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*Foreign direct investment and export under imperfectly
competitive host-country input market*

by

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Abstract: In this paper we examine entry decision of a foreign firm when the input market in the host-country is imperfectly competitive and production requires non-tradable inputs. We show that the foreign firm's strategic choice about FDI and export may affect the price of input in the host-country significantly and provides a rationale for doing both FDI and export at the same time. So, unlike the previous works focusing on the *exogenous factors* to explain that FDI and exports may be 'complement', we show that it may happen when the strategic actions of the foreign firms affect an *endogenous variable* in its favor. We show that this result is robust even if there is competition in the host-country market or the input market in the home country is imperfectly competitive.

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Keywords: Export, Foreign direct investment, Imperfectly competitive input market

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Non-Technical Summary

Empirical evidences suggest that foreign direct investment (FDI) and export can be either substitutes or complements. While the possibility of substitutability between FDI and export has attracted sufficiently large amount of theoretical attention, recent theoretical literature has paid attention to explain that FDI and exports are complements. In this paper we show that FDI and export can be complements when the input market in the host-country is imperfect competitive and production requires non-tradable inputs. This is possible under perfectly competitive as well as under imperfectly competitive home country input market. Foreign firm's strategic choice about FDI and export may affect the price of input in the host-country significantly and provides a rationale for doing both FDI and export at the same time. Unlike the previous works focusing on the *exogenous factors* to explain that FDI and exports may be 'complement', we show that it may happen when the strategic actions of the foreign firms affect an *endogenous variable* in its favor. We show that the incentive for doing both FDI and export reduces under competition in the host-country market.

1 Introduction

Empirical evidences show that multinationals account for a significant portion of international trade. For example, using the data from 1999, Caves et al. (2002) has demonstrated that over 60% of multinational trade can be traced to a small set of developed countries and that 70% of their foreign direct investment is hosted by industrial countries. However, multinationals often face the important choice of export vs. foreign direct investment (FDI), which has generated enormous amount of empirical and theoretical literature.

Empirical evidences suggest that FDI and export can be either substitutes or complements.¹ For a representative sample, one may look at Lipsey and Weiss (1984), Yamawaki (1991), Brainard (1997), Swenson (1999), Clausing (2000), Head and Ries (2001) and Blonigen (2001). While the possibility of substitutability between FDI and export has attracted sufficiently large amount of theoretical attention, the theoretical literature has paid little attention to explain that FDI and exports are complements.

In an earlier contribution Caves (1971) has emphasized scale economies and cost factors in determining the choice between FDI and export. More recently, Casson (1981), Smith (1987), Horstmann and Markusen (1987a, b, 1996), Mukherjee and Broll (2001) and many others have extended this literature. However, all these papers have focused on the trade-off between the cost of doing FDI and economizing on the cost of export. So, these papers show that FDI and export behave like substitutes.

In contrary to the above-mentioned papers, this paper shows that the foreign firms may do both FDI and export at the same time if the input market in the host-country is imperfectly competitive and the inputs are non-tradable. We consider that the cost of input production is higher in the home market (may be due to higher labor cost), but the cost of input production is lower in the host-country, where labor is relatively cheaper. However, the input market in the home country is perfectly competitive whereas it is imperfectly competitive in the host-country.²

¹ By substitutes or s, we mean whether high level of exports is associated (contemporaneously) with a high or low level of FDI respectively (see, Rob, and Vettas, 2003).

² This situation may capture the view that the home country, assumed to be a developed country, has a well-organized and regulated input market whereas the input market in the host-country, which is a developing country, is inefficient and is characterized by imperfect competition.

We consider a monopolist foreign firm in the next section. We find that even if the cost of input production is lower in the host-country, the imperfectly competitive input market may generate higher input price in the host-country compared to the home country. However, export by the foreign firm helps to reduce the price of inputs in the host-country and makes FDI more profitable. So, by choosing the amount of export suitably, the foreign firm may keep the input price lower in the host-country and earns higher profit. If the host-country market is not sufficiently small, we find that it is optimal for the foreign firm to do both export and FDI. But, if the market size of the host-country is sufficiently small, the lower cost of input production in the host-country makes its price lower in the host-country compared to the home country, even if there is no export. Hence, in this situation, the foreign firm does only FDI.

In section 3, we extend our model we consider the impact of competition in the final goods market. Here we consider a host-country firm who is competing with the foreign firm in the host-country like Cournot duopolists and the firms are producing homogeneous products. We find that competition in the host-country increases the foreign firm's incentive for doing FDI only. In contrast to the situation with the monopolist foreign firm, we show that if there is competition in the final goods market, the foreign may do export only. The existence of host-country firm does not allow the foreign firms to keep the input price in the host-country always lower compared to the home country by choosing its export strategically. Hence, if the host-country market is sufficiently large, we find that it is optimal for the foreign firm to do export only. If the host-country market is neither very small, so that FDI only is the optimal choice, nor very large, so the export only is the optimal choice, we show that the foreign firm does both export and FDI. When the market size of the host-country is moderate, the foreign firm can get the benefit of lower input price in the host-country compared to the home country by choosing its amount of export strategically even if it faces competition in the final goods market from a host-country firm.

In section 4, we extend the basic model in another direction to consider the impact of imperfectly competitive home country input market. Here, like section 2, we consider that the host-country market is served by a foreign monopolist. We find that the amount of export and the profit of the foreign firm are lower under

monopolistic home input market compared to the perfectly competitive home input market. But the amount of FDI and the input price in the host-country increases under monopolistic home input market compared to the perfectly competitive home input market.

This paper complements the recent works of Kogut and Kulatilaka (1994), Choi and Davidson (2003) and Rob and Vettas (2003), where it has been shown that FDI and export may be complements when there is uncertainty about cost of production or market demand. Kogut and Kulatilaka (1994) show that if the foreign firms face cost uncertainty, setting up a production facility in the foreign country creates option value and encourages the foreign firms to do both FDI and export. Choi and Davidson (2003) extends this literature to the oligopolistic market and show that the incentive for doing both export and FDI increases due to strategic reasons if the firms compete in *prices*. Contrary to the uncertainty in cost, Rob and Vettas (2003) focus on the situation where demand growth in the host-country is uncertain and provide the rationale for doing both export and FDI by a foreign monopolist.

One common feature of Kogut and Kulatilaka (1994), Choi and Davidson (2003) and Rob and Vettas (2003) is that all of them focus on exogenous factors (either cost uncertainty or demand uncertainty) to show the rationale for doing both FDI and export by the foreign firms. In contrast, the present paper shows that this possibility may arise in *a certain world* but due to strategic reasons. Instead of looking at the *exogenous factor*, the present paper shows that the foreign firms may prefer to do both FDI and export if, by doing so, it can strategically affect an *endogenous variable* (here input price) in its favor.

The remainder of the paper is organized as follows. Section 2 considers the basic model with a monopolist foreign firm. Section 3 extends the analysis of section 2 by incorporating competition in the host-country market. Section 4 extends the analysis of section 2 in another direction to consider the impact of imperfectly competitive input market in the home country. Section 5 concludes.

2 Monopoly market structure

In this section we do our analysis for a monopoly market structure. Assume that there is a foreign firm, called firm 1, who wants to sell its product in another country, called host-country. In this section, we will assume that there is no host-country firm producing this product. This may be due to technological reason. Next section will focus on the possibility of competition between the foreign firm and a host-country firm.

Firm 1 can do either FDI or export or both. Assume that the input market in the home country of firm 1 is perfectly competitive. Assume that firm 1 can buy input at a constant price of c in the home market. But the input market in the host-country is assumed to be imperfectly competitive, which is true in many developing countries. For simplicity, we assume that there is a monopolist input supplier in the host-country. Assume that the monopolist input supplier produces input with a constant marginal cost, which is assumed to be zero, for simplicity. Hence, the cost of production of input is lower in the host-country, which is consistent with the assumption of cheap labor in the host-country. The input supplier in the host-country sells its inputs against a linear price, say w . Further, we assume that the inputs are non-tradable. Therefore, if firm 1 wants to do export, it needs to buy inputs from its home country. But, for FDI, firm 1 needs to buy its input from the host-country. We assume that firm 1 needs one unit of input to produce one unit of output.

We consider the following game. In stage 1, firm 1 chooses the amount of export it will do.³ In stage 2, the monopolist input supplier in the host-country sets price for its inputs. In stage 3, firm 1 decides its amount of production in the host-country. Hence, our analysis allows for export and FDI by firm 1. In stage 4, market-clearing price of the final good produced by firm 1 (through export and/or FDI) is determined and profits are realized. We solve the game through backward induction.

In our game we have considered that firm 1 decides on the amount of export before its decision on FDI. This situation is consistent with the previous literature assuming that the foreign firms first set up their plants in the home country for exports and then go for FDI (see, e.g., Vernon, 1966, Horstmann and Markusen, 1987b, Konishi et al., 1999 and Lin and Saggi, 1999).

³ Alternatively, one can assume that in stage 1, firm 1 is building its capacity for export and the per-unit cost of capacity building is c . Firm 1 cannot change its capacity level once installed.

Assume that inverse market demand for the final product in the host-country is

$$P = a - q - x, \quad a > c > 0 \quad (1)$$

where x and q are respectively the amount of export and FDI by firm 1.

2.1 Decision on FDI

Given the amount of export $x(\geq 0)$, decided by firm 1 and the input price in the host-country (i.e., w), firm 1 maximizes the following expression to determine its output to be produced by FDI

$$\text{Max}_q (a - q - x - w)q + (a - q - x - c)x. \quad (2)$$

Maximizing (2) we find that, given the amount of export, optimal output produced by firm 1 under FDI is

$$q^* = \frac{a - 2x - w}{2}. \quad (3)$$

It is easy to check that the second order condition for maximization is satisfied.

From (3), it is clear that $q^* > 0$ provided $a > 2x + w$. But $q^* = 0$ for $a < 2x + w$. Therefore, if $a < 2x + w$, it follows from (3) that optimal output of firm 1 is $\frac{(a - c)}{2}$.

2.2 Optimal input price in the host-country

Now, we find out optimal input price in the host-country. While choosing optimal price of the input, the monopolist input supplier internalizes the production decision of firm 1 through FDI. Therefore, demand for input is

$$\frac{(a - 2x - w)}{2}, \quad \text{for } w < a - 2x \quad (4)$$

$$0, \quad \text{for } w > a - 2x. \quad (5)$$

So, the monopolist input supplier in the host-country maximizes the following expressions to determine the price of the input, given the amount of export decided by firm 1:

$$\text{Max}_w \frac{w(a - 2x - w)}{2}, \quad \text{for } w < a - 2x. \quad (6)$$

Maximizing (6), we find the optimal price of the input

$$w_{FDI}^* = \frac{(a - 2x)}{2}. \quad (7)$$

We define the optimal input prices as w_{FDI}^* to imply the scenario of positive output of firm 1 under FDI. We find that $w_{FDI}^* < a - 2x$ but $w_{FDI}^* > 0$ provided $x < \frac{a}{2}$.⁵

2.3 Optimal amount of export

Firm 1 realizes how the monopolist input supplier in the host-country will behave for a given amount of export. Therefore, firm 1 maximizes the following expression while choosing its amount of export, x :

$$\text{Max}_x \frac{(a + 2x)(a - 2x) + 4x(3a - 2x - 4c)}{16}. \quad (8)$$

Maximizing (8), we find that $x_{FDI}^* = \frac{(3a - 4c)}{6}$.⁷ The second order condition for

maximization is satisfied. While $x_{FDI}^* = \frac{(3a - 4c)}{6} < \frac{a}{2}$, $x_{FDI}^* = \frac{(3a - 4c)}{6} > 0$ provided

$a > \frac{4c}{3}$. Since, $c < \frac{4c}{3}$, it implies that optimal amount of export is zero for

$a \in (c, \frac{4c}{3})$. But, for $a > \frac{4c}{3}$, optimal amount of both export and FDI are positive.

Following proposition summarizes the above discussion.

Proposition 1: *Assume that the foreign firm is monopolist in the host-country. The foreign firm does only FDI for $a \in (c, \frac{4c}{3})$. But, for $a > \frac{4c}{3}$, the foreign firm does both export and FDI.*

⁴ There is no demand for input if $w > a - 2x$.

⁵ Note that input price in the host-country cannot be less than 0.

⁶ The problem (8) is relevant for $x \leq \frac{a}{2}$. But, the problem faced by firm 1 becomes

$\text{Max}_x (a - x - c)x$, for $x > \frac{a}{2}$. However, this maximization problem $\text{Max}_x (a - x - c)x$ implies

$x = \frac{(a - c)}{2}$, which contradicts the requirement of $x > \frac{a}{2}$. So, in stage one, the maximization problem faced by firm 1 is given by the expression (8). This implies that the amount of FDI is always positive.

2.4 Implications on input price in the host-country

So far we have examined optimal decisions of the final goods producers and the monopolist input supplier. However, we did not explicitly compare input prices in the two countries. This will help us to understand the rationale for different entry strategies of firm 1.

Let us consider the values of $a \in (c, \frac{4c}{3})$. Here, firm 1 does FDI only and the input price in the host-country is $\frac{a}{2}$, which is lower than c for all $a \in (c, \frac{4c}{3})$.

Next, consider the values of $a > \frac{4c}{3}$. Here, firm 1 does both export and FDI and the input price in the host-country is $\frac{2c}{3}$, which is positive and less than c . So, if $a > \frac{4c}{3}$, we find that even if the input price is lower in the host-country to that of in the home country, firm 1 still produces positive amount under export. If $a > \frac{4c}{3}$ and firm 1 does only FDI, the price of the input in the host-country becomes $\frac{a}{2}$, which is greater than the input price in the host-country when firm 1's optimal export is positive, i.e., greater than $\frac{2c}{3}$. The positive amount of export by firm 1 helps to reduce the price of the input in the host-country and increases profit of firm 1.

Thus, we have seen that even if the cost of producing input is lower in the host-country but the input market is imperfectly competitive, a foreign firm may have incentive for doing export when the market size⁸ of the host-country is sufficiently large, i.e., $a > \frac{4c}{3}$. But the foreign firm does FDI irrespective of the market size of the host-country. Hence, it shows that if the host-country market is sufficiently large and the host-country input market is imperfectly competitive, we may expect to see foreign firms doing both FDI and export.

⁷ We denote the amount of export by x_{FDI}^* to imply that for these values of export, firm 1 produces positive amount under FDI.

⁸ Here the intercept term of the demand function is used as a proxy of the market size.

3 Duopoly market structure

In the previous section we have seen that imperfectly competitive host-country input market may be a reason for observing both FDI and export by the same foreign firm. In this section we examine the implications of competition in the final goods market of the host-country on our result.

Assume that there is a host-country firm, called firm 2, producing the final product in the host-country market along with firm 1 considered in the previous section. Firm 1 can do either FDI or export or both. Assume that the firms produce homogeneous products and compete like Cournot duopolists in the host-country.

Like the previous section, we assume that the input market in the home country of firm 1 is perfectly competitive and firm 1 can buy input at a constant price of c in the home market. But there is a monopolist input supplier in the host-country. The marginal cost of input production is assumed to be zero in the host-country. The input supplier in the host-country sells its inputs against a linear price, say w . Further, the inputs are non-tradable. Further, we assume that both firms need one unit of input to produce one unit of output.

We consider the following game. In stage 1, firm 1 chooses the amount of export it will do. In stage 2, the monopolist input supplier in the host-country sets the price for its inputs. In stage 3, firm 1 and firm 2 simultaneously decide their amount of production in the host-country. In stage 4, market-clearing price of the final goods is determined and profits are realized. We solve the game through backward induction.

3.1 Decision on FDI

Given the amount of export $x(\geq 0)$, decided by firm 1 and the input price in the host-country (i.e., w), firm 1 maximizes the following expression to determine the amount of output to be produced through FDI

$$\underset{q_1}{\text{Max}}(a - q_1 - q_2 - x - w)q_1 + (a - q_1 - q_2 - x - c)x. \quad (9)$$

Maximizing (9) we find that the optimal output produced by firm 1 through FDI is

$$q_1 = \frac{a - 2x - q_2 - w}{2}. \quad (10)$$

It is easy to check that the second order condition for maximization is satisfied.

Given the amount of export decided by firm 1 and the input price determined by the monopolist input supplier in the host-country, firm 2 maximizes the following expression to determine its optimal production:

$$\text{Max}_{q_2}(a - q_1 - q_2 - x - w)q_2. \quad (11)$$

Maximizing (11), we find that the optimal output of firm 2 is

$$q_2 = \frac{a - x - q_1 - w}{2}. \quad (12)$$

It is easy to check that second order condition for maximization is satisfied.

Solving (10) and (12), we find the optimal output produced by firm 1 through FDI and the optimal production of firm 2 are respectively

$$q_1^* = \frac{(a - 3x - w)}{3} \quad \text{and} \quad q_2^* = \frac{(a - w)}{3}. \quad (13)$$

It is clear from (13) that $q_1^* > 0$ provided $a > 3x + w$. But $q_1^* = 0$ for $a < 3x + w$.

Therefore, if $a < 3x + w$, it follows from (12) that the optimal output of firm 2 is

$$\frac{(a - x - w)}{2}.$$

3.2 Optimal input price in the host-country

Now, we examine optimal input price in the host-country. While choosing the optimal price of the input, the monopolist input supplier internalizes the optimal production of firm 1 through FDI and the optimal production of firm 2, which are given in (13).

Therefore, demand for inputs is

$$\frac{(2a - 3x - 2w)}{3}, \quad \text{for} \quad w < a - 3x \quad (14)$$

$$\frac{(a - x - w)}{2}, \quad \text{for} \quad w > a - 3x \quad (15)$$

$$0, \quad \text{for} \quad w > a - x. \quad (16)$$

The monopolist input supplier in the host-country maximizes the following expressions to determine the optimal price of the input, given the amount of export decided by firm 1:

$$\text{Max}_w \frac{w(2a - 3x - 2w)}{3}, \quad \text{for} \quad w < a - 3x \quad (17)$$

$$\text{Max}_w \frac{w(a-x-w)}{2}, \quad \text{for } w > a-3x.^9 \quad (18)$$

Maximizing (17) and (18), we find the optimal prices of the inputs are respectively

$$w_{FDI}^* = \frac{(2a-3x)}{4} \quad \text{and} \quad w_0^* = \frac{(a-x)}{2}. \quad (20)$$

We define the optimal input prices as w_{FDI}^* and w_0^* to imply the scenario of positive output of firm 1 under FDI and no output of firm 1 under FDI.

It is easy to check that $w_{FDI}^* < a-3x$ provided $x < \frac{2a}{9}$ and $w_0^* > a-3x$ provided $x > \frac{a}{5}$, where $\frac{a}{5} < \frac{2a}{9}$. Hence, optimal input prices in the host-country are w_{FDI}^* for $x \leq \frac{a}{5}$ and w_0^* for $x \geq \frac{2a}{9}$. But, for $x \in (\frac{a}{5}, \frac{2a}{9})$, optimal input price in the host-country depends on the relative profitability of the input supplier for the input prices w_{FDI}^* and w_0^* . We find that if $x \in (\frac{a}{5}, \frac{2a}{9})$, it is optimal for the monopolist input supplier to charge w_{FDI}^* (w_0^*) provided $x^2 - ax + \frac{a^2}{6} > (<)0$. We find that $x^2 - ax + \frac{a^2}{6} = 0$ for $x = \frac{a(\sqrt{3}-1)}{2\sqrt{3}}$, which is between $\frac{a}{5}$ and $\frac{2a}{9}$.

We summarize the above discussion in the following proposition.

Proposition 2: (a) If $x < \frac{a(\sqrt{3}-1)}{2\sqrt{3}}$, the optimal input price in the host-country will

be $w_{FDI}^* = \frac{(2a-3x)}{4}$. But, for $x < \frac{a(\sqrt{3}-1)}{2\sqrt{3}}$, the optimal input price in the host-

country will be $w_0^* = \frac{(a-x)}{2}$.

(b) Firm 1 does FDI if $x < \frac{a(\sqrt{3}-1)}{2\sqrt{3}}$ but there is no FDI for $x > \frac{a(\sqrt{3}-1)}{2\sqrt{3}}$.

3.3 Optimal amount of export

⁹ Because there is no demand for input if $w > a-x$.

If firm 1 chooses $x < \frac{a(\sqrt{3}-1)}{2\sqrt{3}}$, it realizes that the price of input in the host-country

is $w_{FDI}^* = \frac{(2a-3x)}{4}$ but the input price in the host-country is $w_0^* = \frac{(a-x)}{2}$ for

$x > \frac{a(\sqrt{3}-1)}{2\sqrt{3}}$. Therefore, firm 1 maximizes the following expressions while

choosing the amount of export, x :

$$\text{Max}_x \frac{(2a+3x)(2a-9x)+12x(8a-6x-12c)}{144}, \text{ for } x < \frac{a(\sqrt{3}-1)}{2\sqrt{3}} \quad (21)$$

and

$$\text{Max}_x \frac{(5a-7x-6c)}{6}, \text{ For } x > \frac{a(\sqrt{3}-1)}{2\sqrt{3}}. \quad (22)$$

Maximizing (21) without any restriction on x , we find that $x_{FDI}^* = \frac{(14a-24c)}{33}$.¹⁰ The

second order condition for maximization is satisfied.

However, $x_{FDI}^* = \frac{(14a-24c)}{33}$ is positive provided $a > \frac{12c}{7}$ and is less than $\frac{a(\sqrt{3}-1)}{2\sqrt{3}}$ provided $a < \frac{48\sqrt{3}c}{(33-5\sqrt{3})}$. Hence, solution of (21) implies that for

$a \in (c, \frac{12c}{7})$ firm1's optimal export is zero and produces under FDI only but firm 1's

production under export and FDI are positive for $a \in (\frac{12c}{7}, \frac{48\sqrt{3}c}{(33-5\sqrt{3})})$.

Next, consider the unrestricted optimization problem of (22). Maximizing (22) without any restriction on x , the optimal amount of export is $x_0^* = \frac{(5a-6c)}{14}$.¹¹

However, $x_0^* = \frac{(5a-6c)}{14}$ is greater than $\frac{a(\sqrt{3}-1)}{2\sqrt{3}}$ provided $a > \frac{12\sqrt{3}c}{(14-4\sqrt{3})}$.

¹⁰ We denote the amount of export by x_{FDI}^* to imply that for these values of export, firm 1 produces positive amount under FDI.

¹¹ We denote the amount of export by x_0^* to imply that for these values of export, firm 1 does not produce anything under FDI.

Therefore, solution of (22) implies that if $a > \frac{12\sqrt{3}c}{(14-4\sqrt{3})}$ then firm 1 produces only

under export and nothing under FDI. We find that $\frac{12c}{7} < \frac{12\sqrt{3}c}{(14-4\sqrt{3})} < \frac{48\sqrt{3}c}{(33-5\sqrt{3})}$.

The above analysis shows that if $a \in (c, \frac{12c}{7})$ then we have a unique production decision for firm 1, i.e., here firm 1 produces under FDI only. If $a \in (\frac{12c}{7}, \frac{12\sqrt{3}c}{(14-4\sqrt{3})})$, we have a unique production decision for firm 1 where firm 1

produces positive amounts under export and FDI. If $a > \frac{48\sqrt{3}c}{(33-5\sqrt{3})}$, then also we

have a unique production decision for firm 1 where firm 1 produces under export only and nothing under FDI. But we have two possibilities for

$a \in (\frac{12\sqrt{3}c}{(14-4\sqrt{3})}, \frac{48\sqrt{3}c}{(33-5\sqrt{3})})$. Firm 1 can produce either ‘ $x_{FDI}^* = \frac{(14a-24c)}{33}$ and

also positive amount under FDI’ or ‘ $x_0^* = \frac{(5a-6c)}{14}$ and nothing under FDI’. Whether

firm 1 will prefer the former strategy or the later strategy depends on the relative profitability of these strategies.

Assume that $a \in (\frac{12\sqrt{3}c}{(14-4\sqrt{3})}, \frac{48\sqrt{3}c}{(33-5\sqrt{3})})$. If firm 1 produces

$x_{FDI}^* = \frac{(14a-24c)}{33}$ and also positive amount under FDI, its profit is

$$\pi_1^{EX,FDI} = \frac{(9a-6c)(18c-5a) + (15a-21c)(14a-24c)}{1089}. \quad (23)$$

But if firm produces only under export, i.e., $x_0^* = \frac{(5a-6c)}{14}$, its profit is

$$\pi_1^{EX,0} = \frac{(27a-38c)(5a-6c)}{784}. \quad (24)$$

It is easy to check that (24) is greater than (23) over $a \in (\frac{12\sqrt{3}c}{14-4\sqrt{3}}, \frac{48\sqrt{3}c}{33-5\sqrt{3}})$.¹²

Hence, firm 1 does only export if $a \in (\frac{12\sqrt{3}c}{14-4\sqrt{3}}, \frac{48\sqrt{3}c}{33-5\sqrt{3}})$.

The following proposition summarizes the above discussion.

Proposition 3: (a) Firm 1 does FDI only for $a \in (c, \frac{12c}{7})$.

(b) Firm 1 does both export and FDI for $a \in (\frac{12c}{7}, \frac{12\sqrt{3}c}{14-4\sqrt{3}})$.

(c) Firm 1 does export only for $a > \frac{12\sqrt{3}c}{14-4\sqrt{3}}$.

3.4 Implications on input price

Now we examine the effects of different production strategy of firm 1 on the host-country input price. This will help us to understand the reason behind Proposition 3.

Let us consider $a \in (c, \frac{12c}{7})$. Here, firm 1 does FDI only and the input price in the host-country will be $\frac{a}{2}$, which is lower than c for all $a \in (c, \frac{12c}{7})$. So, here the input price is lower in the host-country compared to that of the home country and firm 1 is always better off under FDI only.

Next, consider $a \in (\frac{12c}{7}, \frac{12\sqrt{3}c}{14-4\sqrt{3}})$. Here, firm 1 does both export and FDI and the input price in the host-country is $\frac{(2a+6c)}{11}$. We find that $\frac{(2a+6c)}{11} \stackrel{>}{<} c$ for

$a \stackrel{>}{<} \frac{5c}{2}$, where $\frac{5c}{2} \in (\frac{12c}{7}, \frac{12\sqrt{3}c}{14-4\sqrt{3}})$. Therefore, for $a \in (\frac{12c}{7}, \frac{5c}{2})$, input price in

the host-country is lower than the input price in the home country of firm 1. But the

¹² We find after straightforward calculation that (24) is greater than (23) provided $0 < 17665a^2 - 21120ac - 62172c^2$. The right hand side of this inequality is increasing in a and positive at $a = \frac{12\sqrt{3}c}{14-4\sqrt{3}}$. So, (24) is greater than (23) over $a \in (\frac{12\sqrt{3}c}{14-4\sqrt{3}}, \frac{48\sqrt{3}c}{33-5\sqrt{3}})$.

input price in the host-country is higher than the input price in the home country of firm 1 when $a \in (\frac{5c}{2}, \frac{12\sqrt{3}c}{14-4\sqrt{3}})$. However, for these values of the host-country market size, i.e., a , if firm has done FDI only, the input price would be $\frac{a}{2}$, which is always greater than $\frac{(2a+6c)}{11}$. Therefore, by doing both FDI and export, firm 1 can keep the input price in the host-country lower and it provides the rationale for doing both FDI and export when $a \in (\frac{12c}{7}, \frac{12\sqrt{3}c}{14-4\sqrt{3}})$.

Lastly consider the situation where $a > \frac{12\sqrt{3}c}{14-4\sqrt{3}}$. Here, firm 1 does export only and the input price in the host-country is $\frac{(9a+6c)}{28}$. We find that $\frac{(9a+6c)}{28} > c$, for all values of $a > \frac{12\sqrt{3}c}{14-4\sqrt{3}}$. Since, here market size in the host-country is sufficiently large, it increases the price of input significantly and reduces firm 1's benefit from FDI. As a result, here firm 1 is better off by doing export only.

3.5 Effect of competition on the production decision of firm 1

Now we are in a position to compare the effects of host-country competition on FDI and export.

Proposition 4: (a) 'Only export by firm 1' may be the outcome when firm 1 faces competition from firm 2 but not when firm 1 is monopoly.

(b) Incentive for 'only FDI by firm 1' is higher when firm 1 faces competition from firm 2 compared to the situation when firm 1 is monopoly.

(c) Incentive for 'both export and FDI by firm 1' is lower when firm 1 faces competition from firm 2 compared to the situation when firm 1 is monopoly.

Proof: (a) It directly follows from propositions 1 and 3.

(b) From Proposition 1 we see that firm 1 does only FDI provided $a < \frac{4c}{3}$ when it is monopoly in the host-country. But firm 1 does only FDI when $a < \frac{12c}{7}$ if it faces competition in the host-country. Since, $\frac{12c}{7} > \frac{4c}{3}$, it proves the result.

(c) Proposition 1 show that firm 1 does both FDI and export provided $a > \frac{4c}{3}$ when it is monopoly in the host-country. But firm 1 does both FDI and export when $a < \frac{12\sqrt{3}c}{(14 - 4\sqrt{3})}$ if it faces competition in the host-country. Since, $\frac{12c}{7} < \frac{12\sqrt{3}c}{(14 - 4\sqrt{3})}$, it proves the result. Q.E.D.

Reason for the above result is s follows. Since marginal cost of production of firm 1 is higher under export compared to FDI, its loss of profit is higher under export compared to FDI due to competition in the host-country and if the market size is sufficiently small. As a result, if the host-country market is sufficiently small, competition in the host-country increases firm 1's incentive for FDI compared to export. If the host-country market is not very small, firm 1 can afford some amount of export since it helps to reduce the input price in the host-country. Since the host-country market is not very small, this benefit from lower input price in the host-country outweighs the negative impact of relatively costly export. But, if the host-country market is sufficiently large, it helps to increase the price of input significantly and reduces the incentive for FDI. Further, since the production of firm 1 in the host-country helps to aggravate the rise in input price in the host-country, firm 1 is better off by doing 'export only' when the host-country market is sufficiently large. Without competition in the host-country and becoming a monopolist producer firm 1 could manipulate the amount of export and FDI in a way so that it can neutralize the effect of higher market size on the host-country input price and gets the benefit from lower input price in the host-country. But, in presence of firm 2 in the host-country, firm is no longer able to neutralize this effect of the host-country input price. Hence, while 'export only' is not optimal without competition in the host-country, it is optimal in presence of competition in the host-country when the host-country market is sufficiently large.

4 Imperfectly competitive home country input market

The purpose of this section is to see whether firm 1 has incentive for both FDI and export if the input market in the home country is also imperfectly competitive. To examine this, we consider a situation that is similar to the section 2 with the exception that the home country input market is imperfectly competitive. We assume that there is a monopolist input supplier in the home country and its marginal cost of production is zero.

We consider the following game in this section. In stage 1, monopolist input supplier in the home country sets price for its inputs. In stage 2, firm 1 chooses the amount of export it will do. In stage 3, the monopolist input supplier in the host-country sets price for its inputs. In stage 4, firm 1 decides its amount of production in the host-country. In stage 5, market-clearing price of the final good produced by firm 1 (through export and/or FDI) is determined and profits are realized. We solve the game through backward induction.

The game of this section from stage 2 is similar to the game of section 2. So, following the analysis of section 1, we can say that given the price of input in the home country, defined as h , optimal amount of export is

$$x_{FDI}^* = \frac{(3a - 4c)}{6}. \quad (25)$$

So, in stage 1, the input supplier in the home country maxims the following expression:

$$\text{Max}_h (h - c) \frac{(3a - 4h)}{6}. \quad (26)$$

So, the optimal price of input in the home country is $h^* = \frac{(3a + 4c)}{8}$. The second order condition for maximization is satisfied.

Therefore, optimal amount of export is $\frac{(3a - 4c)}{12}$, which is positive provided

$$a > \frac{4c}{3}.$$

So, if $a < \frac{4c}{3}$, firm 1 does FDI only and from the analysis of section 1, we can say that here input price in the host-country input price and the optimal output produced by firm 1 under FDI are respectively $\frac{a}{2}$ and $\frac{a}{4}$.

On the other hand, if $a > \frac{4c}{3}$, we can say from the analysis of section 1 that the optimal amount of export, FDI and the host-country input prices are respectively $\frac{(3a-4c)}{12}$, $\frac{(3a+4c)}{24}$ and $\frac{(3a+4c)}{12}$.

Proposition 5: *Suppose there is a monopolist input supplier in the home market. Our result of proposition 1 holds regarding firm 1's decision for FDI and export. If firm 1 does both export and FDI, monopolistic home input market reduces the amount of export and the profit of firm 1 but increases the amount of FDI and the price of input in the host-country, compared to the perfectly competitive home input market.*

Proof: Analyses of this section and section 1 show that firm 1 does only FDI provided $a < \frac{4c}{3}$. But firm 1 does both export and FDI when $a > \frac{4c}{3}$.

Suppose, firm 1 does both export and FDI, i.e., $a > \frac{4c}{3}$. If there is monopoly input supplier in the home market, the optimal export, FDI, the host-country input price and the profit of firm 1 are respectively $\frac{(3a-4c)}{12}$, $\frac{(3a+4c)}{24}$, $\frac{(3a+4c)}{12}$ and $\frac{(3a+4c)(9a-4c)+(6a-8c)^2}{576}$. But, in case of perfectly competitive home input market, the optimal export, FDI, the host-country input price and the profit of firm 1 are respectively $\frac{(3a-4c)}{6}$, $\frac{c}{3}$, $\frac{2c}{3}$ and $\frac{2c(3a-2c)+(3a-4c)^2}{36}$. Comparing the corresponding values under these two systems, we get the result on export, FDI the price of input in the host-country and the profit of firm 1. Q.E.D.

Reason for the above proposition is easy to understand. Since, here home market is also imperfectly competitive it increases the price of input in the home

country compared to perfectly competitive home input market. Hence, it reduces the incentive for export and increases the incentive for FDI. This higher amount of FDI encourages the input supplier to charge relatively higher price. So, when the home input market is imperfectly competitive, firm 1 faces higher input price in both markets compared to the perfectly competitive home input market. As a result, it reduces profit of firm in the former situation compared to the latter.

5 Conclusion

Empirical findings have shown that export and FDI may act either as substitutes or complements. While the previous literature has mainly tried to explain the reasons for substitutability between export and FDI, they have paid little attention to explain that FDI and exports may be complements. Recent theoretical literature has paid attention to the latter situation and has argued that cost uncertainty or demand uncertainty may be the reasons for observing both FDI and export at the same time by same foreign firms. So, the previous literature focuses on the *exogenous factors* to explain this phenomenon.

In this paper we show that we may observe foreign firms doing both FDI and export at the same time if the host-country input market is imperfectly competitive and production requires non-tradable inputs. Export by foreign firms helps to reduce the price of input in the host-country and increases profit of the foreign firm from FDI. Hence, foreign firms may do both FDI and export for strategic reason if export helps to reduce the input price in the host-country significantly even if the foreign firm needs to face relatively higher input price in the home country. The benefit from lower input price in the host-country outweighs the loss from higher input price in the home country and makes the foreign firms better off. Thus, in contrast to the previous literature we show that we may observe both FDI and export at the same time if, by doing so, the foreign firm can affect an *endogenous variable* in its favor.

We show that our results of doing both FDI and export by the foreign firms hold even if the foreign firm faces competition in the host-country market from a host-country firm. This result holds even if the input market in the home country is imperfectly competitive. However, the amount of FDI increases and export reduces when the home country input market is imperfectly competitive compared to the perfectly competitive home input market.

References

- Blonigen, B. A.**, 2001, 'In search of substitution between foreign production and exports', *Journal of International Economics*, **53**: 81 – 104.
- Brainard, S. L.**, 1997, 'An empirical assessment of the Proximity – Concentration trade-off between multinational sales and trade', *American Economic Review*, **87**: 520 – 44.
- Buckley, P. J. and M. Casson**, 1981, 'The optimal timing of a foreign direct investment', *Economic Journal*, **91**: 75 – 87.
- Caves, R. E.**, 1971, 'International corporations: the industrial economics of foreign investment', *Economica*, **38**: 1 – 27.
- Caves, R., J. Frankel and R. Jones**, 2002, *World trade and payments: an introduction*, 9th ed., Addison Wesley.
- Clausing, K. A.**, 2000, 'Does multinational activity displace trade?' *Economic Inquiry*, **38**: 190 – 205.
- Choi, J. P. and C. Davidson**, 2003, 'Strategic second sourcing by multinationals', *Mimeo*, Michigan State University.
- Head, K. and J. Ries**, 2001, 'Overseas investment and firm export', *Review of International Economics*, **9**: 108 – 22.
- Horstmann, I. J. and J. R. Markusen**, 1987a, Licensing versus direct investment: a model of internalization by the multinational enterprise', *Canadian Journal of Economics*, **20**: 464 – 81.
- Horstmann, I. J. and J. R. Markusen**, 1987b, 'Strategic investment and the development of multinationals', *International Economic Review*, **28**: 109 – 21.
- Horstmann, I. J. and J. R. Markusen**, 1996, Exploring new markets: direct investments, contractual relations and the multinational enterprise', *International Economic Review*, **37**: 1 – 19.
- Kogut, B. and N. Kulatilaka**, 1994, 'Operating flexibility, global manufacturing, and the option value of a multinational network', *Management Science*, **40**: 123 – 39.
- Konishi, H., K. Saggi and S. Weber**, 1999, 'Endogenous trade policy under foreign direct investment', *Journal of International Economics*, **49**: 289 – 308.
- Lin, P. and K. Saggi**, 1999, 'Incentives for foreign direct investment under imitation', *Canadian Journal of Economics*, **32**: 1275 – 98.
- Lipsey, R. E. and M. Y. Weiss**, 1984, 'Foreign production and exports of individual firms', *Review of Economics and Statistics*, **66**: 304 – 7.
- Mukherjee, A. and U. Broll**, 2001, 'Export and Direct Investment as a Signal in Global Markets' *Research Paper, 2001/09*, Department of Economics, Keele University.
- Rob, R. and N. Vettas**, 2003, 'Foreign direct investment and exports with growing demand', *Review of Economic Studies*, **69**: 1 – 20.
- Smith, A.**, 1987, 'Strategic investment, multinational corporations and trade policy', *European Economic Review*, **31**: 89 – 96.
- Vernon, R.**, 1966, 'International investment and international trade in the product cycle', *Quarterly Journal of Economics*, **80**: 190 – 207.
- Yamawaki, H.**, 1991, 'Exports and foreign distributional activities: evidence on Japanese firms in the United States', *Review of Economics and Statistics*, **73**: 294 – 300.