International M&A and Asymmetric Information on Market Demand

Kojun HAMADA*

Abstract

This paper examines whether or not the international merger between a foreign firm and a domestic firm occurs in the context of duopolistic competition. Different from the existing literature, we focus on the acquisition by the foreign firm and the asymmetric information on the demand of a domestic market. In acquiring the domestic firm, the foreign firm must pay the information rent in order to gain the market information that only the domestic firm possesses. We show that the foreign firm always prefers to merge, even if it costs the foreign firm the extra payment to the domestic firm.

Keywords : Asymmetric information; countervailing incentive; international mergers
JEL classification : D82; F12; L13

* Associate professor, *Faculty of Economics, Niigata University*
Address: Faculty of Economics, Niigata University, 8050 Ikarashi 2-no-cho, Niigata-shi 950-2181, Japan.
Tel. and fax: +81-25-262-6538.
E-mail address: khamada@econ.niigata-u.ac.jp

1 Introduction

In a decade after WTO reorganized in 1995, the multinational cross-border merger tends to be increasing.[1] Many economists have kept much interested in the satisfactory explanation of this phenomenon. Although there exist many articles on the merger theory in order to explain why mergers occur, one of features peculiar to the cross-border merger is the existence of asymmetric information between foreign firms and domestic firms. The domestic firm often has the informational advantage on the domestic market which cannot be known by the foreign firm in advance. In order to overcome this informational disadvantage, the foreign firm may decide to merge with the domestic firm as a foothold in the domestic market. We analyze how the informational advantage affects the merger activity by the foreign firm.

The paper examines whether or not the international merger between a foreign firm (FF henceforth) and a domestic firm (DF henceforth) occurs in the context of duopolistic competition. There are already many articles on the international mergers. Long and Vousden (1995) analyzed the relationship between the cross-border mergers and trade liberalization and Head and Ries (1997) dealt with the welfare implication of mergers. Collie (2003) analyzed the effect of the trade policy to the domestic merger. Although many researchers analyze mergers in the international setting, the articles concerning asymmetric information as one of reasons of mergers are relatively few. As recent contributions that consider asymmetric information to the analysis of the international M&A, Das and Sengupta (2001) examined the merger offer by the FF to the DF and analyze the bargaining situation. They derived the condition under which the DF accepts the merger offer by the FF. They examined the situation in which when the FF is unaware of the private information of the DF in advance, the lower offer is attractive only for higher type of the DF, although the FF shares the private information after merger under their setting. Banal-Estanol (2002) investigated the incentives to merge when firms have private cost information. They showed that sharing the private information enables the efficient production. Further, Qiu and Zhou (2003) focused on the degree of product differentiation and showed under what conditions the

1) For example, according to UNCTAD (2000), which is quoted by Qiu and Zhou (2003), the value of cross-border M&A increases from $200 billion in 1995 to $720 billion in 1999. The share of cross-border M&A in GDP rose from 0.8% in 1995 to 2.5% in 1999.

merger can acquire the merger profit.

However, most studies concerning the asymmetric information are based on the crucial assumption. After the FF merges with the DF, the FF (and the entity that maximizes joint profit) can share the private information that the FF could not obtain before merger, with no cost. In the existing literature, the merged firm has the complete information. Our motivation begins from the question about no cost of the information sharing after the merger between the DF and the FF.

Different from the existing literature, our paper takes explicitly the asymmetric information between the DF and the FF into consideration. The paper presumes that in merging, the FF cannot gain the private information without cost. The FF need to give the information rent for the DF in order to obtain private information. The merger activity costs the FF the extra payment to the DF for information acquisition. We analyze the situation in which in merging, the FF must offer the merger contract to the DF in order to gain the private information that the DF possesses. The paper examines how the information rent given to the DF influences the profitability of the merger by the FF.

We examine whether or not the international merger makes more profit than that of the non-merger, paying attention to the existence of the ex ante asymmetric information. The paper shows that the foreign firm always prefers to merge, even if it costs the foreign firm the extra payment to the domestic firm and the output level is distorted in order to reduce the information rent. Moreover it is shown that when uncertainty is sufficiently large, the difference of the expected profit of the FF between the merger and the non-merger increases with the degree of uncertainty. This result presents one of the explanations why the international merger is more desirable when the informational advantage becomes more important.

The remainder of the article is organized as follows. Section 2 describes the model and derives the output and the expected profit of the FF in the equilibrium when the FF decides to merge or not. Section 3 compares the output and the expected profit of the FF in both cases in which the merger occurs or not. Section 4 is concluding remarks.

2 The model

In this section, the model is described. We consider the situation in which a domestic firm (DF) has already produced in the domestic market and a foreign firm (FF) plans to enter in this market. Before the FF enters, the DF is a domestic monopoly firm. As two ways of market entry, the FF decides whether or not to merge with the DF. When the FF decides not to merge, the duopolistic competition between the DF and the FF follows. The goods that the DF and the FF supply are homogeneous. We stand for the DF and the FF by the superscript $i=d$ and f respectively.

There exists the asymmetric information about the demand size of the domestic market between the DF and the FF. The DF knows the true demand size, but the FF does not. We assume that the demand size has two values: $\theta_k \in \{\theta_H, \theta_L\}$, $\theta_H > \theta_L \geq 0$; $\Delta\theta \equiv \theta_H - \theta_L > 0$. The FF knows that θ_H and θ_L occur with the probability p and $1-p$ respectively, $0<p<1$. These are common knowledge.[2)]

When the FF decides not to merge, market competition occurs in the fashion of Cournot duopoly. The output level is denoted by $q_k^i;\ i=d,f,\ k=H,L$. The total quantity is $Q=q^d+q^f$ and the inverse demand function is $P(Q)=a+\theta_k-Q$. The production cost is identical and denoted by $c>0$; $a>c$. The expected value of θ_k is denoted by $\bar{\theta} \equiv p\theta_H+(1-p)\theta_L$. The variance is calculated as $\sigma^2=p(1-p)(\Delta\theta)^2$. The profit is denoted by $\pi^i(q^i,q^j)=(P(Q)-c)q^i=(a+\theta_k-c-(q^d+q^f))q^i;\ i,j=d,f,\ j\neq i$.

When the FF decides to merge with the DF, the merged firm acts as a monopoly firm. The output level is denoted by q^m and the price is $P(q^m)$. The profit is denoted by $\pi^m(q^m)=(a+\theta_k-c-q^m)q^m$. When the expected profit of the FF in merging is larger than that in not merging, the FF merges.

As a benchmark, we consider the complete information under which the FF also knows θ_k. When the FF decides not to merge, both firms are engaged in duopolistic competition. The reaction function of each firm is $q_k^i=\frac{a+\theta_k-c-q_k^j}{2}$. The output and the profit in the Cournot-Nash equilibrium are $q_k^{i*}=\frac{a+\theta_k-c}{3}$ and $\pi_k^{i*}=(q_k^{i*})^2=(\frac{a+\theta_k-c}{3})^2$ respectively. The merged firm is aware of θ_k. When FF decides to merge with the DF. The monopoly output and the profit are $q_k^m=\frac{a+\theta_k-c}{2}$ and $\pi_k^m=(q_k^m)^2=(\frac{a+\theta_k-c}{2})^2$ respectively. In this case, the FF

2) θ_k can be reinterpreted as the common marginal cost for both firms.

and the DF prefer to merge evidently, because the profit of the merged firm is always greater than the profit sum of both firms before the merger, $2\pi_k^{i*} = \frac{8(a+\theta_k-c)^2}{36} < \pi_k^m = \frac{9(a+\theta_k-c)^2}{36}$.

In reality, the DF is likely to know more about the preference and the trend of domestic consumers than the FF. We proceed to analyze the incomplete information.

2.1 Non-merger

When the FF decides not to merge, the FF does not know θ_k. They engage in duopoly competition under the incomplete information. We focus on the Bayesian Nash equilibrium. The profit of the DF is denoted by $\pi_k^d(q_k^d, q^f) = (a+\theta_k-(q_k^d+q^f)-c)q_k^d$. The reaction function of the DF is as follows:

$$q_k^d = \frac{a+\theta_k-c-q^f}{2};\ k = H, L. \tag{1}$$

The FF maximizes the expected profit: $\pi^f \equiv E[(P(Q_k)-c)q^f] = (a+\bar{\theta}-c-q^f-pq_H^d-(1-p)q_L^d)q^f$.[3] The reaction function of the FF is as follows:

$$q^f = \frac{a+\bar{\theta}-c-pq_H^d-(1-p)q_L^d}{2}. \tag{2}$$

Solving the simultaneous equations, (1) and (2), the output in the equilibrium is obtained.[4]

$$(q_H^d, q_L^d) = (\frac{a+\theta_H-c}{3}+\frac{(1-p)\Delta\theta}{6}, \frac{a+\theta_L-c}{3}-\frac{p\Delta\theta}{6}),\ q^f = \frac{a+\bar{\theta}-c}{3}. \tag{3}$$

The following inequalities are immediately obtained:

$$q_H^d > q_H^{d*},\ q_L^d < q_L^{d*},\ q_L^d < q_L^{f*} < q^f < q_H^{f*} < q_H^d. \tag{4}$$

The ex post profit of the DF and the expected profit of the FF are as follows:

$$\pi_k^d = (q_k^d)^2 = \frac{(2(a-c)+3\theta_k-\bar{\theta})^2}{36},\ \pi^f = (q^f)^2 = \frac{(a+\bar{\theta}-c)^2}{9}. \tag{5}$$

We compare the (expected) profits between the complete and the incomplete information cases. By (4), it is satisfied that $\pi_H^d > \pi_H^{d*}$, $\pi_L^d < \pi_L^{d*}$, and $\pi_L^d < \pi_L^{f*} < \pi^f < \pi_H^{f*} < \pi_H^d$.[5]

---

3) $E[\cdot]$ denotes the operator of expectation on θ_k.

4) Under the above setting, the solution is interior.

5) Note that when the demand is low, the FF makes higher profit under the incomplete information.

2.2 Merger

We analyze the acquisition of the DF by the FF. First we analyze two benchmark cases.

Full information without cost If the acquiring firm can share information with no cost in merging, the comparison between the merger and the non-merger is equal to the comparison between the merger under the complete information and the non-merger under the incomplete information. The monopoly profit under the complete information always exceeds the sum of the expected profit in the duopolistic competition under the incomplete information. In deciding whether or not to merge, the FF compares the expected profit ex ante. The expected profit is always larger when merging. That is,

$$\pi^f + E[\pi_k^d] < E[\pi_k^m]. \tag{6}$$

It is satisfied that $\pi^f = \frac{(a+\bar{\theta}-c)^2}{9}$ and $E[\pi_k^d] = p\pi_H^d + (1-p)\pi_L^d = \frac{4(a+\bar{\theta}-c)^2+9\sigma^2}{36}$. By $E[\pi_k^m] = p\pi_H^m + (1-p)\pi_L^m = \frac{9[(a+\bar{\theta}-c)^2+\sigma^2]}{36}$, the inequality (6) is satisfied.

No information We analyze the other extreme benchmark. Suppose that the FF remains not knowing the true demand after merger, although the merged firm produces as a monopoly firm.

The expected profit of the FF is $\pi^m = E[(P(\bar{q}^m)-c)\bar{q}^m] = (a+\bar{\theta}-c-\bar{q}^m)\bar{q}^m$. Calculating the monopoly output and the profit, it is obtained that $\bar{q}^m = \frac{a+\bar{\theta}-c}{2}$ and $\pi^m = (\bar{q}^m)^2 = (\frac{a+\bar{\theta}-c}{2})^2$.

We compare the expected profit of the FF when merging with when not merging in this benchmark. If the following inequality is satisfied, the merger is desirable for the FF from the viewpoint of the expected profit.

$$\pi^f + E[\pi_k^d] < \pi^m \text{ if and only if } \sigma^2 < \frac{(a+\bar{\theta}-c)^2}{9}, \tag{7}$$

where is $E[\pi_k^d] = p\pi_H^d + (1-p)\pi_L^d$. If σ^2 is large, the FF expects that the merger is not desirable.

On the other hand, the DF evaluates more accurately whether or not this merger is desirable by calculating the ex post profit.

$$(P(Q_k)-c)q^f + (q_k^d)^2 < (a+\theta_k-\bar{q}^m-c)\ \bar{q}^m \text{ if and only if } \frac{(a+\bar{\theta}-c)^2 - 9(\theta_k-\bar{\theta})^2}{36} > 0. \tag{8}$$

If the deviation from the expected value, $\theta_k - \bar{\theta}$, is large, the DF also expects that the profit of the merged firm is less than the joint profit before merger.

Information acquisition in merging Now, we examine the information acquisition in merging. The FF delegates the DF to produce the goods after merger.

When deciding to merge, the FF is not aware of θ_k, but the DF is aware. The FF offers the merger contract to the DF. The FF as a principal induces the DF as an agent to report the demand type, θ_k, and gives the information rent to the DF. The FF enforces the DF to implement the output level of goods that the DF produces and the transfer that the DF should pay to the FF. Our model applies the revelation principle, which is often used in order to analyze the adverse selection in the principal-agency framework.[6] Therefore, we limit the analysis of the optimal contract to the direct truth-telling mechanism, $\{q(\theta_k), t(\theta_k)\}_{k=\{H,L\}}$. This contract form implies that when the DF reports the demand type as $k=H,L$ to the FF, the output level, q_k, and the transfer, t_k, are assigned by the FF. The offered contract can be abbreviated as $\{q_k, t_k\}_{k=\{H,L\}}$. The contract offered to the DF can be committed by the FF. The monopoly profit when the true type is θ_k and the type reported by the DF is θ_l is denoted by $\pi^m(q_l;\theta_k)=(a+\theta_k-c-q_l)q_l;\ k,l=H,L$.

The objective function of the FF is as follows:

$$\max_{\{q_k,t_k\}_{k=\{H,L\}}} E[t_k]=pt_H+(1-p)t_L, \tag{9}$$

$$\text{subject to } (IC_H)\quad \pi^m(q_H;\theta_H)-t_H \ge \pi^m(q_L;\theta_H)-t_L, \tag{10}$$

$$(IC_L)\quad \pi^m(q_L;\theta_L)-t_L \ge \pi^m(q_H;\theta_L)-t_H, \tag{11}$$

$$(PC_H)\quad \pi^m(q_H;\theta_H)-t_H \ge \pi_H^d, \tag{12}$$

$$(PC_L)\quad \pi^m(q_L;\theta_L)-t_L \ge \pi_L^d. \tag{13}$$

(IC_k) is the incentive compatibility constraint. Note that the participation constraint, (PC_k), depends on the type θ_k because the reservation profit is the profit under the incomplete information in subsection 2.1. That is, $\pi_k^d=(q_k^d)^2=\frac{(2(a-c)+3\theta_k-\bar{\theta})^2}{36}$. When the

6) The revelation principle is first propounded by Myerson (1979). This principle implies as follows: The direct truth-telling mechanism can result in the same payoffs to the principal and the agent as the payoffs in any equilibrium of a game in which the players play through any indirect mechanisms that the principal presents. See Fudenberg and Tirole (1991, Ch.7) for details.

reservation profit depends on the private information, the countervailing incentive is possible to occur.[7)]

In order to specify the characteristics of the optimal contract, we solve the optimal contract using the Lagrange multiplier. The Lagrangean is defined as follows:

$$\begin{aligned}\mathcal{L}\ (q_k,t_k\,;\lambda_k,\mu_k\,;_{\{k=H,L\}}) \equiv & [pt_H+(1-p)t_L] \\ & +\lambda_H[(a+\theta_H-c-(q_H+q_L))(q_H-q_L)-(t_H-t_L)] \\ & +\lambda_L[(a+\theta_L-c-(q_H+q_L))(q_L-q_H)+(t_H-t_L)] \\ & +\mu_H[(a+\theta_H-c-q_H)q_H-t_H-\pi_H^d] \\ & +\mu_L[(a+\theta_L-c-q_L)q_L-t_L-\pi_L^d].\end{aligned} \tag{14}$$

Solving the first-order conditions, the following equations are obtained.

$$t_H\ :\ p=\lambda_H-\lambda_L+\mu_H; \tag{15}$$

$$t_L\ :\ 1-p=-\lambda_H+\lambda_L+\mu_L; \tag{16}$$

$$q_H:\ (\lambda_H+\mu_H)[a+\theta_H-c-2q_H]-\lambda_L[a+\theta_L-c-2q_H]=0; \tag{17}$$

$$q_L\ :\ (\lambda_L+\mu_L)[a+\theta_L-c-2q_L]-\lambda_H[a+\theta_H-c-2q_L]=0. \tag{18}$$

By (15) and (16), $\mu_H+\mu_L=1$. Thus, either (PC_H) or (PC_L) binds necessarily.

If both of (IC_k) and (PC_k) do not bind, the principal can satisfy all constraints and raise her expected profit by increasing the transfer of the original contract from t_k to $t_k+\varepsilon\,;\varepsilon>0$. As a result, either constraint binds necessarily. Either $\lambda_k>0$ or $\mu_k>0$ holds by the slackness condition.

The optimization problem is classified into three cases depending on which of constraints bind:

Case 1: (IC_H) and (PC_L) bind. ($\lambda_H,\mu_L>0,\ \lambda_L=\mu_H=0$.)

Case 2: (IC_H), (PC_H) and (PC_L) bind. ($\lambda_H>0,\ \lambda_L=0,\ \mu_H,\mu_L>0$.)

Case 3: (PC_H) and (PC_L) bind. ($\mu_H,\mu_L>0,\ \lambda_H=\lambda_L=0$.)

The case in which both (IC_L) and (PC_H) bind never occurs. Hereafter, it is defined that $L\equiv a+\theta_L-c$ and $H\equiv a+\theta_H-c$ for notational convenience. Note that $\Delta\theta=H-L$.

7) The countervailing incentive is analyzed by Lewis and Sappington (1989) at first. When the reservation payoff depends on the agent's type, the agent may report that his type is efficient in order to acquire more reservation payoff. In this case, it is possible that the incentive to report the true type works and the principal does not need to give any incentives to the agent. As the reservation utility depending on the type countervails the incentives to lie about the type, this is called as the countervailing incentive.

Case 1 It is satisfied that $\lambda_H = p$ and $\mu_L = 1$ by (15). By (17) and (18), the output level is as follows:

$$q_H = \frac{a+\theta_H - c}{2}, \tag{19}$$

$$q_L = \frac{a+\theta_L - c - \frac{p\Delta\theta}{1-p}}{2}. \tag{20}$$

It is satisfied that $q_H (= q_H^m > q_L^m) > q_L$. Substituting q_H or q_L, the profit function, $\pi^m(q_l;\theta_k)$, is calculated as follows: $\pi^m(q_H;\theta_H) = \frac{H^2}{4}$, $\pi^m(q_L;\theta_H) = \frac{H^2 - (\frac{\Delta\theta}{1-p})^2}{4}$, $\pi^m(q_L;\theta_L) = \frac{L^2 - (\frac{p\Delta\theta}{1-p})^2}{4}$ and $\pi^m(q_H;\theta_L) = \frac{L^2 - (\Delta\theta)^2}{4}$.

By the binding constraints, (PC_L) and (IC_H), the transfer is as follows:

$$t_L = \pi^m(q_L;\theta_L) - \pi_L^d = \frac{1}{36}[5L^2 + 4Lp\Delta\theta - \frac{p^2(9+(1-p)^2)(\Delta\theta)^2}{(1-p)^2}], \tag{21}$$

$$t_H = t_L + \frac{1}{4}(\frac{\Delta\theta}{1-p})^2 = \frac{1}{36}[5L^2 + 4Lp\Delta\theta - \frac{(9(p^2-1)+(1-p)^2p^2)(\Delta\theta)^2}{(1-p)^2}]. \tag{22}$$

In two remaining constraints, (IC_L) is satisfied:

$t_H - t_L = \frac{1}{4}(\frac{\Delta\theta}{1-p})^2 > \pi^m(q_H;\theta_L) - \pi^m(q_L;\theta_L) = \frac{(2p-1)(\Delta\theta)^2}{4(1-p)^2} > 0$.[8] (PC_H) is satisfied under the following condition. As $\pi^m(q_H;\theta_H) - \pi_H^d = \frac{\Delta\theta}{12}[2L - \frac{2p^2+p+3}{1-p}\Delta\theta] \geq 0$, the necessary condition to satisfy (PC_H) is as follows:

$$\Delta\theta \leq \frac{2(1-p)L}{2p^2+p+3}. \tag{23}$$

If $\Delta\theta$ is sufficiently small, (PC_H) is satisfied and the countervailing incentive does not occur.

When (23) is satisfied, the expected profit of the FF is calculated as follows:

$$pt_H + (1-p)t_L = t_L + p(t_H - t_L) = \frac{1}{36}[5L^2 + 4Lp\Delta\theta + \frac{p(9-p(1-p))(\Delta\theta)^2}{1-p}]. \tag{24}$$

Case 3 For the simplification of the analysis, we examine Case 3 in advance of Case 2.

In Case 3, it is satisfied that $\mu_H = p$ and $\mu_L = 1-p$ by (15). As both of (IC_k) do not bind, the FF need not give any incentive at all. The countervailing incentive works strongly.

8) $\frac{1}{4}(\frac{\Delta\theta}{1-p})^2 - \frac{(2p-1)(\Delta\theta)^2}{4(1-p)^2} = \frac{(\Delta\theta)^2}{2(1-p)} > 0$.

By (17) and (18), the output level is as follows:

$$q_H = \frac{a+\theta_H - c}{2}, \tag{25}$$

$$q_L = \frac{a+\theta_L - c}{2}. \tag{26}$$

It is satisfied that $q_H(=q_H^m) > q_L(=q_L^m)$. Substituting q_H or q_L into the profit function, $\pi^m(q_l;\theta_k)$ is calculated as follows: $\pi^m(q_H;\theta_H)=\frac{H^2}{4}$, $\pi^m(q_L;\theta_H)=\frac{H^2-(\Delta\theta)^2}{4}$, $\pi^m(q_L;\theta_L)=\frac{L^2}{4}$ and $\pi^m(q_H;\theta_L)=\frac{L^2-(\Delta\theta)^2}{4}$.

By the binding constraints, (PC_H) and (PC_L), the transfer is as follows:

$$t_L = \pi^m(q_L;\theta_L) - \pi_L^d = \frac{(5L-p\Delta\theta)(L+p\Delta\theta)}{36}, \tag{27}$$

$$t_H = \pi^m(q_H;\theta_H) - \pi_H^d = \frac{(5H+(1-p)\Delta\theta)(H-(1-p)\Delta\theta)}{36}. \tag{28}$$

By $\pi^m(q_L;\theta_L)-t_L=\frac{L^2}{4}-\frac{(5L-p\Delta\theta)(L+p\Delta\theta)}{36}$ and $\pi^m(q_H;\theta_L)-t_H=\frac{L^2-(\Delta\theta)^2}{4}-\frac{(5H+(1-p)\Delta\theta)(H-(1-p)\Delta\theta)}{36}$, (IC_L) is satisfied: $(\pi^m(q_L;\theta_L)-t_L)-(\pi^m(q_H;\theta_L)-t_H)=\frac{\Delta\theta}{12}[3\Delta\theta+2(a+\overline{\theta}-c)]>0$. (IC_H) is satisfied under the following condition. By $\pi^m(q_H;\theta_H)-t_H=\frac{H^2}{4}-\frac{(5H+(1-p)\Delta\theta)(H-(1-p)\Delta\theta)}{36}$ and $\pi^m(q_L;\theta_H)-t_L=\frac{H^2-(\Delta\theta)^2}{4}-\frac{(5L-p\Delta\theta)(L+p\Delta\theta)}{36}$, $(\pi^m(q_H;\theta_H)-t_H)-(\pi^m(q_L;\theta_H)-t_L)=\frac{\Delta\theta}{12}[(3-2p)\Delta\theta-2L]\geq 0$. The necessary condition to satisfy (IC_H) is as follows:

$$\Delta\theta \geq \frac{2L}{3-2p}. \tag{29}$$

If $\Delta\theta$ is sufficiently large, (IC_H) is satisfied and the countervailing incentive works strongly. The FF as a principal need not give any information rent that exceeds the reservation profit.

When (29) is satisfied, the expected profit of the FF is as follows:

$$pt_H + (1-p)t_L = \frac{p(5H+(1-p)\Delta\theta)(H-(1-p)\Delta\theta)}{36} + \frac{(1-p)(5L-p\Delta\theta)(L+p\Delta\theta)}{36}$$

$$= \frac{5(a+\overline{\theta}-c)^2}{36}. \tag{30}$$

As the inequality, $\frac{2(1-p)}{2p^2+p+3} < \frac{2}{3-2p}$, holds. there exists an interval of $\Delta\theta \in [\frac{2(1-p)L}{2p^2+p+3}, \frac{2L}{3-2p}]$ necessarily. When $\Delta\theta$ lies in this interval, both of (23) and (29) are not satisfied. This case is dealt with Case 2. The condition under which both (23) and (29) are not satisfied is rewritten as follows:

$$\frac{2(1-p)L}{2p^2+p+3} \le \Delta\theta \le \frac{2L}{3-2p}. \tag{31}$$

Case 2 When (31) is satisfied, (IC_H), (PC_H) and (PC_L) bind. Under three binding constraints, $\lambda_H > 0$, $\lambda_L = 0$ and $\mu_H, \mu_L > 0$ are satisfied. By (15) and (16), it is satisfied that $\mu_H + \mu_L = 1$ and $p = \lambda_H + \mu_H$. By (17) and (18),

$$q_H = \frac{a+\theta_H - c}{2}, \tag{32}$$

$$q_L = \frac{a+\theta_L - c + \frac{\mu_H - p}{1-p}\Delta\theta}{2}. \tag{33}$$

Later on, we show that $0 \le \mu_H \le p$. As q_L is adjusted in order to bind both constraints, (IC_H) and (PC_L), μ_H is determined in order to bind (IC_H), (PC_H) and (PC_L). It is shown that $q_H (= q_H^m > q_L^m) > q_L$. Substituting q_H or q_L into $\pi^m(q_l;\theta_k)$, it is calculated as follows: $\pi^m(q_H;\theta_H) = \frac{H^2}{4}$, $\pi^m(q_L;\theta_H) = \frac{H^2 - (\frac{(1-\mu_H)\Delta\theta}{1-p})^2}{4}$, $\pi^m(q_L;\theta_L) = \frac{L^2 - (\frac{(\mu_H - p)\Delta\theta}{1-p})^2}{4}$ and $\pi^m(q_H;\theta_L) = \frac{L^2 - (\Delta\theta)^2}{4}$.

By (PC_L) and (IC_H), the transfer is as follows:

$$t_L = \pi^m(q_L;\theta_L) - \pi_L^d = \frac{1}{36}[5L^2 + 4Lp\Delta\theta - \frac{(9(\mu_H - p)^2 + p^2(1-p)^2)(\Delta\theta)^2}{(1-p)^2}], \tag{34}$$

$$t_H = t_L + \frac{1}{4}(\frac{(1-\mu_H)\Delta\theta}{1-p})^2$$

$$= \frac{1}{36}[5L^2 + 4Lp\Delta\theta - \frac{(9(1-p)(2\mu_H - p - 1) + p^2(1-p)^2)(\Delta\theta)^2}{(1-p)^2}]. \tag{35}$$

(IC_L) is satisfied: $t_H - t_L = \frac{1}{4}(\frac{(1-\mu_H)\Delta\theta}{1-p})^2 > \pi^m(q_H;\theta_L) - \pi^m(q_L;\theta_L) = \frac{(1-\mu_H)(2p-1-\mu_H)(\Delta\theta)^2}{4(1-p)^2}$, because $\frac{1}{4}(\frac{(1-\mu_H)\Delta\theta}{1-p})^2 - \frac{(1-\mu_H)(2p-1-\mu_H)(\Delta\theta)^2}{4(1-p)^2} = \frac{(1-\mu_H)(\Delta\theta)^2}{2(1-p)} > 0$. (PC_H) must be bound, that is, $\pi^m(q_H;\theta_H) - t_H - \pi_H^d = \frac{\Delta\theta}{12}[2L + \frac{6\mu_H - (2p^2+p+3)}{1-p}\Delta\theta] = 0$. We obtain $\mu_H = \frac{1}{6}[2p^2 + p + 3 - \frac{2(1-p)L}{\Delta\theta}]$.[9] Substituting μ_H, q_L is derived as follows:

$$q_L = \frac{4L - (2p-3)\Delta\theta}{12}. \tag{36}$$

When (31) is satisfied, the expected profit of the FF is as follows:

$$pt_H + (1-p)t_L = \frac{1}{36}[5L^2 + 4Lp\Delta\theta + \frac{[9(1-p)(p - \mu_H^2) - p^2(1-p)^2](\Delta\theta)^2}{(1-p)^2}]. \tag{37}$$

9) When $\Delta\theta = \frac{2(1-p)L}{2p^2+p+3}$ ($\Delta\theta = \frac{2L}{3-2p}$), $\mu_H = 0$ (respectively $\mu_H = p$). It is shown that $0 \le \mu_H \le p$.

3 Comparison of the output and the expected profit

We examine how the asymmetric information affects the output and the expected profit in the equilibrium. q_H and q_L with regard to $\Delta\theta$ can be graphed out with fixing θ_L in Figure 1.

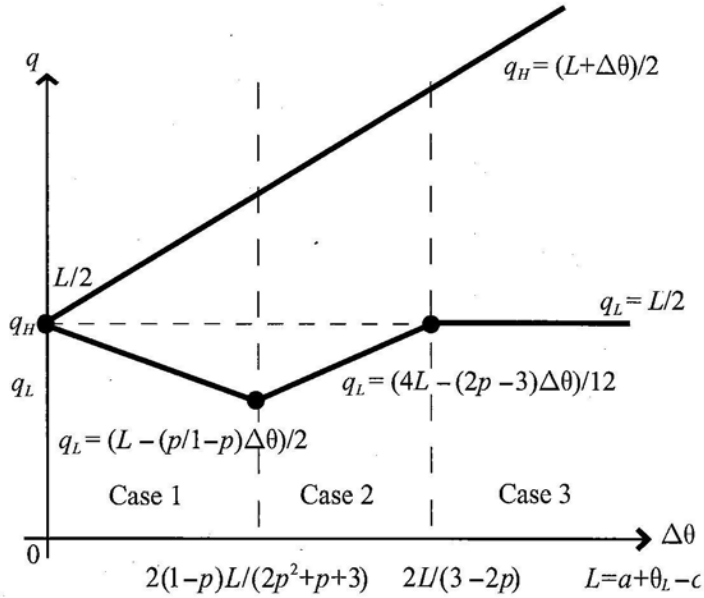

Figure 1: q_H and q_L with regard to $\Delta\theta$

The output of the high demand is always equal to the first-best monopoly output. The output of the low one is less than the first-best if $\Delta\theta$, which is interpreted as the degree of uncertainty, is relatively small. In this case, the merged firm is under provision. It is equal to the first-best output if uncertainty is sufficiently large. The reason is that the reservation payoff depends significantly on the type and this reservation payoff disciplines the DF without any information rent. Thus the countervailing incentive works and the FF need not give the incentive and results in assigning the monopoly output, whichever the types are.

Now we are in a position to state the proposition.

Proposition 1. *When the degree of uncertainty is small, the output level of the low type decreases with* $\Delta\theta$. *When it exceeds a threshold, this output level increases with*

$\Delta\theta$. Finally, when it is sufficiently large, this output level is constant.

This proposition implies that as the degree of uncertainty becomes larger, the countervailing incentive functions more effectively and the FF need not give any information rent to the DF. When the degree of uncertainty is small, the output level of the low type is less than the first-best, although the output of the high type is always equal to the first-best. As the difference of the market size which is the asymmetric information increases, the first-best output is assigned by the FF. When the difference is sufficiently large, the merged firm is engaged in producing at the first-best monopoly level.

As for the merger decision by the FF, we are in a position to state the main proposition.

Proposition 2. *The FF acquires greater expected profit by merging with the DF, whatever the degree of uncertainty is. That is, the FF always decides to merge.*

Proof. We compare the expected profit of the FF in the merger, $pt_H+(1-p)t_L$, with that in the non-merger, π^f. In Case 2, the expected profit of the FF in the merger is denoted by (37). Substituting $\mu_H=0$ into (37), (24) is satisfied. That is, the equation (24) in Case 1 is the special case of (37) in Case 2. First, we consider Case 1 and 2 together. By the above argument, the difference of the expected profit of the FF between $pt_H+(1-p)t_L$ and π^f is calculated as follows:

$$pt_H+(1-p)t_L-\pi^f=\frac{1}{36}[(L-2p\Delta\theta)^2+\frac{9[(p-\mu_H^2)-p^2(1-p)](\Delta\theta)^2}{1-p}]. \tag{38}$$

(38) is calculated by (37) and $\pi^f=\frac{4(L+p\Delta\theta)^2}{36}$. The first-term of the right-hand side of (38) is positive clearly. The numerator of the second-term decreases with $\mu_H, (0\le\mu_H\le p)$. When $\mu_H=p$, this numerator is $9p(1-p)^2(\Delta\theta)^2>0$. Thus (38) is strictly positive. In Case 1 and 2, the FF acquires greater expected profit when merging with the DF. Finally we consider Case 3.[10] The expected profits of FF in the merger and the non-merger are $pt_H+(1-p)t_L=\frac{5(a+\bar{\theta}-c)^2}{36}$ and $\pi^f=\frac{4(a+\bar{\theta}-c)^2}{36}$ respectively. It is clear that $\pi^f<pt_H+(1-p)t_L$ and also in Case 3, the FF acquires larger profit by merging. □

10) In Case 3, the difference of the expected profit, (38), is equivalent only if $\mu_H=p$ and $\Delta\theta=\frac{2L}{3-2p}$.

Proposition 2 implies the following: By the merger, the market structure changes from duopoly to monopoly drastically. From the industrial-wide viewpoint, the optimal coordination of output by a monopoly firm increases the joint profit of the merged firm. Adding to this output coordination, the information acquisition through the contract enables to adjust properly the output level to each demand size and raises the profit. These two effects exceed the agency cost that arises from giving the information rent and distorting the output accompanied with rent reduction. When the demand size is private information for the FF, the information revelation by the DF through the merger contract is desirable for the FF, whichever the demand is high or low. The informational problem is always overcome.

The effects that affect the expected profit can be decomposed into three parts: The first is the output coordination effect by monopolization. The second is the proper adjustment effect by information acquisition. The third is the effect of the agency cost incurred by the information rent to the DF and the distorted output to reduce the rent. In Case 1, the first and the second effects exceed the third effect although the countervailing effect does not work. In Case 2, the first and second effects exceed the third effect, which weakens because the countervailing incentive works in order to bind both participation constraints. In Case 3, both of the output coordination effect and the proper adjustment effect influence the expected profit positively. As the FF need not give any information rent to discipline the DF, the information rent and the distortion on quantity does not occur. As the degree of uncertainty becomes larger, the countervailing effect to the incentive scheme begins to work more significantly and attains the efficient output coordination. As a result, informational distortion does not occur. This is an interesting characteristic of the optimal contract.

We examine how the expected profit of the FF influences by the degree of uncertainty, $\Delta\theta$. By Proposition 2, the expected profit of the FF when merging is always greater than when not merging, whatever $\Delta\theta$ are. However, the difference of the expected profit between π^f and $pt_H+(1-p)t_L$ does not necessarily enlarge with $\Delta\theta$. In Case 1, the difference decreases with $\Delta\theta$. In Case 2 and 3, in which the degree of uncertainty is large, this difference enlarges with $\Delta\theta$.

4 Concluding remarks

We examined whether or not the merger is the profitable choice for the foreign firm, taking into consideration the asymmetric information between the foreign firm and the domestic firm. As a result, the foreign firm always prefers to merge, even if the foreign firm must pay the information rent to the domestic firm in order to gain private information. Further we showed the difference of the expected profit between the merger and the non-merger enlarges as the degree of uncertainty is large.

There are several ways of extension in the paper. In order to analyze the more general competitive environment in the domestic market, the extension to Cournot oligopolistic competition by N firms is needed. However, the proper concept of the equilibrium must be specified under the oligopolistic model. Under the revelation principle that we apply in the model, the optimal contract does not allow to write down the quantity level of other firms. Therefore if we extend the oligopolistic competition, the concepts of the reaction function and the equilibrium need to be reconsidered.

Furthermore, the DF is likely to know more about his own technology than the FF. There exists the asymmetric information on the private cost that only the DF possesses in general. Although we focus on the asymmetric information on the common market information. In this setting, the different offered contract form in merging can be analyzed. Suppose that there exists the cost difference between the FF and the DF. When the FF offers the contract to the DF and the DF reports that his private cost is high, the FF may produce by herself. We presume that the FF delegates all production activities to the DF, since cost is identical. When the costs are different, we need to examine whether the FF can give the proper incentive to the DF to report the cost truthfully.

Acknowledgements

I am grateful to Yasuhiro Takarada and the participants at Contract Theory Workshop (CTW) for helpful comments. The research for this paper is supported by Grants-in-Aid for Scientific Research (KAKENHI 16730095) from JSPS and MEXT of the Japanese Government. The usual disclaimer applies.

References

[1] Banal-Estanol, A. (2002) 'Information-sharing implications of horizontal mergers'. Working paper, Universitat Autonoma de Barcelona.

[2] Collie, D. (2003) 'Mergers and trade policy under oligopoly'. Review of International Economics 11, 55-71.

[3] Das, S.P. and Sengupta, S. (2001) 'Asymmetric information, bargaining, and international mergers'. Journal of Economics and Management Strategy 10, 565-90.

[4] Fudenberg, D. and Tirole, J. (1991) Game Theory. Massachusetts: The MIT Press.

[5] Head, K. and Ries, J. (1997) 'International mergers and welfare under decentralized competition policy'. Canadian Journal of Economics 30, 1104-23.

[6] Lewis, T.R. and Sappington, D.E.M. (1989) 'Countervailing incentives in agency problems'. Journal of Economic Theory 49, 294-313.

[7] Long, N.V. and Vousden, N. (1995) 'The effects of trade liberalization on cost-reducing horizontal mergers'. Review of International Economics 3, 141-55.

[8] Myerson, R.B. (1979) 'Incentive compatibility and the bargaining problem'. Econometrica 47, 61-73.

[9] Qiu, L.D. and Zhou, W. (2003) 'International mergers: incentive and welfare'. Mimeo.

[10] United Nations Conference on Trade and Development (UNCTAD) (2000) 'World Investment Report 2000: cross-border mergers and acquisitions and development'. New York and Geneva: United Nations.