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## On Foreign Market Entry Under Uncertainty

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# On Foreign Market Entry Under Uncertainty

**By**

**Paul A. de Hek and Arijit Mukherjee**

**Abstract**

In an infinite horizon framework with demand uncertainty, we explain a foreign firm's rationale for doing export, joint venture or opening a fully owned foreign subsidiary. We examine the possibility of share renegotiation in a JV over time and explain how this possibility affects the entry decision of a foreign firm. We also show that if the benefit from information acquisition under export is sufficiently strong then a foreign firm may be willing to do export initially even if export is a non-profitable option.

**JEL Classifications:** F12, F23

**Key words:** Demand uncertainty, Export, Joint venture, Foreign direct investment

Outline

## Non-Technical Summary

Many countries, so far restricted foreign investment, are now liberalizing their economies to attract foreign capital and technologies. The pattern of foreign investment shows an interesting trend. While some countries or regions are able to attract significant amount of foreign investment to their economies, other countries or regions are experiencing a gradual increment of foreign investment to their economies. The amount of foreign investment coming to a particular country also shows significantly different trend for different industries. Often it is found that the foreign firms want to increase their share in the project over time when they form joint ventures with the host-country firms.

The purpose of this paper is to explain this phenomenon in an infinite horizon framework with demand uncertainty. We explain a foreign firm's rationale for doing export, joint venture or opening a fully owned subsidiary and also show the possibility of share renegotiation in a joint venture over time. We explain how the possibility of share renegotiation over time can affect the entry decision of a foreign firm.

# 1 Introduction

Many countries, so far restricted foreign investment, are now liberalizing their economies to attract foreign capital and technologies. The policy of globalization adopted by several countries is now eliminating the restrictions on the foreign firms to enter these countries. However, the pattern of foreign investment shows an interesting trend. While some countries or regions are able to attract significant amount of foreign investment to their economies, other countries or regions are experiencing a gradual increment of foreign investment to their economies. For example, while the number of foreign direct investment (FDI) in 1990 – 91 from Japan to China was 165, the FDI from Japan to India was only 7 for that period. While this number in 1992 – 93 has increased to 490 for China, it has increased to only 15 for India (e.g., see Chawla, 1995). The amount of foreign investment coming to a particular country also shows significantly different trend for different industries. It has been also found empirically that the foreign firms want to increase their share in the project over time when they form joint ventures (JVs) with the host-country firms (see, e.g., Mukherjee and Sengupta, 2001 and the references cited there).

The purpose of this paper is to explain this phenomenon in an infinite horizon framework with demand uncertainty. We explain a foreign firm's rationale for doing export, JV or opening a fully owned subsidiary and also show the possibility of share renegotiation in a JV over time. We show how the possibility of share renegotiation over time can affect the entry decision of a foreign firm.

It is well known that the firms planning to enter a foreign market need to take an important decision regarding the mode of entry, e.g., whether to serve the foreign market through export or foreign direct investment. Even if doing foreign investment, the decision about the shareholding in the project is also important to the foreign firms. The literature on multinational firms has already demonstrated several reasons for preferring a particular mode of entry compared to others. For example, they have asked questions such as: When do multinational firms prefer foreign investment against exporting? Or, when do multinational firms prefer a fully owned subsidiary against a licensing contract or JV? It has been found that the answers mainly depend on the costs of internalization, costs of serving the foreign market through exporting and FDI and the possibilities of opportunism. While most of the analysis has been done in a static framework, some authors also looked

at the dynamics of the problem. For a representative sample one may look at Buckley and Casson (1981), Capel (1992), Das (1983, 1999), Ethier (1986), Itagaki (1981), Hirsch (1976), Kabiraj (1999), Rugman (1981), Marjit (1990), Marjit and Broll (1997), Marjit et al. (1995), Marjit and Mukherjee (1998, 2001), Purkayastha (1993), Ray Chaudhuri (1997), Svejnar and Smith (1984) and Tang and Yu (1990).

However, while looking at the optimal entry decisions of foreign firms, the previous papers have ignored the importance of information acquisition and its implications on the mode of entry over time. Though some of the previous studies focused on the existence of cost or demand uncertainty, they have abstracted their analysis from the possibility of information acquisition, which is one of the main focuses of the present paper. We allow for the possibility of forming a JV between the foreign firm and a host-country firm. Participation of the host-country firm in the JV may help to acquire better information about the market condition of the host-country, which, in turn, reduces uncertainty and helps to increase the profit of the project.

More specifically, we consider an infinite horizon game with demand uncertainty where a firm is deciding on the mode of entry, viz., export, JV and fully owned subsidiary. We assume that the foreign firm can reduce the degree of uncertainty if it forms a JV with a domestic firm, who does not have the production technology or is not enough competent to produce the good. The better knowledge of the host-country partner regarding the host-country market conditions may be the reason for lower uncertainty in the JV. But, this reduction in the degree of uncertainty under JV may also depend on the intensity of the host-country firm's stake in the project.

In what follows, in section 2, we do our analysis with the possibility of information acquisition under JV due to the involvement of the host-country firm. We find that if the expected profit does not exceed a critical level then the foreign firm will not go for a fully owned subsidiary. In section 3, we examine the optimal equity sharing between the firms and the possibility of renegotiation depending on the costs of share renegotiation. The foreign firm will never set up a JV if the benefit from forming a JV is not sufficiently large; otherwise the foreign firm will do the JV and then may switch to fully owned subsidiary. This possibility confirms the situations observed in several countries where the firms renegotiate over the shareholding in future periods (e.g., see Mukherjee and Sengupta, 2001). This finding also shows that foreign firms willing to invest in the host-country

markets with demand uncertainty will form a JV in the initial periods and may switch to the fully owned subsidiary in the future period.

In section 4, we show the possibility of adopting a mode of entry in the initial periods if that strategy increases future profits significantly by helping the firm to benefit from information acquisition even if the flow profit in the initial periods is negative. We consider that flow profit from exporting is negative but exporting initially may help the foreign firm to acquire important information, which will be helpful for future foreign investment. Hence, if the benefit from information acquisition is sufficiently strong, the foreign firm is willing to accept losses at the beginning in anticipation of the future gain from better information.

The present paper is most closely related to the papers by Buckley and Casson (1981) and Capel (1992). In their paper, Buckley and Casson (1981) have considered the market-servicing choice as a dynamic problem and have examined the importance of different types of costs on the mode of entry of a foreign firm. This analysis has been extended by Capel (1992) by incorporating the possibility of both market growth uncertainty and real exchange rate uncertainty. Capel (1992) also discusses the implications of more flexible market-servicing modes (such as maintaining the plants both in the home country and foreign country, allowing to make licensing agreements with firms in the host-country) on the entry decisions of the foreign firms. The significant differences between the present paper and Buckley and Casson (1981) and Capel (1992) are as follows. Firstly, we consider the possibility of JV along with export and fully owned subsidiary. As we show, the possibility of JV may encourage the foreign firm to invest in the host-country relatively early compared to Capel (1992). Further, we address the issue of optimal equity sharing in the foreign subsidiary and thus our analysis provides a reason for the observed phenomenon of share renegotiation between the partners in the JVs. Moreover, this analysis provides a rationale for observing different degrees of foreign shareholding in different countries and in different industries. Secondly, in this paper we examine the implications of information acquisition on the entry decisions of the foreign firms. We show that this possibility may encourage a firm to adopt a non-profitable mode of entry in the initial periods if this decision helps the foreign firm to benefit significantly from information acquisition. Further, in our paper we not only consider different rates of learning under different modes of entry, we also assume that the domestic partner's stake in the project can influence the

degree of uncertainty. Lastly, unlike Buckley and Casson (1981), we consider uncertainty about the market demand.

Rest of the paper is organized as follows. The next section develops the basic model. Section 3 determines the optimal equity shareholding of the foreign firm. Section 4 examines the possibility of adopting a non-profitable entry strategy in the initial periods. Section 5 concludes the paper. Some mathematical details are delegated to the appendix.

## 2 The Model

We consider an infinite horizon model where a firm wants to enter a foreign market. The firm can basically choose between three possible modes of entry. One of its possibilities is to export its product to the foreign country. This will generate an instantaneous profit rate of

$$\pi_X = \pi_X Y^{\eta}, \quad \eta > 0 \tag{1}$$

with

$$dY = a_X Y dt + \sigma_X Y dz, \tag{2}$$

where $z$ is a Wiener process. That is, the profit rate $\pi_X$ is continuously affected by a shock $Y > 0$, which follows a geometric Brownian motion with drift $a_X$ and standard deviation $\sigma_X$.

A second possibility for the foreign firm is to open a fully owned subsidiary in the host country. We denote this situation by FDI. This requires an irreversible investment, say $F$, in order to build a fully owned subsidiary in the foreign country. This results in an instantaneous profit rate of

$$\pi_F = \pi_F Y^{\theta}, \tag{3}$$

with

$$dY = a_F Y dt + \sigma_F Y dz, \tag{4}$$

where both drift $a_F$ and standard deviation $\sigma_F$ may differ from $a_X$ and $\sigma_X$. If this firm undertakes FDI then this may help the firm to have better understanding about the market condition of the host-country and this possibility may change the degree of uncertainty faced by this firm. Alternatively, one may think that different political conditions or different characteristics of the input markets in the home country and the host-country may

be responsible for the degree of uncertainty faced by the foreign firm under export and FDI.

For simplicity, in the present analysis we will only consider the situation in which $\theta = \eta$. Hence, this changes the expression (3) to

$$\pi_F = \pi_F Y^{\eta}. \tag{5}$$

The returns to scale parameter $\eta$ reflects the impact of the shock on the profit rate. As shown in Appendix A, if the uncertainty in the profit rate is due to *exchange rate* uncertainty, then the shock will have a different impact under export compared to FDI, i.e., $\theta$ is not equal to $\eta$. But, if the uncertainty is due to the *market size* of the host-country, the shock will have the same impact under export and FDI, i.e., $\theta$ is equal to $\eta$. Hence, in our analysis we consider that the firm is uncertain about the demand conditions of the host-country. Furthermore, we assume that $\pi_F > \pi_X$. It may be that if the foreign firm undertakes FDI, then it can save the transportation cost and/or tariff imposed by the host-country. Another possibility for the profit rate under FDI to be higher than the profit rate under export is that the inputs may be cheaper in the host-country.

The third, and last, possibility of entering the foreign market considered in the present paper is to form a JV with a host-country firm. Let $\alpha$ and $(1-\alpha)$ denote the profit shares of the foreign firm and its host-country partner respectively. To get its share of the profit rate, $\alpha\pi_F Y^{\eta}$, the firm has to invest an equal fraction of the total investment, $\alpha F$. In addition, we allow for the possibility that the profit share affects the level of uncertainty the project is exposed to, that is, $\sigma_F = \sigma_F(\alpha)$. The host-country partner may have better knowledge about the domestic consumers or may have the market specific skills to cope with the market uncertainty in the host-country that helps to reduce uncertainty about the market demand in the host-country. However, the act of knowledge acquisition or providing market specific skills creates disutility to the host-country partner. So, higher equity shareholding of the host-country partner will induce it to contribute more efficiently in the JV and this will affect the profit level of the JV. Notice that if $\alpha = 1$, this case reduces to the case in which the firm chooses to undertake FDI by itself.

Often foreign firms use transfer pricing to extract more surplus on top of dividend income. However, Svejnar and Smith (1984) have demonstrated that transfer pricing and equity shares may act as perfect substitutes. In our framework, the foreign firm can choose the equity share appropriately to get the maximum benefit from the JV. Hence, to convey

the main message of this paper in the simplest way, we abstract our analysis from the issue of transfer pricing. Furthermore, often the intervention by the host-country government also reduces the possibility of transfer prices (see, e.g., Tang and Yu, 1990).

To analyze the conditions under which the firm optimally chooses for export, FDI or JV, let us first consider the expected total discounted stream of profits if the firm decides to participate in a JV.[1] As noted before, this includes the case of FDI when the profit share of the foreign firm is equal to one. Let $E$ denotes the expectation operator and $\Pi_F$ is the total discounted stream of profits of the project in case of foreign investment. Then

$$E\alpha\prod_F = E\left[\int_0^\infty \alpha\pi_F Y^\eta e^{-rt}dt\right] - \alpha F\,, \tag{6}$$

where $r$ is the interest rate and $Y$ evolves according to equation (4). It is easy to show that this can be written as

$$E\alpha\prod_F = \frac{\alpha\pi_F Y^\eta}{r - a_F\eta - \frac{1}{2}\sigma_F^2(\alpha)\eta(\eta-1)} - \alpha F \equiv \pi_I(\alpha)Y^\eta - \alpha F\,. \tag{7}$$

The next step is to write down the functional equation. Let $V(Y)$ be the value of the foreign firm, i.e., the total expected discounted stream of profits of the foreign firm, given the level of the shock $Y$. So,

$$V(Y) = \max\left(E\alpha\prod_F, \pi_X Y^\eta + (1+rdt)^{-1}E[V(Y+dY)]\right). \tag{8}$$

Above equation says that this value is equal to the maximum of 'the total expected profits if the foreign firm is investing in a JV' and 'the total expected profits if the foreign firm does export and postpones investment'. The solution of this problem is in the form of a critical value of $Y$, say $\overline{Y}$, such that if the level of the shock is above the critical value it is optimal for the foreign firm to make the investment[2]. This critical value is given by (see Appendix B):

$$\overline{Y} = \left[\frac{\alpha F}{\left(1-\frac{\eta}{\beta}\right)\left(\pi_I(\alpha) - \pi_{NI}\right)}\right]^{\frac{1}{\eta}}, \tag{9}$$

[1] To analyze the effects of uncertainty and the role of information acquisition on foreign investment in a simple way, we abstract our analysis from the possibility of technology licensing by the foreign firm to a host-country firm. Often international technology transfer involves a huge amount of resource costs that makes technology licensing as an unprofitable option. For example, see, Teece (1977, 1981) for discussions on the resource cost of technology transfer. Further, the possibility of technology licensing may reduce the profit of the licenser in its existing markets due to the entry of the licensee in these markets. The possibility of imitation or 'inventing around' under technology licensing may be responsible for this threat of entry (see, e.g., Kabiraj and Marjit, 1993). Hence, licensing may not be a profitable option to the foreign firm.

[2] See, e.g., Dixit and Pindyck (1994, Chapter 4) for the solution method for this type of problem.

where $\pi_{NI}Y^{\eta}$ is the total expected discounted stream of profits when the foreign firm will never invest to the host-country, that is when it will export its product forever. We find that

$$\pi_{NI}Y^{\eta} = \frac{\pi_X Y^{\eta}}{r - a_X\eta - \frac{1}{2}\sigma_X^2\eta(\eta-1)}. \tag{10}$$

The parameter $\beta > 1$ is a root of the quadratic equation associated with the optimization problem (see Appendix B).

Concerning the critical value given in (9), notice that as long as $\pi_I(\alpha) \le \pi_{NI}$ the foreign firm will never invest in the host-country. As a result, we will only consider the set of $\alpha$'s for which $\pi_I(\alpha) > \pi_{NI}$. Furthermore, we have implicitly assumed that more information and less uncertainty are better for the project. Hence, it creates a restriction on $\eta$ and requires that $\eta < 1$. Therefore, we find that $\eta < \beta$ and $\overline{Y}$ is positive.

The value function, representing the value of the foreign firm, is given by

$$V(Y) = \frac{\eta\left(\pi_I(\alpha) - \pi_{NI}\right)}{\beta}\overline{Y}^{(\eta-\beta)}Y^{\beta} + \pi_{NI}Y^{\eta}. \tag{11}$$

# 3 Optimal profit share

The foreign firm, at least initially, determines its optimal profit share before it decides to make the investment (i.e., either to engage in a JV or to undertake FDI). As a result, the firm takes into account of the effect of the desired profit share on the critical value or threshold level of the shock. If, for example, a higher shareholding of the foreign firm increases the critical value of the shock, it reduces the probability that the investment will actually take place, and, hence, influences the expected stream of profits. However, after the investment has taken place this effect of the profit share on the probability of investment is no longer there. Hence, the optimal profit share, or the path of the optimal profit share, depends on the possibility whether the foreign firm can change its share once that is set. In subsection 3.1, we will discuss one extreme situation in which the firm sets the optimal profit share once and for all, i.e., the firm *cannot* change the share or the costs associated with a change are too high. Subsection 3.2 will deal with another extreme situation where the firm *can* change the optimal share at face value.

## *3.1 The ex-ante optimal profit share with no possibility of share renegotiation*

To determine the ex-ante optimal profit share of the foreign firm, i.e., the profit share that maximizes the value of the foreign firm that has not (yet) made the investment, we rewrite $V(Y)$ as a function of $\alpha$, say $W(\alpha)$, leaving out irrelevant constants (variables independent of $\alpha$):

$$W(\alpha) = \left(\pi_I(\alpha) - \pi_{NI}\right)\overline{Y}^{(\eta-\beta)} \equiv H\alpha^{\frac{\eta-\beta}{\eta}}\left(\pi_I(\alpha) - \pi_{NI}\right)^{\frac{\beta}{\eta}}, \tag{12}$$

for some constant $H$. The derivative of $W(\alpha)$ with respect to $\alpha$ is equal to

$$W'(\alpha) = \frac{H}{\eta}\alpha^{-\frac{\beta}{\eta}}\left(\pi_I(\alpha) - \pi_{NI}\right)^{\frac{\beta}{\eta}}\left[\eta - \beta + \frac{\alpha\beta}{\left(\pi_I(\alpha) - \pi_{NI}\right)}\pi_I'(\alpha)\right]. \tag{13}$$

Taking the derivative of $\pi_I(\alpha)$, which is implicitly defined by equation (7), with respect to $\alpha$ yields

$$\pi_I'(\alpha) = \left[r - a_F\eta + \left(\frac{1}{2} - \frac{\alpha\sigma_F'(\alpha)}{\sigma_F(\alpha)}\right)\sigma_F^2(\alpha)\eta(1-\eta)\right]\frac{\pi_F}{\left[r - a_F\eta + \frac{1}{2}\sigma_F^2(\alpha)\eta(1-\eta)\right]^2}. \tag{14}$$

First, suppose that the uncertainty associated with investment is independent of the level of the profit share, i.e., $\sigma_F(\alpha) \equiv \sigma_F$. Then, as stated by the following proposition, the foreign firm will not consider the possibility of creating a JV, but is only interested in either export or FDI. Let $\alpha^*$ denote the optimal value of the profit share.

**Proposition 1:** *Let $\sigma_F$ be independent from $\alpha$, i.e., $\sigma_F(\alpha) \equiv \sigma_F$. Then $\alpha^* = 1$, implying that the optimal strategy for the firm is to undertake FDI by itself as soon as $Y$ reaches $\overline{Y}$ corresponding to $\alpha = 1$.*

**Proof:** From equation (13) we can derive that the sign of $W'(\alpha)$ is equal to the sign of

$$(\eta - \beta)(\pi_I(\alpha) - \pi_{NI}) + \alpha\beta\pi_I'(\alpha) \equiv \Delta(\alpha), \tag{15}$$

by making use of the fact that, for relevant levels of $\alpha$, $\pi_I(\alpha) > \pi_{NI}$. Since $\sigma_F'(\alpha) = 0$, equation (14) implies that $\pi_I'(\alpha) = \frac{\pi_I(\alpha)}{\alpha}$. Inserting this relation into equation (15) implies that

$$\Delta(\alpha) = \eta(\pi_I(\alpha) - \pi_{NI}) + \beta\pi_{NI} > 0, \tag{16}$$

which proves that $\alpha^* = 1$. Q.E.D.

If the participation of the host-country firm does not provide any benefit then there is no meaning to involve the host-country firm in the project and hence, the foreign firm will do FDI as soon as the expected profit reaches the (associated) critical level. So, in this situation, the foreign firm will do export if the expected profit is less than the critical value and will switch to FDI as soon as the expected profit reaches the critical level. Therefore, this finding shows that the finding of Capel (1992) is a special case of our analysis where the participation of the host-country firm does not provide sufficient benefit to the project, with the exception that unlike Capel (1992) we have no possibility of switching from FDI to export, since we have abstracted fixed cost of production in our analysis.

Now, consider that the uncertainty depends positively on the level of the profit share according to $\sigma_F(\alpha) = \sigma_0 + \alpha\sigma_1$. Therefore, according to equation (13), solving for $W'(\alpha) = 0$ implies that the condition for an interior solution of the optimal profit share is given by

$$\pi_I'(\alpha) = \frac{(\beta - \eta)}{\alpha\beta}(\pi_I(\alpha) - \pi_{NI}) \equiv g(\alpha), \tag{17}$$

where $\pi_I'(\alpha)$ is given by equation (14). We know that if $\alpha$ approaches 0 (from above), $g(\alpha)$ goes to minus infinity, while in case of $\alpha$ equal to 0, $\pi_I'(\alpha)$ equals to $\frac{\pi_F}{\left[r - a_F\eta + \frac{1}{2}\sigma_0^2\eta(1-\eta)\right]}$, which is positive. Therefore, there exists an equilibrium (at least one) if, at $\alpha = 1$, the right-hand side of equation (17), $g(\alpha)$, is higher than the left-hand side, $\pi_I'(\alpha)$, i.e., if

$$\frac{(\beta - \eta)}{\beta}(\pi_I(1) - \pi_{NI}) > \pi_I'(1). \tag{18}$$

Suppose that the values of the parameters are such that this inequality holds. Then there will be at least one value of $\alpha$ that satisfies equation (17) and exists an interior optimal value of the profit share, i.e., $\alpha^* \in (0,1)$. However, as already mentioned in section 2, $\pi_I(\alpha)$ needs to be greater than $\pi_{NI}$. Therefore, we have an interior optimal value of the profit share if $\alpha^*$ is greater than the value of $\alpha$ that makes $\pi_I(\alpha) = \pi_{NI}$.

This result is summarized in the next proposition and is illustrated in Figure 1, which plots both $g(.)$ and $\pi_I'(.)$ as functions of $\alpha$.

**Proposition 2:** *Let* $\sigma_F$ *be dependent on* $\alpha$*, in particular* $\sigma_F(\alpha) = \sigma_0 + \alpha\sigma_1$*, with* $\sigma_0>0$*,* $\sigma_1>0$*, and let equation (18) hold. Then there exists an equilibrium with* $\alpha^* \in (0,1)$.

Hence, if there exists an interior value of the profit share then the foreign firm will form a JV as soon as $Y$ reaches the critical value of $Y$ corresponding to the optimal equity shareholding, which can be obtained from (9). It must be noted that here the calculation of the optimal equity shareholding assumes that the firms will hold this amount of shareholding forever, once the JV is being formed. In other words, there is no possibility of share renegotiation in the future periods. It is easy to check from (9) that the critical vale $\overline{Y}$ is positively related to $\alpha$ if $\pi_I(1) - \pi_{NI} > \pi_I'(1)$, which is true when (18) holds. So, it implies that if the foreign firm makes a JV, it requires a lower level of critical value, $\overline{Y}$, compared to situation with FDI. Hence, the possibility of JV encourages the foreign firm to invest in the host-country relatively early compared to the situation with FDI, as considered in the previous works (see, e.g., Capel, 1992). Further, this finding says that while entering in the host-country markets with demand uncertainty, the foreign firms will prefer to form a JV in the initial periods and may switch to FDI in the future period.

### *3.2 The possibility of share renegotiation*

In the previous subsection we have determined the optimal equity shareholding under the assumption that the firms will hold this equity shareholding forever, once the JV is being formed. Suppose now, however, that the foreign firm can adjust its profit share, after the initial investment has been made, at face value. This possibility allows the foreign firm to raise its future profits from share renegotiation and hence, may encourage the foreign firm to hold a relatively smaller amount of share in the JV initially and getting the benefit of foreign investment. Since each level of equity shareholding has a corresponding critical value of $Y$, it is easy to understand that the foreign firm will decide to start a JV with such amount of equity shareholding that needs the minimal critical value. For convenience, we have rewritten the critical value (as a function of $\alpha$):

$$\overline{Y}(\alpha) = \left[ \frac{\alpha F}{\left(1 - \frac{\eta}{\beta}\right)\left(\pi_I(\alpha) - \pi_{NI}\right)} \right]^{\frac{1}{\eta}}. \tag{19}$$

Differentiating the critical value with respect to $\alpha$ implies that the share that minimizes the critical value, say $\alpha_{\min}$, is implicitly given by

$$\pi_I(\alpha_{\min}) - \pi_{NI} = \alpha_{\min} \pi_I'(\alpha_{\min}). \tag{20}$$

Concerning the existence of $\alpha_{\min} \in (0,1)$, notice that, as long as $\pi_{NI} > 0$, there is an $\alpha_\infty \in (0,1)$ such that $\pi_I(\alpha_\infty) = \pi_{NI}$. Consequently, $\overline{Y}(\alpha) \to \infty$ as $\alpha$ approaches $\alpha_\infty$ from above and, hence, $\overline{Y}(\alpha)$ is decreasing in the neighbourhood of $\alpha_\infty$. Furthermore, the derivative of $\overline{Y}(\alpha)$ with respect to $\alpha$ implies that $\overline{Y}(\alpha)$ is increasing in the neighbourhood of $\alpha = 1$ if

$$\pi_I(1) - \pi_{NI} > \pi_I'(1), \tag{21}$$

which is satisfied if inequality (18) holds. This ensures the existence of $\alpha_{\min} \in (0,1)$. See Figure 2 for an example of $\overline{Y}(\alpha)$.

Suppose that the shock has reached the critical value at which the foreign firm decides to create a JV at the profit share $\alpha_{\min}$. After the formation of the JV, the foreign firm is not interested anymore in exporting since $\alpha_{\min}$ is larger than $\alpha_\infty$, but focuses only on the optimal expected stream of profits in the JV. Hence, it is understandable that as the value of $Y$ increases, the foreign firm may have the incentive for holding a higher level of equity shareholding. Further, since $\alpha_{\min}$ is the amount of shareholding which corresponds to $\overline{Y}_{\min}$ (the minimum of $\overline{Y}$ with respect to α), this amount of shareholding is not necessarily the *ex-post* optimal amount of foreign shareholding corresponding to $\overline{Y}_{\min}$.

The expected profit of the firm *given* that it invests in a JV with profit share $\alpha$ is

$$E\alpha \prod_F = \pi_I(\alpha) Y^\eta - \alpha F. \tag{22}$$

Let $\hat{\alpha}$ denote the ex-post profit share that maximizes the expected profit given in (22), i.e.,

$$\pi_I'(\hat{\alpha}) = \frac{F}{Y^\eta}. \tag{23}$$

Equation (23) implies that the ex-post profit share is dependent on the level of the shock. If $Y$ increases, the desired ex-post profit share increases too. How the profit share changes in response to changes in the shock and to what extend depends on the specific functional

form of $\pi_I'$. Figure 2 contains an example of the relationship between the optimal ex-post profit share and the level of the shock. Suppose that, on average, the level of the shock rises. From Figure 2 it is clear that if the foreign firm wants to form a JV with an equity shareholding equal to $\alpha_{\min}$ then it needs $Y$ to reach the value $\overline{Y}_{\min}$. However, it is clear from the curve labelled $\hat{\alpha}$ in figure 2 that the desired shareholding of the foreign firm, ex-post JV formation, is higher than $\alpha_{\min}$. Hence, ex-post JV formation the foreign firm will like to hold the equity shareholding given by the curve labeled $\hat{\alpha}$ for a particular value of $Y$. Thus, we can say that when the foreign firm can renegotiate the equity shareholding at face value, the foreign firm will form a JV as soon as the value of $Y$ reaches $\overline{Y}_{\min}$ and the foreign firm will hold an equity shareholding, determined from the curve labelled $\hat{\alpha}$, corresponding to $\overline{Y}_{\min}$, i.e., $\hat{\alpha}(\overline{Y}_{\min})$. After that, the equity shareholding of the foreign firm continues to rise along the curve labeled $\hat{\alpha}$ (that is, given that the level of the shock rises). If $\pi_I'$ falls to $0$ before $\alpha$ reaches 1, the desired ex-post profit share will, on average, rise up to the point where $\pi_I'(\alpha) = 0$. Alternatively, if $\pi_I'$ is positive over the whole interval [0,l], as in figures 1 and 2, the optimal profit share will, on average, increase until $\alpha = 1$.

Thus, we have seen that when there is a possibility of share renegotiation, the foreign firm will initially choose a shareholding that is optimal ex-post foreign investment and corresponds to $\overline{Y}_{\min}$, i.e., $\hat{\alpha}(\overline{Y}_{\min})$. Hence, it is easy to understand that this level of equity shareholding may be different from the equity shareholding determined in the last subsection, i.e., $\alpha^*$. Let us now examine the relationship between $\hat{\alpha}(\overline{Y}_{\min})$ and $\alpha^*$. Note that if $Y = \overline{Y}(\alpha^*)$, equation (23) transforms to equation (17), implying that the ex-post optimal profit share is equal to the ex-ante optimal profit share, i.e., $\hat{\alpha} = \alpha^*$. Hence the point of intersection of the two lines in Figure 2 occurs at the ex-ante optimal profit share. It is clear that $\hat{\alpha}(\overline{Y}_{\min})$ is less than $\alpha^*$. This immediately implies that when the foreign firm has the option of share renegotiation, the foreign firm will enter the host-country market by forming a JV with a relatively lower equity shareholding compared to the situation where equity shareholding is non-renegotiable in the future periods. As a result, the foreign firm will invest relatively early in case of share renegotiation compared to the situation with no share renegotiation.

The following proposition summarizes the above discussion of this subsection.

**Proposition 3:** *Let* $\pi_{NI} > 0$. *If share renegotiations in future periods occur at face value then the foreign firm will initially choose the equity shareholding* $\hat{\alpha}(\overline{Y}_{\min})$, *which is less than* $\alpha^*$ *(except when* $Y = \overline{Y}(\alpha^*)$*), and will form a JV as soon as* $Y$ *reaches* $\overline{Y}_{\min}$, *which is lower than* $\overline{Y}(\alpha^*)$. *Hence, in this situation, the foreign firm will do foreign investment relatively early compared to the situation where share renegotiations are not possible. Over time the foreign firm will adjust its shareholding according to condition (23).*

### *3.3 Discussion*

The dependence of the ex-post optimal profit share on the level of the shock creates a tendency with the foreign firm to adjust the profit share with the changing level of the shock. In the previous two subsections we have analyzed two extreme cases, one in which the foreign firm is prohibited to adjust its share and one in which the foreign firm can adjust its share at face value. If a higher share to the foreign firm reduces the profit of the host-country partner, then this possibility may not encourage the host-country partner to raise the share of the foreign firm. However, if, due to a rise in the foreign firm's profit share, the reduction in profit of the host-country partner is less than the extra profit of the foreign firm then there is room for negotiating over the profit share. Since our purpose in this paper is not to focus on this bargaining game between the firms in case of share renegotiation, we are leaving this discussion in the present paper and may take this up in the future research agenda. This possibility of negotiation implies that the profit share can be adjusted but at a value higher than the face value, which implies an effective cost of share renegotiation to the foreign firm. If there is no room for negotiations, the profit share is set just once at the start of the JV and will not be adjusted, as in subsection 3.1. Hence, in this situation, the optimal equity shareholding of the foreign firm will be the one determined in subsection 3.1.

## 4 Export as a source of information

So far we have assumed that the foreign firm cannot affect the uncertainty under foreign investment by doing export initially. However, it may be possible for the foreign firm to

acquire important information while doing export that will help the foreign firm to reduce uncertainty while doing foreign investment. In fact, if the benefit from information acquisition is sufficiently strong, the foreign firm may prefer to do export initially even if export is a non-profitable option to the foreign firm. The purpose of this section is to show this role of information acquisition through a simple process of learning.

We consider the following simple process of learning for our analysis. If the foreign firm engages in export, the standard deviation corresponds to $\sigma_X$. If the foreign firm engages in FDI without having exported its product initially, the standard deviation corresponds to $\sigma_{F,ne}$. But, if the foreign firm does export initially and then switches to FDI, the standard deviation under FDI becomes $\sigma_{F,e} < \sigma_{F,ne}$. Hence, we assume that by doing export initially, the foreign firm can gather more information about the host-country, which helps the foreign firm to receive higher profits under FDI. Note that it is not optimal for the foreign firm to do FDI initially and shift to export, as profit from FDI excluding the fixed cost of doing FDI is higher compared to export since the foreign firm faces lower marginal cost of production under FDI compared to export. It is important to observe that we do not allow any possibility of learning either within export or within FDI. In a more realistic setting, the firm would get the benefit of learning within export or FDI and also when switching from export to FDI, reflected in a gradually declining degree of uncertainty. This would require the standard deviation of the shock to be a (decreasing) function of time, which implies that the shock is no longer described by a (standard) geometric Brownian motion. This would complicate the model too much without serving our purpose in a better way.

Further, for simplicity, we will consider that the foreign firm considers servicing the foreign market through export or a fully owned subsidiary. Hence, we abstract from the possibility of a JV for the reasons of clarity and will discuss the implications of the JV possibility later.

Suppose that the profit rate of exporting the product to the foreign country is negative, i.e., $\pi_X < 0$. In the previous model this would lead the firm to dismiss the possibility of export as a mode of entry. However, in the present setting, the firm gains information if it engages in export before it decides to engage in FDI. This gain in information is being reflected in a reduction in the degree of uncertainty under FDI. Hence, the firm may choose to do nothing – that is, no export initially – while it is waiting for the

shock to reach the critical value at which it will engage in FDI, or, the firm chooses to export initially and in the meantime gains information to face less uncertainty once it makes the investment necessary to set up its fully owned subsidiary.

To find the dominant strategy of the foreign firm, we calculate the value of the firm, $V(Y)$, in both situations. Due to the different degrees of uncertainty, the profits of FDI in the two situations differ according to

$$\pi_{I,j} = \frac{\pi_F}{r - a_F\eta - \frac{1}{2}\sigma_{F,j}^2\eta(\eta-1)}, j = ne, e. \tag{24}$$

The subscripts *ne* and *e* refer to the situations of 'no export initially' and 'export initially' respectively. In this case, the condition on the two standard deviations, i.e., the two measures of uncertainty, implies that the expected profit from setting up a fully owned subsidiary is higher in the situation of 'export initially', due to the decrease in uncertainty, i.e., $\pi_{I,ne} < \pi_{I,e}$.

If the firm chooses not to export initially, the same analysis as in section 2 shows that the critical value of the shock is given by

$$\overline{Y}_{ne} = \left[\frac{F}{\left(1-\frac{\eta}{\beta}\right)\pi_{I,ne}}\right]^{\frac{1}{\eta}}. \tag{25}$$

Then the value of the firm in this situation of 'no export initially' is

$$V_{ne}(Y) = \frac{(\eta/\beta)F}{(1-\eta/\beta)}\left(\frac{Y}{\overline{Y}_{ne}}\right)^{\beta}. \tag{26}$$

Similarly, we can calculate the critical value of the shock in the situation of 'export initially', which is

$$\overline{Y}_{e} = \left[\frac{F}{\left(1-\frac{\eta}{\beta}\right)(\pi_{I,e}-\pi_{NI})}\right]^{\frac{1}{\eta}}. \tag{27}$$

This critical value is lower than the previous critical value for two reasons: The expected profit from FDI is larger and the profit from not investing at the beginning and continuing with export is negative (lower than the profit from doing nothing). Thus, the firm is inclined to invest in the subsidiary sooner when it is exporting than when it is 'doing nothing'. The value of the firm in the situation of 'export initially' is given by

$$V_{e}(Y) = \frac{(\eta/\beta)F}{(1-\eta/\beta)}\left(\frac{Y}{\overline{Y}_{e}}\right)^{\beta} + \pi_{NI}Y^{\eta}. \tag{28}$$

The first term on the right-hand side of this equation is higher than $V_{ne}(Y)$ because of the lower critical value, but the second term is negative because of the (assumed) negative profits of exporting. The net effect is ambiguous and will depend on the values of the parameters and the value of the shock.

To illustrate these findings, we have computed the two value functions given a set of plausible numerical values for the parameters. The result is shown in figure 3. At some point of $Y$, say $\hat{Y}$, the two value functions are exactly equal. At this point the firm is indifferent between 'export initially' and 'no export initially'. If the value of the shock is smaller than $\hat{Y}$, the firm will not export its product, since the probability that the shock reaches the critical value $\overline{Y}_e$ in time, such that the losses due to export will not be too high, is too low. If the value of the shock is larger than $\hat{Y}$, the firm will choose to export its product, expecting that the value of the shock will reach the critical value in time.

To show the possibility of adopting a non-profitable entry strategy initially, we have abstracted our analysis from the possibility of a JV. However, like the previous sections, the gain from working with the host-country partner may provide the incentive for choosing JV initially if the presence of the host-country partner provides sufficiently large benefit to the project's return. However, the conclusion of the previous section was based on the assumption that the foreign firm cannot reduce the amount of uncertainty by taking part in the market. It is easy to understand that the foreign firm's entry decision will depend on the extent of benefit from better information under JV and export. If the rate of information acquisition by participating in the market is sufficiently high, it will reduce the foreign firm's incentive for forming a JV in the initial periods if the cost of share renegotiation is sufficiently large. Therefore, we find the following trade-off between doing export and forming a JV in the initial period. While export yields a lower return than forming a JV, there are also lower costs associated with switching from export to FDI than from a JV to FDI. In the extreme, the foreign firm may not switch from JV to FDI when the cost of switching (i.e., the cost of share renegotiation or breaking down the previous JV and opening a new fully owned subsidiary) is sufficiently large.

# 5 Conclusion

It is empirically found that some countries are able to attract more foreign investments compared to other countries. Also, the amount of foreign investment in a country varies among different industries. Further, it has been observed that, in case of JV, the foreign firms raise their shares in the project over time. In this paper, employing a model of infinite horizon with demand uncertainty, we provide a rationale for these observations.

We show that a foreign firm will be interested in foreign investment provided the profit level exceeds a critical level. While doing foreign investment, a foreign firm may prefer to opt for JV instead of opening a fully owned subsidiary. However, a foreign firm will opt for JV provided the JV helps to reduce market-demand uncertainty significantly. Otherwise, the foreign firm will decide between export and fully owned subsidiary.

If participation in the market helps the foreign firm to acquire important information about market demand, which, in turn, helps to reduce uncertainty, then we show that a foreign firm may prefer to do export initially even if the flow profit from export is negative. Initial export helps the foreign firm to gather important information about market demand and if this benefit is sufficiently strong then a foreign may prefer to do export initially and then switch to foreign investment, even if export is a non-profitable option.

# Appendix

## A Derivation of the profit rates:

Let the demand curve for the good in the host-country market be given by

$$Q = qp^{-\gamma}, \qquad \gamma > 1, \tag{A.1}$$

where $p$ denotes the price (in host-country currency), $Q$ is the total output or quantity demanded in the good market and $q$ is a parameter reflecting the size of the market. We assume that in case of export all (variable) costs are made in the foreign firm's home country while the revenues are based in the host-country. This implies that the profit in case of export is given by $\pi_X = \max(epQ - c_X Q)$, where $c_X$ is the marginal cost and $e$ is the exchange rate (expressed in home currency). If the firm decides to undertake FDI, both costs and revenues are in terms of the foreign currency, implying that profit can be written as $\pi_F = \max e(pQ - c_F Q)$, with $c_F$, which is less than $c_X$, denoting the marginal cost in case of FDI. Carrying out both maximizations leads to the following profit rates:

$$\pi_i = (\gamma - 1)^{(\gamma-1)} \gamma^{-\gamma} q e^{\mu_i} c_i^{(1-\gamma)}, \quad i = X, F, \tag{A.2}$$

with $\mu_X = \gamma$ and $\mu_F = 1$.

Suppose for example that there is uncertainty about the market size. This can be captured by setting $q = q(Y)$, where $Y$ is the size of the market and $q$ is a function reflecting the impact of market size on the level of the demand curve. If $q(Y) = Y^{\eta}$, where $\eta > 0$, then the profit rates can be written as in equations (1) and (3) with $\theta = \eta$, i.e., like (1) and (5).

Another possible source of uncertainty in this set up is the exchange rate. Setting $e = Y$ in equation (A.2) corresponds to the profit rates in equations (1) and (3) when $\eta = \gamma$ and $\theta = 1$.

## B Determination of the critical value:

The optimization problem is given by

$$V(Y) = \max(E\alpha \prod_F, \pi_X Y^{\eta} + (1 + rdt)^{-1} E[V(Y + dY)]), \tag{B.1}$$

with $dY = a_X Y dt + \sigma_X Y dz$. In the continuation region, the second term on the right hand side is the larger of the two. Expanding it by Ito's Lemma and simplifying, we get the partial differential equation satisfied by the value function:

$$\frac{1}{2}\sigma_X^2 Y^2 V''(Y) + a_X Y V'(Y) - rV(Y) + \pi_X Y^{\eta} = 0. \tag{B.2}$$

In addition, $V(Y)$ must satisfy the following boundary conditions:

$$V(\overline{Y}) = E\alpha \prod_F (\overline{Y}) \tag{B.3}$$

and

$$V'(\overline{Y}) = \frac{\partial E\alpha \prod_F (\overline{Y})}{\partial Y}, \tag{B.4}$$

with

$$E\alpha \prod_F = \pi_I(\alpha) Y^{\eta} - \alpha F. \tag{B.5}$$

The function satisfying the equations (B.2) – (B.4) is given by

$$V(Y) = m_1 Y^{\beta} + m_2 \pi_X Y^{\eta}, \tag{B.6}$$

where $m_1$ and $m_2$ are constants that are yet to be determined. The constant $\beta > 1$ is a root of the quadratic equation

$$\frac{1}{2}\sigma_X^2 \beta(\beta - 1) + a_X \beta - r = 0. \tag{B.7}$$

Therefore, we have

$$\beta = \frac{1}{2} - \frac{a_X}{\sigma_X^2} + \sqrt{\left[\frac{a_X}{\sigma_X^2} - \frac{1}{2}\right]^2 + \frac{2r}{\sigma_X^2}}\,. \tag{B.8}$$

Inserting the value function $V(Y)$ into the partial differential equation (B.2) implies that

$$m_2 = \frac{1}{(r - a_X\eta - \frac{1}{2}\sigma_X^2\eta(\eta-1)}\,. \tag{B.9}$$

Hence, the value function can be written as $V(Y) = m_1 Y^{\beta} + \pi_{NI} Y^{\eta}$. Then the two boundary conditions are

$$m_1 \overline{Y}^{\beta} + \pi_{NI}\overline{Y}^{\eta} = \pi_I(\alpha)\overline{Y}^{\eta} - \alpha F\,, \tag{B.10}$$

and

$$\beta m_1 \overline{Y}^{(\beta-1)} + \eta\pi_{NI}\overline{Y}^{(\eta-1)} = \eta\pi_I(\alpha)\overline{Y}^{(\eta-1)}\,, \tag{B.11}$$

implying that $m_1 = \frac{\eta}{\beta}(\pi_I(\alpha) - \pi_{NI})\overline{Y}^{(\eta-\beta)}$ and that $\overline{Y}$ satisfies

$$\left(1 - \frac{\eta}{\beta}\right)(\pi_I(\alpha) - \pi_{NI})\overline{Y}^{\eta} = \alpha F \tag{B.12}$$

or

$$\overline{Y} = \left[\frac{\alpha F}{\left(1 - \frac{\eta}{\beta}\right)(\pi_I(\alpha) - \pi_{NI})}\right]^{\frac{1}{\eta}}\,. \tag{B.13}$$

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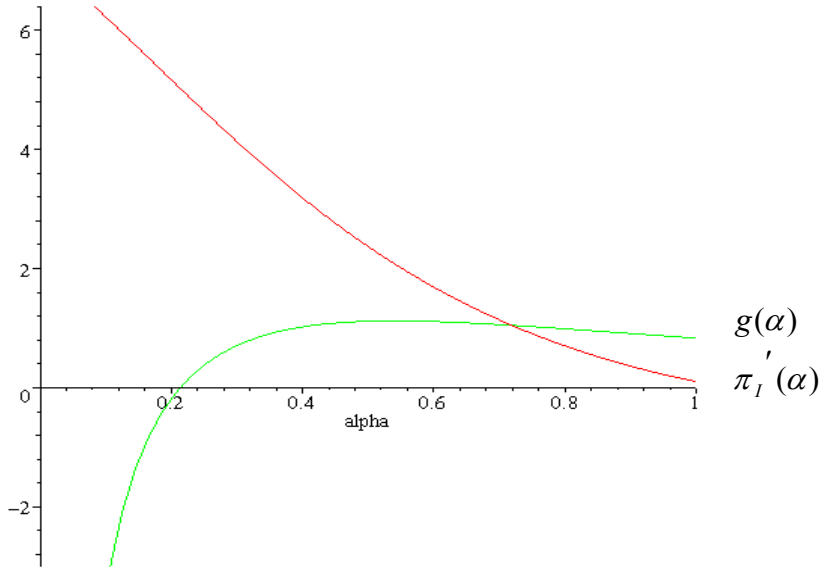


Figure 1: Parameter values: η=0.5, *r*=0.1, $a_F = 0$, $a_X = 0$, $\sigma_F = 0.3 + \alpha(0.9)$, $\sigma_X = 1.5$, $\pi_F = 0.8$, $\pi_X = 0.5$.

$\hat{\alpha}$

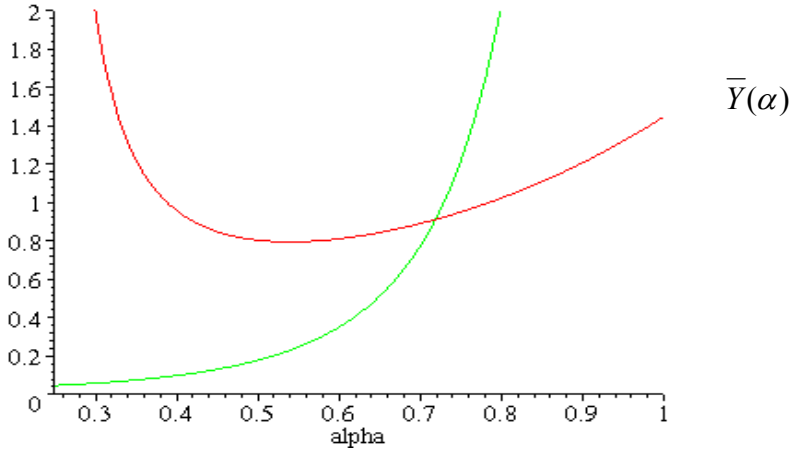


Figure 2: Parameter values: η=0.5, *r*=0.1, $a_F = 0$, $a_X = 0$, $\sigma_F = 0.3 + \alpha(0.9)$, $\sigma_X = 1.5$, $\pi_F = 0.8$, $\pi_X = 0.5$, *F*=1.

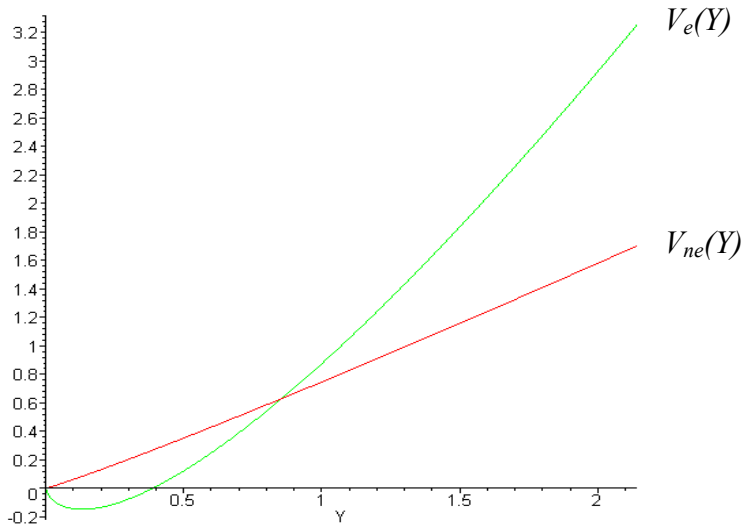


Figure 3: Parameter values: η=0.8, $r$=0.1, $a_F = 0$, $a_X = 0$, $\sigma_{F,e} = 1.3$, $\sigma_{F,ne} = 2$, $\sigma_X = 1.5$, $\pi_F = 0.8$, $\pi_X = -0.8$, $F$=3.