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FOREIGN MARKET PENETRATION UNDER INCOMPLETE INFORMATION ABOUT PRODUCT QUALITY*

SEON JAE KIM** · YOUNG HAN KIM***

This paper examines the optimal strategies of a firm to introduce a new product into a foreign market, and the effects of the government policy under incomplete information about product quality. The paper demonstrates that it is optimal for a high quality firm (H) to enter the foreign market by choosing foreign direct investment (FDI) when the sunk cost of FDI is sufficiently high, and when foreign consumers are more concerned about product quality because the firm can signal high quality by the choice of the expensive FDI. An export subsidy of the domestic government improves domestic social welfare because the subsidy reduces the upward distortion of the separating price, which is the result of informational externality.

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I. INTRODUCTION

When a firm tries to enter a foreign market with a new product, the first barrier to market penetration is the fact that foreign consumers may not know the firm and its product, and therefore are wary of the new product. Confronted with this type of information problem, firms trying to enter a new foreign market expend a significant amount of resources on market penetration efforts to entice the foreign consumers to try out the new product.

In addition, several empirical studies on the actual pattern of foreign market entry show that most firms trying to introduce new products spend a lot of effort

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** Associate Professor, Department of Economics, Paichai University, Taejon, Korea.
*** Chief Researcher, Samsung Economic Research Institute, Seoul, Korea.

on market penetration processes such as setting up service facilities. That is, many firms choose foreign direct investment(FDI) in sales networks as an entry mode to enter a foreign market at the initial stage without much previous experience and reputation.[1]

An interesting example is the case of Kodak Film Co. in the Japanese market. Even though Kodak has made significant efforts to enter the Japanese market, its present market share is limited to 10% while the market share of its closest rival, Fuji, is over 70%. The biggest market entry barrier faced by Kodak probably is an informational entry barrier, and this is well expressed in a recent article in the New York Times: "A main problem for Kodak lies in the perception of consumers. Retailers say many Japanese consumers believe that Fuji film is superior. Several retailers say that even with a roll of Kodak selling at 20 percent less than Fuji, consumers choose Fuji."[2] Confronted with these informational barriers, not only is Kodak itself trying to overcome this informational problem, but the U.S. government has intervened as well, by filing a suit on behalf of Kodak with the WTO and putting additional pressure on the Japanese government to correct this problem.

In addition, several empirical studies on the actual pattern of foreign market entry show that most firms trying to introduce new products spend a lot of resources on market penetration, such as setting up service facilities. That is, many firms choose foreign direct investment(FDI) in a sales network as an entry mode at the initial stage of market penetration.[3] For example, 40% of the foreign investment by the German auto and metal industry goes toward market penetration efforts, such as setting up a sales network and financing companies in the foreign markets.[4]

Reflecting these trends, Neng (1995) argues based on his empirical study that "when there is high uncertainty and complexity in an industry and foreign buyers' search capacity is limited, that is when foreign buyers have incomplete information, the success in export is a function of superior sales networking, which transmits in-

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[1] See Ali and R. Camp (1993), Benito and Welch (1994), and Woodcock, Beamish, and Makino (1994) for the general description of firms' efforts and strategy to enter foreign markets, and see S. Agarwal and S. Ramaswami (1992), and K. Erramili and C. P. Rao (1993) for the description of the firms' choice of the foreign market entry mode.

[2] See the New York Times, June 11, 1996, p. C1/C5 for a detailed description of entry barriers Kodak confronts in the Japanese market.

[3] See Ali and R. Camp (1993), Benito and Welch (1994), and Woodcock and Beamish (1994) for a general description of firms' efforts and strategies to enter foreign markets, and see S. Agarwal and S. Ramaswami (1992), and K. Erramili and C. P. Rao (1993) for a description of firms' choice of the foreign market entry mode

[4] In case of US manufacturers, 35.9% of the total assets of FDI goes toward non-manufacturing sectors such as the wholesale trade sector and other servicing facilities. In addition, 82.7% of us FDI in the wholesale trade sector was made by US manufacturers. In terms of exports shipped to US FDI affiliates in the wholesale trade sector, 91.3% was made by US manufacturers.

formation effectively to get an export order.[5]

The main purpose of this paper is to provide a formal model to explain the new trends of the foreign market penetration strategies of firms and government intervention as mentioned above. Based on the model, we will examine market equilibria, and determine i) the optimal domestic government's trade policy to correct the informational externality, ii) the effects of government policy on the firm's strategies, and iii) the optimal policy regimes among different types of intervention timing. To focus our discussion on the impact of incomplete information, we examine a situation where the firm which enters the foreign market is a monopoly firm.

This paper examines the following issues: i) What is the effect of incomplete information on the firm's equilibrium market entry strategy? ii) What is the signaling role of different entry modes (FDI or exporting) and pricing strategies? iii) What is the optimal government trade policy to correct the informational externality?[6]

This paper demonstrates that it is optimal for a high quality firm (H) to enter the foreign market by choosing foreign direct investment (FDI) as an entry mode when foreign consumers' marginal rate of substitution between price and quality is low, and the sunk cost of foreign direct investment (FDI) is sufficiently high. The firm chooses the expensive FDI because it has the effect of signaling high quality under incomplete information and, therefore, an additional price signaling is not necessary.

With a downward sloping demand curve, the separating price of a high quality firm is upwardly distorted under incomplete information about product quality when the sunk cost of FDI is not sufficiently high. Therefore, an export subsidy by the domestic government improves domestic social welfare because the export subsidy reduces the upward distortion of the separating price, which is the result of informational externality. An import tariff of the foreign government induces the high quality firm to switch its foreign market entry mode from FDI to exporting when FDI has no tariff-jumping effect.

This paper is organized in 6 sections. Section II describes the model. Section III examines the equilibrium market penetration strategies under incomplete information. Section IV determines how market penetration strategies are influenced when the foreign government levies import tariffs. Section V discusses the effects of the domestic government trade policy. Finally, section VI finishes with some concluding remarks.

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[5] See Neng, L. (1995) for details of the evidence and discussion for the export strategy emphasizing effective networking.

[6] FDI in this paper means FDI in a sales network, not FDI in production facility. The reason why we focus our discussion on FDI in a sales network is to reflect the actual foreign market penetration prosess in which firms usually choose FDI in a sales networks instead of a large scale production FDI. When we change our assumption of FDI to FDI in production facility, the only difference would be a tariff-jumping effect.

II. THE MODEL

We consider a single domestic firm's decision problem of how to introduce a new product into a foreign market when foreign consumers do not know the product quality in the initial period.

Assume that quality, q, can take on two values: high quality (q_H) and low quality (q_L), ($q_H > q_L > 0$), and that the quality level is exogenously determined. The probability that quality is high is δ_H, which is common knowledge. Only the monopolist firm observes the actual quality of the product in the first period.

Assume that each consumer buys one unit of the goods or none. Then each foreign consumer 's surplus is

$$U = \begin{cases} \theta q - bP, & \text{if she buys a unit at price } P; \\ 0, & \text{if she does not buy} \end{cases}$$

where θ is the consumer's taste parameter for quality, b is the parameter which represents the magnitude of the consumer's marginal rate of substitution between price and quality, and P is the product's price.[7] For simplicity, we assume that θ is uniformly distributed over the interval [0, 1]. For any given price, a consumer with a high θ obtains larger utility from a given quality level than a consumer with a low θ. Therefore, a consumer with a high θ is willing to pay a higher price for high quality.

Based on the above assumptions, the demand function can be derived as follows; A consumer will buy the good only when consumer surplus is non-negative, i.e. $\theta q - bP \geq 0$. Therefore, only consumers whose taste parameter is higher than the $\frac{bP}{q}$ will buy the good. Then, based on the assumption of a uniform distribution of the taste parameter, the demand function can be defined as $D = [1 - F(\theta)] = 1 - \frac{bP}{q(w)}$ where $F(\theta)$ is the cumulative distribution function of the taste parameter, w represents the consumers' posterior beliefs about product quality after they update their beliefs from observing the firm's actions, and $q(w)$ is the product quality believed by consumers based on their posterior beliefs.[8]

The monopolist must choose a strategy for marketing the new product. This in-

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[7] With the given utility function, the exact form of the marginal rate of substitution between price and quality is $\frac{dq}{dP} = \frac{b}{\theta}$. Therefore, b is the coefficient which represents the magnitude of the marginal rate of substitution between price and quality. In the demand function and in our further discussion, the consumer's taste parameter θ is canceled out by the assumption of a uniform distribution of the taste parameter between zero and one. Therefore, we use the parameter b to represent the characteristics of the foreign consumers.

[8] From the given demand function, price elasticity of demand is defined as follows: $\frac{dD}{dP}\frac{P}{D} = -\frac{b}{q}\frac{P}{D}$. Therefore, b can be interpreted also as the coefficient which represents the magnitude of the price elasticity of demand.

volves choosing an entry mode, exporting through a foreign sales agent or foreign direct investment (FDI) in a sales network in the foreign market, and a pricing strategy. Exporting through a foreign sales agent involves variable cost S per unit, and FDI involves the sunk cost f. S includes the payment to the foreign sales agent, transportation costs, and other variable costs associated with exporting. The price is set by the exporting firm and not by the sales agent. Production involves a constant marginal cost. This cost is higher for high-quality goods, C_H, than for low quality goods, $C_L < C_H$.

The game proceeds as follows. Nature moves first and determines the product quality type. Then the firm chooses its entry mode, such as FDI in a sales network, or exporting through a foreign local sales agent. After that, the price (P_i) is set by the firm. Consumers then observe the firm's entry mode and the price level, and update their beliefs about product quality. Finally they decide whether to buy the product.

We assume that with a downward sloping demand function, the low quality firm can make non-negative profits from exporting and therefore can exist in the market under complete information about product quality.

The firm's profit functions from exporting and FDI are

$$\Pi_i^{EXP} = (P - C_i - S)[1 - \frac{bP}{q(w)}] \geq 0 \qquad \text{where } i = H, L. \tag{1}$$

$$\Pi_i^{FDI} = (P_i - C_i)[1 - \frac{bP_i}{q(w)}] - f \qquad \text{where } i = H, L. \tag{2}$$

III. EQUILIBRIUM MARKET PENETRATION STRATEGIES

The main concern of this study is how incomplete information about product quality influences the firm's optimal strategy in choosing an entry mode between FDI in sales networks and exporting through a foreign sales agent. The firm's optimal pricing strategy is also to be found. Under incomplete information, the firm has two ways of signaling high quality, i.e. through price signaling and through the choice of FDI.

First, we examine the firm's optimal pricing strategies assuming that only exporting through a foreign sales agent is allowed, as a benchmark of further discussion. We determine the optimal strategies by solving the game for sequential equilibria. A sequential equilibrium consists of a combination of strategies; one for each type of firm and one for each foreign consumer, along with a system of beliefs for the consumer. Beliefs need to be consistent with the equilibrium strategies.[9] However,

[9] More formally, an assessment, which is a combination of strategies and belief systems, is consistent if the belief systems can be determined using Bayes rule when each information set is reached with some positive probability, i.e., when the strategies and the beliefs can be regarede as limits of totally mixed strategies and associated beliefs.

the concept of sequential equilibrium does not restrict the out-of-equilibrium-path belief system, and as a result, there might be multiple sequential equilibria with unreasonable out-of-equilibrium path belief systems. Therefore, we use Cho and Kreps' intuitive criterion to refine these possible unreasonable sequential equilibria (Cho and Kreps, 1987). A sequential equilibrium strategy fails the test of equilibrium domination (Cho and Kreps' intuitive criterion) if a type of player has an incentive to choose a deviation strategy, which is equilibrium dominated strategy for the other type of player. That is, if consumers observe a deviation strategy, which is an equilibrium dominated strategy for a type of player (for example, L), then consumers' beliefs put zero probability on type L. Then, if the other type (in our example, H) can get a strictly higher payoff from the deviation payoff than H's equilibrium payoff, the proposed equilibrium fails to be an intuitive equilibrium, because the out of equilibrium belief system assigned in the sequential equilibrium is not reasonable.

Based on the above sequential equilibrium and equilibrium refinement concept, we examine under what conditions can the exporting firm signal high quality through price signaling. In a separating equilibrium with exporting through a foreign sales agent, in which a firm can signal its actual type, H can signal high quality through price signaling. However, in a pooling equilibrium, in which the firm cannot signal its actual type, and therefore different types of firms choose the same strategy, H cannot signal the quality through price signaling credibly. The conditions for the pooling equilibrium are checked first, and the fact, whether this pooling equilibrium passes the equilibrium refinement, is discussed.

a) Preliminary Results

Consumers decide whether to buy after they observe the entry mode and the price level and after they update their beliefs on product quality. But when the exporting firm charges the pooling price, the consumers' posterior beliefs about product quality will be the same as the prior beliefs. Therefore, the consumers' demand would be determined by the expected quality level which we denote by $q_E \equiv \delta_H q_H + (1-\delta_H) q_L$.

Let $C_E \equiv \delta_H C_H + (1-\delta_H) C_L$. With the pooling price, the consumer' posterior belief is the same as the prior belief. Therefore, the demand function in is

$$D = 1 - \frac{bP}{q_E} \tag{5}$$

The profit functions from exporting at the pooling price is

$$\Pi_i^{EXP}(P_P,\ wP(P) = \delta_H) = (P_P - C_i - S)\left[1 - \frac{bP_P}{q_E}\right] \tag{6}$$

where $i = H$ or L and P_P is the pooling price. w is the consumers's posterior belief about the firm's product quality, and therefore, δ_H is the probability that the poster-

ior belief puts on type H.

It will be shown that the pooling equilibrium with the pooling price does not pass Cho and Kreps' intuitive criteria of equilibrium refinement.

Lemma 1. There is no pooling equilibrium which passes Cho and Kreps' intuitive criterion.

Proof: See Appendix 1 for the proof of Lemma 1.

When a firm is restricted to exporting, H can separate itself from L through price signaling. In a separating equilibrium with exporting, H charges the separating price which signals high quality. L does not mimic H, but chooses its own optimal monopoly price. Through this price signaling, the consumers' beliefs about product quality are credibly updated and, therefore product quality is revealed to consumers.

For a separating equilibrium with exporting to be an intuitive equilibrium, there should be no incentive for H to deviate from the separating equilibrium strategy. It has been already shown that there is no pooling intuitive equilibrium with exporting. Therefore, if H's separating equilibrium payoff is higher than the deviation payoff from choosing the deviation strategy, which is an equilibrium dominated strategy of L, this separating equilibrium is the unique intuitive equilibrium.

Lemma 2. When we suppose that only exporting through foreign sales agent is allowed, the separating equilibrium with exporting is the unique intuitive equilibrium in which H sets its first period price at the separating price, P_S^E, and L sets its price at its monopoly price, $\hat{P}_L^E$ with consumers' belief system which assigns probability 0 to H when consumers observe any price other than P_S^E.

Proof: See Appendix 2 for the proof of Lemma 2.

As shown in Appendix 2, the separating price is higher than H's optimal monopoly price. This upward distortion of the separating price is caused by the fact that we have a downward sloping, price elastic demand function.

b) Equilibrium Market Penetration Strategies

Now, we consider the situation where FDI in a sales network is allowed in addition to exporting through a foreign sales agent as an entry mode. The main questions are 1) when does the firm choose to set up its own sales network rather than choose a sales agent, and 2) to what degree does it distort its price to signal quality?

When the firm chooses FDI in a sales network, the choice of FDI can play the three different signaling roles; 1) a full signal of high quality, which does not require an additional price distortion for signaling purpose, 2) a partial signal of high quality, which requires an additional price distortion for signaling purpose, and 3) not a signal of quality at all. The credibility of FDI as a signal of high quality de-

pends on the magnitude of the sunk cost of FDI because if the sunk cost is very high comparing to the marginal cost of exporting, L will never choose FDI, and if the sunk cost is very low, L will always choose FDI. We consider the equilibrium structure on three different cases of the sunk cost.

i) When $f \geq \bar{f}$ (L never chooses FDI)

If the sunk cost of FDI is sufficiently high so that there is no incentive for L to choose FDI, then FDI is a fully credible signal of high quality. The interval of the sunk cost when FDI is a credible signal is[10]

$$f \geq \bar{f} = \frac{(q_H - bC_L)^2}{4bq_H} - \frac{(q_L - b(C_L + S))^2}{4bq_L} \tag{7}$$

When $f \geq \bar{f}$, H will choose FDI instead of exporting if it can get a higher payoff from choosing FDI than the payoff from exporting as in the following condition: $\Pi_H^{FL}(\hat{P}_H^{FDI}, u(FDI) = 1) - \Pi_H^{EXP}(P_S^E, u(EXP, P_S^E) = 1) \geq 0$ where $\hat{P}_H^{FDI}$ is H's monopoly price with FDI, u(FDI) is the consumers' posterior beliefs about high quality when they observe FDI, and u(EXP, P_S^E) is the consumers' posterior beliefs about high quality when they observe an entry mode of exporting through a foreign sales agent and export separating price. When we substitute profit functions, the above condition is written as

$$f \leq \frac{(q_H - bC_H)^2}{4bq_H} - (P_S^E - C_H - S)\left(1 - \frac{bP_S^E}{q_H}\right) = \bar{f} \tag{8}$$

Proposition 1. a) If $\bar{f} < f \leq \frac{(q_H - bC_H)^2}{4bq_H} - (P_S^E - C_H - S)\left(1 - \frac{bP_S^E}{q_H}\right)$, then there is an unique intuitive separating equilibrium with FDI in which H chooses FDI and its optimal monopoly price $(\hat{P}_H^F = \frac{q_H - bC_H}{2b})$. L firm chooses exporting and its optimal monopoly price $\hat{P}_L^E = (\frac{(q_L - b(C_L + S)}{2b})$. In this separating equilibrium with FDI, H chooses FDI as a signal of high quality.

b) If condition (8) does not hold, then the separating equilibrium with exporting in which H chooses exporting and the export separating price, and L chooses export monopoly price is the unique intuitive equilibrium.

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[10] When FDI is a fully credible signal of high quality, the sunk cost of FDI is sufficiently high that even if L is believed to be H with the choice of FDI, L will get a lower profit than its monopoly profit under complete information. Therefore, there is no incentive for L to choose FDI. In this case, the choice of FDI itself is a credible signal of the high quality. This incentive compatibility condition with the choice of FDI is $\Pi_L^{FDI}(P, u(\text{FDI}) = 1) \leq \Pi_L^{EXP}(P_S^E, u(EXP) = 0)$

$$\Rightarrow (P - C_L)\left[1 - \frac{bP}{q_H}\right] - f \leq \frac{[q_L - b(C_L + S)]^2}{4bq_L}$$

The condition (7) can be obtained by rearranging the above condition. If condition (7) holds, L has no incentive to choose FDI. Therefore, H has no need to signal high quality additionally with price distortion.

Proof: See Appendix 3.

Comparative static analysis of (8) shows that when $\bar{f} \geq f$, if b is relatively low, and H's quality is more differentiated from L, the coefficient interval supporting condition (8) becomes larger. In other words, if foreign consumers are more concerned about quality than price level, it is more likely that H chooses FDI to enter the foreign market than to choose exporting. Consumers' prior beliefs about high product quality have no effect on the firm's behavior and strategies because consumers can always credibly update their beliefs in this model.

ii) When $\bar{f} > f \geq \underline{f}$ (L chooses FDI only if it is believed to be H)

When the sunk cost is not sufficiently high, then L has an incentive to choose FDI if it is believed as H with the choice of FDI. In that case, if H signals its high quality with an additional price signaling, then L has no incentive to mimic H by choosing FDI because its actual quality type is revealed to consumers. In this case, FDI is a partially credible signal of high quality. The interval of the sunk cost when FDI is a partial signal is[11]

$$f > f \geq \underline{f} = \frac{(q_L - bC_L)^2}{4bq_L} - \frac{[q_H - b(C_L + S)]^2}{4bq_H} \tag{10}$$

If FDI is a partial signal of high quality, we obtain three sequential equilibria, and when we refine these sequential equilibria, we obtain a unique intuitive equilibria. When $\bar{f} > f \geq \underline{f}$, H will choose FDI only if its payoff from FDI is higher than its payoff from exporting, as follows: $\Pi_H^{FDI}(P_S^{FDI}, w(\text{FDI}, P_S^{FDI}) = 1) - \Pi_H^{EXP}(P_S^E, w(EXP, P_S^E) = 1) \geq 0$ When we substitute the profit function, the above condition is written as[12]

$$(K - A)(2b(C_H - C_L) - K - A) - bS(2q_H - 2bC_H + bS) \geq 4bfq_H$$

Proposition 2. a) When $\bar{f} > f \geq \underline{f}$, the separating equilibrium with FDI, in which H chooses FDI and the FDI separating price and L chooses exporting and the export monopoly price, is the unique sequential equilibrium satisfying the intuitive criterion if

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[11] The above interval of the sunk cost is derived from the following condition. When the condition (7) does not hold, L has an incentive to choose FDI and get a higher profit if consumers believe the firm to be H when the firm chooses FDI. But if L gets the higher profit from exporting than the profit from FDI when its actual quality type is known to consumers, then, FDI is a partially credible signal of high quality. This is because H has to use the price signaling in addition to choosing FDI to separate itself from L. The left hand side inequality of condition (10) is derived from (7) and the right hand side inequality is derived from the following condition: $\Pi_L^{FDI}(\hat{P}_S^F, w=0) \leq \Pi_L^{EXP}(\hat{P}_S^E, w=0)$

[12] $A = \sqrt{(q_H - b(C_L + S))^2 - (q_H/q_L)(q_L - b(C_L + S))^2}$ and $K = \sqrt{(q_H - bC_L)^2 - [q_L - b(C_L + S)]^2(q_H/q_L) - 4bfq_H}$ When we rearrange (11), we obtain the critical value of the sunk cost: $f = [(K - A)(2b(C_H - C_L) - K - A) - bS(2q_H - 2bC_H + bS)]/4bq_H$

$$(K-A)(2b(C_H-C_L)-K-A)-bS(2q_H-2bC_H+bS)\geq 4bfq_H \quad (11)$$

where $A=\sqrt{(q_H-b(C_L+S))^2-(q_H/q_L)(q_L-b(C_L+S))^2}$

and $K=\sqrt{(q_H-bC_L)^2-[q_L-b(C_L+S)]^2(q_H/q_L)-4bfq_H}$

b) If the condition (11) does not hold, the export separating equilibrium is the unique intuitive equilibrium.
Proof: See Appendix 5.

Comparative statics of the condition (11) shows that when $f>\underline{f}\geq \underline{f}$, if b is relatively low, that is, if foreign consumers are more concerned about quality than price, H prefers to choose FDI with additional price signaling for high quality. In this case, the separating price does not allow any incentive for L to mimic H by choosing FDI. The consumers' prior belief about high product quality has no influence on the firm's strategies in both cases.

iii) When $f<\underline{f}$(L always chooses FDI)

When L's profit from FDI is larger than the profit from exporting under complete information, then L will always choose FDI. In that case, FDI has no role in signaling high quality and therefore, FDI is not a credible signal of high quality at all. The interval of the sunk cost is[13] $f<\underline{f}=\frac{(q_L-bC_L)^2}{4bq_L}-\frac{[q_L-b(C_L+S)]^2}{4bq_L}$.

If $f<\underline{f}$, we obtain 3 sequential equilibria, and when we refine these sequential equilibria using the intuitive criterion, we obtain a unique separating intuitive equilibrium.

H will choose FDI only if it can get a higher payoff from FDI than the payoff from exporting as follows; $\Pi_H^{FDI}(P_S^{FDI}, w(\text{FDI}, P_S^{FDI})=1)-\Pi_H^{EXP}(\tilde{P}_S^L, w(EXP, \tilde{P}_S^L)=1)\geq 0$. When we substitute the profit function, the above condition can be written as $f\leq\frac{(q_H-bC_L-SJ)}{2q_H}$[14]

Proposition 3. a) When $f<\underline{f}$, L gets a higher payoff from choosing FDI than the profit from exporting under complete information. We obtain an unique intuitive separating equilibrium, in which H chooses FDI and the FDI separating price and L chooses FDI and FDI monopoly price under complete information if

[13] The above interval of the sunk cost is derived from the following condition. When the sunk cost of FDI is sufficiently low that L gets a higher profit from FDI than exporting even when its actual quality is known to foreign consumers as follows, then L will choose FDI always because FDI is more cost efficient than exporting, and therefore, FDI has no role of signaling: $\Pi_L^{FDI}(P_{L,H}^{FDI}=0)\leq\Pi_L^{EXP}(P_{L,H}^{L}=0)$.

[14] $J=\sqrt{(q_H-bC_L)^2-(q_L-b(C_L+S))^2(q_H/q_L)}$

$$f \leq \frac{(q_H - bC_L - SJ)}{2q_H} = \underline{f}$$

where $J = \sqrt{(q_H - bC_L)^2 - (q_L - bC_L)^2(q_H/q_L)}$.

b) If $\underline{f} > f > \frac{(q_H - bC_L - SJ)}{2q_H}$, the separating equilibrium, in which H chooses exporting and the separating price, and L chooses FDI and FDI monopoly price, is the unique intuitive equilibrium.
Proof: See Appendix 6.

Comparative statics of the above condition shows that if b is low, and the quality difference between H and L is relatively large, it is more probable that the condition for the separating equilibrium, in which H chooses exporting, holds. As the sunk cost of FDI gets lower, the separating price with FDI should be more upwardly distorted so as not to give L any incentive to mimic H. The intuition behind the comparative statics is that when the sunk cost of FDI is too low, if consumers are more concerned about quality, and H's quality is higher, it is more likely that the separating equilibrium holds, in which H chooses exporting and the separating price, and L chooses FDI because L has less incentive to mimic H by choosing exporting. In addition, we can observe that in the separating equilibrium with exporting, the entry mode choice of exporting has a partial signaling effect because H can separate only through the separating price.

The equilibrium structure based on the different intervals of the sunk cost and the properties of each equilibrium can be summarized in [Figure 1] and [Table 1] respectively.

[**Figure 1**]

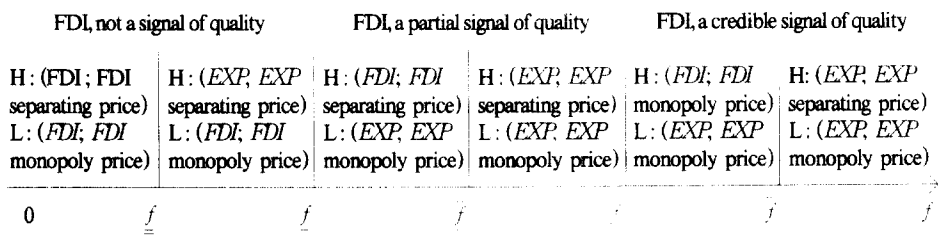

Table 1. Firm's Optimal Strategies

	When FDI is a credible signal of high quality	When FDI is a partially credible signal of high quality	When FDI is not a credible signal of high quality at all
The interval of the sunk cost(f)	$f \geq \underline{f}$	$\bar{f} > f \geq \underline{f}$	$f < \underline{f}$

When b is low and the quality difference is high	H chooses FDI and the FDI monopoly price. L chooses exporting and the export monopoly price.	H chooses FDI and the FDI separating price. L chooses exporting and the export monopoly price.	H chooses exporting and the separating price. L chooses FDI and the FDI monopoly price.
When b is high and the quality difference is low	H chooses exporting and the export separating price. L chooses exporting and the export monopoly price.	H chooses exporting and the export separating price. L chooses exporting and the export monopoly price.	H chooses FDI and the higher FDI separating price. L chooses FDI and the FDI monopoly price.

Ⅳ. MARKET PENETRATION STRATEGIES WHEN THE FOREIGN GOVERNMENT LEVIES TARIFFS

The trade policy of the foreign government can influence the domestic firm's foreign market penetration strategies. When the foreign government imposes a specific import tariff, the import tariff induces the firm to switch from FDI to exporting.

If the foreign government imposes a specifi import tariff on the domestic firm's products, the coefficient interval supporting the separating equilibrium with exporting becomes larger as shown in the followings: When $f > \hat{f}$, if the foreign government imposes a specific import tariff t on a domestic firm's products, the domestic firm's FDI price and the export separating price are increased to

$$P_H^E(t) = \frac{q_H + b(C_H + t)}{2b} \tag{12}$$

$$P_S^E(t) = \frac{q_H + b(C_L + S + t) + \sqrt{[q_H - b(C_L + S + t)]^2 - [q_L - b(C_L + S + t)]^2 \frac{q_H}{q_L}}}{2b} \tag{13}$$

When we substitute these prices into (8), the condition for the intuitive separating equilibrium with FDI, it turns out that the coefficient range supporting FDI separation becomes smaller, that is, the exporting through foreign sales agent becomes more profitable, when FDI is a credible signal of high quality. When the exporting separating price and the FDI price after the tariff are substituted into the condition (8), we obtain

$$f \le \frac{(q_H - b(C_H + t))^2}{4b\, q_H} - (P_S^E(t) - C_H - S - t)\left(1 - \frac{bP_S^E(t)}{q_H}\right) \tag{8}'$$

When we denote the right hand side of the inequality as A, if $\frac{\partial A}{\partial t}$, then it means

that as the foreign government imposes a positive import tariff, the firm's profit under the export separation equilibrium rises relative to the profits under FDI separation. When we substitute (13) into the right hand side of (8)′ and take a partial derivative with respect to the tariff t, we obtain

$$\frac{\partial A}{\partial t}=-\frac{(q_H-b(C_H+t))}{2q_H}-\left(1-\frac{bP_S^E(t)}{q_H}+C_H+S\right)\left(\frac{1}{2}+\frac{1}{2\sqrt{D}}(C_H+S+t)\frac{q_H-q_L}{q_L}\right)<0 \tag{14}$$

where $D=[q_H-b(C_L+S+t)]^2-[q_L-b(C_L+S+t)]^2\frac{q_H}{q_L}$

Therefore, when the foreign government imposes an import tariff, it is more likely that H will switch its entry mode from FDI to exporting.

The economic intuition of this result is that the export separating price increases in a smaller scale than the FDI monopoly price as a result of the import tariff when FDI is a credible signal of high quality, i.e., $f \geq \bar{f}$ as shown in followings:

$$\frac{\partial P_S^E(t)}{\partial t}=\frac{1}{2}-\frac{b(C_L+S+t)(q_H-q_L)}{2q_LR}<\frac{\partial \hat{P}_H^{FDI}(t)}{\partial t}=\frac{1}{2} \tag{15}$$

where $R=\sqrt{\left(\frac{q_H}{q_L}-1\right)(q_Hq_L-b^2(C_L+S+t)^2}$.

As the FDI monopoly price increases more than the export separating price, the FDI monopoly profit decreases more than the export monopoly profit. This means that condition (8) is less probable. Therefore, it is more probable that H firm will switch its entry mode from FDI to exporting when FDI is a signal of high quality.

Even when $f<\bar{f}$, the FDI separating price increases in larger scale than the exporting separating price with the foreign import tariff imposed, therefore, the coefficient interval supporting the separating equilibrium with FDI becomes smaller with the foreign import tariff. That is, a specific import tariff has the same effect as the increase of the variable cost of the firm. Therefore, the optimal monopoly price increases by $t/2$ just as a result of cost increase. But, the separating price is increased less than $t/2$ as a result of the import tariff t. The upwardly distorted separating price reflects the cost increase in smaller scale than the monopoly price. This is easily shown by the fact that the second derivative of the separating price with respect to t is negative while that of the monopoly price is zero; $\frac{\partial^2 P_S^E(t)}{\partial t^2}<0$ *while* $\frac{\partial^2 P_H^{FDI}(t)}{\partial t^2}=0$. Therefore, it is more likely that H switch from FDI to exporting with the foreign import tariff.

The above results and the policy effect of the domestic government discussed in next section are summarized in Table 2.

Table 2. Government's Optimal Policy and Its Effect

	When FDI is a credible signal of high quality	When FDI is a partially credible signal of high quality	When FDI is not a credible signal of high quality at all
The interval of the sunk cost(f)	$f \geq \bar{f}$	$\bar{f} > f \geq \underline{f}$	$f < \underline{f}$
Optimal domestic government policy	No intervention is the best policy.	Export subsidy will improve domestic social welfare.	Export subsidy will improve domestic social welfare.
The effect of the foreign government's import tariff (FDI with no tariff-jumping effect)	It is more probable for H to switch from FDI to exporting.	It is more probable for H to switch from FDI to exporting.	It is more probable for H to switch from FDI to exporting.

V. INTERVENTION BY THE DOMESTIC GOVERNMENT

When there is incomplete information about product quality, H has to distort its price upwardly as a result of informational externality, and this price distortion causes a welfare loss in the domestic country. Therefore, the domestic country can improve its welfare by reducing the upward price distortion. We assume that government cannot verify the product quality *ex ante*.

Proposition 4. If $\bar{f} \geq f$, no intervention is the best policy of the domestic government. If $f < \bar{f}$, a positive export subsidy is the best policy of the domestic government.

Proof: See Appendix 7.

The export subsidy improves domestic social welfare by reducing the upward distortion of the separating price, which is the result of informational externality. This policy effect of the export subsidy can be explained intuitively by observing the change in the separating price. As we can see from (A15), when the government offers an export subsidy, it reduces the upward distortion of the H's separating price. The reduction of the price distortion improves the domestic welfare. However, when FDI is a fully credible signal of high quality, even before the government intervention, there is no price distortion. Therefore, in that case, no intervention is the best policy of the domestic government.

The domestic government intervention has an effect on the firm's entry strategy and this firm's entry strategy change as a result of government intervention has additional welfare effect.

IV. CONCLUDING REMARKS

We investigated how incomplete information about product quality influences the monopolist firm's foreign market penetration strategies. We found that a high quality firm may choose FDI as a way of market penetration even if it is more expensive than exporting. The firm's entry strategies depend on the market characteristics as follows.

If the foreign consumers' price elasticity of demand is high and the quality difference between the high quality and low quality product is small, it is optimal for H to choose exporting through a foreign sales agent and signal high quality just by a price signaling. If the foreign consumers' price elasticity of demand is low and the quality difference between the high quality and low quality product is large, and the sunk cost of FDI is high enough, then it is optimal for H to choose FDI as an entry mode and use the choice of FDI as a signal of high quality and an additional price signal is not necessary. When FDI is a partial signal of high quality, then it is optimal for H to choose FDI and signal high quality additionally through price signaling to separate itself from L.

In the separating equilibrium, the exporting firm signals the quality by the upwardly distorted introductory price, and in that case, a government export subsidy will improve domestic social welfare by reducing the price distortion, which is the result of informational externality. When FDI is a full signal of high quality, there is no price distortion, and therefore, no intervention is the best policy of the domestic government. If the foreign government imposes an import tariff, it is more likely for H to switch from FDI in sales network to exporting when FDI is a signal of high quality and the foreign consumers are more concerned about quality.

APPENDIX

1. The proof of lemma 1.

Proof: a) In the pooling sequential equilibrium, both H and L choose the pooling equilibrium price, P_P^E, with consumers' belief system which assigns probability $\hat{\delta}_H$ to H when they observe the pooling strategy, and puts probability 0 to H if they observe any other strategy. However, we show that the off-the-equilibrium-path belief system of the pooling equilibrium is not intuitive, and fails to pass Cho and Kreps' intuitive criterion. Suppose that if L chooses a deviation price, P′, which is higher than the pooling price, then L is believed to be H by the consumers. Take P' such that

$$\Pi_L^{EXP}(P, q_L, w=1)=\Pi_L^{EXP}(P_P^E, q_L, w=\hat{\delta}_H)$$
$$(P'-C_L-S)\left(1-\frac{bP'}{q_H}\right)=(P_P^E-C_L-S)\left(1-\frac{bP_P^E}{q_E}\right) \quad \text{(A1)}$$

When we substitute the pooling price into (A1), we can solve (A1) for P' as

$$P'=\frac{q_H+b(C_L+S)+\sqrt{[q_H-b(C_L+S)]^2-[q_E-b(C_L+S)]^2\frac{q_H}{q_E}}}{2b} \quad \text{(A2)}$$

It is straightforward that the deviation price P' is higher than L's optimal monopoly price with $w=1$:

$$P'=\frac{q_H+b(C_L+S)+\sqrt{[q_H-b(C_L+S)]^2-[q_E-b(C_L+S)]^2\frac{q_H}{q_E}}}{2b}$$
$$>\hat{P}_L(w=1)=\frac{q_H+b(C_L+S)}{2b}$$

Therefore, when L chooses a price which is higher than P', which is already higher than the optimal monopoly price, it obtains a lower payoff. Then, $P'+\varepsilon$ is an equilibrium dominated strategy for L because

$$\Pi_L^{EXP}(P', \varepsilon, p_L, w=1)<\Pi_L^{EXP}(P_P^E, q_L, w=\hat{\delta}_H)$$

Therefore, if consumers observe the above deviation strategy, consumers' belief put zero probability on type L. Now, we check whether there is any incentive for H to deviate from setting the price at the pooling equilibrium price to the devia-

tion strategy, which is an equilibrium dominated strategy for L.

$$\Pi_H^{EXP}(P', q_H, w=1)=\Pi_H^{EXP}(P_P^E, q_H, w=\delta_H)$$

$$=(P'-C_H-S)\left(1-\frac{bP'}{q_H}\right)-(P_P^E-C_H-S)\left(1-\frac{bP_P^E}{q_E}\right) \tag{A3}$$

If (A3) turns out to be positive, it means that there is an incentive for H to deviate from the pooling equilibrium. When we substitute (A1) into (A3), (A3) can be rewritten as

$$\Pi_L^{EXP}(P', q_L, w=1)=\Pi_L^{EXP}(P_P^E, q_L, w=\delta_H)$$

$$=\Pi_H^{EXP}(P', w=1)-\Pi_L^{EXP}-\Pi_L^{EXP}(P', w=1)-\Pi_H^{EXP}(P_P^E, w=\delta_H)+\Pi_L^{EXP}(P_P^E, w=\delta_H)$$

$$=(P'-C_H-S)\left(1-\frac{bP'}{q_H}\right)-(P'-C_L-S)\left(1-\frac{bP'}{q_H}\right)$$

$$-(P_P^E-C_H-S)\left(1-\frac{bP_P^E}{q_E}\right)+(P_P^E-C_L-S)\left(1-\frac{bP_P^E}{q_E}\right)$$

$$=(C_H-C_L)\left(\frac{bP'}{q_H}-\frac{bP_P^E}{q_E}\right)$$

$$=\frac{(C_H-C_L)(q_E\sqrt{[q_H-b(C_L+S)]^2-[q_E-b(C_L+S)]^2\frac{q_H}{q_E}}-b(q_H-q_E)(C_L+S)]}{2q_Hq_L} \tag{A4}$$

We can check the sign of (A4) by checking the sign of (A5)

$$q_E\sqrt{[q_H-b(C_L+S)]^2-[q_E-b(C_L+S)]^2\frac{q_H}{q_E}}-b(q_H-q_E)(C_L+S)] \tag{A5}$$

and the sign of (A5) is same as (A6).

$$q_E^2\left([q_H-b(C_L+S)]^2-[q_E-b(C_L+S)]^2\frac{q_H}{q_E}\right)-\left(b(q_H-q_E)(C_L+S)\right)^2$$

$$=(q_H-q_E)q_H[q_E+b(C_L+S)][q_E-b(C_L+S)]>0 \tag{A6}$$

Therefore, H has an incentive to deviate from the pooling equilibrium to a P' at which consumers believe that the firm is H, thus obtaining a higher profit. Hence, the pooling equilibrium fails to pass the Cho and Kreps' intuitive criteria for equilibrium refinement. An intuitive pooling equilibrium does not exists because the demand function is downward sloping in this model. The proof of non-existence of

the FDI pooling equilibrium follows the same way.

2. The proof of lemma 2

The export separating price is derived from L's self-selection condition, which does not give L any incentive to mimic H. Therefore, when L chooses the separating price, L's maximum profit should be lower or equal than its monopoly profit under complete information. L's profit from choosing a separating price is

$$\Pi_L^{EXP}(P_S^E,\ w=1)=(P_S^E-C_L-S)[1-\frac{bP_S^E}{q_H}] \tag{A7}$$

When L chooses a separating price, profit should be equal or less than the L's profit with its monopoly price as in (A17). L's optimal monopoly profit from exporting is

$$\Pi_L^{EXP}(P_L^E, w=0)=\frac{[q_L-b(C_L+S)]^2}{4bq_L} \tag{A8}$$

Therefore, L's self-selection condition is

$$\Pi_L^{EXP}(P_S^E,\ w=1)\leq\Pi_L^{EXP}(P_L^E,\ w=0)$$

$$(P_S^E-C_L-S)[1-\frac{bP_S^E}{q_H}]\leq\frac{[q_L-b(C_L+S)]^2}{4bq_L} \tag{A9}$$

When we solve the binding condition of the above condition for the separating price, we obtain two separating prices as follows:

$$\begin{aligned}\bar{P}_S^E&=\frac{q_H+b(C_L+S)+\sqrt{[q_H-b(C_L+S)]^2-[q_L-b(C_L+S)]^2\frac{q_H}{q_L}}}{2b}\\ \underline{P}_S^E&=\frac{q_H+b(C_L+S)-\sqrt{[q_H-b(C_L+S)]^2-[q_L-b(C_L+S)]^2\frac{q_H}{q_L}}}{2b}\end{aligned} \tag{A10}$$

When we compare profits from these two separating prices, we can see that the profit from the high separating price is dominant one as follows. The intuition is that the high separating price is closer to H's optimal monopoly price under complete information. Therefore, the high separating brings the higher profit to H than the low separating price as shown in follows.

$$\Pi_H^{EXP}(P_S^E, C_H, u(P_S^E)=1)-\Pi_H^{EXP}(P_P^E, C_H, w(P_S^E)=1)$$

$$=\frac{(C_H-C_L)\sqrt{(q_H-b(C_L+S))^2-(q_L-b(C_L+S))^2}\,q_H/q_L}{q_H}>0$$

Therefore, the high separating price is the sequential separating price. When H sets its price as above, L has no incentive to mimic H and therefore sets its price at its own monopoly price. Because there is no pooling sequential equilibrium, there is no incentive for H to deviate from this separating equilibrium. The H obtains the non-negative profit from choosing the separating price and the L's export monopoly price is also positive. Therefore the individual rationality condition is also satisfied. Hence, the separating equilibrium is the unique sequential equilibrium which passes the intuitive criteria of equilibrium refinement. QED.

3. The proof of Proposition 1.

Proof: For the separating equilibrium with FDI to be an intuitive equilibrium, the out of equilibrium path belief system should be reasonable. That is, each player should not have any incentive to deviate to an out of equilibrium strategy, which is an equilibrium dominated strategy for other type of player.

(EXP, Export separating price) is an equilibrium dominated strategy for L, because $\Pi_L^{EXP}(P_S^E, w(EXP, P_S^E)=1)\leq\Pi_L^{EXP}(P_L^L, w(P_L^L)=0)$. Therefore, if consumers observe P_S^E, their beliefs put zero probability on type L. The above equilibrium is an intuitive equilibrium if H has no incentive to deviate to the out of equilibrium strategy, which is an equilibrium dominated strategy for L as follows:

$$\Pi_H^{FDI}(P_H^{FDI}, q_H, w(FDI)=1)-\Pi_H^{EXP}(P_S^E, q_H, w(EXP, P_S^E)=1)\geq 0.$$

When we substitute specific profit function into the above condition, we obtain

$$\frac{(q_H-bC_H)^2}{4bq_H}-f\geq(P_S^E-C_H-S)\left(1-\frac{bP_S^E}{q_H}\right) \tag{A11}$$

Condition (8) is derived by rearranging (A11). Because there is no pooling equilibrium with FDI, if (8) holds, the separating equilibrium with FDI is the unique sequential separating equilibrium satisfying the intuitive criterion, because the out of the equilibrium path belief system is reasonable. QED.

4. The supplement to the proof of proposition 1: Comparative statics

Proof: When the separating price is substituted, the condition (A11) can be rearranged as follows:

$$\left((q_H - bC_H)^2 - 4bq_H f - [q_H + b(C_L - 2C_H - S) + A][q_H - b(C_L + S) - A]\right)/(4bq_H) \geq 0 \quad \text{(A12)}$$

where $A = \sqrt{[q_H - b(C_L + S)]^2 - [q_L - b(C_L + S)]^2 \frac{q_H}{q_L}}$

Denote the left term of the above condition as B. When we take the partial derivative of the left hand side term in (A12) with respect to b, we obtains a negative sign.

$$\frac{\partial B}{\partial b} = -\frac{A^2 + b(2AA' + 2A'(C_H + S) + 2b(S(2C_H + S) + C_L(2C_H - C_L)) - C_H^2) + S)](C_H + S))}{4q_H b^2} < 0 \quad \text{(A13)}$$

where $A = \sqrt{[q_H - b(C_L + S)]^2 - [q_L - b(C_L + S)]^2 \frac{q_H}{q_L}}$,

$$A' = \frac{b(C_L + S)^2(q_H - q_L)}{q_L \sqrt{[q_H - b(C_L + S)]^2 - [q_L - b(C_L + S)]^2 \frac{q_H}{q_L}}} > 0$$

When we take a derivative of B with respect to q_H, we obtain a positive sign as follows:

$$\frac{\partial B}{\partial q_H} = q_H^2 - b^2 C_H^2 + (1 + A^{-1/2})\left((2(q_H - b(C_L + S)) - (q_L - b(C_L + S))^2/q_L\right) + 2A - bC_H > 0$$

where $A = \sqrt{[q_H - b(C_L + S)]^2 - [q_L - b(C_L + S)]^2 \frac{q_H}{q_L}}$.

Third, as we can see from (A11), there is no prior belief term, δ_H in (A11). Because there is no pooling equilibrium satisfying the intuitive criterion and because the consumers' beliefs are always credibly updated, the consumers' prior beliefs have no influence on either the firm's behavior or the conditions of the separating equilibrium. QED.

5. The proof of Proposition 2.

Proof: When $\bar{f} > f \geq \underline{f}$, the firm's strategy to choose exporting and export separating price, (EXP, P_S^E), is a deviation strategy which is an equilibrium dominated strategy for L in the separating equilibrium with FDI. If H gets a lower profit from choosing the deviation strategy rather than its equilibrium payoff, then the proposed separating equilibrium with FDI is an intuitive equilibrium. Therefore, if the following condition holds, the FDI separating equilibrium is an intuitive equilibrium.

$$\Pi_H^{FDI}(P_S^{FDI}, u(\text{FDI}, P_S^{FDI})=1)-\Pi_H^{EXP}(P_S^E, u(EXP, P_S^E)=1)\geq 0$$

When we substitute the profit function into above condition, we obtain

$$\begin{aligned}&(q_H+b(C_L-2C_H)+K)(q_H-bC_L-K)-4bq_Hf\\&\quad-(q_H+b(C_L-2C_H-S)+A)(q_H-b(C_L+S)-A)\geq 0\end{aligned}$$

The above condition can be simplified as

$$(A-K)(A+K-2b(C_H-C_L))-bS(2q_H-2bC_H+bS)\geq 4bfq_H$$

where $A=\sqrt{(q_H-b(C_L+S)^2)-\frac{q_H}{q_L}(q_L-b(C_L+S)^2)}$

and $K=\sqrt{(q_H-bC_L)^2-[q_L-b(C_L+S)]^2\frac{q_H}{q_L}-4bfq_H}$ QED.

6. The proof of Proposition 3.

Proof: When $f<\underline{f}$, (EXP, export separation price) is an equilibrium dominated strategy for L because L gets a higher equilibrium payoff from FDI than the payoff from exporting when FDI separating equilibrium holds, in which both H and L choose FDI. Therefore, FDI separating equilibrium FDI is an intuitive equilibrium if the following condition holds:

$$\Pi_H^{FDI}(P_S^{FDI}, u(FDI, P_S^{FDI})=1)-\Pi_H^{EXP}(\tilde{P}_S^E, u(EXP, \tilde{P}_S^E)=1)\geq 0.$$

When we substitute the profit function into the above condition for the intuitive equilibrium, we obtain

$$\Pi_H^{FDI}(P_S^{FDI},\ w(FDI,\ P_S^{FDI})=1)-\Pi_H^{EXP}(P_S^{E},\ w(EXP,\ P_S^{E})=1).$$

$$=\frac{(q_H+b(C_L-2C_H)+J)(q_H-bC_L-J)-(q_H+b(C_L-2C_H-S)+K)(q_H-b(C_L+S)-K)}{4bq_H}-f\geq 0$$

if $f\leq\frac{(q_H-bC_L-SJ)}{2q_H}$,

where $J=\sqrt{(q_H-bC_L)^2-(q_L-bC_L)^2(q_H/q_L)}$

and $K=\sqrt{(q_H-b(C_L+S))^2-(q_L-bC_L)^2(q_H/q_L)+4bfq_H}$.

Therefore, if the sunk cost is relatively low, the separation equilibrium, in which both H and L choose FDI and H chooses FDI separation price, and L chooses the optimal monopoly is the unique intuitive equilibrium. In this case, the choice of FDI has no signaling effect because L also chooses FDI. QED.

7. The Proof of Proposition 4.

When FDI is a fully credible signal of high quality, there is no price distortion because H chooses the FDI monopoly price. The firm's strategy to maximize its profit also maximizes social welfare, and therefore, no intervention is the best policy of the domestic government.

If $f<\bar{f}$, the separating price is upwardly distorted as a result of informational externality. Therefore, a government intervention to reduce this informational externality will improve domestic social welfare. The domestic social welfare function from export separation with an export tax t is

$$W_S^{EXP}=\delta_H\Pi_H^{EXP}(P_S^{E}(t))+(1-\delta_H)\Pi_L^{EXP}(P_L^{E}(t))+t\left(\delta_H D(P_S^{E}(t))+(1-\delta_H)D(P_L^{E}(t))\right) \qquad \text{(A14)}$$

where t is a specific export tax per unit of export. (If $t<0$, it is an export subsidy.)

If the government intervenes with an export tax t, it can be interpreted as a increase of the variable cost of H and L. Then we can rewrite the welfare function as follows:

$$W_S^{EXP}=\delta_H(P_S^{E}(t)-C_H-t-S)\left(1-\frac{bP_S^{E}(t)}{q_H}\right)$$
$$+(1-\delta_H)\frac{[q_L-b(C_L+t+S)]^2}{4bq_L}+t\left(\delta_H\left(1-\frac{bP_S^{E}(t)}{q_H}\right)+(1-\delta_H)\left(1-\frac{b\hat{P}_L^{E}(t)}{q_L}\right)\right) \qquad \text{(A15)}$$

where

$$P_S^E(t)=\frac{q_H+b(C_L+S+t)+\sqrt{[q_H-b(C_L+S+t)]^2-[q_L-b(C_L+S+t)]^2\frac{q_H}{q_L}}}{2b}$$

$$\hat{P}_L^E(t)=\frac{q_L+b(C_L+S+t)}{2b}.$$

When we solve the first order condition of the social welfare maximization problem for t, the optimal policy turns out to be a negative tax, that is a positive subsidy as follows:

$$\frac{\partial W_S^{EXP}}{\partial t}=0$$

$$t^*=-\frac{\delta_H\left(1-\frac{q_H-b(C_L+S)}{2q_H}\right)P_S'+(1-\delta_H)\left(1-\frac{q_L-b(C_L+S)}{8bq_L^2}\right)}{A}<0 \qquad \text{(A16)}$$

where A is a positive constant and $P'>0$

Therefore, the optimal government policy is a negative export tax, i.e. a positive export subsidy. QED.

REFERENCES

Agarwal S. and S. Ramaswami, "Choice of Foreign Market Entry Mode: Impact of Ownership, Location and Internationalization Factors," *Journal of International Business Studies*, Vol. 23, 1992, 1-27.

Ali, A and R. Camp, "The Relevance of Firm Size and International Business Experience to Market Entry Strategies," *Journal of Global Marketing*, Vol. 6, 1993, 91-111.

Bagwell, K and R.W. Staiger, "The Role of Export Subsidies When product Quality is Unknown," *Journal of International Economics*, Vol. 27, 1989, 69-89.

Bagwell, K and M. Riordan, "High and Declining Prices Signal Product Quality," *American Economic Review*, Vol. 81, 1991, 224-239

Benito G. and L. Welch, "Foreign Market Servicing: Beyond Choice of Entry Mode," *Journal of International Marketing* , Vol. 2, 1994, 7-27.

Chen, M. L., "The Role of R&D Subsidies When Product Quality is Unknown", *Journal of International Economics*, Vol. 31, 1991, 251-270.

Cho, I. K. and D. M. Kreps, "Signaling Games and Stable Equilibria," *Quarterly Journal of Economics*, Vol. 102, 1987, 179-211.

Grossman, G. and H. Horn, "Infant-industry Protection Reconsidered: The Case of Informational Barrier to Entry," *Quarterly Journal of Economics*, Vol. 103, 1988, 767-87.

Horstmann, I. and J. Markusen, "Endogenous Market Structure in International Trade," *Journal of international Economics*, Vol. 32, 1992, 109-129.

Erramilli, K. M. and C. P. Rao, "Service Firm's International Entry-mode Choice: A Modified Transaction-Cost Analysis Approach," *Journal of Marketing*, Vol. 57, 1993, 19-38.

Martin, S., "Oligopoly Limit Pricing: Strategic Substitute, Strategic Complements," *International Journal of Industrial Organization*, Vol. 13, 1995, 41-65.

Mayer, W., "The Infant Industry Argument," *Canadian Journal of Economics*, Vol. 17, 1984, 249-269.

Motta, M., "Endogenous Quality Choice: Price vs. Quantity Competition," *The Journal of Industrial Economics*, Vol. 51, 1993, 113-131.

Smith, A., "Strategic Investment, Multinational Corporations and Trade Policy," *European Economic Review*, Vol. 31, 1987, 89-96.

Spulber, D., "Bertrand Competition when Rivals' Costs are Unknown," The *Journal of Industrial Economics*, Vol. 53, 1995, 1-11.

Tirole, J., *The Theory of Industrial Organization*, MA: MIT Press, 1998.

Woodcock, C.P. and P. Beamish, and S. Makino, "Ownership-based Entry Mode Strategies and International Performance," *Journal of International Business Studies*, Vol. 25, 1994, 253-273.