International M&A and
Asymmetric Information on Market Demand

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International M&A and Asymmetric Information
on Market Demand*

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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 about the international mergers, 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.

JEL classification: D82; F12; L13

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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 or its own technology 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. For example, 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 analyzed mergers in the international setting, the articles concerning asymmetric information as one of reasons of mergers are relatively few. As one of recent contributions that consider the 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 analyzed the bargaining situation. They

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\(^1\)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.
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 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 needs 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.

Our concern also shares the similar issue related to the information sharing in oligopoly. Raith (1996) presented a general model in which examines under which conditions oligopolists have an incentive to share private information. The literature on information sharing focuses on whether or not the competitive firms share their private information in the setting of oligopolistic competition, if this sharing does not conflict their interests. Although our paper relates this issue, their literature considers the cartel formation by all firms, but we focus on the acquisition by the FF to the DF as a merger form. Studies on the information sharing premise the equivalent bargaining power among firms. It contrasts with our paper in the sense that we consider the unequal bargaining power between the acquiring firm and the acquired firm. In order to describe the merger offer by the acquiring firm, the paper applies the framework of the principal-agent theory to the international trade theory, which few papers contribute the contract theory to this field of research.

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. examines the effect on the domestic welfare. Section
5. summarizes and concludes.

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. It is assumed that the demand size has two values: $\theta_k \in \{\theta_H, \theta_L\}, \theta_H > \theta_L, \Delta \theta \equiv \theta_H - \theta_L > 0$. The FF knows that $\theta_H$ and $\theta_L$ occur with the probability $p$ and $1 - p$ respectively. It is assumed that $0 < p < 1$. This is 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 $c > 0$. The expected value of $\theta_k$ 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 $\pi^i(q^i, q^j) = (P(Q) - c)q^i = (a + \theta_k - c - (q^d + q^f))q^i; i, j = d, f, j \neq i$. ²

²$\theta_k$ can be reinterpreted as the common marginal cost for both firms.
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 \( \pi_m(q_m) = (P(q_m) - c)q_m = (a + \theta_k - c - q_m)q_m. \)

When the expected profit of the FF in merging is larger than that in not merging, the FF decides to merge.

2.1. Complete information

We consider the complete information as a benchmark. The FF also knows \( \theta_k \). When the FF decides not to merge, both firms are engaged in duopolistic competition. The reaction function of each firm is

\[
q^i_k = \frac{a + \theta_k - c - q^j_k}{2}; i, j = d, f, j \neq i; k = H, L.
\]

The output and the profit in the Cournot-Nash equilibrium are \( q^{i*}_k = \frac{a + \theta_k - c}{2} \) and \( \pi^{i*}_k = (q^{i*}_k)^2 = (\frac{a + \theta_k - c}{2})^2; i = d, f \) respectively.

The merged firm is aware of \( \theta_k \). When FF decides to merge with the DF, the monopoly output and the profit are \( q^m_k = \frac{a + \theta_k - c}{2} \) and \( \pi^m_k = (q^m_k)^2 = (\frac{a + \theta_k - c}{2})^2 \) respectively.

Under the complete information, the FF and the DF prefer to merge obviously. The profit of the merged firm is always larger than the profit sum of both firms before the merger: \( 2\pi^{i*}_k = \frac{8(a + \theta_k - c)^2}{36} < \pi^m_k = \frac{9(a + \theta_k - c)^2}{36} \).

2.2. Incomplete information

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 case.
2.2.1. Non-merger

When the FF decides not to merge, the FF does not know $\theta_k$. 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:

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

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

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

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

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

The following inequalities are immediately obtained:

$$q_H^d > q_H^{d*}, \; q_L^d < q_L^{d*}, \; q_L^f < q_L^{f*} < q_f < q_H^{f*} < q_H^d. \quad (4)$$

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

$$\pi_k^d = (q_k^d)^2 = \frac{(2(a - c) + 3\theta_k - \overline{\theta})^2}{36}, \; \pi_f = (q_f)^2 = \frac{(a + \overline{\theta} - c)^2}{9}. \quad (5)$$

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

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

4 It is assumed that the solution is interior.

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

Next we analyze the acquisition of the DF by the FF.

**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 than when not merging. That is,

\[
\pi^f + E[\pi^d_k] < E[\pi^m_k].
\]  

(6)

It is satisfied that \( \pi^f = \frac{(a+\bar{q} - c)^2}{9} \) and \( E[\pi^d_k] = p\pi^d_H + (1 - p)\pi^d_L = \frac{4(a+\bar{q} - c)^2 + 9\sigma^2}{36} \). As \( E[\pi^m_k] = p\pi^m_H + (1 - p)\pi^m_L = \frac{9[(a+\bar{q} - c)^2 + \sigma^2]}{36} \), the inequality (6) is satisfied.

**No information** We analyze the other 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 \( \pi^m = E[(P(\bar{q}^m) - c)\bar{q}^m] = (a + \bar{q} - c - \bar{q}^m)\bar{q}^m \). Calculating the monopoly output and the profit, it is obtained that \( q^m = \frac{a+\bar{q} - c}{2} \) and \( \pi^m = (\bar{q}^m)^2 = (\frac{a+\bar{q} - c}{2})^2 \).

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.

\[
\pi^f + E[\pi^d_k] < \pi^m \text{ if and only if } \sigma^2 < \frac{(a + \bar{q} - c)^2}{9},
\]  

(7)
where is $E[\pi^d_k] = p\pi^d_H + (1 - p)\pi^d_L$.

If $\sigma^2$ 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.

$$(P(Q_k) - c)q^d + (q^d_k)^2 < (a + \theta_k - \overline{\theta} - c)\overline{q}^n$$ if and only if $\frac{(a + \overline{\theta} - c)^2 - 9(\theta_k - \overline{\theta})^2}{36} > 0$. (8)

If the deviation from the expected value, $\theta_k - \overline{\theta}$, 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 $\theta_k$, but the DF is. 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, $\theta_k$, 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. 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 $\{q_k, t_k\}_{k=\{H,L\}}$.

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6The 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.
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 $π^m(q_l; θ_k) = (a + θ_k - c - q_l)q_l; k, l = H, L$.

The objective function of the FF is as follows:

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

subject to $(IC_H)$ $π^m(q_H; θ_H) - t_H ≥ π^m(q_L; θ_H) - t_L,$

$(IC_L)$ $π^m(q_L; θ_L) - t_L ≥ π^m(q_H; θ_L) - t_H,$

$(PC_H)$ $π^m(q_H; θ_H) - t_H ≥ π^d_H,$

$(PC_L)$ $π^m(q_L; θ_L) - t_L ≥ π^d_L.$

$(IC_k)$ 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 2.2.1. That is, $π^d_k = (q^d_k)^2 = (2(a-c)+3θ_k-\overline{θ})^2. \text{ When the reservation profit depends on the private information, the countervailing incentive may occur.}^{7}$

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:

$$\mathcal{L}(q_k, t_k; λ_k, µ_k; \{k=H,L\}) \equiv [pt_H + (1 - p)t_L]
+ λ_H[(a + θ_H - c - (q_H + q_L))(q_H - q_L) - (t_H - t_L)].$$

$^{7}$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 needs not 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.
\[+ \lambda_L[(a + \theta_L - c - (q_H + q_L))(q_L - q_H) + (t_H - t_L)]\]
\[+ \mu_H[(a + \theta_H - c - q_H)q_H - t_H - \pi_H^d]\]
\[+ \mu_L[(a + \theta_L - c - q_L)q_L - t_L - \pi_L^d].\]

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

\[t_H : p = \lambda_H - \lambda_L + \mu_H; \quad (15)\]
\[t_L : 1 - p = -\lambda_H + \lambda_L + \mu_L; \quad (16)\]
\[q_H : (\lambda_H + \mu_H)[a + \theta_H - c - 2q_H] - \lambda_L[a + \theta_L - c - 2q_H] = 0; \quad (17)\]
\[q_L : (\lambda_L + \mu_L)[a + \theta_L - c - 2q_L] - \lambda_H[a + \theta_H - c - 2q_H] = 0. \quad (18)\]

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 \(t_k + \varepsilon; \varepsilon > 0\). That is, the original contract cannot be optimal. As a result, either constraint binds necessarily. In other words, either \(\lambda_k > 0\) or \(\mu_k > 0\) is satisfied by the slackness condition.

We solve this maximization problem in a heuristic way and clarify the characteristics of the optimal contract. The optimization problem is classified into four 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. \((\mu_H, \mu_L > 0, \lambda_H = \lambda_L = 0)\)

Case 4: \((IC_L)\) and \((PC_H)\) bind. \((\lambda_L, \mu_H > 0, \lambda_H = \mu_L = 0)\)
Case 1 is the usual case in the adverse selection model, in which only the incentive compatibility constraint of the efficient type and the participation constraint of the inefficient type bind. It is shown that Case 4 never occurs in Appendix. Hereafter, it is defined that \( L \equiv a + \theta_L - c \) and \( H \equiv a + \theta_H - c; \Delta \theta = H - L \) for notational convenience. It is assumed that \( L > 0 \).

**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:

\[
q_H = \frac{a + \theta_H - c}{2},
\]

\[
q_L = \frac{a + \theta_L - c - \frac{\pi \Delta \theta}{1-p}}{2}.
\]

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

\[
t_L = \pi^m(q_L; \theta_L) - \pi^d_L = \frac{1}{36}[5L^2 + 4LP\Delta \theta - \frac{p^2(9 + (1-p)^2)(\Delta \theta)^2}{(1-p)^2}],
\]

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

We confirm that the two remaining constraints are satisfied. \((IC_L)\) is satisfied: \( t_H - t_L = \frac{1}{4}[(\Delta \theta)^2 - \frac{(2p-1)(\Delta \theta)^2}{4(1-p)^2}] > 0 \).

It is shown that \((PC_H)\) is satisfied under the following condition. As \( \pi^m(q_H; \theta_H) - \pi^d_H = \frac{\Delta \theta}{12}(2L - \frac{2p^2+p+3}{1-p}) \geq 0 \), the necessary condition to satisfy \((PC_H)\) is as follows:

\[
\Delta \theta \leq \frac{2(1-p)L}{2p^2 + p + 3}.
\]
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:

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

**Case 3** For the simplification of the analysis, we examine Case 3 at first and Case 2 in turn.

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 needs not give any incentive at all. The countervailing incentive works strongly. By (17) and (18), the output level is as follows:

$$q_H = \frac{a + \theta_H - c}{2}, \quad (25)$$

$$q_L = \frac{a + \theta_L - c}{2}. \quad (26)$$

It is satisfied that $q_H = q_H^m > q_L = q_L^m$. Substituting $q_H$ or $q_L$ into the profit function, $\pi^m(q; \theta_k)$ 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:

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

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

We confirm that the two remaining constraints are satisfied. It is satisfied that $\pi^m(q_L; \theta_L) - t_L = \frac{L^2}{4} - \frac{(5L - p\Delta \theta)(L + p\Delta \theta)}{36}$ and $\pi^m(q_H; \theta_L) - t_H = \frac{L^2 - (\Delta \theta)^2}{4} - \frac{(5H + (1 - p)\Delta \theta)(H - (1 - p)\Delta \theta)}{36}$. Thus $(IC_L)$ is satisfied: $(\pi^m(q_L; \theta_L) - t_L) - (\pi^m(q_H; \theta_L) - t_H) = \frac{\Delta \theta^2}{4}[3\Delta \theta + 2(a + \bar{\theta} - c)] > 0$.

It is shown that $(IC_H)$ is satisfied under the following condition. It is satisfied that $\pi^m(q_H; \theta_H) - t_H = \frac{H^2}{4} - \frac{(5H + (1 - p)\Delta \theta)(H - (1 - p)\Delta \theta)}{36}$ and $\pi^m(q_L; \theta_H) - t_L = \frac{H^2 - (\Delta \theta)^2}{4} - \frac{(5L - p\Delta \theta)(L + p\Delta \theta)}{36}$. As the
following inequality, \((\pi^m(q_H;\theta_H) - t_H) - (\pi^m(q_L;\theta_H) - t_L) = \frac{\Delta \theta}{H^2}[(3 - 2p)\Delta \theta - 2L] \geq 0\) is satisfied, 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 needs not give any information rent that exceeds the reservation profit.

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

\[
pt_H + (1 - p)t_L = \frac{p(5H + (1 - p)\Delta \theta)(H - (1 - p)\Delta \theta)}{36} + \frac{(1 - p)(5L - p\Delta \theta)(L + p\Delta \theta)}{36}
= \frac{5(a + \theta - c)^2}{36}. \tag{30}
\]

The following inequality is satisfied: \(\frac{2(1 - p)L}{2p^2 + p + 3} < \frac{2L}{3 - 2p}\). Thus there exists an interval of \(\Delta \theta \in \left[\frac{2(1 - p)L}{2p^2 + p + 3}, \frac{2L}{3 - 2p}\right]\) necessarily. When \(\Delta \theta\) lies in this interval, the optimal contract in Case 1 does not satisfy \((PC_H)\) and that in Case 3 does not satisfy \((IC_H)\). In the case in which both of (23) and (29) are not satisfied, the FF needs to adjust the quantity and the transfer pairs in order to satisfy both constraints. We deal with this case in Case 2. Arranging the condition under which both (23) and (29) are not satisfied, the condition is rewritten as follows:

\[
\frac{2(1 - p)L}{2p^2 + p + 3} \leq \Delta \theta \leq \frac{2L}{3 - 2p}. \tag{31}
\]

**Case 2** When (31) is satisfied, three constraints, \((IC_H), (PC_H)\) 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, it is satisfied that $0 \leq \mu_H \leq p$. As $q_L$ is adjusted in order to bind both constraints, $(IC_H)$ and $(PC_L)$, $\mu_H$ is determined in order to bind three constraints, $(IC_H)$, $(PC_H)$ and $(PC_L)$. It is shown that $q_H (= q_H^m > q_L^m) > q_L$. Substituting $q_H$ or $q_L$ into the profit function, $\pi^m(q_l; \theta_k)$, is calculated as follows: $\pi^m(q_H; \theta_H) = H^2$, $\pi^m(q_L; \theta_H) = \frac{H^2-(1-\mu_H)(\Delta \theta)^2}{4(1-p)}$.

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

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

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

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

It is checked that $(IC_L)$ is satisfied: $t_H - t_L = \frac{1}{4}(1-\mu_H)(\Delta \theta)^2 > \pi^m(q_H; \theta_L) - \pi^m(q_L; \theta_L) = \frac{(1-\mu_H)(2p-1-\mu_H)(\Delta \theta)^2}{2(1-p)^2}$, because $\frac{1}{4}(1-\mu_H)(\Delta \theta)^2 - \frac{(1-\mu_H)(2p-1-\mu_H)(\Delta \theta)^2}{2(1-p)^2} = \frac{(1-\mu_H)(\Delta \theta)^2}{2(1-p)^2} > 0$.

$(PC_H)$ must be bound. That is, $\pi^m(q_H; \theta_H) - t_H - \pi^d_H = \frac{1}{12}[2L + \frac{6\mu_H - (2p^2 + p + 3)}{1-p} \Delta \theta] = 0$.

$\mu_H$ is determined in order to satisfy this equation. By the simple calculation, it is determined that $\mu_H = \frac{1}{4}[2p^2 + p + 3 - \frac{2(1-p)L}{2\Delta \theta}]$. Substituting $\mu_H = \frac{1}{4}[2p^2 + p + 3 - \frac{2(1-p)L}{2\Delta \theta}]$, $q_L$ is derived as follows:

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

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

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

---

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

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3. Comparison of the output and the expected profit

In this section, we examine how the asymmetric information affects the output and the expected profit in the equilibrium. We list the output level, \( q_H \) and \( q_L \), with regard to \( \Delta \theta \) in Table 1.

**Table 1 around here**

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 needs not give the incentive and results in assigning the monopoly output, whichever the types are.

\( q_H \) and \( q_L \) with regard to \( \Delta \theta \) can be graphed out with fixing \( \theta_L \) in Figure 1. Note that the difference between \( q_H \) and \( q_L \) becomes larger as \( \Delta \theta \) becomes larger.

**Figure 1 around here**

Now we are in a position to state the proposition.

**Proposition 1.** When the degree of uncertainty is small \( (\Delta \theta \leq \frac{2(1-p)L}{2p^2+p+3}) \), the output level of the low type decreases with \( \Delta \theta \). When it exceeds a threshold, \( \Delta \theta \geq \frac{2(1-p)L}{2p^2+p+3} \), the output level increases with \( \Delta \theta \). Finally, when it is sufficiently large \( (\Delta \theta \geq \frac{2L}{3-2p}) \), the output level is constant.

This proposition implies that as the degree of uncertainty becomes larger, the countervailing incentive functions more effectively and the FF needs 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.

So far we cover all cases in which the optimization problem should be solved. Now, we are in a position to state the proposition.

**Proposition 2.** The FF acquires larger 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, \( \pi_f \). 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 \( \pi_f \) is calculated as follows:

\[
p t_H + (1 - p)t_L - \pi_f = \frac{1}{36}[(L - 2p\Delta\theta)^2 + \frac{9[(p - \mu_H^2) - p^2(1 - p)](\Delta\theta)^2}{1 - p}].
\]  

(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 \( \mu_H, (0 \leq \mu_H \leq p) \). 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 larger expected profit when merging with the DF.

Next we consider Case 3.\(^{10}\) The expected profits of FF in the merger and the non-merger are

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\(^{10}\)In Case 3, the difference of the expected profit, (38), is equivalent only if \( \mu_H = p \) and \( \Delta\theta = \frac{2L}{3 - 2p} \).
\[ pt_H + (1 - p)t_L = \frac{5(a + \bar{\theta} - c)^2}{36} \]
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. That is, the FF acquires larger expected profit when merging with the DF in all cases.

**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 overcome in this setting.

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 needs 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, $\Delta \theta$. When deciding not to merge, the FF gains the expected profit, $\pi^f = \frac{4(L+p\Delta \theta)^2}{36}$, which increases with $\Delta \theta$. When the FF decides to merge the DF, the expected profit is classified into three cases in Table 2.

**Table 2 around here**

The expected profit of the FF with regard to $\Delta \theta$ can be graphed out with fixing $\theta_L$, when the FF decides to merge or not. By Proposition 2, the expected profit of the FF when merging is always larger than when not merging, whatever $\Delta \theta$ are. However, the difference of the expected profit between $\pi^f$ 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. Welfare and policy implications

4.1. Welfare analysis

In this section, we analyze the effects of the merger to social welfare.

Preferences of the representative consumer in the domestic country are represented by a quasi-linear utility function $V(m, Q) = m + U(Q)$, where $U(Q) = (a + \theta_k)Q - \frac{1}{2}Q^2$. Here, $m$ is the numeraire good, $Q$ is total quantity of the good produced by the DF and the FF. The utility function yields the following inverse demand function: $P(Q) = a + \theta_k - Q$. As there is no
income effect in this formulation, the consumer’s surplus is \( CS(Q;\theta_k) = U(Q) - pQ = \frac{1}{2}Q^2 \). It depends only on the total quantity \( Q \). The producer’s surplus is the profit of the domestic firm, which is denoted by \( PS(\theta_k) \). The social welfare of the domestic country consists of the sum of the consumer’s and the producer’s surplus and it is denoted as \( W \equiv CS(Q;\theta_k) + PS(\theta_k) \).\(^{11}\) The domestic government has only the interest about the social welfare.

It is assumed that the domestic government is unaware of the true demand and knows that \( \theta_H \) and \( \theta_L \) occur with the probability \( p \) and \( 1-p \) respectively.\(^{12}\) The domestic government evaluates the social welfare with the expected value, which is \( E[W] = E[CS(Q;\theta_k) + PS(\theta_k)] \).

When the merger does not occur, the duopoly competition between the DF and the FF follows. In this case, the expected consumer’s surplus is calculated as \( E[CS(Q;\theta_k)] = \frac{1}{2}(pQ_H^2 + (1-p)Q_L^2) = \frac{2(a+\theta-c)^2}{9} + \frac{\sigma^2}{8} \). The expected profit of the DF is as follows: \( E[PS(\theta_k)] = p\pi^d_H + (1-p)\pi^d_L = \frac{4(a+\theta-c)^2}{36} + \frac{3\sigma^2}{8} \). Summing up the consumer’s and the producer’s surplus, the expected social welfare in the non-merger is as follows: \( EW^{NM} \equiv E[CS(Q;\theta_k) + PS(\theta_k)] = \frac{(a+\theta-c)^2}{3} + \frac{3\sigma^2}{8} \).

On the other hand, when the FF decides to merge, the expected consumer’s surplus is as follows: \( E[CS(Q;\theta_k)] = \frac{1}{2}(pq_H^2 + (1-p)q_L^2) \). In the above analysis, the output level is classified into three parts by Table 1 and Figure 1. We list the consumer’s surplus in Table 3.

**Table 3 around here**

By comparing the expected consumer’s surplus when the FF merges or not, it is shown that this consumer’s surplus in the non-merger is always larger than that in the merger. As the

\(^{11}\)Although the domestic government may put some weights on the consumer’s and the producer’s surplus, our analysis remains unchanged in quality.

\(^{12}\)In general, the domestic government familiar with the domestic market may be aware of \( \theta_k \). In this case, the welfare needs to be evaluated with the real value of \( \theta_k \).
consumer’s surplus depends only on the total quantity, we compare the total quantity in both cases. The total quantity in the merger is as follows: \( Q_k = q_k^d + q_k^l = \frac{4L^2 - 63(p-1)}{6}; \) \( k = H, L. \) \( q_k \) is shown in Table 1. It is calculated that \( Q_k > q_k^k; k = H, L \) by the simple calculation.

That is, the expected consumer’s surplus is always larger in the non-merger than in the merger: \( \frac{1}{2}(pQ_H^2 + (1-p)Q_L^2) > \frac{1}{2}(pq_H^2 + (1-p)q_L^2). \)

The reason is that the merged firm chooses the monopoly output and the under-provision accompanied with high price causes deterioration of the consumer’s surplus. For the domestic consumer, the merger is not desirable.

Next, we calculate the expected profit of the DF when the DF is acquired by the FF. The expected profit of the DF is as follows:

\[
E[\pi_k^m - t_k] = p(\pi^m(q_H; \theta_H) - t_H) + (1-p)(\pi^m(q_L; \theta_L) - t_L).
\]

It is classified into three cases like Table 1.

In Case 1, the profits of the high type and the low type are as follows:

\[
\pi^m(q_H; \theta_H) - t_H = \frac{(L+\Delta \theta)^2}{4} - \frac{1}{36}L^2 + 4Lp\Delta \theta - \frac{9(p-2)-11(p-1)^2p^2}{(1-p)^2}(\Delta \theta)^2
\]

and \( \pi^m(q_L; \theta_L) - t_L = \frac{2(a-c)+3\theta-\bar{\theta}}{36} = \frac{(2L-p\Delta \theta)^2}{36} \)

by \((IC_H)\). The expected profit of the DF is as follows:

\[
E[\pi_k^m - t_k] = \frac{4L^2 + 14Lp\Delta \theta - (5p+17p^2)(\Delta \theta)^2}{36}. \]

On the other hand, the expected profit when not to merge is \( E[\pi_k^m] = p\pi_H^d + (1-p)\pi_L^d = \frac{4L^2 + 8Lp\Delta \theta + (9-5p)p(\Delta \theta)^2}{36}. \) The difference between the expected profits is as follows:

\[
E[\pi_k^m - t_k] - E[\pi_k^d] = \frac{p\Delta \theta[2L - \frac{2p^2 + 3}{1-p}]}{12} \geq 0. \tag{39}
\]

If \( \Delta \theta = 0 \) and \( \Delta \theta = \frac{2(1-p)L}{2p^2 + p + 3}, \) the difference between the expected profits is equal to zero. The sign of this difference is strictly positive if \( 0 < \Delta \theta < \frac{2(1-p)L}{2p^2 + p + 3}. \) Thus the merger gives more profit to the DF in Case 1.

In Case 2 and 3, in order to bind \((PC_L)\) and \((PC_H)\), the profits of the high type and the
low type are as follows: \( \pi^m(q_H; \theta_H) - t_H = \pi^d_H \) and \( \pi^m(q_L; \theta_L) - t_L = \pi^d_L \). The expected profit of the DF is as follows: 

\[
E[\pi^m_k - t_k] = p\pi^d_H + (1 - p)\pi^d_L = \frac{4(a+\theta-c)^2 + 9\sigma^2}{36}. 
\]

If \( \Delta\theta \geq \frac{2(1-p)L}{2p^2+p+3} \), the expected profit of the DF in the merger is equal to that in the non-merger. In other words, the merger is indifferent for the DF in Case 2 and 3. When the degree of uncertainty is large, only the reservation payoff is given to the DF. We list the producer’s surplus in Table 4.

**Table 4 around here**

Summing up the consumer’s and the producer’s surplus, the expected social welfare when merging is calculated: 

\[
EW^M \equiv E[CS(Q; \theta_k) + (\pi^m_k - t_k)]. 
\]

The consumer’s surplus in the merger is always larger than that in the non-merger. The producer’s surplus in the merger is equal to that in the non-merger in Case 2 and 3. Therefore the social welfare in the merger is larger in Case 2 and 3.

In Case 1, the consumer’s surplus is larger in the non-merger, but the producer’s surplus is smaller. However, summing up the surplus, it is obtained that the social welfare is large in the non-merger in Case 1, by the tedious calculation. It implies that the loss of the consumer’s surplus exceeds the gain of the producer’s surplus because of the dead-weight loss by monopolization such as the usual argument on monopoly. The information rent given to the DF does not exceed the increase of the consumer’s surplus. The following proposition can be derived.

**Proposition 3.** The expected social surplus is always larger in the non-merger than in the merger.

**Proof.** In the above analysis, we have already shown that the expected consumer’s surplus which depends only on the total quantity is always larger in the non-merger than in the merger, by comparing the total quantity level. In Case 2 and 3, the expected producer’s surplus in the
merger is equal to that in the non-merger. Thus in Case 2 and 3, the expected social surplus is larger in the non-merger than in the merger. In Case 1, the consumer’s surplus in the non-merger is larger, but the producer’s surplus is smaller. We compare directly the difference of the social welfare. The increment of the producer’s surplus by the merger is calculated by (39). the decrement of the consumer’s surplus by the merger is calculated as \( \Delta E[CS(Q; \theta_k)] = \frac{7L^2 + 32Lp\Delta \theta + \frac{\sigma^2(\tau_k + 2)\Delta \theta}{1-p} }{72} \) by Table 3. By the tedious calculation, it is satisfied that \( \Delta E[CS(Q; \theta_k)] - (E[\pi^m_k] - t_k) - E[\pi^d_k]) = \frac{7L^2 + 20Lp\Delta \theta + \frac{\sigma^2(\tau_k + 2)\Delta \theta^2}{1-p} }{72} > 0 \). The decrement of the consumer’s surplus is larger than the increment of the producer’s surplus. Thus it is shown the expected social surplus is always larger in the non-merger than in the merger.

As a result, it is desirable for the domestic government that the FF does not merge with the DF from the viewpoint of the expected social surplus.

4.2. Policy implications

In this section, we briefly argue how the import tariff by the domestic government affects the profitability of the merger. Introducing the import tariff to the FF makes the FF lessen the profit under duopolistic competition. The choice of the merger makes more attractive for the FF. As the consumer’s surplus and the social welfare declines by the merger, the imposition of the tariff that encourages the merger is not desirable for the domestic government, if no regulation concerning the merger such as foreign capital-ratio regulation is accompanied with.

In order to analyze the policy effect of the import tariff, we need to take the cost difference between the DF and the FF into consideration. Although the analysis is more complicated, the fundamental logic is the same as the above analysis. The marginal costs of the DF and the FF
are denoted by $c^d$ and $c^f$ respectively.

In the non-merger case, the reaction function of the DF and the FF are $q^d_k = \frac{a + \theta_k - c^d - q^f}{2}$, $k = H, L$ and $q^f = \frac{a + \theta - c^f - (1-p)q^d}{2}$ respectively. The output pair in the equilibrium is $(q^d_H, q^d_L) = \left( \frac{a + \theta_H - (2c^d - c^f)}{3} + \frac{(1-p)\Delta \theta}{6}, \frac{a + \theta_L - (2c^d - c^f)}{3} - \frac{p\Delta \theta}{6} \right)$ and $q^f = \frac{a + \theta - 2c^f + c^d}{3}$. The profit of the DF is $\pi^d_k = (q^d_k)^2 = \left( 2(a + \theta_k - (2c^d - c^f)) + A\Delta \theta \right)^2$, where $A = 1 - p$ if $k = H$ and $A = -p$ if $k = L$. The expected profit of the FF is $\pi^f = E[(P(Q_k) - c^f)q^f] = (q^f)^2 = \frac{(a + \theta - (2c^d - c^f))^2}{9}$. In the merger case, the FF delegates to produce to the DF and the production cost is $c^d$. In this case, the reservation profit of the DF is $\pi^d_k = (q^d_k)^2 = \left( 2(a + \theta_k - (2c^d - c^f)) + A\Delta \theta \right)^2$; $A = 1 - p$ if $k = H$ and $A = -p$ if $k = L$. If the countervailing incentive does not work, the FF offers the contract that gives more than the reservation profit to the DF.

Suppose that the domestic government imposes the import tariff $T$ per output to the FF. The production cost of the FF becomes higher than that of the DF in the non-merger case. When the initial cost is identical, that is, $c = c^d = c^f$, the cost difference by the imposition of the tariff is $T = c^f - c^d$. The higher the import tariff $T$ is, the smaller the expected profit of the FF is and the larger the profit of the DF is. Because the expected profit of the FF decreases, it looks at a glance that the merger is more desirable for the FF. As the reservation profit of the DF increases, however, we must investigate the effect that influences the reservation profit when the FF offers the contract to the DF. When the FF delegates the FF to produce, as the government cannot impose any tariff to the FF, the cost of the merged firm remains $c$. The characteristic of the optimal contract is the same as we analyzed in the above section. As long as the output coordination effect and the information acquisition effect exceed the demerit by the agency cost, the merger is chosen by the FF. The similar analysis as Section 3. can be shown. As the extreme case, if the import tariff is sufficiently high, the FF cannot make profit.
in duopolistic competition under the incomplete information. However, as the FF decides to merge with the DF, the monopoly profit subtracting the reservation profit of the DF is strictly positive.

It is shown that the merger is always chosen by the FF in Proposition 2. Therefore the imposition of the tariff brings only the effect that transfer from the consumer to the DF. Because the import tariff cannot deter the merger, the policy that imposed the import tariff to the FF is not desirable for the consumer. This policy has only the effect on income redistribution through the rise of the reservation profit of the DF. The revenue by tariff transfers the social welfare from the domestic consumer to the DF. The tariff policy influences the income distribution between the consumer and the producer.

When the domestic government gives the production subsidy, $s$, to the DF, the effect of the subsidy is the same as that of the import tariff. That is, by giving the subsidy to the DF, the cost difference by the subsidy becomes $s = c^f - c^d$. As the merger is always chosen by the FF, the tariff is not paid by the FF. The subsidy to the DF is accompanied with the income transfer from the producer to the consumer through the subsidy.

Therefore instead of the import tariff and the production subsidy, the government should set the policy that deters the FF from entering the domestic market directly, such as foreign capital-ratio regulation or foreign investment restraint. This entry barrier decreases the profit when the FF merges with the DF. Under this regulation on the entry of the FF, the merger becomes less desirable for the FF obviously. As the lump-sum entry fee is paid by the FF to the domestic government when the FF merges, this policy is desirable for the domestic government from the viewpoint of social welfare. The welfare loss by monopolization may be recovered by the entry fee.
5. Concluding remarks

We examined whether or not the merger is the profitable choice for the foreign firm, taking
the asymmetric information between the foreign firm and the domestic firm into consideration.
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 com-
petitive 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. We should also analyze other competitive forms such as price competition,
Stackelberg game and product differentiation, although the model is more complicated.

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. In the
above setting, we presume that the FF delegates all production activities to the DF, since their
cost is identical. When the costs are different, we need to examine whether or not the FF can give the proper incentive to the DF to report the cost truthfully and what is the characteristics of the optimal contract.
Appendix

The proof that Case 4 does not occur

In Case 4, both of (IC\textsubscript{L}) and (PC\textsubscript{H}) bind. It is satisfied that $\lambda_L = 1 - p$ and $\mu_H = 1$ by (15).

By (17) and (18), the output level is as follows: $q_H = \frac{a + \theta_H - c + \frac{(1-p)\Delta \theta}{p}}{2}$ and $q_L = \frac{a + \theta_L - c}{2}$.

Substituting $q_H$ or $q_L$ into the profit function, $\pi^m(q_l; \theta_k)$ is calculated as follows:

$\pi^m(q_H; \theta_H) = \frac{H^2 - (1-p)\Delta \theta^2}{4}$, $\pi^m(q_L; \theta_H) = \frac{H^2 - (\Delta \theta)^2}{4}$, $\pi^m(q_L; \theta_L) = \frac{L^2}{4}$, and $\pi^m(q_H; \theta_L) = \frac{L^2 - (\Delta \theta)^2}{4}$.

The transfer is as follows:

$t_H = \pi^m(q_H; \theta_H) - \pi^d_H = \frac{1}{36} [5H^2 - 4H(1-p)\Delta \theta - \frac{(1-p)^2(9+p^2)(\Delta \theta)^2}{p^2}]$ by (PC\textsubscript{H}).

$t_L = t_H + \frac{1}{4} \frac{(\Delta \theta)^2}{p} = \frac{1}{36} [5H^2 - 4H(1-p)\Delta \theta - \frac{9(1-p)^2 - 1 + p^2(1-p)^2(\Delta \theta)^2}{p^2}]$ by (IC\textsubscript{H}).

We check whether or not both of constraints are satisfied. Although (IC\textsubscript{H}) is satisfied, (PC\textsubscript{L}) is not satisfied: $\pi^m(q_L; \theta_L) - \pi^d_L = \frac{\Delta \theta}{36} [-6L + \frac{2p^2 + 5p - 18}{p} \Delta \theta] < 0$ because $2p^2 + 5p - 18 < 0$. Thus it is shown that this case does not occur.
References


\[
\begin{array}{|c|c|c|}
\hline
\text{Case 1} & \text{Case 2} & \text{Case 3} \\
\hline
\Delta \theta \leq \frac{2(1-p)L}{2p^2+p+3} & \frac{2(1-p)L}{2p^2+p+3} \leq \Delta \theta \leq \frac{2L}{3-2p} & \Delta \theta \geq \frac{2L}{3-2p} \\
\hline
\end{array}
\]

\[
q_H = \frac{L+\Delta \theta}{2} (= q_H^m) \\
q_L = \frac{L-\Delta \theta}{2} (< q_L^m) \\
\]

\[
\frac{4L-(2p-3)\Delta \theta}{12} (< q_L^m) \quad \frac{L}{2} (= q_L^m)
\]

Table 1: \( q_H \) and \( q_L \) with regard to \( \Delta \theta \)

\[
\begin{array}{|c|c|c|c|}
\hline
\text{non-merger} & \text{the expected profit} & \text{Case 1} & \text{Case 2} & \text{Case 3} \\
\hline
\text{merger} & \pi^f & \frac{4(L+p\Delta \theta)^2}{36} & \pi_1 & \pi_2 & \pi_3 \\
\hline
\pi_1 = \frac{5L^2+4Lp\Delta \theta+\frac{p(3-p)(1-p))}{1-p}}{36} & \pi_2 = \frac{5L^2+4Lp\Delta \theta+\frac{p(1-p)\Delta \theta^2}{(1-p)^2}}{36} & \pi_3 = \frac{5(L+p\Delta \theta)^2}{36}. \\
\hline
\end{array}
\]

Table 2: the expected profit of the FF

31
Table 3: the expected consumer’s surplus

<table>
<thead>
<tr>
<th></th>
<th>Case 1</th>
<th>Case 2</th>
<th>Case 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>non-merger</td>
<td>$\frac{1}{2}(pQ_H^2 + (1-p)Q_L^2)$</td>
<td>$\frac{2(L+p\Delta \theta)^2}{9} + \frac{\sigma^2}{8}$</td>
<td>$L^2 + \frac{\sigma^2}{8}$</td>
</tr>
<tr>
<td>merger</td>
<td>$\frac{1}{2}(pq_H^2 + (1-p)q_L^2)$</td>
<td>$L^2 + \frac{\sigma^2}{8}$</td>
<td>$\frac{B}{288}$</td>
</tr>
<tr>
<td>$B = 4(4+5p)L^2 + 8(2p^2+4p+3)L\Delta \theta + (36p + (1-p)(2p-3)^2)(\Delta \theta)^2$.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4: the expected producer’s surplus

<table>
<thead>
<tr>
<th></th>
<th>Case 1</th>
<th>Case 2</th>
<th>Case 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>non-merger</td>
<td>$p\pi_H^d + (1-p)\pi_L^d$</td>
<td>$\frac{4(L+p\Delta \theta)^2 + 9\sigma^2}{36}$</td>
<td>$\frac{4(L^2 + 14pL\Delta \theta - (p+17)p^2(\Delta \theta)^2}{16p}}{36}$</td>
</tr>
<tr>
<td>merger</td>
<td>$E[\pi_k^m - t_k]$</td>
<td>$\frac{4L^2 + 14pL\Delta \theta - (p+17)p^2(\Delta \theta)^2}{16p}$</td>
<td>$\frac{4(L+p\Delta \theta)^2 + 9\sigma^2}{36}$</td>
</tr>
</tbody>
</table>

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