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Foreign market entry and host-country welfare: a theoretical analysis

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Abstract

Many developing countries are liberalizing their economies to allow higher equity participation by the foreign firms. We argue that the possibility of joint venture can reduce the number of technology transfers. Hence, joint venture can reduce the welfare of a host-country by creating higher market-concentration. However, higher profit generation under joint venture encourages the foreign firm to transfer relatively better technology and may make the host-country and the firms better-off under joint venture than licensing. For sufficiently large efficiency-gain, the host-country allows fully owned subsidiary of the foreign firm.

JEL classification: F21, F23
Keywords: Joint venture, Licensing, Welfare

Outline

Non-Technical Summary

Last few decades have seen significant changes in the policies of the developing countries. Developing countries are liberalizing their policies to attract better technologies from the technologically advanced firms. However, initially the liberalizing countries were mainly interested for technology licensing agreements. The cases for international joint ventures are increasing dramatically in the recent years.

This paper examines the optimal host-country policy regarding foreign investment when technology licensing involves opportunistic behavior of the foreign firm. We show that the formation of a joint venture may reduce the number of technology transfers and helps to increase the market-concentration. Hence, joint venture can reduce the welfare of a host-country by creating higher market-concentration. However, higher market-concentration can increase efficiency by encouraging the foreign firm to transfer relatively better technology to the host-country. If this efficiency-gain is sufficiently large then the JV can make both the firms and the host-country better-off compared to technology licensing. For sufficiently large efficiency-gain, the host-country allows fully owned subsidiary of the foreign firm.

1 Introduction

Technical progress is an important factor for economic growth. Many developing countries are liberalizing their policies to attract superior technologies from the technologically advanced foreign firms. In the last few decades the cases of international technology transfers have increased significantly. However, the developing countries were mainly interested for technology licensing. For example, in the early 1980s India has opened the doors for seeking new technologies through licensing or technological collaborations and the number of such collaborations has grown (see e.g., Economic and Political Weekly, 1985 and Bagchi, 1987). Under international technology licensing, a technologically advanced foreign firm transfers its superior technology to one or more technologically backward firms in the domestic countries and receives payments for this technology transfer. However, equity participation by the foreign firms was continued to be restricted.

As time passes, these countries gradually relax their restrictions and allow foreign equity participation in the domestic projects. However, these policy reforms were targeted mainly for international joint ventures (JVs) than fully owned foreign subsidiaries. As an example, India, in the early 1990s, has allowed 51% foreign equity participation in 35 high priority sectors as automatic approval but for higher than this it is decided through case by case study (see Saqib, 1995). The literature on international business also shows rising trend of international JVs in the developing countries. Korbin (1988) reported that in some less developed countries nearly 80% of the total foreign capital entered through JVs.

There is already a vast literature on technology licensing. As a representative sample one may look at Teece (1977, 1981), Gallini and Wright (1990), Rockett (1990), Marjit (1989, 1990a), Kabiraj and Marjit (1992a, 1992b, 1993), Singh (1992) and Mukherjee (2001, 2002). The earlier works on technology licensing mainly address the possibilities of technology licensing, the qualities of the licensed technologies, the optimal patent licensing contracts and the

concentration effects of technology licensing agreements.[1] The literature on international JV is relatively new but growing. Here the authors are mainly addressing the issues such as transfer pricing, formation of the JVs and the welfare effects of JVs (see, e.g., Svejnar and Smith, 1984, Falvey and Fried, 1986, Marjit, 1990b, Tang and Yu, 1990, Lee and Shy, 1992, Purakayastha, 1993, Ray Chaudhuri, 1995, Al-Saadon and Das, 1996, Marjit and Mukherjee, 1998, Das, 1998 and Mukherjee, 2000, Roy Chowdhury , 2001 and Sinha, 2001a and 2001b).

The present paper starts off with this background and highlights a potential conflict between the interests of the firms and the host-country. If there is a possibility of multiple licensing then each licensee internalizes the potential competition while accepting a licensing offer. This possibility of competition encourages each licensee to reduce its payment for the licensed technology. As a result, it can reduce the profit of the licenser. However, if the licenser and the licensee make a JV then it encourages the licenser to reduce the number of technology transfer. This, in turn, increases market-concentration and generates higher profit to these firms. Therefore, while JV can be a preferred option to the firms, the welfare of the host-country can be more under licensing compared to JV.

However, higher market-concentration under JV can encourage the technology seller to transfer relatively better technology to the host-country. If this efficiency-gain is sufficiently stronger then the firms as well as the host-country are better-off under JV than licensing. Therefore, if international JVs are formed mainly to get the benefits from higher market-concentration then it may not be worthwhile to encourage such JVs. But, if higher market-concentration can lead to sufficient efficiency-gain by attracting relatively better technology to the host-country then these JVs are welcomed. For sufficiently large efficiency-gain, the host-country can allow fully owned subsidiary of the foreign firm.

The present paper is related to Tang and Yu (1990) and Lee and Shy (1992). Tang and Yu (1990) consider different entry strategies of a foreign firm and conclude that the welfare of a host-country is maximal under international JV. In contrary, this paper shows that the welfare of a host-country can be higher under

* An informal discussion with Sudipto Bhattacharya on related issues has helped me to develop this idea. It is needless to say that any shortcoming is my responsibility. The author acknowledges the financial support from the Netherlands Technology Foundation (STW).

[1] Markusen (1995) and Pack and Saggi (1997) provide surveys on this area.

licensing or fully owned subsidiary compared to JV if technology licensing involves opportunistic behavior of the foreign technology seller and technology transfer is costly. Focusing on international JV only, Lee and Shy (1992) argue that whether an increase in the regulated share of foreign ownership increases the welfare of a host-country depends on the managerial control in the JV. In contrary, the present paper focuses on the role of market concentration and the associated efficiency-gain to determine the effect of a higher regulated foreign shareholding on the welfare of a host-country.

The rest of the paper is organized as follows. In the second section we provide the basic model and the results. Section 3 concludes.

2 The model and the results

Consider a firm who has a technology to produce a product and wants to enter another country, called host-country. This firm can enter the host-country either through technology licensing or through foreign investment. However, the government policy of the host-country imposes a constraint on the shareholding of this firm if it wants to enter through foreign investment.

We consider the following game. At stage 1, the host-country government decides the amount of maximum foreign shareholding in the host-country. The host-country government decides this level of foreign shareholding by maximizing the welfare of the host-country. We consider that welfare of the host-country is the summation of consumer surplus and the profit of the host-country firm(s). If the host-country government does not allow fully owned subsidiary of the foreign firm then the foreign firm can either license its technology to the host-country firm(s) or form JV(s) with host-country firm(s). For simplicity, we assume that there are two potential firms in the host-country and neither of them have the technology to produce this product. After the host-country government's decision on maximum foreign shareholding, the foreign firm, at stage 2, chooses the quality of the technology to be transferred either through licensing or through foreign investment. We measure the quality of the technology by the corresponding marginal cost of production. Better quality of the technology implies lower marginal cost of production. In stage 3, the foreign firm decides whether to license

its technology to the host-country firm(s) or investing in the host-country. In case the foreign firm licenses the technology or forms JVs, it gives take-it-or-leave-it offer(s) to the host-country firm(s). The host-country firm(s) either accept or reject the offer. We normalize the profits of the host-country firms to zero if they do not produce this product. Hence, each host-country firm accepts an offer of the foreign firm if its net profit is positive. At stage 4, the outputs are produced and the profits are realized. We solve the back through backward induction. The basic structure of the game is shown in Figure 1.

Figure 1

We assume that there are no costs specific to licensing and foreign investment. This will help us to focus on the effects of market concentration on host-country policy. Further, consider that the current law does not allow firm 2 and firm 3 to collude.

Assume that the outputs of these firms are homogeneous and the inverse market demand function for the product is

$$P = a - q \,, \tag{1}$$

where the notations have usual meanings. Further, we assume that if there are more than one firm producing in the host-country market, the market is characterized by Cournot competition.

Let us first examine the foreign firm's incentive for licensing and foreign investment for given host-country policy and the quality of the technology. Then we will see the effect on the quality of the technology and on the host-country policy.

2.1 For a given host-country policy and foreign technology

Consider that the foreign firm has a technology corresponding to the constant marginal cost of production c. In the following analysis, we label the foreign firm and the potential licensees by firm 1, firm 2 and firm 3. Assume that firm 2 and

firm 3 are symmetric. Denote π_i, $i = 1,2,3$, as the profit of the ith firm in the product market (i.e., revenue minus total variable cost).

It is easy to understand that if the host-country government allows fully owned subsidiary of the foreign firm then the foreign firm has no incentive for licensing or forming JV(s) with host-country firm(s). Hence, in this situation, the foreign firm opens its fully owned subsidiary in the host-country. But, if the host-country government does not allow fully owned subsidiary of the foreign firm, the foreign firm has to decide whether to do licensing or JV(s).

Let us consider the game under technology licensing. Assume that firm 1 wants to license its technology to a host-country firm. Without loss of generality, we consider that the firm 1 wants to license the technology to firm 2. However, firm 1 cannot commit to an exclusive licensing. High cost of monitoring or lack of punishment possibility may encourage the firm 1 to transfer the technology to firm 3 once it has transferred the technology to firm 2.[2] Alternatively, we may think that the technology seller can invent around the initial technology and can make a technology, which is almost similar to the initial technology and corresponds to the constant marginal cost of production c.[3] Therefore, there is a possibility that firm 1 may transfer its technology to firm 3 even if it licenses the technology to firm 2.

So, the problem under licensing is as follows. First, firm 1 gives a licensing offer to firm 2. Firm 2 either accepts or rejects the offer. If firm 2 accepts, firm 1 licenses the technology to firm 2 and takes an up-front fixed fee.[4] Then firm 1 decides whether to license the technology to firm 3. If firm 1 decides to license the technology to firm 3, firm 1 gives an offer to firm 3. Firm 3 either accepts or rejects the offer. If firm 2 has rejected the initial offer of firm 1, firm 1 gives an offer to firm 3. After the acceptance or rejection by firm 3, firm 1 decides whether to give another offer to firm 2, and the game continues in this way until firm 1 stops offering further licensing contract. Firm 2 or firm 3 accepts an offer as long

[2] See Hart and Tirole (1990) for related problems in the vertically separated industry.

[3] The literature on licensing in the oligopolistic markets has considered the possibility of re-entry by the licenser after technology licensing. For example, one may look at Katz and Shapiro (1985), Marjit (1990a) and Mukherjee (2001).

[4] The problem of getting ex-post payment under licensing may induce the firm 1 to charge only up-front fixed fee under patent licensing contract. This may be due to purely informational reasons or because of the imitation possibility from the licensee after the technology transfer. For example, one may refer to Katz and Shapiro (1985), Marjit (1990a), Marin and Schnitzer (1995) and Mukherjee (2001) for licensing contract with fixed-fee only.

as acceptance does not make them worse-off compared to rejection.[5] We assume away any cost of delaying between the offers.

Hence, we have the following proposition under technology licensing.

Proposition 1: *Firm 1 licenses the technology to firm 2 and firm 3 and firm 1's payoff is* $2\pi(c,c)$.[6]

Proof: It is easy to understand that, under the problem of licensing specified above, firm 1 has always the incentive to license the technology to another firm given that it has already licensed the technology to a firm. Thus, if both firm 2 and firm 3 have the licensed technology, then each licensee gets a payoff $\pi(c,c)$. Hence, firm 2 and firm 3 accept an offer which calls for an up-front fixed fee less than or equal to $\pi(c,c)$; otherwise, these firms are better-off by rejecting an offer which calls for an up-front fixed fee more than $\pi(c,c)$. Therefore, firm 1 charges $\pi(c,c)$ to each licensee and licenses the technology to firm 2 and firm 3.

Q.E.D.

Now, consider another way of technology transfer, viz., JV. Again, without loss of generality, we consider a JV agreement between firm 1 and firm 2. We assume that, in a JV, firm 1 transfers the technology to the JV firm and the partners receive the shares of profits according to their equity shares in the JV (see, e.g., Tang and Yu, 1990, Lee and Shy, 1992, Al-Saadon and Das, 1996).[7] However, firm 1 has always the possibility to make another agreement with firm 3 even if

[5] If one interprets the technology of the foreign firm as input then our framework has a similarity with the one considered in Hart and Tirole (1990) if the fully owned subsidiary of the foreign firm in the host-country is not allowed. However, the present paper focuses on a problem, viz., on the host-country policy, which is different from Hart and Tirole (1990), and endogenizes the possibility of licensing, partial integration and fully owned subsidiary of the foreign firm.

[6] Call $\pi_2(c,c) = \pi_3(c,c) = \pi(c,c)$, where the first and second arguments of the profit functions show the marginal cost of firm 2 and firm 3 respectively.

[7] Profits are assumed to be verifiable. Further, we assume away the possibility of other types of payments like up-front fixed fee and/or output royalty along with equity sharing in the JV. Often, the government regulation may be a reason for this (see Tang and Yu, 1990). However, in our analysis, the possibility of other type of payment such as an up-front fixed fee will increase the incentive for international JV as it will help the foreign firm to raise its profit through fixed-fee or output royalty if the restriction on foreign shareholding restricts the foreign firm to increase its profit. In a paper Svejnar and Smith (1984) have shown that equity share and transfer price can act as substitutes.

firm 1 forms a JV with firm 2.[8] Therefore, like technology licensing, we consider a similar game under JV. Since firm 1 gives a take-it-or-leave-it offer to the host-country firm under JV, it is easy to understand that firm 1 holds shares in the JV(s) up to the government regulated maximum foreign shareholding.

Suppose, α defines the firm 1's fraction of share in the JV and $(1-\alpha)$ is the share of the respective host-country firm in the JV. Let $\bar{\alpha} \leq 1$ shows the upper limit of foreign equity participation in the host-country. Note that if $\alpha = 1$ then it implies that firm 1 can open its fully owned subsidiary in the host-country.

Before going further, it is worth discussing the decision making procedure in a JV, which is always an important concern to the JV partners and important for the market outcomes. There are different ways of modeling the decision-making in a JV. To make our analysis simple, we assume that in the JV the foreign partner gives the technical know-how and the JV management takes the production decision to maximize the aggregate profit of the JV firm, as considered in Kwoka (1992). Since we consider that the JV partners get only dividend incomes according to their equity shares in the JV and there is no moral hazard problem, our results remain unaffected even if we consider that, in a JV, the domestic partner takes decisions on production and marketing the product (see, e.g., Purkayastha, 1993). However, the incentive for JV formation increases if we allow the foreign firm to take the production decision in the JV since, in case the foreign firm forms two JVs, it allows the foreign firm to internalize the effects of its shareholding in two JV firms on its aggregate profit. However, we are not going to discuss the possibility of foreign control in the JV since it does not add much insight to our main analysis, as clear from the following analysis.

Hence, it is easy to understand that, in our structure of JV, it is better for firm 1 to license the technology to firm 3 against a take-it-or-leave-it offer instead of forming a JV with firm 3 when firm 1 has already formed a JV with firm 2. However, if one allows lump-sum payment in the JV then firm 1 becomes indifferent between licensing and JV with firm 3, given that it has a JV with firm 2.

[8] Often the JV agreement prevents a firm to make another collaboration in the same market. In our framework, such restriction will provide further incentive for JV. However, we rule out this possibility here. Often it is found that a firm is producing similar products in a market where it has a JV already (see, e.g., Mukherjee and Sengupta, 2001).

If firm 1 and firm 2 form a JV and firm 1 makes another licensing contract with firm 3 then the profit of firm 1 is

$$\alpha\pi_J(c,c)+\pi_3(c,c),$$

(2)

where $\pi_J(c,c)$ shows the duopoly profit of the JV firm. Therefore, given a JV between firm 1 and firm 2, firm 1 does not have the incentive to license the technology to firm 3 provided

$$\alpha\pi_J(c) > \alpha\pi_J(c,c)+\pi_3(c,c) \Rightarrow \alpha > \frac{\pi_3(c,c)}{\left(\pi_J(c)-\pi_J(c,c)\right)} \ (=\alpha^c, say),$$

(3)

where $\pi_J(c)$ shows the monopoly profit of the JV firm.[9] Note that $\alpha^c < 1$ provided

$$\pi_J(c) > \pi_J(c,c)+\pi_3(c,c),$$

(4)

i.e., if monopoly profit is greater than the duopoly industry profit, which is always true under our demand specification. The conditions (3) and (4) show that if monopoly profit is more than the duopoly industry profit then, given that firm 1 has formed a JV with firm 2, there exists a sharing rule such that firm 1 does not transfer the technology to firm 3.

In the JV, firm 1 receives a dividend income after production. Hence, if firm 1 holds sufficiently large amount of shares in the JV then firm 1 does not want to create another source of production by transferring the technology to firm 3. Thus, a suitably designed JV can guarantee exclusive technology transfer by eliminating the commitment problem.

Firm 1 prefers this JV compared to licensing if it makes the firm 1 better-off. Therefore, firm 1 forms the JV agreement provided

$$\alpha\pi_J(c) > 2\pi(c,c) \Rightarrow \alpha > \frac{2\pi(c,c)}{\pi_J(c)} \ (=\alpha^*, say).^{10}$$

(5)

[9] It is easy to understand that if we have considered foreign control of the JV, it would affect the value of α^c by affecting $\pi_J(c,c)$ and $\pi_3(c,c)$.

[10] Note that $\pi_J(c,c) = \pi_3(c,c) = \pi(c,c)$.

$\alpha^* < 1$ provided

$$\pi_J(c) > 2\pi(c,c).$$

(6)

JV generates higher industry profit by creating a monopoly of the JV firm, while the market becomes duopoly under licensing. Therefore, if the monopoly profit is greater than the duopoly industry profit then firm 1 is better-off under JV with firm 2 than licensing the technology to both firm 2 and firm 3, if firm 1's shareholding in the JV is sufficiently large.

While constructing (5), we have assumed that when making a JV, firm 1 is not giving the technology to firm 3. This is always consistent with condition (3) provided α^* is greater than α^c. If condition (4) (or, (6)) is satisfied, then we have $\alpha^* > \alpha^c$. Hence, if the monopoly profit is more than the duopoly industry profit then there exists a sharing rule that helps to eliminate the commitment problem and makes the collaborating firms better-off.

Hence, the following proposition is immediate.

Proposition 2: *(a) If monopoly profit is greater than the duopoly industry profit, i.e.,* $\pi_J(c) > 2\pi(c,c)$ *and* $\bar{\alpha} > \alpha^*$*, then firm 1 will form a JV with firm 2 and firm 1 will transfer its technology to the JV only.*

(b) If $\bar{\alpha} \le \alpha^*$ *then firm 1 will prefer licensing to both firm 2 and firm 3 compared to a JV with firm 2.*[11]

Proof: (a) Above discussion proves the result.

(b) Assume that $\pi_J(c) > 2\pi(c,c)$ and $\bar{\alpha} < \alpha^*$. Hence, α^* crosses the upper limit of the government regulated foreign equity participation. So, for any $\alpha \le \bar{\alpha}$, it is not possible for firm 1 to be better-off under JV compared to licensing.

Q.E.D.

[11] If $\bar{\alpha} = \alpha^*$, we assume that firm 1 does licensing.

Thus, we show that when firm 1 cannot commit to an exclusive licensing contract, a JV between the licenser and the licensee may solve this commitment problem if the government regulated foreign shareholding is sufficiently large.[12] But, for sufficiently small government regulated foreign shareholding, firm 1 is not able to extract more profit under JV compared to licensing. Therefore, government regulation on foreign equity participation may prevent firm 1 to form a JV. However, it is clear that if we have allowed the firm 1 to use fixed-fee or royalty as a substitute for dividend incomes (see, Svejnar and Smith, 1984) then JV becomes a preferable option to firm 1.

At this stage, it is worthwhile to mention the difference between the JV agreement considered in this paper and a licensing scheme with profit sharing arrangement. In case of licensing with profit sharing arrangement, firm 1 becomes an outsider and does not have any role in the decision making at firm 2. Hence, it can impose a constraint on firm 1 for receiving payment under licensing ex-post production if there is opportunistic behavior of firm 2. For example, firm 2 can imitate the foreign technology after getting it and can avoid ex-post payment by producing with the imitated technology (see, e.g., Gallini and Wright, 1990 and Rockett, 1990). On the other hand, by making a suitable combination of voting and non-voting shares, firm 1 can get significant power in the management of the JV firm (see, e.g., Dasgupta and Tao, 1998). Hence, a suitably formed JV helps firm 1 to get ex-post payment by eliminating the opportunistic behavior of firm 2. Therefore, JV not only makes the payment ex-post production, JV also helps the technology seller to receive payment ex-post production by providing some managerial control in the firm. This possibility of getting some degree of managerial control in a firm makes the JV agreement sufficiently different from a licensing contract with a profit sharing arrangement.

From the above analysis we see that JV creates higher market-concentration than licensing. Hence, for a given foreign technology, we have the following proposition on the welfare of the host-country.

[12] In a different context, viz., in case of vertically separated industry, Hart and Tirole (1990) have shown that vertical merger can solve the commitment problem when the exclusive-dealing contracts between the upstream firm and downstream firms are not enforceable.

Proposition 3: *Consider a given foreign technology and* $\bar{\alpha} > \alpha^*$. *If the total surplus under licensing is greater than that of under JV, i.e.,* $CS(c,c) + 2\pi(c,c) > CS(c) + \pi(c)$, *where* $CS(.)$ *shows the consumer surplus, the welfare of the host-country is higher under licensing compared to JV.*

Proof: If the firm 1 forms a JV then the host-country welfare under JV is given by

$$(1-\bar{\alpha})\pi_J(c) + CS(c).$$

(7)

But, if the firm 1 makes a licensing contract then the host-country welfare is given by $CS(c,c)$.

Now, suppose that we have

$$CS(c,c) + 2\pi(c,c) > CS(c) + \pi(c).$$

(8)

Or, $$CS(c,c) > CS(c) + (1-\bar{\alpha})\pi_J(c) + [\bar{\alpha}\pi_J(c) - 2\pi(c,c)].$$

(8')

If JV is profitable to firm 1 then we must have $\bar{\alpha}\pi_J(c) > 2\pi(c,c)$. Then from (8') it is clear that $CS(c,c) > CS(c) + (1-\bar{\alpha})\pi_J(c)$ and hence, the host-country welfare is more under licensing compared to JV.

Q.E.D.

From Proposition 3 we find that, for a given foreign technology, while JV is privately profitable to the collaborating firms, host-country welfare is higher under licensing. Hence, it creates a conflict between the interests of the collaborative firms and the host-country.

Thus, our result contradicts the finding of Tang and Yu (1990), where JV generates higher host-country welfare compared to technology licensing. We have found that if JV helps to prevent multiple technology transfer then this type of JV can reduce the welfare of a host-country compared to technology licensing. It is easy to understand that if firm 1 has other possible ways of extracting profits (e.g. an up-front fixed fee) under JV then this will further reduce the welfare of the host-country.

It must be noted that while constructing the welfare function of the host-country, we have given same weight to the consumer surplus and the profit share of the domestic firm. Depending on the government's ideology and the product identity (e.g., necessary or luxury products), these weights may differ. If consumer surplus gets more weight in the welfare function then JV makes things further worse-off; however, on the other hand, if the profit of the domestic firm is the main concern to the host-country then JV tends to increase the welfare of the host-country.

2.2 Choice of foreign technology

So far we have considered the problem under licensing and JV, for a given foreign technology. This is possible if one considers that technology transfer does not involve significant costs and therefore, the foreign firm wants to transfer the same technology under licensing and JV. However, it has been already well documented in the literature that international technology transfer involves sufficient amount of costs to be incurred by the technology seller (see, e.g., Teece, 1977, 1981 and Lee and Shy, 1992). Hence, both the quality of the technology to be transferred and the mode of the technology transfer become the important questions faced by the foreign technology suppliers. This section focuses on this issue.[13]

Assume that firm 1 can transfer a technology corresponding to the marginal cost of production c but at a cost $f(c)$, where $c \in [0,a]$. Lower marginal cost comes with greater expenses on the improved technology and we assume that $f' < 0, f'' > 0$, $f''' = 0$ and $f(a) = 0$. However, while deciding the quality of the transferred technology, firm 1 needs to internalize its following action regarding the mode of entry.

First, consider the situation where the firm 1 wants to make a licensing agreement ex-post technology choice. The analysis of the previous section shows that, given the quality of the technology, firm 1 gets $2\pi(c,c)$ under licensing.

[13] We assume that the foreign firm faces this cost of technology transfer even if it opens a fully owned subsidiary in the host-country. This is possible if we consider that the foreign technology needs to make compatible for the host-country environment. Or, we can think that this cost refers to the opportunity cost of technology transfer.

Therefore, at stage 2, firm 1 maximizes the following expression to determine the quality of the technology:

$$\underset{c}{Max}\, 2\pi(c,c) - f(c).$$

(9)

Maximizing (9) we get the optimal quality of the technology from the following condition:

$$2\pi'(c,c) - f'(c) = 0.$$

(10)

Given the demand specification, condition (10) reduces to

$$-\frac{4(a-c)}{9} - f'(c) = 0.$$

(10')

Second order condition for this maximization problem requires that $\frac{4}{9} < f''(c)$. Assume that the second order condition for maximization holds. Let c_l^* be the optimal quality of the technology that satisfies the equation (10'). So, in this situation, the payoff of firm 1 ex-post technology transfer is $2\pi(c_l^*, c_l^*)$.

However, given the quality of the technology c_l^*, firm 1 does licensing ex-post technology choice if $\bar{\alpha} \le \alpha^*(c_l^*)$, where $\alpha^*(c_l^*) = \frac{2\pi(c_l^* c_l^*)}{\pi(c_l^*)}$. Given the demand specification, we find that $\alpha^*(c_l^*) = \frac{8}{9}$ and does not depend on the marginal cost of production.[14] Therefore, it is optimal for firm 1 to license ex-post technology choice if $\bar{\alpha} \le \frac{8}{9}$. Further, since condition (10) or (10') does not depend on $\bar{\alpha}$, any change in $\bar{\alpha}$ between 0 and $\frac{8}{9}$ does not affect c_l^*.

If $\bar{\alpha} > \frac{8}{9}$, firm 1 will do JV and hence, for any $\bar{\alpha} > \frac{8}{9}$, it will not be optimal for firm 1 to maximize the expression (9). For $\bar{\alpha} > \frac{8}{9}$, firm 1 maximizes the

[14] Note that $\alpha^*(c_l^*)$ does not depend on the marginal cost of production can be true even for non-linear market demand. For example, if the demand function is $P = a - q^{\delta}$, with $\delta > 1$, we find that $\alpha^*(c_l^*) = 2^{\frac{1}{\delta}}\left(\frac{1+\delta}{2+\delta}\right)^{\frac{(1+\delta)}{\delta}}$ and does not depend on the marginal cost of production.

The value of $\alpha^*(c_l^*)$ depends on the assumption that there are two host-country firms producing under licensing. Generally, the value of $\alpha^*(c_l^*)$ is $\frac{4n}{(n+1)^2}$ if n firms produce under licensing.

following expression for choosing the optimal quality of the technology to be transferred:

$$\underset{c}{Max}\ \bar{\alpha}\pi_J(c) - f(c).$$

(11)

The first order condition for maximization gives

$$\bar{\alpha}\pi_J'(c) - f'(c) = 0.$$

(12)

Given the demand specification, condition (12) reduces to

$$-\frac{2\bar{\alpha}(a-c)}{4} - f'(c) = 0.$$

(12')

Second order condition for this maximization problem requires that $\frac{\bar{\alpha}}{2} < f''(c)$. Since, $\bar{\alpha}$ can take the maximum value of 1, we assume that $\frac{1}{2} < f''(c)$. Hence, the second order condition for maximization holds $\forall \alpha \in (\frac{8}{9},1]$. Let c_J^* shows the quality of the technology that solves the equation (12'). It is clear from (12') that as $\bar{\alpha}$ increases, it reduces c_J^*, since $\frac{\partial c_J^*}{\partial \bar{\alpha}} = -\frac{(a-c)}{(2f''(c)-\bar{\alpha})}$. However, the effect of higher $\bar{\alpha}$ on c_J^* reduces with lower market size of the host-country, i.e., a, and/or higher rate of change of the marginal cost of technology choice, i.e., $f''(c)$.

It is easy to check from (10') and (12') that $c_J^* < c_l^*$ since firm 1 does JV for $\bar{\alpha} > \frac{8}{9}$. This implies that if firm 1 understands that ex-post technology choice it will form a JV instead of licensing then firm 1 will develop relatively better technology compared to a situation where firm 1 will do licensing ex-post technology choice.

The following proposition summarizes the above discussions of this subsection.

Proposition 4: *(a) If the government regulated maximum shareholding of firm 1 is sufficiently small (i.e., $\bar{\alpha} \le \frac{8}{9}$) then an increment in the government regulated shareholding of firm 1 over $[0,\frac{8}{9}]$ does not affect the quality of the technology to be transferred in the host-country.*

(b) If the government regulated maximum shareholding of firm 1 is not sufficiently small (i.e., $\bar{\alpha} > \frac{8}{9}$) then firm 1 transfers better technology corresponding to the optimal technology under case (a) of this proposition. Any further increment of the government regulated shareholding of firm 1 will improve the quality of the transferred technology.

From the above discussions it is clear that sufficiently higher foreign shareholding (i.e., $\bar{\alpha} > \frac{8}{9}$) has following effects. Firstly, it increases the concentration in the host-country market compared to the situation where $\bar{\alpha} \leq \frac{8}{9}$. Secondly, any increment in the foreign shareholding over $(\frac{8}{9},1]$ reduces the profit of the host-country firm for any given level of the transferred technology. Lastly, a higher shareholding of firm 1 over $(\frac{8}{9},1]$ encourages firm 1 to transfer relatively better quality technology to the project. Therefore, while higher shareholding over $(\frac{8}{9},1]$ increases efficiency in production due to the transfer of a relatively better technology, higher foreign shareholding increases market concentration and also reduces the host-country firm's share of profit. So, the net effect on host-country welfare is ambiguous and as we will discuss in the next subsection, the effect on welfare depends on the market size of the host-country and the rate of change of the marginal cost of technology choice.

2.3 Host-country policy

So far we have derived the optimal technology choice and the mode of entry of the foreign firm, given the host-country policy regarding the foreign shareholding in the host-country. In this section we will examine the optimal host-country policy that maximizes the welfare of the host-country.

The above analysis shows that host-country welfare is $W_l = CS(c_l^*, c_l^*)$ for any $\bar{\alpha} < \frac{8}{9}$. But, for $\bar{\alpha} > \frac{8}{9}$, host-country welfare is $W_J = (1-\bar{\alpha})\pi_J(c_J^*) + CS(c_J^*)$, where $c_J^* = c_J^{\min}$ for $\bar{\alpha} = 1$. Realizing the relationship between the optimal foreign technology and the maximum foreign shareholding, we find that $\frac{\partial W_J}{\partial \bar{\alpha}} \gtreqless 0$ as

$$\frac{3}{2} \gtreqless \frac{(f''(c)-\bar{\alpha})}{(1-\bar{\alpha})}.$$

(13)

Second order condition for choosing the optimal foreign technology provides the restriction that $f''(c) > \frac{1}{2}$. Further, it is easy to check that, given $f'''(c) = 0$, the right hand side (RHS) of (13) is increasing (decreasing) in $\bar{\alpha}$ for $f''(c) > (<)1$. Also, we find that RHS of (13) is equal to $(9f''(c) - 8)$ at $\bar{\alpha} = \frac{8}{9}$.

2.3.1 For $\frac{1}{2} < f''(c) < 1$

If $\frac{1}{2} < f''(c) < 1$, RHS of (13) is decreasing in $\bar{\alpha}$ and is less than the left hand side (LHS) of (13) for $\bar{\alpha} = \frac{8}{9}$ and $\bar{\alpha} = 1$. Therefore, $\frac{\partial W_J}{\partial \bar{\alpha}} > 0$ for any $\alpha \in (\frac{8}{9}, 1]$. So, it is easy to understand that if $CS(c_l^*, c_l^*) > CS(c_J^{\min})$, the optimal $\alpha \in [0, \frac{8}{9}]$ and the foreign firm does licensing. But, if $CS(c_l^*, c_l^*) < CS(c_J^{\min})$, the optimal $\bar{\alpha} = 1$ and hence, the foreign firm opens the fully owned subsidiary.

2.3.2 For $1 < f''(c)$

If $1 < f''(c)$, RHS of (13) is greater than the LHS of (13) at $\bar{\alpha} = 1$ and hence, $\frac{\partial W_J}{\partial \bar{\alpha}} < 0$ at $\bar{\alpha} = 1$. But, for $\bar{\alpha} = \frac{8}{9}$, RHS of (13) is less than, equal to or greater than the LHS of (13) provided $(9f''(c) - 8) \lessgtr \frac{3}{2}$, which depends on $f''(c)$. Therefore, at $\bar{\alpha} = \frac{8}{9}$, $\frac{\partial W_J}{\partial \bar{\alpha}} \gtrless 0$ according to $(9f''(c) - 8) \lessgtr \frac{3}{2}$. Hence, if $f''(c)$ is (not) sufficiently greater than 1, we have $\frac{\partial W_J}{\partial \bar{\alpha}} (>) < 0$.

First, consider that $f''(c)$ is such that $\frac{\partial W_J}{\partial \bar{\alpha}} > 0$ at $\bar{\alpha} = \frac{8}{9}$. Hence, in this situation, W_J attains a maximum value at, say, $\bar{\alpha}_J$, where $\bar{\alpha}_J \in (\frac{8}{9}, 1)$. Therefore, the optimal $\alpha \in [0, \frac{8}{9}]$ and the foreign firm does licensing if $CS(c_l^*, c_l^*) > W_J(\bar{\alpha}_J)$.

But, for $CS(c_l^*, c_l^*) < W_J(\bar{\alpha}_J)$, the optimal $\bar{\alpha} = \bar{\alpha}_J$ and the foreign firm does JV with foreign shareholding equals to $\bar{\alpha}_J$.

Next, consider that $f''(c)$ is such that $\frac{\partial W_J}{\partial \bar{\alpha}} < 0$ at $\bar{\alpha} = \frac{8}{9}$. Hence, in this situation, optimal $\alpha \in [0, \frac{8}{9}]$ for $CS(c_l^*, c_l^*) > (1 - \frac{8}{9})\pi_J(c_J^*(\frac{8}{9})) + CS(c_J^*(\frac{8}{9}))$ and the foreign firm does licensing. But, if $CS(c_l^*, c_l^*) < (1 - \frac{8}{9})\pi_J(c_J^*(\frac{8}{9})) + CS(c_J^*(\frac{8}{9}))$, the optimal $\bar{\alpha} = \frac{8}{9} + \varepsilon$, where $\varepsilon > 0$ and very small, and hence, the foreign firm does a JV with its shareholding equals to $(\frac{8}{9} + \varepsilon)$.

The following proposition summarizes the above discussion on the optimal foreign shareholding.

Proposition 5: *(a) Suppose,* $\frac{1}{2} < f''(c) < 1$. *In this situation, the host-country will either allow very low foreign shareholding such that licensing occurs, i.e.,* $\alpha \in [0, \frac{8}{9}]$, *or will allow fully owned subsidiary of the foreign firm, i.e.,* $\bar{\alpha} = 1$.
(b) Suppose, $1 < f''(c)$. *Here, the host-country will not allow fully owned subsidiary of the foreign firm. The host-country will either allow very low foreign shareholding such that licensing occurs, i.e.,* $\alpha \in [0, \frac{8}{9}]$, *or will allow foreign shareholding of* $(\frac{8}{9} + \varepsilon)$ *(for* $(9f''(c) - 8) > \frac{3}{2}$*) or* $\bar{\alpha}_J \in (\frac{8}{9}, 1)$ *(for* $(9f''(c) - 8) < \frac{3}{2}$*).*

The reason for the above finding is as follows. Sufficiently higher foreign shareholding has two effects on the host-country welfare. On one hand, it helps to attract relatively better technology to the host-country but, on the other hand, it reduces host-country welfare by reducing the profit of the host-country firm for a given quality of the technology. If the effect of higher foreign shareholding on the quality of technology is not significant then higher government regulated foreign shareholding reduces the welfare of the host-country. This occurs when the size of the host-country market is sufficiently small. In this situation, host-country will not allow sufficiently higher foreign shareholding and as a result, licensing will take place.

Higher shareholding by the foreign firm will attract sufficiently better quality of technology when the market size of the host-country is not very small and if it is not very costly to transfer better technology to the host-country (i.e., when $\frac{1}{2} < f''(c) < 1$). In this situation, it is optimal for the host-country to allow fully owned subsidiary of the foreign firm.

Now, consider that the host-country market is not sufficiently small but it is sufficiently costly to transfer better technology to the host-country (i.e., $f''(c) > 1$). Then higher foreign shareholding will attract relatively better technology to the host-country but not as good as like the previous situation (i.e., where $\frac{1}{2} < f''(c) < 1$). Hence, in this situation, after certain amount of foreign shareholding, the loss of profit of the host-country firm dominates the gain from relatively better foreign technology. Therefore, after a certain amount of foreign shareholding, any rise in the foreign shareholding reduces host-country welfare and hence, the host-country welfare is maximized if it allows JV with this critical foreign shareholding, i.e., up to $\overline{\alpha}_J$, as shown in the above analysis.

From the above analysis, it is easy to understand that given a technology level, the welfare of the host-country is more under licensing compared to JV. Therefore, after stage 2, i.e., after the choice of technology, the government of the host-country has an incentive for not allowing the JV. Therefore, a committed host-country policy is crucial for our result. If there is a chance of policy reversal after stage 2 then the foreign firm has less incentive for transferring a relatively better technology to the host-country. So, unlike Al-Saadon and Das (1996), this paper shows that a host-country can enjoy higher welfare under a committed government policy.

3 Conclusion

Last few decades have seen significant changes in the policies of the developing countries. Developing countries are liberalizing their policies to attract better technologies from the technologically advanced firms. However, initially the liberalizing countries were mainly interested for technology licensing agreements. The cases for international JVs are increasing dramatically in the recent years.

This paper examines the optimal host-country policy regarding foreign investment when technology licensing involves opportunistic behavior of the foreign firm. The formation of a JV may reduce the number of technology transfers and helps to increase the market-concentration. Hence, a host-country can have lower welfare under JV than licensing while the firms are better-off under JV compared to licensing. However, higher market-concentration can increase efficiency by encouraging the foreign firm to transfer relatively better technology to the host-country. If this efficiency-gain is sufficiently large then the JV can make both the firms and the host-country better-off compared to technology licensing. For sufficiently large efficiency-gain, the host-country is better-off by allowing fully owned subsidiary of the foreign firm.

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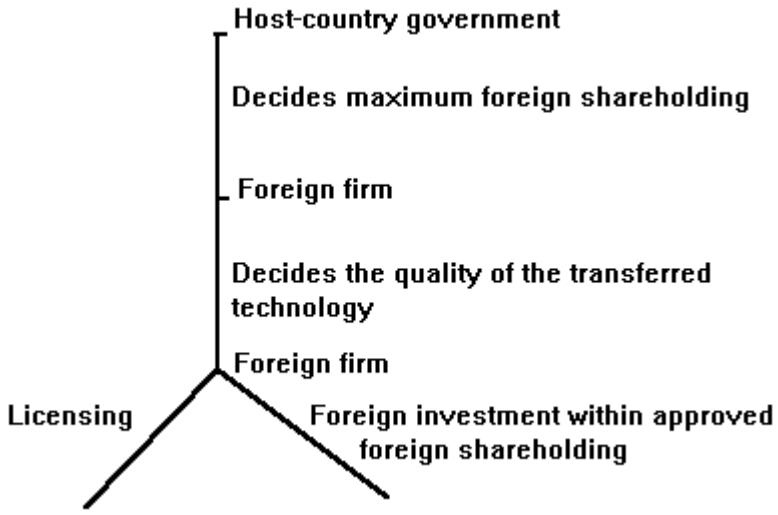

Figure 1: The basic structure of the game