Multinational firm and its operational choice:  
Inward and outward investment

Nobuko Serizawa**  
Niigata University

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Abstract

This paper studies how a multinational enterprise coordinates the investment portfolio and the 
foreign operational choice. Possible choices for the portfolio are inward and outward investments, 
i.e., research and development (R&D) investment and foreign direct investment (FDI). For the 
foreign operational choices, there are FDI and the licensing in which the former requires financial 
investment and the latter does not. It is shown that the host country’s R&D and FDI policies affect 
the behavior the MNE via financial constraint and that the host government’s FDI restrictive 
policy does not necessarily reduce MNE’s FDI, and the R&D promotive policy may not increase 
MNE’s R&D.

Keywords: multinational enterprise, budget constraint, investment portfolio, R&D, FDI, subsidiary, joint 
venture, licensing, spillover

JEL Classification: F21, F23, L24, O32, O38

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** Correspondence: Faculty of Economics, Niigata University; 8050, 2-no-cho Ikarashi, Niigata, 950-2181, 
Japan. TEL&FAX: +81-25-262-6568, E-mail: serizawa@econ.niigata-u.ac.jp
1. Introduction

Cross-border trade is said prevalent in countries that locate close to the production location of a multinational enterprise (hence force, MNE). In addition to location advantage, there are many factors that affect MNE’s foreign operational choices. The operational choice of a MNE will be affected not only by the accessibility to the foreign markets and the readiness of the foreign country’s social and economic infrastructure but also by firm’s internal resource allocation issue. For example, if a firm intends to invest in R&D and directly to the foreign market but faces the budget constraint, it must arrange the portfolio among inward and outward investments, such as R&D investment and FDI. The former contributes to increase market competitiveness and the latter to increase profit opportunity. Then, how a MNE coordinates R&D investment and foreign operational choice when it confronts with budget constraint?

In the earlier literature, Dei (1990), Motta (1992) and Buckely and Casson (1998) show that high trade costs encourage a MNE to choose FDI in the operational choices between export and FDI. Lankes and Venables (1996) study that the market size of the host country is a driving force for choosing FDI. These literature focus on the advantage of FDI, the way to obtain the control right of a local firm, but they do not consider the tradeoff between market expansion and market competitiveness when the firm confronts with the resource constraint. A MNE must accommodate investment money for FDI and R&D, which means that the behavior of a MNE can be correctly understood when both investment portfolio and operational choices are discussed simultaneously. Regarding to this issue, Wong (1995) explains how the allocation of MNE’s firm-specific management resource affects MNE’s FDI revenue under the given R&D level. Ethier and Markusen (1996) discuss the effect of a given level of R&D investment on MNE’s operational choice between exporting, licensing and FDI. Petit and Sanna-Randaccio (2000) develop the first international duopoly model, in which both firms’ operational choices, i.e., export and FDI, and R&D level are endogenously determined. But they do not take the issue of firm’s resource allocation into account. Kasuga (2003) focuses on ownership structure of a MNE and shows that the organizational type of FDI, subsidiary and joint venture, is affected by the capital market imperfection. But he does not take the level of R&D into account. On the other hand, now a day we see many cases in which horizontally competitive MNE’s form technological alliance. Since it takes time and costs to effectively manage a newly set up foreign affiliate, a MNE may seek other way than export and FDI. It is the alliance such as licensing contract that a MNE can avoid such

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1 In the OLI theory, Dunning (1993) explains that a MNE invests directly to the host country and manages a local firm when (i) it owns firm specific resources like technology and management know-how, Ownership-specific advantage, (ii) it can procure abundant and cheap production factors in the host country, Location-specific advantage, and (iii) it can save transaction costs by integrating local firm vertically, Internalization advantage.
managerial and pecuniary costs. But how much of the technology is transferred from the MNE (licenser) to the foreign recipient (licensee)?

Note that there are two types of externally in the technology transfer, the one is the direct spillover of the knowledge and the other is the indirect one, that is, the drain of the tacit knowledge through learn-by-doing. If the host government regards the accumulation of the human capital is the most urgent, it may introduce measures to promote inward FDI so that the welfare of the host country increases in FDI. However, since the MNE is constrained to the budget, the increase in FDI reduces the MNE’s financial asset necessarily for R&D investment, which results in the reduction of the world welfare as far as the increase in R&D output improves the welfare. On the other hand, when the host government considers the direct technology transfer is the most important so that it may restrict foreign capital inflow and induce technology alliance. Under such situation, the constrained MNE shifts the financial asset from FDI to R&D, and then the welfare of the host country and that of the world may increase. So the policies introduced in the host country play curtail role in determining the behavior of the MNE. But few literatures explain how a MNE coordinate the alliance and the FDI when the host government may impose policies for R&D and FDI.

I attempt to explore the mechanism lays behind MNE’s behavior in coordinating for the investment portfolio and the foreign operational choice given the host country’s trade policies. I take up two operational choices, FDI and the licensing contract. The former requires the MNE to invest money in acquiring control right of a local firm but the latter does not. The motivation of this paper is close to Petit and Sanna-Randaccio (2000), however, what discriminates between this study and theirs as well as other previous literature is that I deal with the alliance in addition to FDI. Furthermore, since MNE’s operational choice is affected by whether the MNE aims at the short-run or the long-run profit, the duration of the investment project is explicitly reflected in the term structure.

The main findings are the following: (i) the knowledge spillovers and the host government’s policies for FDI and R&D play the important role for the determination of MNE’s strategies. (ii) The marginal change in the R&D policy and the FDI policy in the pro- and con-foreign-capital-inflow regimes may give the opposite effects on the optimal R&D level. This implies that the host government can not always guide the MNE properly toward the direction to which the introduced R&D and FDI policies aim at. (iii) I derive the necessarily and sufficient condition for the MNE to choose the licensing. (iv) When the host government introduces restrictive foreign-capital-inflow policy, the MNE’s optimal R&D level may lower in the subsidiary choice than that in the joint venture. However, when the MNE chooses the joint venture and the licensing together, the equilibrium R&D level is lower than that in the choice without the licensing.
This paper is organized as follows. Section 2 describes the behavior of a MNE, in which the relation between investment portfolio and operational choices are explained. In Section 3, I first model the regime when the MNE may invest in a joint venture with a foreign partner, and next the subsidiary regime. These two are without the licensing contract. Then, I explore the model when the licensing is allowed as the third operational choice. The derived optimal R&D levels are compared among regimes. Section 4 concludes.

2. Behavior of a MNE: Investment portfolio and operational choice

Given host country’s policies, a financially constrained MNE arranges its investment portfolio and the foreign operational choices simultaneously. As mentioned earlier, the investment portfolio of the MNE consists of the inward competitiveness investment and the outward foreign expansion investment, that is, R&D investment and FDI, respectively. If the MNE puts more weight on R&D investment, the investment money left for FDI is reduced if the financing from the third party is not allowed. The trade-off for the increase in market competitiveness is some loss of the profit chance from FDI. On the other hand, the MNE will seek another operational choices other than FDI since it takes time to prove FDI be effective. For FDI, MNE may incur direct fixed cost and indirect managerial and localization costs. So, the licensing, the cross-licensing and the patent pool are preferable for a myopic MNE who looks for the immediate profit.\(^2\) If the MNE intends to save localization cost for enhancing R&D level, the licensing may be preferred. I call them the alliance, which is distinguished from FDI. The former is defined as the choices that do not require monetary investment, but the latter does. In this paper, I illustrate the licensing contract for the possible alliance choice.

FDI: a subsidiary and a joint venture

There are two types for FDI depending on how much of the share of a foreign affiliate is owned by the MNE. The MNE invests the money to acquire \(\theta\) 100\% share of a foreign affiliate, \(\theta \in (0, 1]\).\(^3\) I call the foreign affiliate a subsidiary if \(\theta = 1\) and a joint venture if \(1 > \theta > 0\). For the joint venture, the MNE and the foreign partner input firm’s own R&D output and jointly maximize the joint profit, but the MNE incurs spillover cost.

\(^2\) A patent pool is a consortium of at least two companies agreeing to cross-license patents, which are often licensed to the third party. The creation of a patent pool can save time and R&D costs as well as legal costs of the vested interests, but the larger patent pool may distort market competition.

\(^3\) The parameter \(\theta\) can be the given bargaining power. The way to acquire control right of an organization, e.g., through green field investment, Merger and Acquisition, and other bargaining measures, is not the concern of this paper.
The Alliance: licensing contract

If the MNE and a foreign firm agree to conclude a licensing contract, the MNE (the licenser) must decide how much of its technology is transferred to the partner (the licensee). For the licensing contract, I suppose that the MNE can make profit immediately after it concludes the contract. Since the technology of the MNE may spill over to the licensee, MNE incurs monitoring costs to halt the spillover. 4

Fig.1 Investment portfolio and operational choices of the MNE:
The flow of the investment money and the R&D output.

3. The model

3.1 Decision making process of a MNE

There is one MNE in the home country and there are one potential foreign investor/firm and one potential foreign firm. So that when the MNE chooses a joint venture, it jointly invests with a foreign investor, and it concludes the licensing contract with the other foreign firm when the MNE chooses the alliance. Firms undertake the R&D activities in their corresponding native country and the R&D output is transferred to the foreign affiliate if the MNE chooses FDI and the licensing. While the MNE can expand the activity over the national border, it is supposed that the foreign affiliate and a potential foreign partner can not expand the foreign activities. The MNE produces goods in the home country as well as in the foreign country when it acquires a foreign affiliate through FDI. For the simplicity, I assume that there is no risk both in the markets and in the R&D activities, and the asymmetric information inside the firm or between the firms is assumed away.

Next I explain the time structure of the model. There are two consecutive short periods, the first and the second period. The short term means one period, and the long term two periods, in which discount factor is assumed zero. Firms can produce in each period, and production is completed at each period. Firms’ R&D activities, however, will be conducted once at the beginning of the first period and their results appear immediately before the first period production starts.

At the beginning of the first period, the budget constrained MNE decides investment portfolio

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4 There are costs and benefits in the cooperative activities. For example, in the conventional discussions of a research joint venture, it is explained that horizontally competitive firms prone to form R&D cartel to internalize the spillover cost. See, for example, d’Aspremont and Jacquemin (1988) and Suzumura (1992), who show that the bigger the spillover rate, the stronger the firms’ motivations for forming research cartel in the homogeneous-goods oligopoly models.
as well as foreign operational choice, simultaneously, the given the host country’s policies. As the financing from the third party is assumed away, MNE’s resource allocation restricts its operational choice. (i) If the MNE decides to invest in both R&D and FDI, it then decides how much to invest in R&D and in FDI. Under FDI, it takes time until the profit from the foreign affiliate is realized in the second period, therefore it is the long term project. On the other hand, (ii) if it chooses the licensing it is assumed that the MNE can immediately transfer the part of its obtained R&D output and receives royalty revenue in addition to the profits earned in the home country. So it must decide the transfer rate of the technology for the licensing contract as well.

The relation between operational choices and profit chances is summarized in Table1.

Table.1 MNE’s profits in the foreign market.¹

Finally I explain the investment portfolio. Let \( K_0 \) be the MNE’s initial financial asset, which is allocated between R&D investment, \( K \), and FDI, \( K^* \), then \( K_0 = K + K^* \). So the amount of FDI is expressed as

\[
K^* = K_0 - K. \tag{1}
\]

Let \( k \) be the MNE’s R&D input and assume the amount of R&D investment is linear in the R&D input, that is, \( K = ck \), in which the marginal cost of R&D input \( c \) is positive constant. The R&D production function, however, exhibits decreasing-return-to-scale, which is presumed quadratic as \( f(k) = k^{1/2} \).

Note that the type of R&D is neither the process innovation nor the product innovation. I assume that R&D produces positive lump sum investment output at one time, that is, the brand.² Since the owner of the brand can use it in selling the relevant products like other quasi-public goods, the brand contributes to expand the sales revenue of the brand holder. I define this type of R&D contribution as

\[
Rk^{1/2} \tag{2}
\]

¹ Under any choice, the MNE can make profits in the home country both in the first and the second periods. The profit structure of the model is explained later.
² The noted characteristics of the brand are: (i) because of non-rivalry characteristic, the number of users is not limited, and (ii) under proper maintenance effort, it is not obsolete so that the brand holder can use it in the long run.
where $R$ is firm’s net sales revenue calculated by subtracting the production cost from the sales revenue.\(^7\)

### 3.2 Foreign Direct Investment without the Alliance

I first analyze FDI, i.e., a joint venture and a subsidiary, in the mode without the licensing contract. Moreover, since the subsidiary is assumed to be the special case of the joint venture, I first illustrate the case for the joint venture.

When the MNE and a foreign investor/firm agree to setup a joint venture, they jointly sell the products binding individually developed technology $k$ and $k^*$ in the manner $(k+k^*)^{1/2}$ where $k^*$ is the foreign investor’s R&D output. From the assumption, it takes time to put a newly formed organization, i.e., the foreign affiliate obtained by FDI, the profit of the affiliate is realized at the end of the second period. Let $K^*$ be the size of the foreign affiliate, which is evaluated at the unit exchange rate. Then, the profit of the foreign affiliate in the second period becomes

$$
\pi^*_2 = \theta \pi^*_1 + (1-\theta) \pi^*_2 = R^*_2 (k+k^*)^{1/2} - K^* 
$$

where the asterisks express the variables relate to the foreign country, the number of the subscripts express the period, the superscripts $A$ mean the variables relate to the foreign affiliate, $R^*_2$ is the affiliate’s second period sales revenue.

In contrast to the foreign investor, I assume that the MNE incurs additional localization cost for FDI. This indirect cost, for example, can be parallel to the human-capital accumulation cost which is necessarily to enhance the absorptive capability of the local stuff of the foreign affiliate, or more directly it may reflect the entry barrier for the MNE. Let $t^*$ be the policy parameter relating to the foreign-capital-inflow policy, that is, FDI policy, introduced by the host government. Then the MNE has to pay $t^* \theta K^*$ for FDI. Note with $t^* < 0$, the host government introduces promotive capital inflow policy, and with $t^* > 0$, restrictive policy.\(^8\) Moreover, as the knowledge is supposed to spill from the MNE to the host country, the MNE pays the spillover cost. This parameter can be viewed as the R&D policy parameter.\(^9\) Because, if the host government introduces the stronger

\[^7\] More specifically, it can be $R=pq-C(q)$, in which $p$, $q$, and $C(q)$ are the price and the demand of the goods, and total production cost, respectively. Since this paper does not refer to the market structure, I simply assume that production cost is zero and that $R$ be the net sales revenue.

\[^8\] The increase in $t^*$ corresponds to the more restrictive foreign-capital-inflow policy and the reduction in $t^*$ more promotive policy.

\[^9\] Such $s^*$ can show the foreign country’s readiness for accepting the foreign technologies. For example, the greater $s^*$ means inferior social infrastructure reflecting the weaker intellectual property rights
intellectual property right (IPR) policy, knowledge spillover will be regulated. Let \( s^* \in [0, 1] \) be the spillover rate and \( s^*\theta \) be the spillover cost. So the net revenue for the MNE under the joint venture option becomes \( \pi^F = \theta \pi^A - t^*\theta K^*-s^*\theta k \), in which the superscripts \( F \) mean MNE’s FDI and \( c>s^* \) is assumed. Then the profits of the MNE in each period are:

<table>
<thead>
<tr>
<th>Period</th>
<th>Profit Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>( t=1 )</td>
<td>Profit in the home country; ( \pi_1 = R_1 k^{1/2} - K )</td>
</tr>
<tr>
<td>( t=2 )</td>
<td>Profit in the home country; ( \pi_2 = R_2 k^{1/2} )</td>
</tr>
<tr>
<td></td>
<td>MNE’s net dividend from FDI; ( \pi^F = \theta \pi^A - t^<em>\theta K^</em>-s^*\theta k )</td>
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</table>

The MNE’s total profit choosing FDI is defined as

\[
\Pi^M = \pi_1 + \pi_2 + \pi^F = [(R_1+R_2)k^{1/2} - K] + \theta [R_2^* (k+k^*)^{1/2} -(1+t^*)K^*-s^*k] \tag{4}
\]

where the superscripts \( M \) mean the MNE. If the MNE chooses the subsidiary option, then \( \theta=1 \) and \( k^*=0 \) will be substituted for the net total profit in (4). Moreover, the MNE’s net investment money necessarily for FDI depends on the localization cost \( t^* \) so the effective FDI cost is \( (1+t^*)\theta K^* \) and that of the foreign investor’s be \( (1-\theta)K^* \). So that the magnitude of the foreign investor’s investment for the joint venture is \( (1-\theta)K^* = (1-\theta)(K_0-c^*k) \) from (1).

Since the foreign investor can not operate across the border, its profits are restricted in the foreign market. In the first period, the foreign investor invests in the R&D and it jointly operates the affiliate in the second period when it agrees to hold \( (1-\theta) \) % share of a joint venture. I assume that the R&D production function of the foreign investor also exhibits decreasing return, \( f(k^*) = k^*/2 \) and the R&D cost is \( c^*k^* \) where \( c^* \) is the foreign investor’s marginal R&D cost. Then the profit of the foreign investor in each period is:

<table>
<thead>
<tr>
<th>Period</th>
<th>Profit Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>( t=1 )</td>
<td>Profit in the foreign country; ( \pi_1 = R_1^* k^{1/2} - c^<em>k^</em> )</td>
</tr>
<tr>
<td>( t=2 )</td>
<td>Dividend from the joint venture; ( \pi_2^F = (1-\theta) \pi_2^* )</td>
</tr>
</tbody>
</table>

where the superscripts \( P \) mean the foreign investor. The total profit of the foreign investor becomes

\[
\Pi^P = \pi_1 + \pi_2^F = R_1^* k^{1/2} - c^*k^* + (1-\theta)[R_2^* (k+k^*)^{1/2} - K^*] \tag{5}
\]

policy, and the smaller \( s^* \) reflects inferior technological absorption capability of the host country. And with \( s^*=1 \), the technology is perfectly stolen and with \( s^*=0 \), there is no spillover.\(^{10}\) If the marginal spillover cost is greater than the marginal R&D investment cost, tribally the MNE does not choose FDI.
First, I derive the firms’ optimal R&D levels under the joint venture option. Since two firms simultaneously decide R&D investment and the investment size of the affiliate simultaneously, and the discount factor for the second period is assumed zero, the model is solved as if it is static. From (4) and (5), the joint profit of the affiliate is defined as

\[
V^F = \Pi^M + \Pi^P, \quad (6)
\]

and the MNE and the foreign investor solve for \( \max_{k_1, k_2} V^F \). For simplicity, assuming \( R_1 = R_2 = R, \ c = c' = c > 0, \) and \( R - c > 0, \) and differentiating (6) in terms of each factor. From solving the two first-order conditions, we have the optimal R&D levels for the MNE and the foreign partner, respectively:

\[
k^{JV}_1 = \left( \frac{R}{X} \right)^2, \quad (7-1)
\]

\[
k^{JV}_2 = \left( \frac{R}{2cX} \right) (X^2 - 4c^2), \quad (7-2)
\]

where \( X = (c + \theta t^*) - \theta s^* \neq 0 \) is the net social cost for foreign capital flow, in which \( (c + \theta t^*) \) is the social cost and \( \theta s^* \) is the social benefit from the capital flow. Under \( t^* > 0, \) \( ct^* \) can be the essential marginal cost of the MNE’s capital, then we have \( (ct^* - s^*) > 0 \) and \( X > 0. \) On the other hand, with \( t^* < 0, \) \( ct^* \) is the essential marginal subsidy for the capital inflow, so that we have \( (ct^* - s^*) < 0 \) and \( X < 0. \) That is, if \( t^* > 0, \) then \( 1 \geq ct^* \) and \( X \geq 2c, \) and if \( t^* < 0, \) then \( c(3 + ct^*) \leq \theta s^* \) and \( X \leq -2c. \) The firms’ second-order conditions hold.

**Lemma 1:** The optimal level of MNE’s R&D for the joint venture option is \( k^{JV}_1 = \left( \frac{R}{X} \right)^2, \) and that of the partner is \( k^{JV}_2 = \left( \frac{R}{2cX} \right) (X^2 - 4c^2) \geq 0 \) in which \( X = (c + \theta t^*) - \theta s^* \neq 0. \)

When the policy of the host government is pro-foreign-capital-inflow, \( t^* < 0, \) and \( X < 0 \) holds, we have \( \frac{\partial k^{IV}}{\partial s^*} = \frac{2R^2 \theta}{X^3} < 0, \ \frac{\partial k^{IV}}{\partial t^*} = -\frac{2cR^2 \theta}{X^3} > 0, \ \frac{\partial k^{IV}}{\partial c} = -\frac{2R^2 (ct^* - s^*)}{X^3} < 0, \) and \( \frac{\partial k^{IV}}{\partial R} = \frac{2R}{X^2} > 0. \) When the host government imposes stronger IPR policy, i.e., smaller \( s^* \), the MNE increases R&D investment so that FDI decreases. However, the introduction of additional promotive capital-inflow policy, the greater \( |t^*|, \) reduces the FDI cost. The MNE intending to avoid spillover cost associating with the increase in the R&D investment takes advantage of relatively cheap FDI by investing more in FDI, which in turn reduces R&D investment. On the other hand, the marginal increase in MNE’s share rate increases FDI cost, which in turn reduces MNE’s R&D investment. Because \( \theta \) directly affects on the net revenue from FDI. The expansion of the market revenue increases R&D
investment.

Lemma 2: In the equilibrium of the pro-foreign-capital-inflow regime, \( t^* < 0 \), the host government’s additional supportive policy for MNE’s R&D (smaller spillover cost) may increase the MNE’s optimal level of the R&D investment so that MNE’s FDI is reduced, but that for FDI (smaller FDI cost) may reduce MNE’s R&D investment and increase FDI. The marginal increase in MNE’s share rate of the joint venture may reduce MNE’s R&D, and the marginal expansion of the market revenue increases the optimal level of the MNE’s R&D investment.

However, when the host government restricts foreign capital inflow, i.e., \( t^* > 0 \), FDI is costly. In this case, we have \( \frac{\partial k^{IV}}{\partial s} > 0 \), \( \frac{\partial k^{IV}}{\partial t} < 0 \), and \( \frac{\partial k^{IV}}{\partial \theta} < 0 \). Note that with the stronger IPR policy, the MNE reduces R&D investment. As the practical financial constraint is \( K_0 = (c+s^*)k + (1+t^*)K^* \), marginal reduction in the spillover cost encourages the MNE to shift its mode from competitiveness-oriented to expansion-oriented. Note that, when the host government looses restrictive capital-inflow policy, the MNE shifts from expansion-oriented to competitiveness-oriented mode, then it increases R&D investment and reduces FDI. The expansion in the sale revenue increases R&D. The increase in share holding raises the relatively high FDI cost so that the MNE is forced to reduce R&D investment.

Lemma 3: In the equilibrium of the con-foreign-capital-inflow regime, \( t^* > 0 \), the host government’s supportive policy for R&D investment reduces the MNE’s optimal level of the R&D investment, however, for FDI reduces FDI. The marginal increase in the MNE’s share rate and that in the market revenue increases (reduces) and reduces (increases) FDI (R&D), respectively.

For the case when the MNE chooses the subsidiary, the objective function of the MNE becomes

\[
\Pi^M = \pi^1 + \pi^2 + \pi^2^* [R_1 + R_2] (1/2 - K) + [R_2^* (1/2 - (1+t^*)K - s^* k)]
\]

with \( \theta = 1 \) and \( k^* = 0 \). Assuming \( R_1 = R_2 = R_2^* = R \) and differentiating it in terms of \( k \) yields the optimal R&D level for the subsidiary choice:

\[
k^* = \frac{9R^2}{4(c^t - s)}.
\]

(8)

In the pro-foreign-capital-inflow regime, \( t^* < 0 \), we have \( \frac{\partial k^s}{\partial s} = \frac{9R^2}{2(s - ct^*)} < 0 \), and \( \frac{\partial k^s}{\partial t} = \frac{9cr^2}{2(s - ct^*)} > 0 \). and on the contrary in the con-foreign-capital-inflow regime, \( t^* > 0 \), we have \( \frac{\partial k^s}{\partial s} > 0 \), \( \frac{\partial k^s}{\partial t} < 0 \) and \( \frac{\partial k^s}{\partial R} > 0 \).
Lemma 4: The optimal level of R&D for the subsidiary is 

\[ k^* = \frac{9R^2}{4(c^2 - s')}. \]

Under the given policy of the host government, the marginal change in the host government’s policies for R&S and FDI and the marginal expansion of the market revenue give the similar effects as in the case of the joint venture on the MNE’s optimal R&D level.

Lemma 1–4 are summarized:

Proposition 1: Under the given host country’s trade policy, it is the financial constraint and the costs incurred in the spillover and the localization that affect the behavior of the MNE. The marginal changes in R&D policy and FDI policy give the opposite effects on the equilibrium R&D level in pro- and con-foreign-capital-inflow regime. But the marginal increase in the share rate and the market revenue increase FDI and R&D, respectively, in both regimes. Note in the con-foreign-capital-inflow regime, the marginally stronger intellectual property right policy may reduce R&D and increase the MNE’s FDI, however, the marginally promotive capital-inflow policy may increase R&D and reduce the FDI.

3.3 FDI and the Alliance: the licensing contract

From assumption, the alliance formation does not require financial investment so that the MNE must decide how much of its technology be transferred if it licenses its technology. The type of the alliance is presumed as the long term licensing contract, under which the licensee can use this technology in two periods. For simplicity, I assume that the candidate for the licensee is other than the foreign investor of the joint venture. If the both parties agree to sign the contract, but re-negotiation is not allowed. The licensing contract brings the same amount of the royalty revenue in each period. If the MNE’s technology is assumed to be superior to that of the licensee, application of the transferred technology requires the licensee to devote considerable efforts. That is, applying the licensed technology exhibits decreasing return for the licensee. Let MNE’s technology transfer rate be \( \tau \in [0, 1] \) and \( r > 0 \) be per unit royalty fee, and I assume that the amount of the transferred technology be \( k^{1/2} \). Then the per period MNE’s licensing revenue is defined as

\[ rk^{1/2}. \quad (9) \]

On the other hand, the MNE must pay monitoring cost not to allow technology spillover to the licensee, which is given as \( C^L = m \cdot k \). The superscripts \( L \) denote variables under the licensing and \( m \) is marginal monitoring cost. So the MNE’s net royalty revenue in each period is

\[ \pi^t = rk^{1/2} - C^L. \quad (10) \]
where $i=1,2$.\textsuperscript{11}

If the licensing contract is the third operational choice next to the FDI choices, i.e., the subsidiary and the joint venture, the MNE will maximize the total sum of the profit from FDI (4) and the licensing revenues. Let $\Pi_{ML}$ be the MNE’s total profit including the licensing, then

$$
\Pi_{ML} = \Pi_M + \Pi_L = [\pi_1 + \pi_2 + \pi_2^T] + 2[\tau r^{1/2} - C].
$$

(11)

Now that the MNE has three operational choices for the foreign market expansion, but the choice for the prospective joint venture partner is unchanged as (5). In this regime, the objective function of the MNE and the prospective foreign investor becomes

$$
V_L = \Pi_{ML} + \Pi_P.
$$

(12)

Given the host government’s policy, the MNE maximizes $V_L$ in terms of $k$ and $\tau$. I assume that $R=R_1=R_2=R_2'$ and $c=c'=m$ for simplicity. Then the MNE’s two first-order conditions are

$$
V_L = (ct - s')\theta + 2\left(\tau r^{1/2} - cr\right) + \frac{R}{2k^{1/2}} + \frac{R}{2(k + k')}^{1/2} = 0
$$

(13-1)

$$
V_L = \frac{r k}{2\tau^{1/2} - c k}\sigma = 0
$$

(13-2)

where the subscripts with $V_L$ denote their derivatives.\textsuperscript{12}

The foreign partner as well maximizes $V_L$ in terms of $k'$ and its first-order condition is

$$
V_L = \frac{R}{2(k + k')}^{1/2} - c.
$$

(14)

Solving (13) and (14) for $k$, $k'$, and $\tau$ yield

$$
k_L = \left(\frac{2cR}{Y}\right)^2
$$

(15-1)

---

\textsuperscript{11} This type of alliance is different from consignment sales, which can be a special case of exports when handling charges paid for a local partner/distributor is considered as an additional trade cost.

\textsuperscript{12} From (13), we have $V_{kL} = -\frac{R}{2k^{3/2}} - \frac{R}{4(k + k')^{1/2}} < 0$, $V_{k} = -\frac{rk}{2\tau^{3/2}} < 0$, $V_{k'} = V_{kL} = V_{kL} = 2\left(\frac{r}{2\tau^{1/2} - c}\right)$, and $\Delta = V_{kL} < 0$, $V_{kL} < 0$, $V_{kL} < 0$, $V_{kL} > 0$ is assumed.
\[
\tau = \frac{-r^2 - 4cX}{4c^2}
\]  
(15-2)

\[
k^* = \left( \frac{R}{2cY} \right)^2 (Y^2 - 16c^4)
\]  
(15-3)

where \(Y = r^2 + 2c^2 + \theta(c't' - s')\) if \(r^2 + 2cX > 0\). With \(t' > 0\), \(Y > 0\) holds but with \(t' < 0\), the signs of \(X\) and \(Y\) are indeterminate. Note that the MNE licenses the technology when \(r^2 + 4cX \leq 0\), that is, \(t' < 0\) and \(X < 0\). Then \(Y < 0\).

**Proposition 2.** When the licensing contract is the third choice for the MNE, the MNE signs the contract if and only if the host government gives it the FDI subsidy, \(t' < 0\). In this regime, the optimal level of R&D transfer rate is

\[
\tau = \frac{-r^2 - 4cX}{4c^2} \geq 0.
\]

With \(Y < 0\), we have

\[
\frac{\partial k}{\partial s} = 16c^3 R^2 \frac{\theta}{Y^3} < 0, \quad \frac{\partial k}{\partial t'} = -16c^4 R^2 \frac{\theta}{Y^3} > 0 \quad \text{and} \quad \frac{\partial k}{\partial \theta} = -16c^3 R^2 (t' \theta - s') \frac{\theta}{Y^3} < 0,
\]

and \(\frac{\partial k}{\partial R} = \frac{8c^2 R}{Y^2} > 0\). The marginal change in the parameters affect on the transfer rate as

\[
\frac{\partial \tau}{\partial s} = \frac{\theta}{c} > 0, \quad \frac{\partial \tau}{\partial t'} = -\theta < 0 \quad \text{and} \quad \frac{\partial \tau}{\partial \theta} = -\frac{c't' - s'}{c} > 0.
\]

The higher technology will be transferred if the host government subsidizes FDI and the more the host government promotes FDI, the more the MNE may increase the transfer rate. But, the stronger IPR policy may reduce the transfer rate. Moreover, from (15-1) and (15-2) with \(\tau > 0\), the actual transferred technology to the licensee is

\[
k = k^* \frac{r^2 - 2cX}{Y^2}. \quad (16)
\]

Then with \(Y < 0\),

\[
\frac{\partial k}{\partial s} = -\frac{4c^2 R^2 (r^2 + 6cX)}{Y^3 \sqrt{r^2 - 4cX}} < 0, \quad \frac{\partial k}{\partial t'} = \frac{4c^2 R^2 (r^2 + 6cX)}{Y^3 \sqrt{r^2 - 4cX}} > 0, \quad \frac{\partial k}{\partial \theta} = \frac{4c^2 R^2 (ct' - s') (r^2 + 6cX)}{Y^3 \sqrt{r^2 - 4cX}} < 0,
\]

and

\[
\frac{\partial k}{\partial r} = \frac{2cR^2 (3r^2 + 14cX)}{Y^3 \sqrt{r^2 - 4cX}} > 0, \quad \frac{\partial k}{\partial \theta} = \frac{4cR \sqrt{r^2 - 4cX}}{Y^2} \geq 0. \quad (13)
\]

When the host government imposes stronger IPR policy, the MNE increases R&D investment so that FDI decreases. However, the introduction of additional promotive capital-inflow policy reduces the FDI cost. The MNE intending to avoid spillover cost associating with the increase in the R&D investment takes advantage of relatively cheap FDI by investing more in FDI, which in turn reduces R&D investment. On the other hand, the marginal increase in MNE’s share rate increases FDI cost, which in turn reduces MNE’s R&D investment. The increase in the per unit royalty fee and the market’s sales revenue may increase \(k\).

---

13 As \((r^2 - 4cX) \geq 0\), so \((r^2 + 4cX) < 0\). On the other hand, since \(2cX < 0\), we have \((r^2 + 6cX) < 0\) and \((3r^2 + 14cX) < 0\).
3.4 Comparisons

I compare the MNE’s R&D levels in the equilibrium. First compare the MNE’s optimal R&D levels under the choices between subsidiary and joint venture without the licensing. Subtracting (8) from (7-1), we have

\[ k_{JV} - k_S = \frac{2R^2(s'(2 - 3\theta) + c(3 - t'(2 - 3\theta)))(-s'(2 + 3\theta) + c(3 + t'(2 + 3\theta)))}{4(s' - ct')X^2} \]

and this sign is indeterminate. Under restrictive foreign-capital-inflow policy and the spillover is negligible, \( s' \to 0 \), the optimal R&D levels is higher in the joint venture option than in the subsidiary,

\[ k_{JV} - k_S > 0 \text{ if } t' > 0. \quad (17) \]

Since \( \frac{\partial k_{JV}}{\partial \theta} < 0 \), the increase in the holding share of the joint venture costs more for the FDI. So the investment money left for the R&D investment is reduced for the MNE.

Next compare the levels in the regimes of the joint venture without and with the licensing. Subtracting (7-1) from (16), we have

\[ \tilde{k} - k_{JV} = \frac{r^2R^2(r^2 + 4cX)}{X^2Y^2} \leq 0. \quad (18) \]

As the host government subsidizes foreign capital inflow, the MNE invests relatively more in FDI than in R&D, that is, the R&D activity is required to achieve the higher productivity. But, when the MNE licenses its technology, the MNE incurs monitoring cost in addition to the spillover cost paid for the joint venture. These costs negatively affect on the R&D productivity, so that the MNE invests less R&D in the regime of the joint venture and the licensing than in that without the licensing.

Lemma 5. If the host government introduces restrictive capital inflow policy and the technology spillover is negligible, the optimal R&D level is higher in the joint venture option than in the subsidiary option. However, the combination of the joint venture and the licensing may yield the lower R&D level than that without the licensing.

4. Conclusions

A firm is basically constrained to the budget so as the MNE’s investment portfolio is affected by
the arrangement among inward and outward investments. When the MNE can introduce other expansion tools without investing directly to the host country, it is able to save the investment money for enhancing its technological competitiveness. It is the alliance such as licensing contract that may help the MNE to save the entry cost for FDI and to earn short-term profit. I therefore introduce the licensing as the possible tool next to FDI for the constrained MNE when it must decide investment portfolio and foreign operational choice, simultaneously. In the model, I show that the slipover cost and the host government’s policies for FDI and R&D play the important role for the determination of MNE’s operational choice. It is also shown that the small change in the host government’s R&D and FDI policies give the opposite effect on the equilibrium R&D level of the MNE.

Since I focus on the internal decision making process of a MNE, firms’ interactive and strategic behavior are not dealt with. For the endogenous determination of the choice between investment portfolio and operational choice, it is necessarily to reflect the market risk and the firms’ risk preference explicitly.
References


Fig. 1 Investment portfolio and operational choices of the MNE:
The flow of the investment money and the R&D output.
### Operational choices vs. Profit from the foreign market

<table>
<thead>
<tr>
<th>Operational choices</th>
<th>Profit from the foreign market</th>
</tr>
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<tr>
<td>FDI subsidiary</td>
<td>the second period (100% profit of a foreign affiliate’s profit)</td>
</tr>
<tr>
<td>joint venture</td>
<td>the second period (100% profit of a foreign affiliate’s profit)</td>
</tr>
<tr>
<td>Alliance licensing</td>
<td>the first and the second period (royalty revenue)</td>
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Table.1 MNE’s profits in the foreign country.