' costs", American Economic Review Vol. 73, No. 2, pp. 267–271.

[17] Sexton, R. J. (2000). "Industrialization and consolidation in the U.S. food sector: implication for competition and welfare", American Journal of Agricultural Economics, Vol. 82, No. 5, pp. 1087–1104.

[18] Shaked, A. and Sutton, J. (1982). "Relaxing price competition through product differentiation", Review of Economic Studies, Vol. 49, No. 1, pp. 3–13.

[19] Shaked, A. and Sutton, J. (1983). "Natural oligopolies", Econometrica, Vol. 51, No. 5, pp. 1469–1483.

[20] Sibley, D. and Weisman, D. (1998). "Raising rivals' cost: The entry of an upstream monopolist into downstream markets", Information Economics and Policy, Vol. 10, No. 4, pp. 451–470.

[21] United States Department of Agriculture. (2004). "2002 Census of agriculture. Market value of agricultural products sold including direct and organic: 2002 and 1997."

Available at: http://www.agcensus.usda.gov/Publications/2002/Volume_1,_Chapter_1_US/st99_1_002_002.pdf

[22] Wrigley, N. (2001). "The consolidation wave in U.S. food retailing: a European perspective", Agribusiness, Vol. 17, No. 4, pp. 489–513.

[23] Ziss, S. (2005). “Horizontal merger and successive oligopoly”, Journal of Industry, Competition and Trade, Vol. 5, No. 2, pp. 99–114

Table 1.

Table 1: Encroachment decision

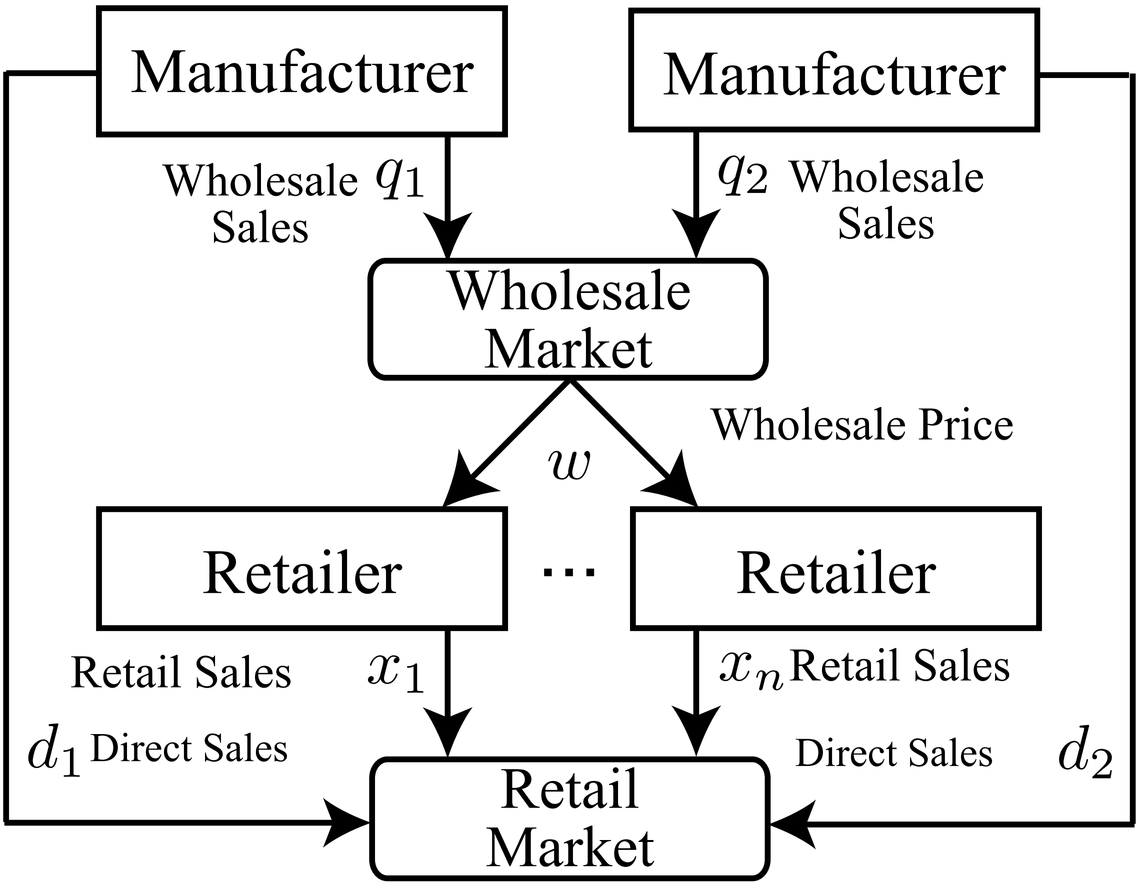
		Manufacturer 2	
		Encroachment (E)	No-encroachment (N)
Manufacturer 1	Encroachmet (E)	π_{M1}^{EE}, π_{M2}^{EE}	π_{M1}^{EN}, π_{M2}^{EN}
	No-encroachment (N)	π_{M1}^{NE}, π_{M2}^{NE}	π_{M1}^{NN}, π_{M2}^{NN}

Table 2.

The maximum number of retailers such that all manufacturers encroach ($n^{\max}$).

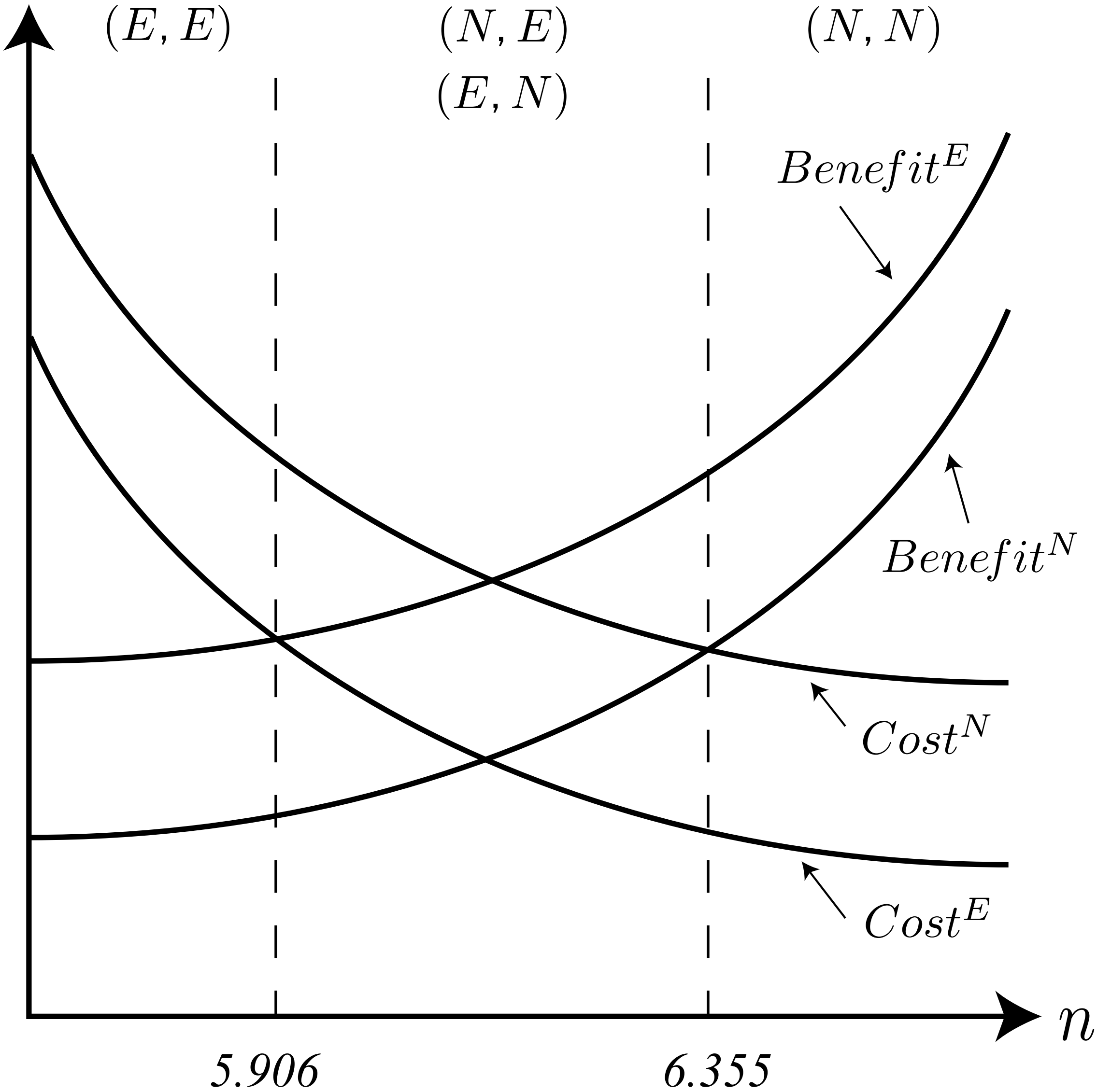
The number of manufacturer	2	3	4	5	10	30	50	100	1000
$n^{\max}$ under unique equilibrium	5	4	7	11	21	61	101	201	2001
$n^{\max}$ under multiple equilibria	5	4	7	12	57	589	1,687	6,906	705,433

Figure 1.



Manufacturer
Manufacturer
Wholesale q_1
Sales
q_2 Wholesale
Sales
Wholesale
Market
Wholesale Price
w
Retailer
$\cdots$
Retailer
Retail Sales
x_1
x_n Retail Sales
d_1 Direct Sales
Direct Sales
d_2
Retail
Market

Figure 2.



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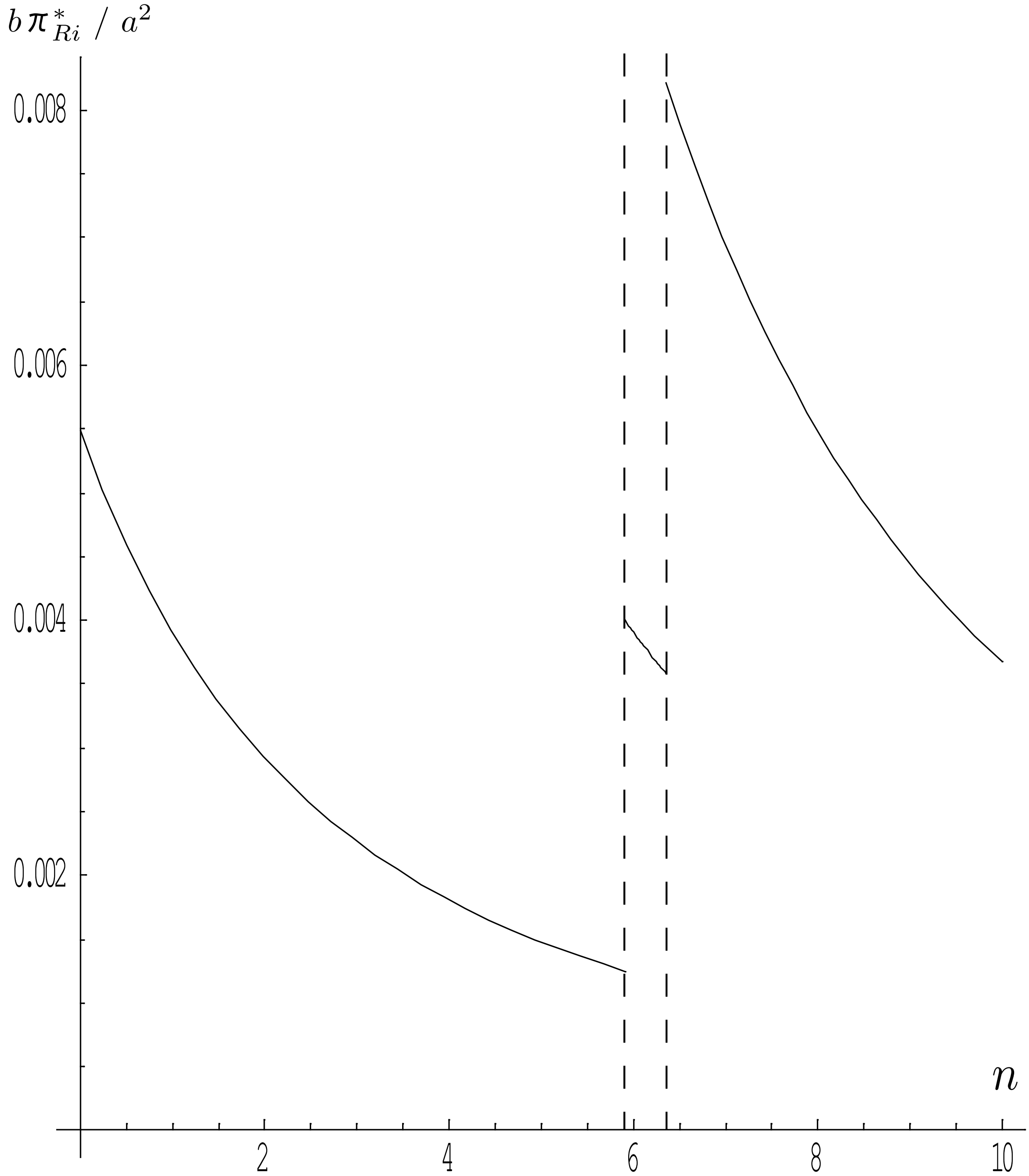

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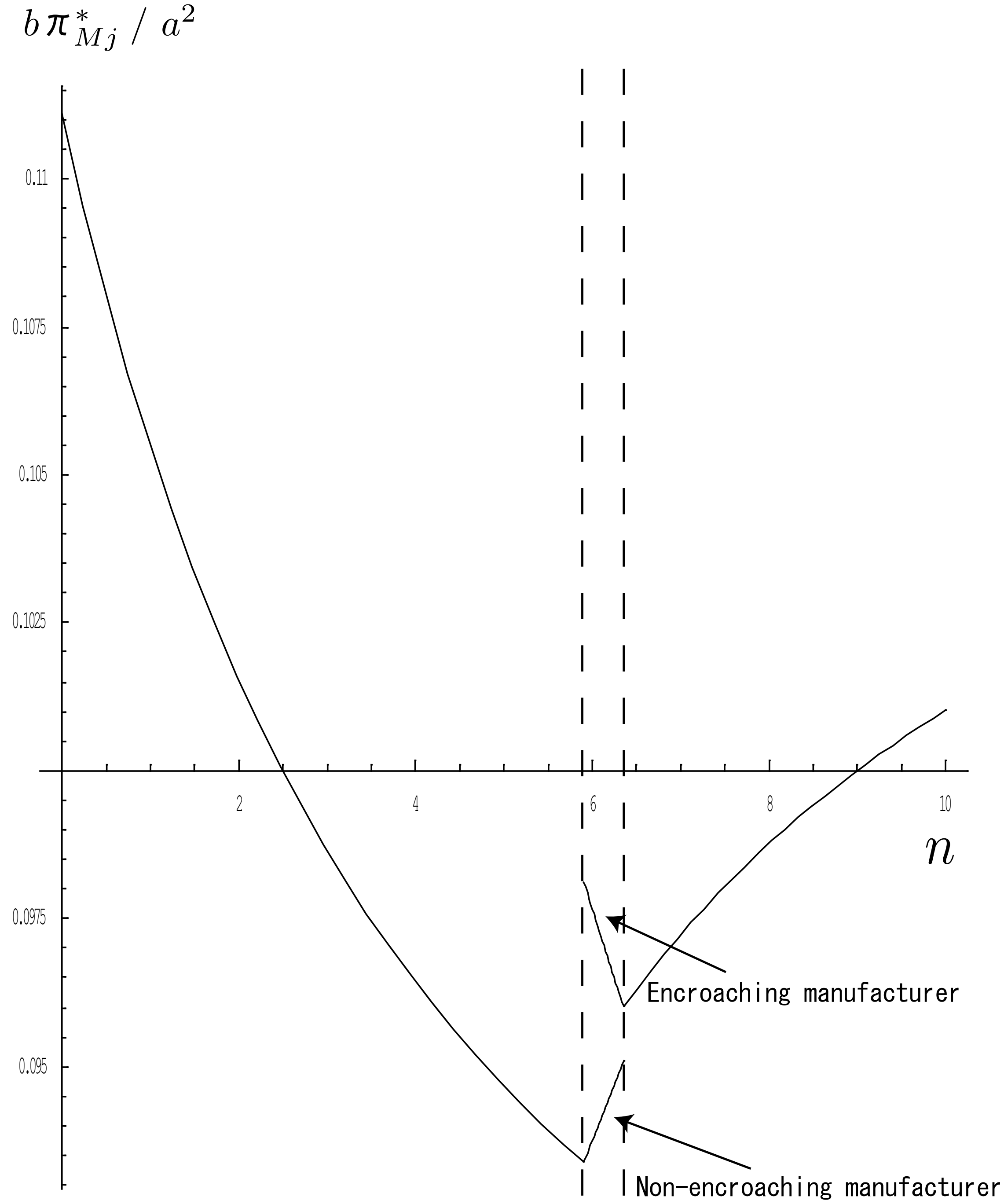


$b\pi^*_{Mj} / a^2$
0.11
0.1075
0.105
0.1025
0.0975
0.095
2
4
6
8
10
n
Encroaching manufacturer
Non-encroaching manufacturer

Figure 5.

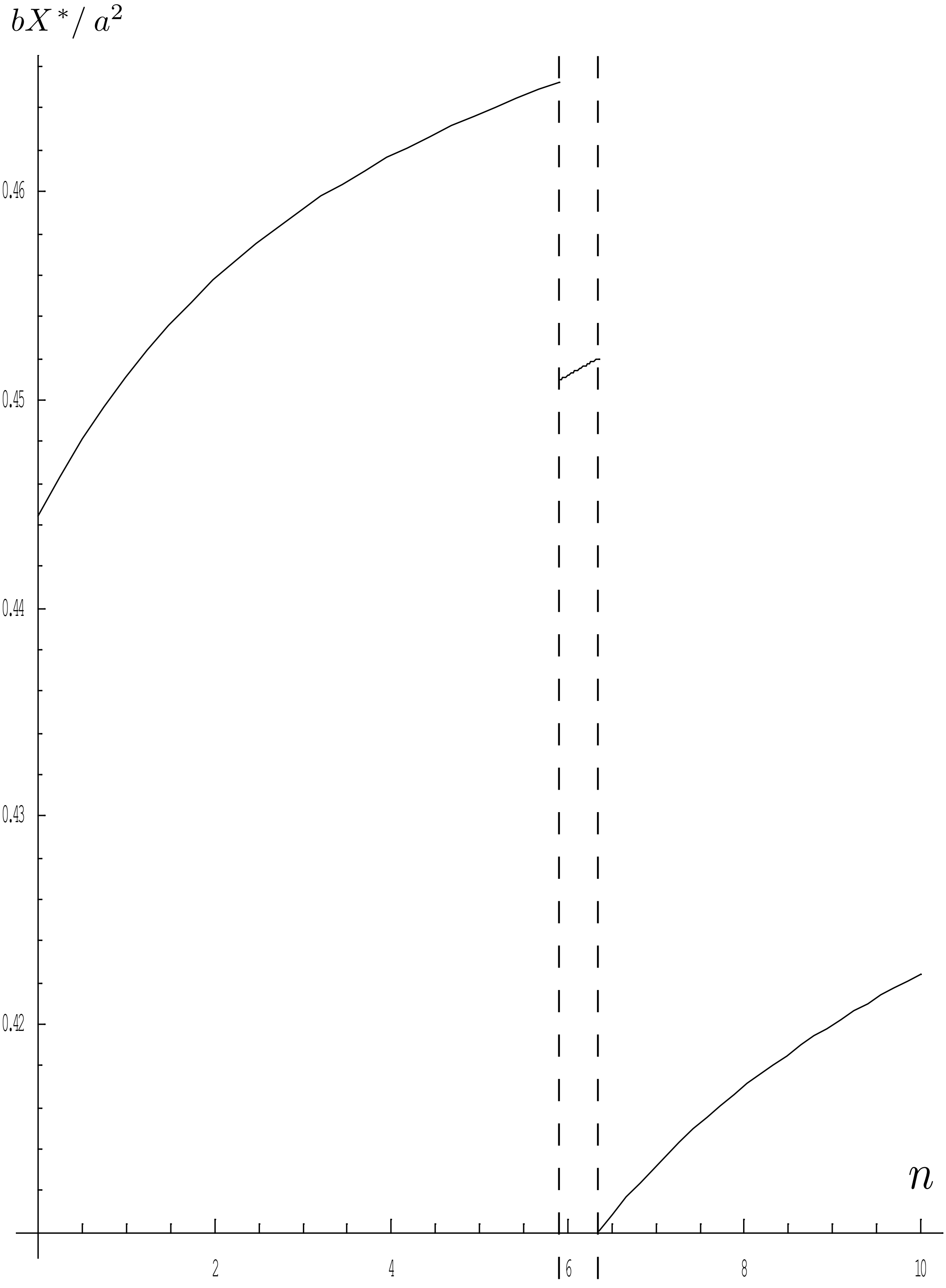
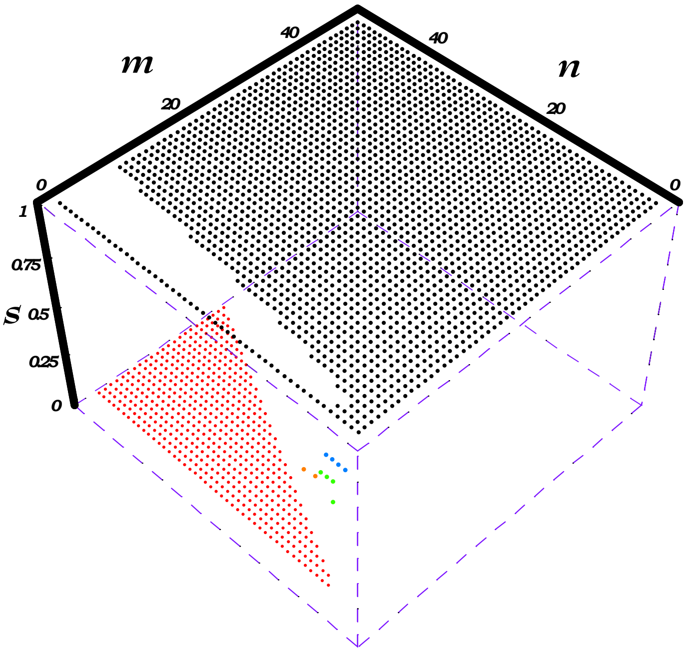


Figure 6.

(a)



(b)