Economics Bulletin

Volume 29, Issue 3

Vertical integration with fixed cost in an upstream market: NSK/Amatsuji merger

Tomomichi Mizuno
Competition Policy Research Center, Japan Fair Trade Commission

Koki Arai
Competition Policy Research Center, Japan Fair Trade Commission

Chizuru Ikeda
Graduate School of Law, Kobe University

Nobufumi Nishimura
Faculty of Economics, University of Toyama

Abstract

In this paper, we discuss the case of the integration between NSK and Amatsuji Steel Ball by using the successive oligopoly model. We show that the integration does not lead to input foreclosure. However, it leads to customer foreclosure, if the fixed cost of a rival firm in the upstream market is high. Even in the case of customer foreclosure, since the integration reduces the final goods price, it is always beneficial for consumers.

Citation: Tomomichi Mizuno and Koki Arai and Chizuru Ikeda and Nobufumi Nishimura, (2009) "Vertical integration with fixed cost in an upstream market: NSK/Amatsuji merger", *Economics Bulletin*, Vol. 29 no.3 pp. 2438-2448.
Submitted: Aug 11 2009. **Published:** September 28, 2009.

1. Introduction

Following vertical integration, there is room for a problem concerning the exclusion of a firm outside the integration. When non-integrated firms cease trading, it is known as customer foreclosure and input foreclosure. Customer foreclosure occurs if a merged downstream firm refuses to buy products from a non-merged upstream firm, which makes it difficult for the latter to run its business. Input foreclosure, on the other hand, occurs if a merged upstream firm refuses to sell products to a non-merged downstream firm, thereby creating a difficult situation for the latter.

A case concerning customer and/or input foreclosure with respect to vertical integration is that of NSK Ltd. (NSK), which integrated Amatsuji Steel Ball Mfg. Co., Ltd. (Amatsuji). In this case, vertical integration was investigated by the Japan Fair Trade Commission (JFTC) in detail.[1] An interesting point in this case is that a merged upstream firm has an economy of scale, and a merged downstream firm runs its business in multiple markets. Since it was unclear whether or not the effect of vertical integration is anti-competitive, the integration was examined. In this paper, we model the related markets in the NSK/Amatsuji case and consider the effects of integration.

The results are as follows: With respect to input foreclosure, if a competitor of a merged upstream firm has a high fixed cost, then it is possible that the upstream firm ceases trading in the upstream market. However, this leads to a decrease in the consumer price in the downstream market; therefore, this integration is beneficial for consumers.

In this paper, upstream and downstream firms take imperfect competition in their markets. Previous work concerning this type of market analyzed three effects of vertical mergers when (1) both the stages are oligopolistic and vertically integrated and (2) nonintegrated producers coexist (Greenhut and Ohta 1979; Salinger 1988; Lin 2006). Under certain conditions, a vertical merger causes the price of the final goods to increase, because increased concentration increases the price of the intermediate goods, which effect dominates depends on market structure. This analysis is important considering the different perspectives of the Chicago School.[2]

This paper is organized as follows: Section 2 explains the background of the NSK/Amatsuji case. Section 3 constructs a model, Section 4 presents the solution and equilibrium of the model, and Section 5 discusses customer and/or input foreclosure with respect to vertical integration based on the model in reference to JFTC's claims. Finally, Section 6 concludes the paper.

2. Background of the Case

JFTC investigated the case of the NSK-Amatsuji merger and concluded that this integration did not substantially restrain competition in a particular field of trade. The following sums up JFTC's annual merger review report.

---

[1] See http://www.jftc.go.jp/ma/jirei2/H17jirei7.html (in Japanese: annual merger reviews case 7 in 2005).

[2] For the Chicago argument, see Bork (1979) and Posner (1976). Perry (1989) provides a detailed explanation of these arguments.

Amatsuji manufactures and sells steel balls. NSK purchases steel balls as input and manufactures and sells bearings, including ball bearings, linear guides, and ball screws. NSK purchases steel balls as input mainly from Amatsuji. Although NSK and Amatsuji do not belong to the same market, they have a buyer-seller relationship. Therefore, this integration is considered as vertical integration.

In Japan, the market size of steel balls was about 30 billion yen in 2004 and ball bearings accounted for about 20 billion yen. In Japan, in 2004, the market size of ball bearings was 240 billion yen, that of linear guides was 54 billion yen, and that of ball screws was 51 billion yen. The shares of NSK and Amatsuji are described in Tables 1–4.

Steel balls are manufactured as per international standards (ISO3290) and domestic standards (JIS-B-1501), which is pursuant to international standards. A steel balls manufacturer makes products based on these standards, and there is no significant difference in the technical level and quality of the products. According to this homogeneity, some bearing manufacturers purchase steel balls from multiple steel ball manufacturers to make similar ball bearings as input.

Since expensive facilities are required to produce steel balls, it is important to increase the amount of sales and maintain the capacity operating rate for the purpose of decreasing the unit cost of the product, recouping the capital invested, and making profits. Against the backdrop of this industry situation, JFTC made the following statement as the discussion point of the substantial restraint of trade through unilateral conduct. First, NSK does not have an incentive to stop purchasing steel balls from Amatsuji; however, if NSK does so, there are some bearing manufacturers who can be influential sales partners. In this regard, it is not considered whether or not the planned integrated parties substantially restrain competition in the trading of steel balls through unilateral conduct. Second, It is needed for keeping a constant amount of quantity to reduce Amatsuji's product cost of steel ball; therefore, the supply to bearing manufacturers apart from NSK will continue. Therefore, it is not considered whether or not the planned integrated parties substantially restrain competition in the trading of bearings, such as ball bearings, through unilateral conduct.

We model the actual situation by focusing on the following characteristics of the market:

(i) The products of the upstream market are provided to multiple markets.

(ii) The product of each market is homogeneous.

(iii) A firm in the downstream market runs its business in multiple downstream markets, and it does not hold a strong position among its competitors in the downstream market.

(iv) A fixed cost is required for the products of the upstream market.

3. Model

There exist an upstream market and two downstream markets. In the upstream market, Amatsuji (hereafter upstream firm 0) and its rival firm (upstream firm 1) manufacture steel balls (hereafter input). In downstream market 1, NSK (hereafter downstream firm 0) and its rival firm (downstream firm 1) purchase steel balls as input from the upstream market and manufacture ball bearings (hereafter output 1). In downstream market 2, downstream firm 0 and another rival firm (downstream firm 2) purchase steel balls as input and manufacture linear guides (hereafter output 2). In other words, downstream firm 0 operates in both the downstream markets.

The technology used by the upstream firms is symmetric and the input produced by them is homogeneous. When the upstream firms produce input, they incur a fixed cost f rather than a marginal cost. Given input price w, each downstream firm purchases input and produces output. In downstream markets 1 and 2, one unit of output is made with one unit of input. In downstream market 2, downstream firm 0 incurs a marginal cost $c(>0)$ in order to produce output 2. For other production, the marginal cost for producing output is zero. Following Salinger (1988), the input price is determined such that the demand for the input is equal to the supply.

The timing of our model is as follows. First, each upstream firm chooses the amount of input produced by it. The amount of input produced by an upstream firm $j,(j=0,1)$ is denoted by q_j. Next, given the total amount of input, input price w is determined. Second, given the input price, each downstream firm chooses the amount of output. We denote the amount of output produced by downstream firm 0 in downstream market $k,(k=1,2)$ by x_{0k} and the amount of output produced by downstream firm $i,(i=1,2)$ by x_i.

The inverse demand function in each downstream market is symmetric. We denote that the prices of outputs 1 and 2 are p_1 and p_2, respectively. We assume that the inverse demand functions in downstream markets 1 and 2 are $p_1=1-x_{01}-x_1$ and $p_2=1-x_{02}-x_2$, respectively.

The profit of upstream firm 0 π_{U0} and that of upstream firm 1 π_{U1} are

$$\pi_{U0}=w(q_0,q_1)q_0-f\ ,\ \ \pi_{U1}=w(q_0,q_1)q_1-f\ . \tag{1}$$

The profit of downstream firm 0 π_{D0}, that of downstream firm 1 π_{D1}, and that of downstream firm 2 π_{D2} are

$$\pi_{D0}=(1-x_{01}-x_1-w)x_{01}+(1-x_{02}-x_2-w-c)x_{02}\,, \tag{2}$$

$$\pi_{D1}=(1-x_{01}-x_1-w)x_1\,,\ \ \pi_{D2}=(1-x_{02}-x_2-w)x_2\,. \tag{3}$$

In this paper, we discuss whether or not vertical integration between upstream firm 0 and downstream firm 0 leads to customer and input foreclosures. Hence, we compare the case where upstream firm 0 and downstream firm 0 integrate vertically with the case where they

do not. If the upstream and downstream firms integrate, they maximize their joint profit. In other words, the profit of a vertically integrated firm is

$$\pi_V = w(q_0, q_1)q_0 + (1 - x_{01} - x_1)x_{01} + (1 - x_{02} - x_2 - c)x_{02} - f\ . \tag{4}$$

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

4. Calculating Equilibrium

First, we consider the case where upstream firm 0 and downstream firm 0 do not integrate. From (2) and (3), the first-order condition leads to the following outcomes in downstream markets 1 and 2:

$$x_{01} = \frac{1-w}{3},\ \ x_1 = \frac{1-w}{3},\ \ x_{02} = \frac{1-w-2c}{3},\ \ x_2 = \frac{1-w+c}{3}. \tag{5}$$

Since input price w is determined such that the aggregate amount of input produced by upstream firms is equal to the aggregate amount of products sold to consumers by downstream firms, we must satisfy $q_0 + q_1 = x_{01} + x_1 + x_{02} + x_2$. Substituting (5) into this equation, we obtain the inverse demand function for input: $w = (4-c)/4 - 3(q_0 + q_1)/4$. Substituting the inverse demand function into (1) and solving the first-order condition in the upstream market, the following outcomes are obtained.

$$q_0^N = q_1^N = \frac{4-c}{9},\ \ p_1^N = \frac{10-c}{18},\ \ p_2^N\ \frac{5(c+2)}{18},\ \ w^N = \frac{4-c}{12}, \tag{6}$$

$$\pi_{U0}^N = \pi_{U1}^N = \frac{(c-4)^2}{108} - f\ ,\ \ \pi_{D0}^N = \frac{265c^2 - 178c + 64}{648},\ \ \pi_{D1}^N = \frac{(c+8)^2}{1296},\ \ \pi_{D2}^N = \frac{(13c+8)^2}{1296}, \tag{7}$$

where superscript N indicates the case in which upstream firm 0 and downstream firm 0 do not integrate vertically. To guarantee positive outcomes in the equilibrium, we assume that $c < 8/23 \approx 0.3478$.

Next, we consider the case where upstream firm 0 and downstream firm 0 integrate vertically. From (3) and (4), the first-order conditions lead to the following outcomes in downstream market 1:

$$x_{01}=\frac{w+1}{3},\ \ x_1=\frac{1-2w}{3},\ \ x_{02}=\frac{1+w-2c}{3},\ \ x_2=\frac{1+c-2w}{3}. \tag{8}$$

Since input price w is determined such that the aggregate amount of input is equal to the aggregate amount of output, we must satisfy $q_0+q_1=x_1+x_2$. Substituting (8) into this equation, we obtain the inverse demand function for input: $w=(c+2)/4-3(q_0+q_1)/4$. Substituting the inverse demand function and (8) into (1) and (4), from the first-order conditions, we obtain $q_0=0$, since $c<18/23\approx 0.3478<2/5$. Hence, substituting the inverse demand function and $q_0=0$ into (1), from the first-order conditions, we obtain the following outcomes:

$$q_0^I=0,\ \ q_1^I=\frac{c+2}{6},\ \ w^I=\frac{c+2}{8},\ \ p_1^I=\frac{c+10}{24},\ \ p_2^I=\frac{9c+10}{24}, \tag{9}$$

$$\pi_V^I=\frac{113c^2-140c+100}{288}-f,\ \ \pi_{U1}^I=\frac{(c+2)^2}{48}-f,\ \ \pi_{D1}^I=\frac{(c-2)^2}{144},\ \ \pi_{D2}^I=\frac{(3c+2)^2}{144}, \tag{10}$$

where superscript I denotes the case with vertical integration.

5. Analysis

5.1. Input and customer foreclosures

Here, we consider whether or not vertical integration between upstream firm 0 and downstream firm 0 causes input foreclosure. From (9), the vertically integrated firm does not sell its input to the rival downstream firms. On the other hand, since $q_1^I>0$, the rival downstream firms do not exit from the downstream markets. Hence, we obtain the following proposition.

Proposition 1. *Consider that the existing fixed cost causes an economy of scale. The vertically integrated firm does not supply its products to the rival downstream firms. However, the rival downstream firms can operate since the rival upstream firm sells its products to the downstream firms.*

This result is similar to that of Salinger (1988). However, Salinger does not consider the market where the downstream unit of an integrated firm operates in multiple markets before vertical integration. The intuition behind Proposition 1 is as follows. Consider that the integrated firm decreases the sales of its input in the upstream market by one unit and

increases the sales of its output in the downstream market by one unit. The output price in the downstream market does not change, but the integrated firm gains profits, since it can take the entire markup, which in part, is taken by the rival downstream firm. Therefore, the integrated firm has no incentive to supply its input to the rival downstream firms.

Next, we consider whether or not the integrated firm purchases input from the rival upstream firm; in our model, the integrated firm has no incentive to do so. This is because even if the markup of input is sufficiently small, the cost of producing input is always smaller than that of buying it.

Since the integrated firm does not sell its input, the rival upstream firm may be excluded from the upstream market. From (7) and (10), we obtain $\pi_{U1}^{I} - \pi_{U1}^{N} = -(c+14)(2-5c)/432 < 0$. The reason that the inequality holds in the above is the assumption that $c < 8/23$. Hence, vertical integration reduces the profits of the rival upstream firm. If the decrease in the profits of rival upstream firms is significant, it may withdraw from the upstream market, since it may not gain profits higher than the fixed cost. The following proposition summarizes the above discussion.

Proposition 2. *Consider that the existing fixed cost causes an economy of scale. Vertical integration leads to customer foreclosure if* $(c+2)^2/48 < f < (c-4)^2/108$.

The intuition behind Proposition 2 is as follows. When upstream firm 0 and downstream firm 0 integrate vertically, the rival upstream firm loses the demand of the downstream unit of the integrated firm. Moreover, since after the integration, the non-integrated downstream firms compete with a more efficient rival, the demand of the former decreases. Hence, vertical integration reduces the profits of non-integrated upstream firms. If the decrease is significant, the integration causes customer foreclosure.

When customer foreclosure occurs, we obtain the equilibrium outcomes by supposing that $q_1 = 0$. Hence, by substituting (8), $w = (c+2)/4 - 3(q_0 + q_1)/4$, and $q_1 = 0$ into (4), the first-order conditions lead to the following outcomes:

$$q_0^E = \frac{2c}{5}, \quad w^E = \frac{10-c}{20}, \quad p_1^E = \frac{30-c}{60}, \quad p_2^E = \frac{19c+30}{60}, \tag{11}$$

$$\pi_V^E = \frac{180+161c^2-180c}{360} - f, \quad \pi_{D1}^E = \frac{c^2}{900}, \quad \pi_{D2}^E = \frac{121c^2}{900}, \tag{12}$$

where superscript E denotes the case where upstream firm 1 withdraws from the upstream market.

5.2. The effect of vertical integration on the output price

Even if customer foreclosure occurs, vertical integration may reduce the output price, since the integration reduces double marginalization. Here, we compare the outcomes before the integration with those after the integration. From (6), (9), and (11), we obtain the following results.

$$p_1^E - p_1^N = p_2^E - p_2^N = \frac{7c-10}{180} < 0, \quad p_1^I - p_1^N = p_2^I - p_2^N = \frac{7c-10}{72} < 0, \tag{13}$$

where the reason of satisfying the inequalities is based on the assumption that $c < 8/23$. Summarizing the above discussion yields the following corollary.

Corollary 1. *Vertical integration reduces the profits of rival firms and the output price.*

The intuition behind Corollary 1 is as follows. First, vertical integration does not have a negative factor that reduces the profit of the integrated firm. Hence, vertical integration occurs. Next, although vertical integration increases the input price, it also reduces double marginalization. Therefore, the output price decreases.

This result is interesting in comparison with JFTC's statement in this case. JFTC states that it is needed for keeping a constant amount of quantity to reduce Amatsuji's product cost of steel balls; therefore, the supply to bearing manufacturers apart from NSK will continue. Our model described the high fixed cost as an expensive facility to produce steel balls. Thus, this type of market is considered as the situation of scale economy. However, based on our model analysis, it may be impossible to continue supply for the rival firm in the downstream market.

JFTC made another statement that if NSK stops purchasing steel balls from Amatsuji, there are some bearing manufacturers who can be influential sales partners. In this case, it is not considered whether or not the planned integrated parties substantially restrain competition in the trading of steel balls through unilateral conduct. However, based on our model analysis, in case of a higher fixed cost, it is possible that the rival steel ball manufacturers cease trading by vertical integration. Thus, it is not always possible for the rival steel ball manufacturers to supply to rival firms in the downstream market.

6. Conclusion

From our analysis, the vertical integration between NSK and Amatsuji may lead to customer foreclosure, if the fixed cost of Amatsuji's rival is high. However, the integration is beneficial for consumers, since it always reduces the final goods price. Although the latter result is similar to the conclusion of JFTC, the reason that this result is obtained is different. JFTC alleges that since there exists an economy of scale, integration does not restrict competition. In our study, the economy of scale, however, is not reason enough to support their argument.

References

Bork, R. (1978) *The Antitrust Paradox*, Basic Books: New York.

Greenhut, M.L. and H. Ohta (1979) "Vertical integration of successive oligopolists" *American Economic Review* **69**, 137–141.

Japan Fair Trade Commission (2005) Case 7: Amatsuji Steel Ball Mfg. Co., Ltd., stock acquiring by NSK Ltd., <URL：http://www.jftc.go.jp/ma/jirei2/H17jirei7-01.html>

Lin, P. (2006) "Strategic spin-offs of input divisions" *European Economic Review* **50**, 977–993.

Perry, M.K. (1989) "Vertical Integration: Determinants and Effects" in *Handbook of Industrial Organization* by R. Schmalensee and R.D. Willig, Eds., North-Holland: Amsterdam.

Posner, R.A. (1976) *Antitrust law*, University of Chicago Press: Chicago.

Salinger, M.A. (1988) "Vertical mergers and market foreclosure" *Quarterly Journal of Economics* **103**, 345–356.

Appendix: Tables

Source of all the following tables is the JFTC report (2005).

Table 1: steel balls

ranking	manufacturer	market share
1	Amatsuji	50%
2	company A	40%
	others	5%
	import	5%
	total	100%
HHI about 4,200		

Table 2: ball bearings

ranking	manufacturer	market share
1	NSK	35%
2	company B	25%
3	company C	20%
4	company D	5%
	others	5%
	import	10%
	total	100%
HHI about 2,400		

Table 3: linear guides

ranking	manufacturer	market share
1	company E	60%
2	company F	20%
3	NSK	10%
	others	5%
	import	5%
	total	100%
HHI about 4,600		

Table 4: ball screws

ranking	manufacturer	market share
1	NSK	35%
2	company G	25%
3	company H	15%
4	company I	5%
	others	15%
	import	5%
	total	100%
HHI about 2,200		