Shared Equity Policy in Joint Ventures for Host Countries

Mei-Fang Chung
Department of International Trade,
Kun Shan University,
Taiwan
(Email: chung@mail.ksu.edu.tw)

Abstract: This paper provides a game model for examining the host overseas investment policy and MNEs equity strategy in international joint ventures. This paper refines previous Chen and Chung's (2008) results and considers the host policy about MNEs' joint-venture. This paper shows foreign firms increase their technology transfer incentive because less competition from the joint-venture partner when a foreign firm holds lower shares. And the holding shares of foreign firms must be not smaller than 50 percent. The host welfare increases with foreign firms' minority equity. The equity conflict exists in the higher technology spillover and transfer cost cases. Hence, the host governments always impose investment restrictions on MNEs in the Developing countries. Otherwise, it has more loose policy in the Developed countries.

I. INTRODUCTION

Since the 1980s many less developed countries (LDCs) have been pursuing a policy of domestic liberalization. One of the goals behind such policies is to attract foreign multinational enterprises (MNEs). Katrak (1981) examines a host country's commercial policy towards a multinational firm that has formed a joint venture (JV) with a local firm. And Chowdury and Chowdury (2002) also show that many LDCs are actively trying to promote joint ventures as a vehicle for such foreign participation. The joint-venture law of China not only encourages foreign firms to sell their products outside China, but also promotes local participation of equity of MNEs. The rate of joint venture formation in the LDCs has increased dramatically in the last three decades. Many studies have shown that joint venture is formed because of government regulation in developing countries.[1] These countries expect to benefit from technology spillovers through the shared equity. This is why we say that international joint venture is the most fascinating development in the international business. Many scholars point out MNEs tend to use shared equity mode as the first step into foreign market, especially when they face higher political and economic risk in host countries (Harrigan 1988)

[1] For instance, Beamish (1985), Janger (1980) and Tomlinson (1971) all support the discourse about joint ventures were formed because of government regulation in developing countries with empirical data. Mukherjee and Sengupta (2001) also show that the threshold into developing countries is the liberation for shareholdings.

Generally, most MNEs carefully plan the entry mode before engaging in overseas investment. The ownership structure is the priority issue to deal with. Lecraw (1984) states that positive relationship existing between technology capacity and foreign ownership. Padmanabhan and Cho (1996) gather observations from Japanese enterprises and find that the more expenses on R&D (research and development), the higher foreign ownership there would be. For the problem of technology grab, many enterprises prefer adopting a higher ownership strategy. Numerous theses about entry strategy for MNEs show that the more severe free-rider problem a host country has the more likely the decrease on technology transfer will be. Therefore, MNEs prefer adopting direct entry or higher ownership to avoid the technology transfer grab. However, an opposite result is found that higher ownership for a foreign firm does not have a positive effect on the incentive of transferring technology in our joint venture entry mode and Cournot competition construction.

In order to merge into host country and enter the foreign market easily, MNEs will choose the appropriate partner and optimal ownership. Most of the papers regarding JVs ownership structure usually stress the importance on characteristic of foreign firms or the host markets; however, less emphasis has been placed on concerning competition conditions between foreign and host firms. And the host welfare of joint venture formation has received relatively little theoretical attention. (One exception is Chowdury and Chowdury (2002) who examine the welfare implication of joint venture considering the cost symmetry.) In this paper we make a three-stage game model in analyzing the optimal ownership for MNEs and the host welfare of joint venture between MNEs and host firms.

This paper concentrates on ownership structure for the JV parties and considers the optimal equity policy for host welfare. When the restrictions on MNEs shares ratio from host government are removed, it means the ceilings on foreign firm's equity are withdrawn in liberalization. Many developing countries remove foreign investment restraint to attract technology inflow in droves. MNEs are not forced to release shares to host firms anymore. Thus, this paper attempts to solve the optimal shares ratio of MNEs and develop an optimal equity policy for host country under this liberation trend. Many literatures indicate JV mode can benefit the developing countries in promoting technology. Thus, this work adds technology spillover for joint venture partner into our model.[2] Furthermore, we analyze the host welfare and try to find out the optimal host policy in international joint ventures.

Chowdury and Chowdury (2001) provide a dynamic JV life cycle, allow the Cournot – Competition between JV partner and foreign firm and they emphasize the joint ventures on production factors. Chen and Chung (2008) also use Cournot – Competition to analyze the optimal equity for MNEs. But they have never yet considered about the host position. This paper will think over the equity structure on joint venture entry mode for MNEs and host countries by taking account of the cooperation and competition role for joint venture partner.

This paper finds equity conflict between MNEs and host countries. And the conflict is increasing with higher technology spillover and transfer cost. How to construct the foreign investment policy for attracting MNEs' entry and technology transfer to increase host welfare is the important guiding principle for host governments.

[2] Chung (2006), Inkpen (2000) and Hamel (1991) use empirical data to support the better technology advantage for joint venture partner in joint ventures mode.

The rest of this paper is organized as follows. Section II outlines the basic model. In section III the optimality of ownership, technology transfer and the products are established. Section IV analyzes the optimal equity policy for host welfare. Section V provides concluding remark.

II. THE MODEL

This paper follows Chen and Chung's (2008) model and considers optimal host equity policy in international joint venture. There are n domestic firms, a foreign firm (denoted as f) tries to enter the market of this host country by inviting a domestic partner (which is one of the n domestic firms and is denoted as h) to build a joint venture (denoted as j). We assume that the foreign firm holds a share of ownership α of the joint venture and the domestic partner (h) owns 1-α share.[3] The foreign firm is assumed to have a higher technology in production so as to produce at a relatively lower production cost. However, the introduction of the new technology into the host country will stimulate or spill over to the domestic partner and yield changes of the market competition.

The entry game proceeds as follows. In the first stage, the foreign firm determines its shares ratio α ($0<\alpha\leq 1$), and gives 1-α to the cooperative partner at a lump-sum transfer V.[4] After resolving its shareholding, the foreign firm chooses the level of technology transfer (x) to the joint venture firm at the second stage. Technology transfer lowers the marginal production cost at the third stage but it is a costly process. The transferred technology x of the foreign firm incurs a technology transfer cost $C(x)$ and will lower the marginal production cost of the joint venture to c-x. Assume that the cost of technology transfer is $C(x) = \tau x^2/2$ where $\tau = \pi x^2 C/\partial^2 x$ determines the convexity of the function and denotes the efficiency of technology transfer. A higher τ represents a higher transfer cost for a same level of technology transfer. The new technology in the joint venture will spill over to the domestic partner, which can therefore reduce its marginal cost of own firm by βx, $0\leq\beta\leq 1$. The parameter β is the measure of technology spillover to the domestic partner.[5] We assume that the spillover degree (β) is exogenous as the argument of Muller and Schnitzer (2006) and Blomstrom and Sjoholm (1999) claim.[6] Moreover, the technology spillover benefits only the partner of the joint venture. At the last stage, the foreign firm f (which owns α shares of the joint venture firm), the domestic partner h (which runs its own firm and owns 1-α shares of the joint venture j), and all the other n-1domestic firms (each denoted as i, $i = 1, \ldots, n\text{-}1$) compete in a Cournot competition, in which outputs q_f, q_h, and q_i are determined, respectively. The perfect equilibrium of this game is found by solving backwards.

Assume that the inverse demand function is $p(q) = a - q$, where $q = q_h + q_f + \sum_{i=1}^{n-1} q_i$. The profit function of individual firm is given by:

3 To remain the control of the joint venture, the foreign will only release a share less than 50% to the domestic partner. Therefore, the joint venture firm will be under the foreign firm's control (Mowery 1992, Gong 2004)

4 This lump-sum transfer is decided by the bargaining power of JV two parties.

5 Harris and Holmstrom (1982) firstly argues R&D coordination leads to the free rider problem in JVs research, it means technology will have spillover effect.

6 Blomstrom and Sjoholm (1999) state that local participation in JV facilitates spillover and the degree of foreign ownership does not affect its extent; Muller and Schnitzer (2006) show the spillover degree is affected by the country and industry characteristic, but the influence is not assured.

$$\pi_f = \alpha\pi_j = \alpha[(a - q_h - q_f - \sum_{i=1}^{n-1} q_i - c + x)q_f - \tau x^2/2], \quad (1)$$

$$\pi_h = [a - q_h - q_f - \sum_{i=1}^{n-1} q_i - c + \beta x]q_h + (1-\alpha)\pi_j, \quad (2)$$

$$\pi_i = (a - q_h - q_f - q_i - \sum_{k=1,k\neq i}^{n-2} q_k - c)q_i. \quad (3)$$

The π_j denotes the profit of the joint venture firm of which α proportion belongs to the foreign firm and 1-α proportion goes to the domestic partner, as shown in equation (1) and (2).

III. MODEL ANALYSIS

3.1 Product Market

Given the entry mode and ensuing technology transfer, firms choose output levels to maximize their own profits in the third stage. Each firm's optimal output is as the following equations:

$$q_f = [(a-c) + (n+1-\beta)x]/(n+1+\alpha), \quad (4)$$

$$q_h = \{\alpha(a-c) + [n(\alpha+\beta-1) + (\beta-1)]x\}/(n+1+\alpha), \quad (5)$$

$$q_i = [(a-c) - (\alpha+\beta)x]/(n+1+\alpha) \quad (6)$$

***Lemma* 1**. The third-stage equilibrium outputs exhibit the following properties: (1) $\partial q_f/\partial\alpha < 0$, $\partial q_h/\partial\alpha > 0$, and $\partial q_i/\partial\alpha < 0$. (2) $\partial q_f/\partial\beta < 0$, $\partial q_h/\partial\beta > 0$, and $\partial q_i/\partial\beta < 0$. (3) $\partial q_f/\partial x > 0$, $\partial q_h/\partial x > 0$ if $\alpha+\beta>1$, and $\partial q_i/\partial x < 0$. (4) $\partial q_f/\partial n < 0$, $\partial q_h/\partial n < 0$, and $\partial q_i/\partial n < 0$.

Proof.
$\partial q_f/\partial\alpha = -[(a\text{-}c)+(n+1\text{-}\beta)x] / (n+1+\alpha)^2 < 0$, $\partial q_i/\partial\alpha = -[(a\text{-}c)+(n+1\text{-}\beta)x] / (n+1+\alpha)^2 < 0$,
$\partial q_h/\partial\alpha = \{(n+1)(a\text{-}c)+[n(n+2\text{-}\beta)+(1\text{-}\beta)]x\} / (n+1+\alpha)^2 > 0$,
$\partial q_f/\partial\beta = -x / (n+1+\alpha) < 0$, $\partial q_h/\partial\beta = (n+1)x / (n+1+\alpha) > 0$,
$\partial q_i/\partial\beta = -x / (n+1+\alpha) < 0$, $\partial q_f/\partial x = (n+1\text{-}\beta) / (n+1+\alpha) > 0$,
$\partial q_h/\partial x = [n(\alpha+\beta\text{-}1)+(\beta\text{-}1)] / (n+1+\alpha) > 0$, if $\alpha+\beta > 1$,
$\partial q_i/\partial x = -(\alpha+\beta) / (n+1+\alpha) < 0$, $\partial q_f/\partial n = -[(a\text{-}c)-(\alpha+\beta)x] / (n+1+\alpha)^2 < 0$,
$\partial q_h/\partial n = -\alpha[(a\text{-}c)-(\alpha+\beta)x] / (n+1+\alpha)^2 < 0$, $\partial q_i/\partial n = -[(a\text{-}c)-(\alpha+\beta)x] / (n+1+\alpha)^2 < 0$.

3.2 Technology Transfer

In the second stage, given the foreign firm's shares holding and expecting the third-stage equilibrium outputs as in equation (4), (5), and (6), the foreign firm chooses the level of technology transfer to maximize its profit. We can write the firm's first-order condition for technology transfer as:

$$\alpha[\frac{\partial\pi_j}{\partial q_f}\frac{\partial q_f}{\partial x} + \frac{\partial\pi_j}{\partial q_h}\frac{\partial q_h}{\partial x} + (n-1)\frac{\partial\pi_j}{\partial q_i}\frac{\partial q_i}{\partial x} + q_f - \tau x] = 0, \text{ where } q_f - \tau x = \frac{\partial\pi_j}{\partial x} \quad (7)$$

Using equation (7) and Lemma (1), we can obtain the optimal technology transfer function:

$$x^* = \frac{2(n+1-\beta)(a-c)}{(n+1+\alpha)^2\tau - 2(n+1-\beta)^2} \tag{8}$$

For the existence of technology, we need: $\tau > 2(n+1-\beta)^2/(n+1+\alpha)^2$. Since q_f, q_h and q_i must be greater than zero to keep firms in the market by Eq. (4),(5),(6) and (8), we need

$$\tau \geq \frac{2(n+1-\beta)}{(n+1+\alpha)} = \underline{\tau}', \text{ if } \alpha+\beta \geq 1. \quad \tau \geq \frac{2(n+1-\beta)(1-\beta)}{\alpha(n+1+\alpha)} = \underline{\tau}'', \text{ if } \alpha+\beta<1. \tag{9}$$

***Lemma* 2**. When the foreign firm's shareholding of the joint venture or the technology spillover degree is higher, the foreign firm will decrease its technology transfer. When the number of firms in the host market increases, the technology transfer of foreign firms increases if the cost of technology transfer $\tau \in (\tau, {}^{2(n+1-\beta)^2}\!/_{(n+1+\alpha)(n+1-\alpha-2\beta)})$, but it decreases if $\tau > {}^{2(n+1-\beta)^2}\!/_{(n+1+\alpha)(n+1-\alpha-2\beta)}$.

Proof. Taking derivative with respect to equation (8), we obtain:

$$\frac{dx^*}{d\alpha} = \frac{-4[(n+1-\beta)(n+1+\alpha)(a-c)\tau]}{[(n+1+\alpha)^2\tau - 2(n+1-\beta)^2]^2} < 0$$

$$\frac{dx^*}{d\beta} = \frac{-2(a-c)[(n+1+\alpha)^2\tau + 2(n+1-\beta)^2]}{[(n+1+\alpha)^2\tau - 2(n+1-\beta)^2]^2} < 0$$

$$\frac{dx^*}{dn} = \frac{-2(a-c)[(n+1+\alpha)(n+1-\alpha-2\beta)\tau - 2(n+1-\beta)^2]}{[(n+1+\alpha)^2\tau - 2(n+1-\beta)^2]^2} < 0,$$

if $\tau > 2(n+1-\beta)^2/[(n+1+\alpha)(n+1-\alpha-2\beta)]$.

In an economic sense, when τ is sufficiently large, technology transfer becomes much more expensive (and therefore the foreign firm has lower incentive to transfer technology), resulting in less profit of the foreign firm under a more competing market. Nevertheless, when transfer cost turns out to be sufficiently low, the effective transfer process would increase the transfer incentive to take advantage of the cheap cost reduction.

3.3 Shares Ratio Strategy

When forming joint ventures, how many shares should be sold to the domestic partner is the MNE's first-step for maximizing its profit. It maximizes equation (1) with respect to shares ratio (α), given the expectation of equation (4), (5), (6) and (8), we obtain equation (10). The first term (π_j) is the direct firm *f*'s incentive for shareholding. The higher firm *j's* revenue leads firm *f*'s preference, and it represents the scale effect of shareholding with respect to α (denoted as $\boldsymbol{EE}^{\alpha}$), at the same time, firm *f* must absorb technology transfer cost ($\tau x^2/2$). The first term ($\partial\pi_j/\partial\alpha$) in the bracket is zero. The second term ($\partial\pi_j/\partial q_h \times \partial q_h/\partial\alpha$) in the bracket captures the

partner strategic effect of shareholding (***PSE***$^{\alpha}$). PSE^{α} should be negative because an increase in firm *f*'s shareholding enhances firm *h*'s output and harms firm *j*'s profit. The third term $((n\text{-}1)\times\partial\pi_j/\partial q_i\times \partial q_i/\partial\alpha)$, termed as the strategy effect of shareholding (***SE***$^{\alpha}$) should be positive because of strategic substitution ($\partial\pi_j/\partial q_i<0$).

$$\begin{aligned}\frac{d\pi_f}{d\alpha} = \pi_j + \alpha\frac{d\pi_j}{d\alpha} = \pi_j + \alpha\{&\frac{\partial\pi_j}{\partial\alpha} + [\frac{\partial\pi_j}{\partial q_f}\frac{\partial q_f}{\partial x} + \frac{\partial\pi_j}{\partial q_h}\frac{\partial q_h}{\partial x} + (n-1)\frac{\partial\pi_j}{\partial q_i}\frac{\partial q_i}{\partial x}\\ &+ \frac{\partial\pi_j}{\partial x}]\frac{\partial x}{\partial\alpha} + [\frac{\partial\pi_j}{\partial q_f}\frac{\partial q_f}{\partial\alpha} + \frac{\partial\pi_j}{\partial q_h}\frac{\partial q_h}{\partial\alpha} + (n-1)\frac{\partial\pi_j}{\partial q_i}\frac{\partial q_i}{\partial\alpha}]\}\\ = \pi_j + \alpha[&\frac{\partial\pi_j}{\partial\alpha} + \frac{\partial\pi_j}{\partial q_h}\frac{\partial q_h}{\partial\alpha} + (n-1)\frac{\partial\pi_j}{\partial q_i}\frac{\partial q_i}{\partial\alpha}] = 0\end{aligned} \tag{10}$$

Therefore, applying *Lemma* 1 and *Lemma* 2, equation (10) can be rewritten as Eq. (11):

$$\begin{aligned}&EE^{\alpha} + \alpha PSE^{\alpha} + \alpha SE^{\alpha} = \frac{\tau}{2}x^2,\\ &\frac{(n+1+\alpha)(n+1-\alpha)(a-c)^2\tau^2}{[(n+1+\alpha)^2\tau - 2(n+1-\beta)^2]^2} = \frac{2(n+1-\beta)^2(a-c)^2\tau}{[(n+1+\alpha)^2\tau - 2(n+1-\beta)^2]^2},\end{aligned} \tag{11}$$

where

$$EE^{\alpha} - \frac{\tau}{2}x^2 = \frac{\partial\pi_f}{\partial\alpha} = \pi_j = q_f^2 - \frac{\tau}{2}x^2$$

$$EE^{\alpha} = \frac{(n+1+\alpha)^2(a-c)^2\tau^2}{[(n+1+\alpha)^2\tau - 2(n+1-\beta)^2]^2} > 0,$$

$$PSE^{\alpha} = \frac{\partial\pi_j}{\partial q_h}\frac{\partial q_h}{\partial\alpha} = \frac{-(n+1)(n+1+\alpha)(a-c)^2\tau^2}{[(n+1+\alpha)^2\tau - 2(n+1-\beta)^2]^2} < 0,$$

$$SE^{\alpha} = (n-1)\frac{\partial\pi_j}{\partial q_i}\frac{\partial q_i}{\partial\alpha} = \frac{(n-1)(n+1+\alpha)(a-c)^2\tau^2}{[(n+1+\alpha)^2\tau - 2(n+1-\beta)^2]^2} > 0.$$

The LHS of equation (11) is the marginal revenue of α (denoted as MR^{α}), and the RHS is the marginal cost (denoted as MC^{α}).

$$\begin{aligned}\frac{\partial MR^{\alpha}}{\partial\beta} - \frac{\partial MC^{\alpha}}{\partial\beta} = &\frac{4(n+1-\beta)(a-c)^2\tau}{[(n+1+\alpha)^2\tau - 2(n+1-\beta)^2]^3}[2(n+1-\beta)^2 - (n+1+\alpha)(n+1\\ &-3\alpha)\tau] > 0.\end{aligned} \tag{12}$$

This implies that the marginal profit of foreign firm increases as β and will induce higher shareholdings.

In mathematics of equation (11), we find that the downscale of MC^{α} due to τ again dominates the MR^{α} effect.

$$\frac{\partial MR^{\alpha}}{\partial \tau} - \frac{\partial MC^{\alpha}}{\partial \tau} = \frac{2(n+1-\beta)^2(a-c)^2}{[(n+1+\alpha)^2\tau - 2(n+1-\beta)^2]^3}[2(n+1-\beta)^2 - (n+1+\alpha)(n+1 -3\alpha)\tau] > 0. \quad (13)$$

Therefore, this implies that the marginal profit of foreign firm increases as τ and will induce higher shareholdings.

By equation (11), we obtain the optimal shares ratio for the foreign firm:

$$\alpha^{*} = \sqrt{\frac{(n+1)^2\tau - 2(n+1-\beta)^2}{\tau}}. \quad (14)$$

The superscript * of α denotes the equilibrium. For the Eq.(9) requirement, we can get $0.5 \le \alpha^{*} \le 1$.[7] The result consists with many countries' foreign investment law (Mowery, 1992; Gong, 2004). Since $\partial\alpha^{*}/\partial\tau > 0$ and $\partial^2\alpha^{*}/\partial\tau^2 < 0$, the optimal shares ratio is concave in τ.[8]. Considering Eq.(9) and the range of α, we can get the corollary about the limit of transfer cost (τ) as following:

Corollary:

(1) if $\alpha+\beta \ge 1$, $\underline{\tau}' = \frac{2(n+1-\beta)^2}{(n+1)^2 - 0.25} \le \tau \le \frac{2(n+1-\beta)^2}{(n+1)^2 - 1} = \bar{\tau}'$

(2) if $\alpha+\beta < 1$, $\underline{\tau}'' = \frac{2(n+1-\beta)(1-\beta)}{\alpha(n+1+\alpha)} \le \tau \le \frac{2(n+1-\beta)^2}{(n+1)^2 - 1} = \bar{\tau}''$.

***Lemma* 3**. A foreign firm's shareholding increases with higher technology spillover degree or higher transfer cost, And the foreign firm's shareholding must be greater than 50%.

Proof. Taking derivative with respect to equation (14), we obtain:

$$\frac{d\alpha^{*}}{d\beta} = \frac{2(n+1-\beta)}{\tau}[(n+1)^2\tau - 2(n+1-\beta)^2]^{-\frac{1}{2}} > 0.$$

Higher spillover degree (i.e., higher β) gives domestic joint venture partner firm higher free-riding benefit, and reduce the marginal revenue for holding higher shares. Nevertheless, less technology transfer leads smaller marginal cost for higher shareholdings in higher β. The advantage from decreased technology transfer cost is larger than the inferiority from reducing marginal revenue. Therefore, the foreign firm will prefer holds more shares to evade spillover risk. When cost of technology transfer is higher, a higher shares foreign firm does not have chance to increase marginal revenue through technology transfer advantage. However, higher τ leads smaller marginal cost for holding shares. It will encourage the foreign firm to increase its shareholding for higher profit. This result is consistent with Chung's (2006), which re-examine the ownership in Sino-foreign joint venture after China's WTO accession and find

7 See Appendix 1. And this result refines Chen and Chung's (2008) findings.

8 $\partial^2\alpha^{*}/\partial\tau^2 = -[(n+1-\beta)^2/\tau^4]\{2\tau\,(n+1-\beta)^2\,[(n+1)^2-2(n+1-\beta)^2/\tau]^{-1/2}+(n+1-\beta)^2[(n+1)^2-2(n+1-\beta)^2/\tau]^{-3/2}\}<0$.

that the higher shareholding, even wholly foreign owned mode, will be the preferred strategy when the MNEs face markets with little capital and a higher transfer costs. On the other hand, in the highly developed markets like America and the European Continent, the cost of technology transfer is relatively lower, which leads the foreign firms to hold smaller shares to reduce competition.

The number of firms in market also has effect on foreign firm's shares ratio.

$$\frac{\partial MR^{\alpha}}{\partial n}-\frac{\partial MC^{\alpha}}{\partial n}=\frac{2(a-c)^{2}\tau}{[(n+1+\alpha)^{2}\tau-4(n+1-\beta)^{2}]^{3}}[2(n+1-\beta)(2n^{2}+4n-\beta n+2-\beta$$

$$-3\alpha^{2}-2\alpha\beta)\tau-(n+1+\alpha)(n+1-2\alpha)\tau^{2}-4(n+1-\beta)^{3}]. \qquad (15)$$

Above equation is greater than zero when τ is sufficiently large.

From Equation (15), the marginal revenue curve of α with high n_1 (denoted as curve $MR^{\alpha}(n_1)$) has single crossing with the marginal revenue curve of α with low n_2 (represented as $MR^{\alpha}(n_2)$), and the marginal cost of α, denoted as $MC^{\alpha}(\tau_1)$ and $MC^{\alpha}(\tau_2)$ with $\tau_1 > \tau_2$. Then the equilibrium shares ratio shows to be lower under higher market competition (as $MR^{\alpha}(n_1)$ in the *Figure 1*.), when the cost of technology transfer is sufficiently cheap (as $MC^{\alpha}(\tau_2)$ in the Figure1.).

$$\frac{d\alpha^{*}}{dn}=[\frac{(n+1)^{2}\tau-2(n+1-\beta)^{2}}{\tau}]^{-\frac{1}{2}}[\frac{(n+1)\tau-2(n+1-\beta)}{\tau}]<0\text{, if } \tau<2(n+1-\beta)/(n+1).$$

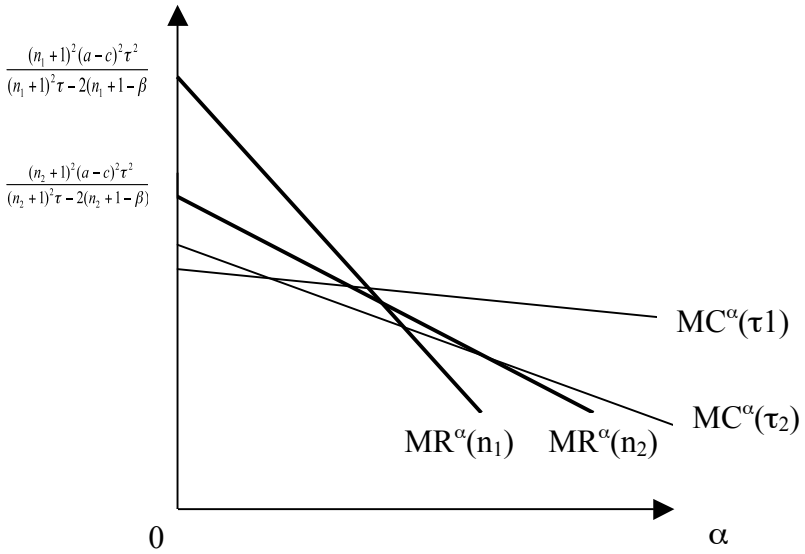
***Lemma* 4**. When the number of firms in the host market increases, the foreign firm's equilibrium shares ratio decreases if the marginal cost of technology transfer $\tau \in (\underline{\tau}', {}^{2(n+1-\beta)}\!/_{(n+1)})$ and $(\underline{\tau}'', {}^{2(n+1-\beta)}\!/_{(n+1)})$, but it increases if $\tau > {}^{2(n+1-\beta)}\!/_{(n+1)}$.

In an economic sense, if τ is low enough (technology transfer is higher efficiency), the more competitive market magnify the shareholdings influence on output of firm *f* and firm *h*, it means lower $\boldsymbol{PSE}^{\alpha}$ and larger $\boldsymbol{EE}^{\alpha}$ with *n*. Consequently, the foreign firm is inclined to sell more shares to firm *h* and transfer more technology when entering the more competitive market. Take the cost advantage from higher technology transfer to get over adverse factor of competition. In contrast, higher ownership policy is adopted in situations involving higher transfer costs and a more competitive host market. This result coincides with the entry strategy of numerous MNEs. MNEs are happy to release shares in low transfer cost markets like Europe (Shetty 1979). On the contrary, MNEs have a preference for higher ownership strategies when entering the competitive China market and transfer less technology (Business in China, 2004). Because selling shares to reduce market competition in a highly competitive market has little effect.[9] Combining *Lemma* 3 and 4, we build the following Proposition 1.

***Proposition* 1: A** MNE adopts a higher equity strategy, transfer less technology and have reduced output capacity when entering host markets characterized by high technology spillover, low technology transfer efficiency and high competitiveness.

[9] $\partial(\partial qf/\partial\alpha)/\partial n = [2(\alpha-c)+(n+1-\alpha-2\beta)x]/(n+1+\alpha)^{3}>0$.

Figure 1: The Optimal Shares Ratio



IV. HOST COUNTRY EQUITY POLICY

The investment policy by host government plays an important role in economic growth for developed and developing countries. MNE maximizes Eq. (1) by setting the optimal equity level, but the question of which equity policy most benefits host welfare remains unclear. To analyze the welfare of host country (HC), we follow Hillman's (1982) approach to form welfare function as $W(\pi, CS)$, which consists of domestic firm's profits $[\pi_h+(n\text{-}1)\pi_i]$ and net consumer surplus (CS).[10] The host welfare is calculated and summarized as the following:

$$W = \pi_h + (n-1)\pi_i + \mathrm{CS}$$
$$= (a-c-q+\beta x)q_h + (1-\alpha)[(a-c-q+x)q_f - \frac{\tau}{2}x^2] + (n-1)(a-c-q)q_i + \frac{1}{2}q^2. \quad (16)$$

The government maximizes political support by choosing a shares ratio that maximizes the welfare function,[11]

$$\frac{dW}{d\alpha} = \frac{d\pi_h}{d\alpha} + (n-1)\underset{-}{\frac{d\pi_i}{d\alpha}} + \underset{+}{\frac{dCS}{d\alpha}}. \quad (17)$$

Through mathematics, it reveals that higher consumer surplus and lower profit of domestic firms from higher ownership of foreign firms. The negative firms' profit effects dominate the positive consumer surplus effect, and thus higher shares ratio (α) is associated with lower host welfare. Hence, host countries prefer the MNEs' minority equity. Higher MNEs' ownership

[10] We assume that W[×] is well-behaved, ie., $W_{\pi_h+(n-1)\pi_i} > 0$, $W_{CS} > 0$, $W\pi\pi < 0$, $W_{CSCS} < 0$.
[11] See Appendix 2.

damages host welfare is consistent with the ownership ceiling for foreign firm entry in developing countries by Beamish (1985) and Teng *et al* (2001).[12] As Beamish (1988, p. 17) writes, "The most common reason cited for a multinational taking a minority equity position were existing regulations and/or local tax advantage."

However, in ownership liberalization, MNEs can determine their preferred equity ownership, therefore, equity conflicts exist between MNEs and host countries (HCs). Host governments hope minority-equity for foreign firms to benefit their welfare more. However, MNEs prefer majority-equity in the higher transfer cost and technology spillover cases (from ***Proposition* 1**). Even MNEs want to enter the host market as WFOEs (wholly foreign owned enterprise) under the β =1case. Enormous conflict exists between the preferred shares levels of MNEs and host governments. The equity conflicts between MNEs and HCs increase with transfer cost and technology spillover degree.

The lower shares ratio of foreign firms induces higher technology transfer and higher host welfare. This work reveals that technology transfer not only provides higher local consumer surplus but also provides the joint venture partner with an opportunity to gain cost advantage through technology spillover and share the profits generated by the formation of the joint venture. Although the other host firms will be harmed by the higher level of technology, but the positive effects dominate the negative one. Consequently, HCs prefer higher technology introduction because it benefits national welfare more. This finding matches that of Takarada (2006), who concludes that technology transfer benefits the recipient country.

If the policy measures of the HCs are considered, *Figure 2* shows the optimal shares ratio for MNEs and HCs. We find the HC has a stronger incentive to require MNEs to release their shares. The preference divergence of shares ratio between MNEs and host country is larger with higher transfer cost. MNEs prefer holding higher shares under higher τ, however, host country hope MNEs releasing more shares. Even, wholly- foreign-owned will be the choice for MNEs under perfect spillover case (β=1).

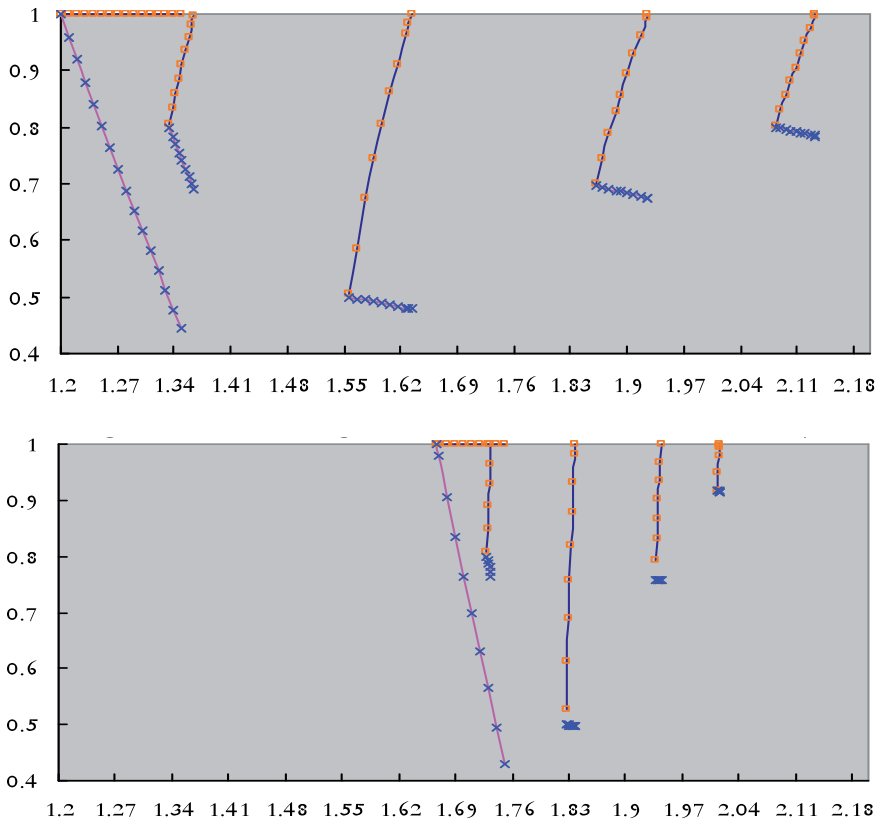
V. CONCLUSIONS

In this paper I developed a model for analyzing the optimal equity strategy for Multinational enterprises (MNEs) and host countries. It finds that the results are critically dependent on the environment of host countries.

In the three-stage and three-style firms game model, higher shareholding of MNEs leads to a decrease in technology transfer which is found in more competitive host market with higher technology transfer cost and spillover environment. The analyses is similar with Chen and Chung (2008), furthermore, I get a demonstration that MNEs will hold shares larger than 50 percent and have stronger control force on joint venture firm. This result is analogous to Buckley *et al* (2004), Thompson (2003) and Wong (2001) which show that foreign firms are not willing to transfer technology into JV to avoid the risk of technology spillover. And the lower technology transfer is unfavorable for host welfare. The minority-equity and higher technology transfer from MNEs is the preference for host welfare.

[12] Teng *et al* (2001) conclude that a host country may set ceiling on ownership to maximize its national welfare.

Figure 2: The Foreign Firm's Shares Ratio for MNEs and Host Country



Notes: Simulations are performed within the space of $(1.2, 0.4) \leq (\tau, \alpha) \leq (2.18, 1)$, the MNEs' optimal equity from Eq. (14) and the host welfare simulation from Appendix 3. Line α^{**} is the expected MNE's shares ratio for maximizing host country welfare under given β. Line α^{*} is the MNE's expected shares ratio for maximizing its profit. The subscript of α^{*} and α^{**} represent the given different technology spillover (β).

The host legal regime has an effect on the foreign investment. The incentive of technology transfer will decline when foreign firm exposes the risk of no perfect IRP (Intellectual Right Protection). This coincides with the high spillover degree, and a higher ownership for MNEs will result. Teece (1998) suggested that whether a technology transfer is successful in a host country may depend on the local legal integrity. It has shown that joint venture firm's higher technology introduction benefits the host welfare. It means lower host welfare resulting from higher technology spillover and transfer cost. How to build the preferred environment for foreign investment is the important policy program for developing countries.

The forces of globalization appear to have diminished the use of shared ownership (Desai, Foley, 2002). But host countries are eager for the shared equity and higher technology transfer to benefit their economic growth and welfare. In our model, the host country prefers foreign firm's minority-equity conclusion is consistent with previous studies and many developing countries. Only protecting the IRP and declining the host transfer cost can benefit the host welfare.

Since MNEs will adopt the majority holdings and it leads the equity conflict between MNEs and host countries. How to give incentives and attract foreign investment will be an important and difficult task for host government.

APPENDIX

A1. The Minimum of Shares Ratio

(1) $\alpha+\beta\geq 1$

$(\alpha^*)^2 = (n+1)^2 - \frac{2(n+1-\beta)^2}{\tau}$, substitute $\tau = \underline{\tau}' = \frac{2(n+1-\beta)}{(n+1+\alpha)}$,

$\alpha^* = \frac{-(n+1-\beta)+\sqrt{(n+1-\beta)^2+4\beta(n+1)}}{2}$, substitute $\underline{\beta} = 1-\underline{\alpha}^*$ and get $\underline{\beta}$ is 0.5. The minimum α^* occurs at $\alpha* = \beta = 0.5$.

(2) $\alpha+\beta<1$

$(\alpha^*)^2 = (n+1)^2 - \frac{2(n+1-\beta)^2}{\tau}$, substitute $\tau = \underline{\tau}'' = \frac{2(n+1-\beta)(1-\beta)}{\alpha(n+1+\alpha)}$,

$(\alpha^*)^2 = (n+1)^2 - \frac{\alpha^*[n+1+(\alpha^*)](n+1-\beta)}{(1-\beta)}$,

$\alpha^* = \frac{-[n^2+(2-\beta)n+(1-\beta)]+\sqrt{[n^2+(2-\beta)n+(1-\beta)]^2+4(n+2-2\beta)(1-\beta)(n+1)^2}}{2(n+2-2\beta)}$,

The minimum α^* is 0.5.

A2. The Welfare Variation from Shareholding Ratio

$\frac{dW}{d\alpha} = \frac{d\pi_h}{d\alpha} + (n-1)\frac{d\pi_i}{d\alpha} + \frac{dCS}{d\alpha}$. Through simulation, we find $dW/d\alpha < 0$.

(a) $\frac{d(n-1)\pi_i}{d\alpha} = 2(n-1)q_i\frac{dq_i}{d\alpha} < 0$. (from Lemma 1.)

(b) $\frac{d\pi_h}{d\alpha} = \frac{(a-c)^2}{A^4}\{\{[2(n+1+\alpha)\tau^2 - 2(n+1-\beta)(1+2\alpha-\beta-\alpha\beta-\beta n)\tau]A^2\}$
$-4(n+1+\alpha)A\tau\{(n+1+\alpha)^2\tau^2 - 2(n+1-\beta)[n(2-\beta-\alpha\beta)+$
$(1-\beta)(2+\alpha+\alpha^2)]\tau + 4(1-\beta)^2(n+1-\beta)^2\}\}$

From simulation, we find the host joint venture partner's profit decreases with α.

(c) $$q = \frac{(n+\alpha)(a-c)+(\alpha+\beta)x}{n+1+\alpha} = \frac{[(n+\alpha)(n+1+\alpha)\tau - 2(n-\beta)(n+1-\beta)](a-c)}{(n+1+\alpha)^2\tau - 2(n+1-\beta)^2},$$

$$\frac{dq}{d\alpha} = \frac{(a-c)\tau}{[(n+1+\alpha)^2\tau - 2(n+1-\beta)^2]^2}[(n+1+\alpha)^2\tau - 2(n+1-\beta)(n+1+2\alpha+\beta)] > 0.$$

$$CS = q^2/2,\ \frac{dCS}{d\alpha} = q\frac{dq}{d\alpha} > 0.$$

A3. The Host Welfare

$$\frac{W}{(a-c)^2} = \frac{1}{(n+1+\alpha)^2}\{[\frac{1}{2}(n+\alpha)^2 + n] + \frac{2(n+1-\beta)}{A}[n(1+\alpha\beta-2\alpha)+\beta(\alpha^2+3\alpha+1)-1]$$

$$\frac{dq}{d\alpha} = \frac{(a-c)\tau}{[(n+1+\alpha)^2\tau - 2(n+1-\beta)^2]^2}[(n+1+\alpha)^2\tau - 2(n+1-\beta)(n+1+2\alpha+\beta)] > 0.$$

$$+\frac{4(n+1-\beta)^2}{A^2}\{[1-(1-\beta)(\alpha+\beta)]n^2 + [2(1+\beta^2)+\alpha\beta(\alpha+\beta)+\beta(2\alpha-3)-\alpha]n$$
$$+(1-\alpha^2-2\beta)-\tau/2(1-\alpha)(n+1+\alpha)^2\}\}.$$

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