# International Merger: The Role of Asymmetric Information

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**Abstract:** This paper considers the possibility of international merger in the presence of private information regarding demand and cost. It is shown that asymmetric information alone does not explain the failure of merger in a Cournot duopoly market. Asymmetric information coupled with some other market imperfections may cause merger initiative to fail.

**Keywords: International merger, asymmetric information and entry.**

**JEL Classification Numbers**: **D43, D82, G34**, **L41.**

[*] For many of our results in this paper I will closely follow Sinha (2001 and 2006), which are in the context of international joint ventures. I have prepared this paper for the workshop on "Advances in Economics: Some New Directions in Theory and Applications" to be held at Ramakrishna Mission Vidyamandir, Belur Math during December 22-23, 2006.

# 1. Introduction

There is a large theoretical literature on the issue of merger in industrial organization. In the competitive context the question of acquisition or merger under Cournot competition was posed by, among others, Salant et.al. (1983), Farrel and Shapiro (1990), Kamien and Zang (1990), Levin (1990)[1]. Gilbert and Newberry (1992) consider the strategic factors affecting "build or buy" decision of potential entrants. However, in these models with complete information about costs and profits, the central finding is that merger is profitable for the merging firms under duopoly. And in the context of oligopoly the merger is profitable only for a proper subset of firms. The major part of the literature is concerned about the domestic merger.[2] However, in the era of globalization many firms consider the option to merge with a local firm as an important option to enter into the new geographical territory. In other words, the cross border merger is on the rise in the current trend of globalization and foreign investment. Horn and Persson (1999) points out that more than half of the foreign firms' investment occur in the form of mergers and acquisitions. According to UNCTAD, in western industrial countries international mergers made up of more than 60% of total foreign direct investments in 1997 and the number is increasing. Despite the empirical reality there is very little theory on international mergers. Recently Qiu and Zhou (2004) show that under asymmetric information about local market, the information sharing enhances the profitability of a merger between domestic and foreign firm. On the other hand, Das and Sengupta (2001) considered international merger in the presence of private information regarding domestic demand and foreign cost. They established asymmetric information might cause "a hindrance to merger" in the international context. I re-examine the merger issue under both types of asymmetric information as in Das and Sengupta (2001).

The purpose of the paper is to explicitly model a merger game between a foreign firm and a host firm in the presence of private information regarding demand and cost. I show that the asymmetric information alone does not explain the failure to merge in a Cournot duopoly market. I consider an entry game with one foreign firm as entrant and a host firm as incumbent in a particular host market. There are two main sources of asymmetric information in the context of international merger. First, the demand in the host country may be better known to the host firm than the foreign firm which is planning to enter the new country. Second, the cost structure of the

[1] Some of the other papers in merger are Fauli-Oller (1997), Gaudet and Salant (1991), Perry and Porter (1985) etc.
[2] Among the recent literature Banal-Estanol (2004) argues that mergers can be profitable even in unconcentrated markets under uncertainly and private information due to the information sharing effect.

foreign firm may not be known to the host firm in question. Thus, I consider two different scenarios: (1) when the host firm has private information about the local market demand; and (2) when the foreign firm has private information regarding its own cost of production. I show that despite the private information merger will be formed. However, some other imperfections like incomplete contract and high entry cost may complicate the merger process and merger may not be formed for some parameter values. Though the model is best suited for the international merger given the characteristics of asymmetric information, but it would be clear form the analysis that the model can also be applied to domestic merger depending on the asymmetry of information.

The rest of the paper is organised as follows. In Section 2, we describe the basic framework of our analysis and present the complete information version of the game. Section 3 presents the merger game with private information regarding demand. Private information regarding cost is analysed in Section 4. Section 5 concludes the paper.

## 2. Complete information

There is only one host firm in the host country market and there is one foreign firm, which is planning to enter either through acquisition or by direct entry into the same product market. To begin with they have the same technology for production, which means they have the same marginal cost of production. Both parties are risk neutral.

The structure of the game is as follows.

**Stage 1.** The foreign firm makes a merger offer of buying out some shares '***s***' at a price '***p***'.

**Stage 2.** The host firm can either accept or reject the offer.

**Stage 3.** The foreign firm decides whether to enter directly or not.

After this the production takes place and the profit is realised at the end of the period. In case of entry the firms compete a la Cournot with the same cost structure.

We assume that (1) the foreign firm enters if it gets strictly greater payoff than the no-entry option and (2) the host firm accepts the buy-out offer when its payoff is weakly greater than that under rejection. If the foreign firm wants to enter directly it has to incur a set up cost $F$ ($>0$).

First we consider the complete information version of the game where market demand and cost functions are all common knowledge. Suppose the profit under monopoly production is j. We also assume that the total duopoly profits is less than the monopoly profit.

Suppose, the host firm rejects the buy-out offer. After rejection the foreign firm decides whether to enter or not. If it enters then there will be Cournot duopoly competition between the foreign firm and the host firm. Suppose under Cournot duopoly competition, the profit for each unit is $\lambda j$, where $\lambda < 1/2$. We assume that the entry of the foreign firm is credible:

**(A1).** $\lambda j - F > 0$.

Thus, the host firm would get $\lambda j$ by rejecting the foreign firm's offer. This is the host firm's reservation payoff. Since the total duopoly profits is less than the monopoly profit in the host market then there exists gain from merger. In other words, note that the entry of the foreign firm to compete with the host firm involves not only the cost of setting up a business but also a competitive loss due to duopoly competition. So the entry reduces the total surplus in the relationship. Therefore, the foreign firm would try to avoid direct entry to maximise its payoff. Note that the strategy of buying out completely by paying a price $\lambda j$ to the host firm generates the payoff $(j - \lambda j)$ for the foreign firm. This is the maximum payoff the foreign firm can obtain. The foreign firm does not enter after the buy-out, as it owns the business fully. Thus, one option for the foreign firm to merge is to offer the reservation payoff to the host firm and acquire the business fully. From this option the foreign firm would receive $(j - \lambda j)$, which is better than making a direct entry to compete in the host market.

Now we try to find out the other possible equilibrium share buy-out for merger. Note that even after the merger the foreign firm has the option of entry. So to avoid entry in equilibrium the buy-out of share must be such that the entry threat vanishes post merger. Suppose, after the buy-out the host firm holds $\alpha$ share of the business and the foreign firm holds the rest, $(1-\alpha)$. Thus, the foreign firm 's entry threat vanishes post merger, if

$\lambda j + (1-\alpha)\lambda j - F \leq (1-\alpha) j$.

$$\text{i.e., } \alpha \leq \frac{1 + \frac{F}{j} - 2\lambda}{1 - \lambda} = h \text{ (say).} \qquad (1)$$

Thus, for $\alpha \in [0, h]$, the foreign firm does not enter after acceptance of the merger offer. Now the foreign firm by making an acceptable offer of buy-out s(j) shares at price p(j) such that after acceptance, the host firm holds $\alpha$ share and $\alpha j + p(j) = \lambda j$ where $\alpha \in [0, h]$, the foreign firm gets

($j - \lambda j$). This offer will be accepted by the host firm, since by rejection it does not get more as entry will take place after the rejection. So we write our first proposition.

**Proposition 1**. *The foreign firm makes a merger offer such that the host firm gets $\lambda j$ and the host firm accepts that offer. The foreign firm does not enter after the merger.*

Under complete information, the above result is consistent with Salant et.al. (1983).

## 3. Private information regarding demand

Let us suppose that the demand condition in the domestic market is private information of the host firm. For simplicity, we assume that this demand can take two values: high or low. The host firm knows the actual demand in the market. This can be justified on the grounds that a local firm is likely to be better informed about the market demand through its existing social and business networks, or the host firm, being the local agent, might have greater ability to interpret the consumers' reaction to the product. Thus, the host firm has better information about the size of the domestic market. On the other hand, the foreign firm has some prior belief about these states of demand. We denote the monopoly profit in the high state of demand by *X* and in the low state of demand by *Y*. Now depending on the private information, the host firm can be identified as *high type* (if it knows that the demand is high) and *low type* (if it knows that the demand is low). The foreign firm's prior belief about the high state of demand is represented by a probability *q* in the beginning of the game. Since the host firm has private information about the true state of demand, the foreign firm faces an 'adverse selection' problem in buying out shares from the host firm for the merger.

We make the assumption that asymmetric information is resolved just before the production stage. So the production takes place according to the market demand: high or low. We take the same $\lambda$ [3] to be the ratio of duopoly profit to monopoly profit for both states of demand. We assume that the

[3] Consider the inverse demand function $P = A - bQ$ and cost function $C = cQ$ (where A, b and c are positive real numbers; and P and Q are price and quantity respectively). Since any firm produces output after observing the demand, so if the foreign firm believes that the intercept A is uncertain and can take two values $A_1$ and $A_2$ ($A_1 > A_2$) with probability q and 1-q respectively then $X = (A_1 - c)^2 / 4b$ and $Y = (A_2 - c)^2 / 4b$. Under Cournot competition $\lambda = 4/9$ for both states of demand. This analysis can also be carried out more generally with different $\lambda$ for different states of demand. To avoid algebraic complications we take a common $\lambda$ for both states.

entry of the foreign firm is credible irrespective of its prior belief about the demand condition. Since $X>Y$, so we need to assume only the following.

**(A2).** $\lambda Y - F > 0$.

Thus, the reservation payoff of the host firm is $\lambda j$, depending on its type j = X or Y.

## 3. 1 Merger with no-entry commitment

Suppose, the merger takes effect through the purchase of shares from the host firm at a price with the commitment from the foreign firm that in case of acceptance of the merger offer the foreign firm would not enter. Thus, under this commitment contract the stage 3 of the game is modified. Now it should be rephrased as the foreign firm has the option of entry only when the merger offer is rejected. Given the reservation payoffs described above the foreign firm has to make a merger offer (s(j), p(j)) such that following set of constraints are satisfied.

$(1 - s(j))\, j + p(j) \geq \lambda j$ for j = X and Y (2a)

and $(1 - s(j))\, j + p(j) \geq (1 - s(\sim j))\, (j) + p(\sim j)$. (2b)

where ~j is the complement of state j.

The first condition implies that the participation constraint of each type of the host firm must be satisfied and the second set of conditions implies that the offers must be incentive compatible. So any separating contract which is accepted by both types must satisfy the above set of constraints. In pooling contract a single buyout offer is accepted by both types and so only the condition (2a) is relevant.

To solve for the optimal merger offer in the present context let us now mention the strategy of the host firm depending on its type.

High type: Accept any merger offer, which gives a payoff weakly greater than $\lambda X$,
and reject otherwise;

Low type: Accept any merger offer, which gives a payoff weakly greater than $\lambda Y$,
and reject otherwise.

Given the acceptance rule adopted by the host firm, the foreign firm needs to find out the pair of shares and buy-out prices for the merger such that the above participation and incentive compatibility constraints are satisfied. First consider a simple pooling contract where the foreign firm buys out shares $s=1-\lambda$ at a price p = 0, satisfying both the constraints. This offer would be accepted by the host firm irrespective of its types as no type of the host firm does better by

rejecting the buy-out offer, due to entry after rejection. The foreign firm is appropriating the entire surplus from the merger, so it does not have any incentive to make any other unacceptable offer to the host firm. With this pooling contract the foreign firm receives

$q\{X-\lambda X\}+(1-q)\{Y-\lambda Y\}$ (3)

Now a closer look into this adverse selection problem would enable us to establish that there exists a set of separating contracts which do equally well for the foreign firm. Consider the menu of merger offer with the share purchase s(X) and s(Y) leaving shares $\alpha_X$ and $\alpha_Y$ to the high type and low type host firm respectively such that the participation constraints and the incentive constraints are satisfied. To be precise, any $(1-s(X))=\alpha_X \in (\lambda, 1]$ and $(1-s(Y))= \alpha_Y \in [0, \lambda)$ such that $p(X) = (\lambda - \alpha_X)X$ (negative) and $p(Y)=(\lambda- \alpha_Y)Y$ (positive) would constitute a separating contract satisfying the participation constraints with equality leading to the same expected payoff to the foreign firm as in the pooling contract. Intuitively, the foreign firm can choose to hold less shares in the merged business asking some high payment from the high type host firm and choose to hold a large share by offering a low price for the extra shares to the low type host firm. This menu of separating offer will be accepted by the respective types only. Thus, we have,

**Proposition 2.** *With no-entry commitment, when the merger offer consists of a price and share distribution, merger always takes place even though the host firm has private information regarding demand.*

This proposition contradicts Das and Sengupta (2001) which propounded that asymmetric information may be "a hindrance to merger". In their model the merger offer was restricted to a lumpsum payment made by the principal (who makes the offer) to the agent. Whereas in our model the principal (the foreign firm) may offer a menu of shareholding in the merged business along with lumpsum payments (which can be made payable to either party). Also the shareholdings of the sort considered above in a separating contract allows the possibility that the foreign firm can sell the business to host firm in the process of merger if the host firm is high type and it can take over the whole business in case the host firm is a low type. Thus, even restricting the merger offer to lumpsum payments does not block the merger in this case.

## 3. 1 Merger without no-entry commitment

In the above section we have shown that even with asymmetric information merger is not blocked. Now we would show that merger may be blocked if the foreign firm's option of entry is open even after the acceptance of the merger offer. In typical merger phenomenon, the parties are contractually bound not to enter after the merger in the same or related business of the merged entity. However, for the liberalizing economies such as India, it has been observed that the foreign firm has entered with a wholly owned subsidiary in the same product market even after the merger (joint venture to be precise).[4] We now analyse this possibility. For this we take the game as described in the beginning of section 2 and show that merger initiative may fail when the foreign firm does not write a binding contract to stay out of the market after merger.

To analyse the full game first note that the merger offer does not fail with certainty. This is because the foreign firm can offer to merge with the low type host firm by offering a lumpsum payment $\lambda Y$ to own the business completely. This offer will be accepted by the low type host firm as it cannot receive anything more due to the entry after rejection. The high type host firm will reject this offer as it does not get $\lambda X$ $[>\lambda Y]$. Then the entry will occur only for the high type host firm. This strategy is strictly better for the foreign firm as compared to any other strategy which involves the entry of the foreign firm for both types of the host firm.

Given the above discussion only the following class of strategy for the foreign firm is tenable:
S1: Make an offer such that both types accept and enter if rejection occurs[5],
S2: Make an offer such that the low type accepts but the high type rejects and enter if rejection occurs,
S3: Make an offer such that the high type accepts but the low type rejects and enter if rejection occurs,
To find out the range of shareholdings such that entry does not take place after the acceptance of a separating buy-out contract, we define the following critical value of $\alpha$:

$$h_j = \frac{1 + \frac{F}{j} - 2\lambda}{1 - \lambda} \text{ for } j = X \text{ and } Y$$

Note that $h_x < h_y$ since X>Y. Hence, we argue that any separating contract which is acceptable to both types must leave the host firm with the share $\alpha$(j), where j =X or Y such that

[4] See Sinha (2006) for some cases in Indian context.
[5] An offer can be a menu of buyout contracts consisting of various amounts of shares and its corresponding prices.

$\alpha(j) \in [0, h_j]$. (4)

Similarly, under pooling contract the buy-out offer must involve s(j) such that after acceptance, entry does not take place. If the host firm holds $\alpha$ share after buy out ($\alpha$=1-s(j)), then the entry threat would vanish if

$q \{(1-\alpha)\lambda X + \lambda X - F -(1-\alpha)X\} +(1- q) \{(1-\alpha)\lambda Y +\lambda Y - F -(1-\alpha)Y\} \leq 0.$ (5)

Note that as $\alpha$ decreases, the possibility of the condition (5) being satisfied increases.

To determine perfect Bayesian equilibrium we consider the following three possible cases of parameter configurations. Case (1) $\lambda \leq h_x < h_y$, Case (2) $h_x < \lambda < h_y$ and Case (3) $h_x < h_y \leq \lambda$

**Proposition 3.** *In* Case (1) $\lambda \leq h_x < h_y$, *the following strategy combination constitutes a perfect Bayesian equilibrium. The foreign firm makes a pooling merger offer s(j) = (1-*$\lambda$*) at price p(j) = 0 for j=X and Y. Both types of the host firm accept the offer in equilibrium.*

**Proof**: First note that the above pooling offer satisfies the participation constraints for both types of the host firm given by 2(a) and the foreign firm does not enter after the acceptance of the buy-out offer (by (5)). No type of the host firm does better by rejecting the buy-out offer, as the entry would take place after rejection. And the foreign firm does not do any better by making unacceptable offer to any type as in that case (strategy S2 or S3) the entry will take place subsequently after rejection by one type of the host firm. As a result, the payoff of the foreign firm would be less in that equilibrium as compared to the payoff from above strategy.

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Here the foreign firm offers to merge with *1*-$\lambda$ amount of share at zero price. After the merger the entry threat of the foreign firm vanishes as the host firm holds $\lambda$ ($\leq h_x < h_y$) share of the merged business. Both types of the host firm accept the merger offer and entry of the foreign firm never occurs in equilibrium. Note that there exists a range of separating contract, which does equally well for the foreign firm. Consider the contract s(Y) > *1*-$\lambda$ and p(Y) such that the low type host firm gets (*1*- s(Y)) Y + p(Y) = $\lambda$Y and s(X) = *1*- $\alpha_X$ such that $\alpha_X \in (\lambda, h_x)$ with p(X) = ($\lambda$- $\alpha_X$)X (negative). This is a class of such separating contract.

Now we would consider Case 3 and leave the analysis of Case 2 for the reader.

Consider S1 strategy first. We argue that the foreign firm gets more payoff from pooling contract than from separating one when the merger offer is made such that both types of the host firm

accept it. Under separating contract the foreign firm has to buy at least $(1 - h_x)$ amount of shares from the high type by paying $(\lambda - h_x)X$ price to make it acceptable to the high type host firm. By accepting this offer the low type would get $\lambda Y + (\lambda - h_x)(X-Y)$. As a result the total expected payoff to the foreign firm under separating contract when both types accept is given by

$$q\{X-\lambda X\} +(1-q)\{Y - \lambda Y - (\lambda - h_X )(X-Y)\}. \quad (6)$$

On the other hand, for pooling contract we claim that there exists $\alpha^*$ such that, the no-entry condition (5) becomes zero at $\alpha^*$. Thus, if a single menu of merger offer is made which is accepted by both types of the host firm and the host firm holds $\alpha$ share post merger then for any $\alpha \leq \alpha^*$, the foreign firm would not enter post merger. Now $\alpha^* \in (h_x, h_y)$ for any $q\in(0, 1)$. This is because at $\alpha = h_X$ , condition (5) is negative and at $\alpha = h_Y$, the condition (5) is positive. Hence by continuity it follows that $\alpha^*$ exists and belongs to the said range. Also, it is obvious from the definition of $h_X$ and $h_Y$ that for $\alpha < h_X$, the condition (5) is negative for all values of q. Thus the foreign firm can offer any share $\alpha \leq \alpha^*$ to the host firm and still avoids entry in equilibrium. Note that to make the offer acceptable to both types of the host firm the merger offer must consist of a share price such that the high type's participation constraint is satisfied. To avoid excess payment in pooling contract the foreign firm can optimally buy-out $1 - \alpha^*$ amount of share such that the participation constraint is satisfied for the high type. This leads to the low type appropriating some rent. Thus, the low type host firm's payoff under the pooling contract is $\lambda Y + (\lambda - \alpha^*)(X-Y)$. Hence the expected total payoff for the foreign firm under pooling contract when both types accept the merger offer is given by $q\{X-\lambda X\} +(1-q)\{Y - \lambda Y - (\lambda - \alpha^*) (X-Y)\}$. By comparing the payoffs it is clear that the payoff under pooling contract is greater than the separating one since $\alpha^* > h_X$ for $q\in(0, 1)$.

Note that any offer acceptable to the high type host firm would also be acceptable to the low type host firm. Hence strategy S3 is not a feasible option for the foreign firm. Then the only remaining merger offer for the foreign firm is S2, that is to offer very low payoff to the host firm such that only the low type host firm accepts and the foreign firm enters to compete with the host firm in case of rejection.

This offer can be made by completely buying out the low type after paying the reservation payoff $\lambda Y$. This offer will not be accepted by the high type as it would not get its reservation payoff. The merger offer to the low type may be s(Y) and p(Y) such that $1-s(Y) < \lambda$ and $p(Y)= [s(Y) - 1+\lambda]Y$.

A lump*sum* fixed payment λY to the low type host firm for the whole business will also do. Hence, under the strategy S2, the foreign firm would get

$q [\lambda X - F] + (1-q)[Y-\lambda Y]$. (7)

Thus, in case 3 the relevant strategies are S1 (under pooling contract), and S2. Now depending on the payoffs we get the following proposition.

**Proposition 4.** *In case 3, the following strategy combination constitutes a perfect Bayesian equilibrium. There exists a prior probability q* such that the foreign firm chooses the strategy S2 for q< q* and it chooses S1 for q ≥ q*. When the strategy S1 is played, both types accept the offer and when the strategy S2 is played only the low type accepts the offer and the foreign firm enters consequent upon the rejection by the high type.*[6]

Thus, without no-entry commitment merger may not take place. This is due to the fact that without no-entry commitment the foreign firm is restricted to choose merger offer from a constrained set. Thus, asymmetric information *per se* is not responsible for the failure of merger. However, combined with it the incomplete contract on entry blocks the merger under certain parameter configurations.

## 4. Private information regarding cost

Now we introduce another sort of private information into our analysis of international merger. In the context of international entry it is natural to suppose that the foreign firm's cost of production is not known to the host firm. First we would show with help of a linear example that the presence of asymmetric information regarding cost does not block the merger. Then we would move on to show that introducing some market imperfections can lead to a situation where merger may not occur.

Consider the following linear inverse demand function: $P = a - Q$, where $P$ is the price of the good, $a$ is a positive constant and $Q$ is the industry output. Suppose to begin with both the foreign firm and the host firm have a common constant marginal cost $\bar{c}$. Suppose foreign firm has a monopoly access to an R&D project which reduces its marginal cost from $\bar{c}$ to zero with

[6] Note that (6) is greater than (7) for q=1 and (7) is greater than (6) for q=0. Now given the continuity of payoffs q* exists and the result is obtained.

probability q∈*(0, 1) at some R&D cost* (which is not relevant for our merger story). Thus, the foreign firm fails to innovate the technology with probability $(1-q)$. Given the R&D outcome the merger game starts with an asymmetric information, where the host firm does not know whether the foreign firm is successful in R&D or not. The game is as described below.

**Game:** The foreign firm offers to merge with the host firm. The host firm either accepts or rejects the offer. In case of rejection both firms compete *a la* Cournot. In case the merger offer is accepted foreign firm operates in the market under monopoly with the best available technology and host firm receives the merger price.

Note that the host firm would not know the true cost of the foreign firm but the host firm would have a belief about the R&D outcome that the foreign firm is the low cost type (with zero marginal cost) with probability q and the high cost type (with marginal cost $\bar{c}$) with probability $(1-q)$. Given this belief structure what the host firm can expect to get by rejecting the merger offer and then from the subsequent competition (under Baysian equilibrium) is the following:

$$\Pi_H = \frac{1}{9}\left[a - \bar{c} - q\bar{c}\right]^2.^{7} \qquad (8)$$

This is the minimum payoff that needs to be offered by the foreign firm to takeover the host firm. The host firm would accept this offer, as it cannot do any better by rejection. Thus, under a pooling equilibrium when both types of foreign firm offers to merge then both types of foreign firm has to pay the above payoff to the host firm. In this pooling offer, the low cost type foreign firm is paying more than what it would have paid had there been complete information. Note that any attempt by the low cost type foreign firm to offer a less payoff would also be mimicked by the high cost type foreign firm, as a result host firm would do better by rejecting those offers.[8] We need to check whether both cost types of foreign firm would in fact be willing to merge with the host firm by paying $\Pi_H$. To this end we write the following proposition.

**Proposition 5.** *The foreign firm would merge with the host firm irrespective of its cost realization under incomplete information.*

[7] Routine calculation of the Bayesian equilibrium under Cournot duopoly will yield this payoff to host firm (See Gibbons (1991), 146).

[8] There does not exist any separating offer since the low cost type would always offer a complete buy-out offer and the high cost type host firm would always mimic that offer.

**Proof***:* Note that in case the foreign firm does not merge with the host firm, it has to compete with host firm under Cournot duopoly competition. Since there is incomplete information in the market competition stage, the profits of foreign firm under Bayesian equilibrium depending on the private information would be

$\Pi_F(0) = \frac{(2a+\bar{c}+q\bar{c})^2}{36}$, when the private information is marginal cost =0; (9)

$\Pi_F(\bar{c}) = \frac{(2a-2\bar{c}+q\bar{c})^2}{36}$, when the private information is marginal cost = $\bar{c}$. (10)

After merger foreign firm operates in the market as a monopolist. Thus, the low cost type foreign firm would take over host firm by paying $\Pi_H$ if,

$$\frac{a^2}{4} - \frac{1}{9}[a-\bar{c}-q\bar{c}]^2 > \frac{(2a+\bar{c}+q\bar{c})^2}{36}$$

$$\Rightarrow \frac{a^2}{4} > \frac{1}{9}[a-\bar{c}-q\bar{c}]^2 + \frac{(2a+\bar{c}+q\bar{c})^2}{36}$$

Note that the RHS is a strictly convex function of q, attaining a minimum at q= $\frac{(2a-5\bar{c})}{5\bar{c}}$. Therefore, to show that LHS>RHS, it is sufficient that LHS >RHS both at q=1 and 0. Now, by putting q=1 the RHS can attain the value $\frac{(a-2\bar{c})^2}{9} + \frac{(a+\bar{c})^2}{9}$. However, $\frac{a^2}{4} > \frac{(a-2\bar{c})^2}{9} + \frac{(a+\bar{c})^2}{9}$ holds after simplification by assumption $a > 2\bar{c}$. Also, by putting q=0, we find that the RHS attains the value $\frac{(a-\bar{c})^2}{9} + \frac{(2a+\bar{c})^2}{36}$, which is less than $\frac{a^2}{4}$, since $a > \bar{c}$. Thus, we state that the low cost type foreign firm would takeover the host firm.

On the other hand, the high cost type foreign firm would takeover host firm provided,

$$\frac{(a-\bar{c})^2}{4} - \frac{1}{9}[a-\bar{c}-q\bar{c}]^2 > \frac{(2a-2\bar{c}+q\bar{c})^2}{36}.$$

Routine calculation shows that the condition holds. ν

Thus the above analysis shows that the merger will take place between the two firms even with asymmetric information regarding cost of production.

For the following analysis let us assume that the initial marginal costs for both firms are $c_1$ and in case the foreign firm is successful in innovation the marginal cost of the foreign firm becomes $c_2$ ($<c_1$). The new technology is drastic as compared to the existing technology with marginal cost $c_1$. As earlier the probability of successful innovation is q.

Now we make a crucial assumption that the entry of the foreign firm is not feasible when the foreign firm is not successful in its innovation, however, entry is feasible when the foreign firm is successful in innovation. Suppose, the host firm rejects the merger offer from the foreign firm. After rejection, the low cost type foreign firm would enter the host market. In case the high cost type foreign firm also decides to enter then there will be Cournot duopoly competition under incomplete information. Assuming that the host firm produces strictly positive output in such an equilibrium we can fix the parameter zone consistent with our assumption. Assume that in the Baysian Cournot equilibrium the low cost type foreign firm receives a payoff $\Pi_F^d(c_2)$ and the high cost type foreign firm receives $\Pi_F^d(c_1)$. Thus a sufficient condition for the entry to be feasible for low cost foreign firm and not feasible for the high cost foreign firm is given by

**(A3).** $\Pi_F^d(c_2) > F > \Pi_F^d(c_1)$.

We consider the same merger game. Under the assumption (A3), if the foreign firm is successful in innovation, the host firm would receive zero by rejecting the merger offer of the foreign firm, since the foreign firm would enter to monopolise the market consequent upon the rejection. On the other hand, if the foreign firm is not successful in innovation, the host firm can receive the monopoly payoff $\Pi(c_1)$ by rejecting the merger offer since after rejection, the foreign firm would not enter the host market. The host firm has a prior belief that the foreign firm has the new technology with probability q. To find out the equilibrium of the full game let us define a new term $\overline{R}$ such that

$$\overline{R} = (1-q)\,\Pi(c_1), \qquad (11)$$

and obtain the following proposition on the merger outcome of this game.

**Proposition 6.** *There are two types of equilibria of the merger game.*

***Pooling equilibrium:*** *Suppose $\overline{R} \leq F$. Then the foreign firm makes a pooling merger offer to the host firm by paying $\overline{R}$ irrespective of the innovation outcome and the host firm accepts that offer.*

***Separating equilibrium:*** *If* $\bar{R} > F$*, then neither type of the foreign firm makes any merger offer. The low cost type foreign firm (with the new technology) enters to monopolise the market and the high cost type foreign firm (without the new technology) stays out of the host market.*

Proof: (a) Suppose, the host firm undertakes the strategy that it would accept any merger offer (s, p) such that $(1-s)\Pi(c_1)+p \geq \bar{R}$ for any $q \in (0, 1)$ and otherwise, it would reject the buy-out offer with the belief that the offer has come from the high cost type foreign firm (i.e., q = 0). Given this strategy of the host firm, the low cost type foreign firm would make a complete buy-out offer by paying a price $p = \bar{R}$. If the low cost type foreign firm makes a partial buy-out offer which is acceptable to the host firm, then it has to choose s and p such that the host firm gets $(1-s)\Pi(c_1)+p \geq \bar{R}$. In case of a partial buy-out offer, 1-s >0, so the low cost type foreign firm is paying more since $\Pi(c_2) > \Pi(c_1)$. Thus, the low cost type foreign firm does better by a complete buy-out offer as defined above rather than a partial one. Note that given the strategy of the host firm, the low cost type foreign firm would be better off by offering $\bar{R}$ to the host firm. This is because by not making any merger offer and subsequently entering it would incur the setup cost *F*, which is greater than what it pays to completely buy-out the host firm ($\bar{R}$).

Now, we argue that the high cost type foreign firm would replicate this complete buy-out offer. Otherwise, by choosing any partial buy-out offer the high cost type would reveal its identity, since this partial buy-out offer would never be made by the low cost type. In that case, the host firm would reject that offer in order to get the monopoly payoff $\Pi(c_1)$, since the high cost type would not enter after the rejection. Hence, the high cost type would mimic to be low cost type and make the same complete buy-out offer, which gets accepted by the host firm. Also, the high cost type foreign firm would be better off by making that complete buy-out offer rather than making an unacceptable offer and then staying out of the host market to receive zero. Now, given the pooling merger offer of a fixed payment $\bar{R}$, the foreign firm's true identity (as to whether it is high cost type or low cost type) will not be revealed to the host firm. Consequently, the host firm's prior belief about the foreign firm's type will not change. The host firm would accept that offer as by rejection the host firm will get $q.0 + (1-q)\,\Pi(c_1)$, which is equal to $\bar{R}$. Thus, we have a pooling equilibrium outcome with the foreign firm making a merger offer by paying $\bar{R}$ regardless of its technological capability, and the host firm accepting that offer.

(b) It is obvious from the above discussion that any buy-out offer made by the low cost type, such that the host firm gets a payoff less than $\overline{R}$, would also be mimicked by the high cost type foreign firm. The host firm, by rejecting such pooling offer, would get the expected payoff $\overline{R}$, since the low cost type foreign firm would enter and the high cost type foreign firm would stay out of the host market. Therefore, any buy-out offer such that the host firm gets less than $\overline{R}$, would be rejected by the host firm. As a result, if $\overline{R} > F$, then the low cost type foreign firm differentiates itself by entering directly (without making any merger offer) to get $\Pi(c_2) - F > \Pi(c_2) - \overline{R}$. This is because entry is made only by the low cost type foreign firm and observing that entry the host firm updates its belief and produce nothing as it infers that the foreign firm has the drastic technology. Now if the buy-out offer is made, it reveals the information to the host firm that the foreign firm is of the high cost type. So the low type foreign firm has to make the offer by giving a payoff to the host firm, which is equal to $\Pi(c_1)$. Thus, the high cost type foreign firm obtains zero. The high cost type foreign firm may simply stay out of the market without making any such offer to get the same payoff. So the host firm's expected payoff under separating equilibrium is also $\overline{R}$. Thus, if $\overline{R} > F$, the separating equilibrium outcome involves that no merger offer is made by the foreign firm and the low cost type foreign firm enters and the high cost type foreign firm stays out of the host market. g

Let us discuss the intuition of the above proposition. If the entry cost is relatively high, the low cost type foreign firm will have strong incentive to avoid this cost by buying out the host firm rather than entering with a subsidiary. Since the optimal buy-out contract is an upfront price, both types of foreign firms would act in the same manner. This makes it impossible for the low cost type foreign firm to "separate" itself from a high cost type foreign firm. Hence, a pooling equilibrium exists with a fee (which is lower than the entry cost) for merger. If the entry cost is relatively low then the low cost type foreign firm would do better by simply entering the domestic market even if it has to bear the entry cost, since it obtains a high profit as a monopolist with low cost in the domestic market. It is assumed that the high cost type foreign firm would never find it profitable to enter in the domestic market and operate as a duopolist, so the high cost type foreign firm simply stays out of the host market. Thus, a separating equilibrium exists.

The above proposition establishes that market imperfection in the form of high entry cost may lead to no merger being formed. It is important to note that private information regarding cost alone does not account for the blocking of merger, but coupled with the possibility of no entry for some cost parameter lead to the failure of merger.

## 4. Conclusion

In this paper we have investigated the international mergers in a Cournot duopoly set up with asymmetric information. We have clarified that the asymmetric information *per se* is not a hindrance to merger. However, asymmetric information combined with some other market imperfections or incomplete contracts may lead to a failure of merger under Cournot duopoly.

There are quite a few directions in which the paper can be extended. First is how the results change in an oligopoly market. The likelihood of merger goes down with more number of firms unless there are some other gains from mergers such as cost advantages are introduced. We have kept out the issue of information sharing from our present analysis. It is quite challenging to look into this issue in depth (may be in line with Qiu and Zhou (2004)). One might also look into the nature of technological progress and R&D investment by the firms. In a broader context the competition policy relating to the present model may be another interesting area of extension.

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