

# Multinationals' mode of entry with presence of vertical spillovers

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## Abstract

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Multinationals' mode of foreign expansion may depend on whether or not they expect technological externalities or spillovers to generate new competition. Existing models where ex-post spillovers affect the ex-ante entry choice usually study the choice between exporting and FDI with horizontal spillovers. I consider a monopoly firm with a vertical production structure that has four possible modes of entry, one of which includes outsourcing of intermediate input production to a host country firm. Technological spillovers in this model are vertical, generating threat of entry of a new intermediate input producer. When outsourcing contracts are incomplete, vertical spillovers that generate threat of entry upstream do not necessarily benefit the multinational in the downstream market.

*Keywords:* Multinational firms, Vertical spillovers, Outsourcing, Incomplete contracts, Mode of entry

*JEL classification:* F12, F23, L12, L14

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## 1. Introduction

Multinationals' mode of entry into a new market may depend on whether or not they expect technological externalities or spillovers to generate new competition. Existing models where mode of entry is affected by spillovers, all consider horizontal spillovers. Typically, when the multinational expects that spillovers may generate new competition in its product market after establishing a subsidiary, it may choose to enter the new market with exports rather than with foreign direct investment (FDI).<sup>1</sup> I investigate the effect of vertical spillovers on a multinational's mode of foreign expansion. With vertical spillovers I mean spillovers of interme-

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intermediate input technology. The effect such spillovers have in this paper is to generate threat of entry in the intermediate input market.

Despite the documented increase in vertical fragmentation of production (e.g. Hummels, Ishii and Yi 2001), theoretical work on vertical technology transfer and vertical spillovers hardly exists. One exception is Pack and Saggi (2001), who discuss vertical technology transfer through outsourcing of intermediate input production. They take the outsourcing decision as given and focus on how vertical spillovers that generate threat of entry affect profits, while I compare profits from outsourcing with other modes of entry in order to illustrate how vertical spillovers affect a multinational's mode of foreign expansion.

There is a large empirical literature looking for horizontal spillovers from FDI in the form of productivity effects in local firms. In a recent survey of this literature, Görg and Greenaway (2001) conclude that there is no strong evidence for positive horizontal spillovers from foreign firms to host country firms.<sup>2</sup> Smarzynska (2002) argues that since multinationals have incentives to limit spillovers of their final good technology, horizontal spillovers should not be expected, but since multinationals may benefit from more productive local suppliers, vertical knowledge spillovers to suppliers may be more likely than horizontal spillovers (see also Moran 2001). Recent empirical studies looking for vertical spillovers through backward linkages, tend to find evidence in support of such spillovers (see Blalock and Gertler 2003, Jabbour and Mucchielli 2003 and Smarzynska 2002).

In order to study the effect of vertical spillovers on multinationals' mode of entry choice, I construct a model where a multinational considers entering a new market where it has monopoly power for its final good. The multinational controls the technology for producing both the final good and an intermediate input. It

produces both the input and the final good in its home plant. Given this vertical production structure, I consider four different modes of entry: 1) exporting, 2) subsidiary production of the final good with intermediate inputs imported to the subsidiary from the home plant (I call this mode of entry vertical FDI), 3) subsidiary production of both the final good and the intermediate in the subsidiary (horizontal FDI), and 4) subsidiary production of the final good and outsourcing of the input to a local supplier (outsourcing).

Both under horizontal FDI and outsourcing, the MNE must decide on how much resources to use in order to transfer intermediate input technology. The more resources used for technology transfer, the lower the unit costs of input production, and the lower the costs of the firm that benefits from spillovers.

Following Pack and Saggi (2001), I assume that technology transferred to an outsourcing partner can spill over to another local firm in the host country and generate threat of entry of a new input supplier. While Pack and Saggi assume the final good producer and the intermediate input producer to interact in a bilateral monopoly, I assume that outsourcing is governed by incomplete contracts. Ottaviano and Turrini (2002) also discuss mode of entry choice with incomplete outsourcing contracts as one possible mode of entry. The main difference to Ottaviano and Turrini's model is that I introduce the possibility of vertical spillovers under outsourcing.

The incomplete contracting framework is based on recent work on outsourcing versus internal production by Grossman and Helpman (2002). The basic justification for incomplete outsourcing contracts is that the quality of intermediate inputs, though observable by the parties to the contract, cannot be verified by a third party. Nonverifiable quality implies noncontractible quality, which again

implies that an ex-ante contract which only specifies a price and a quantity of the input is impossible. The multinational will not sign a contract which only specifies a price and a quantity of the input, since the supplier would have incentives to shirk on quality to cut costs. The result of contractual incompleteness is that the multinational and the supplier have to resort to bargaining after the inputs are produced. With no alternative buyer of the inputs, the supplier has a weak bargaining position because it faces potential hold-up from the final good producer. The result is that the supplier has insufficient incentives to produce the optimal quantity of inputs. The technology transfer decision is also negatively affected by the incomplete contracting environment. But whereas the supplier has no alternative buyer for its inputs and thus has no outside option in the negotiations, the multinational can import inputs to its subsidiary from the home plant.

If the knowledge of how to produce the intermediate input spreads to another local firm, the multinational can get inputs from the new supplier. This threat of upstream entry has different effects in an outsourcing relationship governed by bilateral monopoly as in Pack and Saggi (2001) and in the incomplete contracting framework considered here. In the Pack and Saggi model, the incumbent supplier reacts to threat of entry by reducing its price to keep the potential entrant out of the market. The result is of course beneficial for the multinational, while it hurts the supplier. With incomplete outsourcing contracts threat of upstream entry has the effect of improving the outside option of the multinational. Though its profits from outsourcing increase with the possibility of new suppliers, outsourcing will in some cases not be a possible mode of entry for the multinational if local suppliers are unwilling to enter an outsourcing relationship when they expect vertical spillovers.

The setting of the model is described in section 2, profits from the different entry modes are presented in section 3. Section 4 contains the mode of entry discussion, while section 5 concludes.

## 2. The model

A multinational firm considers entering a new market  $M$  with its final product. Market demand is given by

$$y = A/p^2, \tag{1}$$

where  $A$  is a measure of market size. Production of the final product requires one unit of intermediate input per unit of final output, otherwise the assembly process is costless. The input needed is specific for the final good and the firm controls blueprints or patents for both stages of production. Our firm can choose four different modes of entry: exports, horizontal or vertical FDI, or outsourcing.

The firm can export the final product from its home plant to the new market. Exports are subject to (iceberg) trade costs: when exporting  $y$  units of the final good, only  $\tau_E y$  units arrive to be sold in  $M$ ,  $\tau_E \in (0, 1)$ . When  $\tau_E$  is close to one, trade costs are very low, while as  $\tau_E$  approaches zero, trade costs become prohibitive. The marginal and unit cost of producing the intermediate in the home plant is 1.

Under the remaining modes of entry considered here, the MNE establishes a subsidiary in  $M$  for assembly of the final product. Establishing the assembly plant requires the firm to invest a fixed cost  $I$ . The three remaining modes of entry differ with respect to how the new assembly plant gets inputs.

First, if the MNE chooses to import inputs from its home plant to the new subsidiary, the mode of entry is called vertical FDI (V). Input trade is also subject to trade costs,  $\tau_V \in (0, 1)$ , which may differ from final good trade costs under mode E. If trade costs for final goods are lower than for inputs, exporting will dominate vertical FDI for all market sizes. When input trade costs are low, the MNE will choose vertical FDI if the market is big enough to sustain the fixed costs of establishing the assembly plant.

The two other ways of getting inputs are either by internal production in the new plant (horizontal FDI (H)) or by outsourcing (O) to a local firm in M. Both ways require technology transfer from the home base of the MNE. The unit costs of producing inputs will be lower, while the costs of transfer are higher the better technology the MNE transfers to its own subsidiary or to an outsourcing partner. The best technology the MNE can transfer is the same technology as it has in its home plant. I set this level of transfer to 1 ( $T_i = 1$ ,  $i = \text{H, O}$ ) and call this full technology transfer. When  $T_i < 1$  there is less than full technology transfer. The MNE has a cost of  $T_i^2$  to transfer  $T_i$ , and the resulting unit cost for the input producer would be  $1/T_i$ .

The trade-off between outsourcing and horizontal FDI involves comparing two different inefficiencies. Given the assumption of nonverifiable input quality, the two firms have to bargain over how to share the surplus that could be generated by exchange of the inputs after the inputs are produced. The supplier faces a risk of being held up once the inputs are produced, and this reduces the incentives for input production given the technology it has received from the multinational. The multinational anticipates suboptimal input production, which reduces its incentives for technology transfer.

While outsourcing generates a hold-up problem, I assume that internal production of both input and final good in a foreign country requires some extra monitoring and governance that increase the unit costs of inputs produced internally. If, for a given level of technology transfer  $T$ , the outsourcing partner has unit cost  $1/T$ , the subsidiary of the MNE has unit cost  $1/(T\tau_H)$ , where  $\tau_H \in [0, 1]$  represents the cost disadvantage of conducting integrated production in a foreign country. The unit cost of producing the input in the subsidiary is larger than in the home plant if  $\tau_H < 1$ . Without a cost disadvantage of internal production ( $\tau_H = 1$ ), the MNE would never consider outsourcing under incomplete contracts.

To illustrate the effect of incomplete outsourcing contracts, I also include outsourcing with complete contracts. The MNE's mode of entry choice is clearly affected by whether outsourcing contracts are complete or incomplete.

Under outsourcing, the technology for input production may spread to other firms in M and may enable a new supplier to produce the inputs needed by the MNE. For simplicity, I assume that spillovers are perfect, a potential new supplier will have the same unit costs as the incumbent supplier that received technology transfer from the MNE. I assume that technological spillovers are only possible in the case of outsourcing, and not when the MNE produces the inputs within the subsidiary.<sup>3</sup> One argument in support of this could be that the local firm is likely to be more embedded in the local economy than the entering multinational, and existing demand and supply links between the local firm and other firms are likely channels for spillovers. Once a local firm has received technology transfer it should have incentives to protect its technology from potential competitors. The assumptions I have made imply that host country firms are less able to protect their technology than foreign firms located in the same market. (Could host countries be

under more pressure to protect the intellectual property of entering multinationals than that of their own firms?) Even if the multinational might want vertical spillovers from its own plant, it might still want to limit such spillovers if vertical and horizontal spillovers cannot be separated when both production processes are done in the same plant.

Appendix A illustrates the sequence of decisions under the different modes of entry.

### 3. Profits under different modes of entry

#### 3.1. Exports of final goods

The MNE decides how much of the final product to sell in M, taking account of the fact that an amount  $y$  shipped from its home plant only serves the demand  $\tau_E y$  in M. The profit maximization problem is

$$\max_y \Pi_E = p\tau_E y - y,$$

where market demand is given by equation (1). The result is that the MNE produces and ships

$$y = \frac{1}{4}A\tau_E,$$

and gets total profits (equal to operating profits)

$$\Pi_E = \frac{1}{4}A\tau_E. \tag{2}$$

#### 3.2. Vertical FDI

After investing the fixed cost  $I$  to establish an assembly plant, the MNE decides the amount of inputs to ship to its new plant. Due to transport costs, shipping



$x$  units of input will only serve  $\tau_V x$  units of final demand. The MNE maximizes operating profits of the new assembly plant

$$\max_x \pi_V = p\tau_V x - x.$$

This is the same decision problem as under the export mode, so operating profits are

$$\pi_V = \frac{1}{4}A\tau_V, \quad (3)$$

and total profits are

$$\Pi_V = \pi_V - I. \quad (4)$$

When transport costs for inputs are larger than for final goods ( $\tau_V < \tau_E$ ), exports of the final good will always dominate vertical FDI; if there are no transport costs to save by shipping inputs rather than final goods, it does not pay to invest in an assembly plant in the new market.

### 3.3. *Horizontal FDI*

With horizontal FDI the MNE establishes both input production and final good production in the new market. After sinking the fixed cost  $I$  to establish the assembly plant, the MNE must decide on the level of technology transfer for input production. Given the level of technology, the MNE makes its production decision. The maximization problem is solved by backwards induction. First, for a given technology level  $T_H$ , maximize profits with respect to quantity produced.

$$\text{Max}_x \Pi_H = px - \frac{1}{\tau_H T_H} x - T_H^2.$$

The resulting quantity depends on the technology level and the cost disadvantage of internal production

$$x = \frac{1}{4}AT_H^2\tau_H^2.$$

Second, find the optimal level of technology transfer by solving

$$\underset{T_H}{Max} \Pi_H = \sqrt{Ax} - \frac{1}{T_H\tau_H}x - T_H^2.$$

$\sqrt{Ax}$  is the total sales revenue  $px$  with the inverse of the demand function in (1) substituted for  $p$ . The resulting level of technology transfer is

$$T_H = \begin{cases} \frac{1}{8}A\tau_H & \text{if } A < \frac{8}{\tau_H} \\ 1 & \text{if } A \geq \frac{8}{\tau_H}. \end{cases} \quad (5)$$

From (5) we see that full technology transfer under horizontal FDI requires a relatively large market and a small cost disadvantage of internal production (large  $\tau_H$ ).

Total profits are

$$\Pi_H = \begin{cases} \frac{1}{64}A^2\tau_H^2 - I & \text{if } A < \frac{8}{\tau_H} \\ \frac{1}{4}A\tau_H - 1 - I & \text{if } A \geq \frac{8}{\tau_H}, \end{cases} \quad (6)$$

where the first line in (6) is the profit level with less than full technology transfer, and the second line profits with full technology transfer.

#### 3.4. Outsourcing with incomplete contracts

After establishing the assembly plant, the MNE transfers input technology to a local supplier, and conducts only the assembly of the final good in its subsidiary. With incomplete contracts the two firms bargain over how to share the surplus from exchange of the inputs after technology transfer and input production have

taken place. The surplus they can share is the revenue generated from sale of the final good. Given the market demand in (1), surplus is

$$S = \sqrt{Ax}. \quad (7)$$

Let the generalized Nash bargaining solution determine the outcome of the negotiation:

$$\underset{S^S}{Max} N = [S^S - F^S]^\beta [S - S^S - F^{MNE}]^{(1-\beta)},$$

where  $S^S$  is the share going to the supplier, while the MNE gets the residual  $S^{MNE} = S - S^S$ .  $\beta \in (0, 1)$  is the bargaining power of the supplier. If the two firms are unable to agree, they walk away with whatever is their outside option. The outside options or fallback positions are  $F^S$  and  $F^{MNE}$ . The general solution to the bargaining problem is

$$S^S = \beta(S - F^{MNE}) + (1 - \beta)F^S \quad (8)$$

$$S^{MNE} = (1 - \beta)S + \beta F^{MNE} - (1 - \beta)F^S. \quad (9)$$

Anticipating the bargaining outcome, the supplier decides how much to produce given the technology transfer it has received from the MNE

$$\underset{x}{Max} \Pi^S = \beta(S(x) - F^{MNE}) + (1 - \beta)F^S(x) - \frac{1}{T_O}x$$

Since the fallback of the MNE will depend on whether it can get inputs from somewhere else,  $F^{MNE}$  is independent of the supplier's decision. The supplier's own fallback will depend on how much inputs it has produced, since the fallback will depend on whether or not it can sell the inputs to someone else. So in general, the first order condition for the supplier is

$$\beta \frac{\partial S}{\partial x} + (1 - \beta) \frac{\partial F^S}{\partial x} = \frac{1}{T_O}. \quad (10)$$

It states the familiar result that marginal income be equated to marginal costs. Marginal income in (10) comes from two sources. By producing more inputs the supplier increases its income through the first term because surplus increases, while the second term comes from an improvement in its own fallback that increases the share of the surplus going to the supplier.

Moving backwards to the first stage in the sequence of decisions, the decision problem of the MNE is how much technology to transfer to its outsourcing partner, given what it expects the supplier to produce and how they will share the resulting surplus.

$$Max_{T_O} \Pi_O^{MNE} = (1 - \beta)S(T_O) + \beta F^{MNE}(T_O) - (1 - \beta)F^S(T_O) - T_O^2$$

In general, both fallback positions depend on the MNE's choice of investment. So the general first order condition for the MNE is

$$(1 - \beta) \frac{\partial S}{\partial T_O} + \beta \frac{\partial F^{MNE}}{\partial T_O} = 2T_O + (1 - \beta) \frac{\partial F^S}{\partial T_O} \quad (11)$$

On the left hand side of (11), the marginal benefits of increased technology transfer come from its contribution to both the surplus and the fallback of the MNE. The marginal costs on the right hand side of (11) consist of the direct cost of technology transfer and an indirect cost through the possible effect better technology in input production has on the fallback of the supplier.

Now consider more closely the fallbacks of our two firms. The fallback of the supplier will depend on whether an alternative buyer for the inputs exists. With no alternative final good producer that can make use of the specific input, the supplier's fallback is zero. The MNE can get the input from its home plant if negotiations with the supplier break down, so the fallback is the profit from vertical FDI in (3).

The main role played by the possibility of technological spillovers in this model is that spillovers generate threat of entry by new firms. A potential new supplier will change the MNE's fallback in its negotiations with the incumbent supplier. From the general first order conditions of the supplier and the MNE in (10) and (11) it is clear that the fallback positions will influence the decisions of the two firms and the resulting profits each firm can get with an incomplete outsourcing contract.

I discuss outsourcing without spillovers as case A, while outsourcing with spillovers is denoted case B. The variables that differ between the two cases have subscripts A and B.

#### 3.4.1. Case A: No technology spillovers

If the two firms are unable to reach an agreement on how to split the surplus, the supplier has no alternative buyer of the produced input and its fallback is zero

$$F^S = 0. \quad (12)$$

The MNE can get inputs from its home plant if no agreement is reached with the outsourcing partner. This alternative way of getting inputs to its assembly plant determines the fallback as equal to operating profits from vertical FDI in (3)

$$F_A^{MNE} = \pi_V. \quad (13)$$

The first order conditions, (10) and (11), from the profit maximization problem of the two firms are now

$$\beta \frac{dS}{dx} = \frac{1}{T_{O_A}} \quad (14)$$

$$(1 - \beta) \frac{\partial S}{\partial T_{O_A}} = 2T_{O_A}. \quad (15)$$

Insert surplus from equation (7) into (14) to get the production of inputs

$$x_A = \frac{1}{4}A\beta^2T_{O_A}^2. \quad (16)$$

The MNE expects this output level and the optimal level of technology transfer that follows from (15) is

$$T_{O_A} = \begin{cases} \frac{1}{4}(1-\beta)A\beta & \text{if } A < \frac{4}{(1-\beta)\beta} \\ 1 & \text{if } A \geq \frac{4}{(1-\beta)\beta}. \end{cases} \quad (17)$$

(17) states that when the market is relatively small or the bargaining power of the supplier is either very small or very large, there will be less than full technology transfer. With small  $\beta$  the supplier has little incentives to produce inputs, and this makes the MNE reluctant to incur high costs of technology transfer. With large bargaining power, even if the supplier produces more inputs, the MNE is still reluctant to transfer technology because it gets a very small share of the surplus generated.

To find the profit levels of the two firms insert the optimal quantity (16) into the surplus expression (7), and use this together with the fallbacks (12) and (13) in (8) and (9) to find the shares of the surplus going to each firm. The resulting profit levels are then

$$\Pi_{O_A}^{MNE} = \begin{cases} T_{O_A}^2 + \beta\pi_V - I & \text{if } T_{O_A} < 1 \\ (1-\beta)\frac{1}{2}A\beta - 1 + \beta\pi_V - I & \text{if } T_{O_A} = 1 \end{cases} \quad (18)$$

$$\Pi_A^S = \begin{cases} \frac{1}{4}A\beta^2T_{O_A} - \beta\pi_V & \text{if } T_{O_A} < 1 \\ \frac{1}{4}A\beta^2 - \beta\pi_V & \text{if } T_{O_A} = 1. \end{cases} \quad (19)$$

3.4.2. *Case B: Spillovers generate threat of entry*

Technological spillovers now make it possible for a new supplier to produce the inputs required by the MNE. When bargaining with the incumbent supplier the MNE will be better off. The reason is that the MNE can turn to the new supplier if negotiations with the incumbent break down. If spillovers are not perfect, the new supplier has somewhat higher costs than the incumbent ( $\gamma/T_O > 1/T_O$ ), but in the following I assume perfect spillovers. The incumbent supplier has still no alternative buyer for its inputs, so fallback is unchanged from case A.

The fallback of the MNE in its negotiations with the incumbent supplier is now defined as the share of the surplus it can get when bargaining with the new supplier. In the potential second round bargaining with the new supplier, fallbacks are the same as in case A; zero for the new supplier and profits from vertical FDI for the MNE. Since the second round bargaining has the same structure as in case A, the new supplier faces the same trade-off as the incumbent supplier did in case A. I assume the potential new supplier has the same bargaining power as the incumbent supplier. The resulting share for the MNE will be the same as in case A and is given by (9). This share now defines the fallback for the MNE in the bargaining with the incumbent supplier

$$F_B^{MNE} = (1 - \beta) \frac{1}{2} A \beta T_{O_B} + \beta \pi_V. \quad (20)$$

For (20) to be the relevant fallback for the MNE, it must be the case that it is better than the fallback without threat of entry of a new supplier (13). This implies  $\beta T_{O_B} > \frac{1}{2} \tau_V$ .

The incumbent supplier faces the same tradeoff as without threat of entry of a new supplier, and will produce the same as without spillovers for a given level

of technology transfer

$$x_B = \frac{1}{4}A\beta^2 T_{O_B}^2. \quad (21)$$

Since the technology transfer decision affects marginal costs of both the incumbent and the new supplier, the MNE faces a new tradeoff when making its technology transfer decision. The MNE decides on how much technology to transfer given what it knows the outsourcing supplier will produce and what a new supplier will produce if the incumbents cannot agree. The first order condition in equation (11) is now

$$(1 - \beta) \frac{\partial S}{\partial T_{O_B}} + \beta \frac{\partial F_B^{MNE}}{\partial T_{O_B}} = 2T_{O_B} \quad (22)$$

Use equations (7), (20) and (21) in the first order condition to solve for the optimal level of technology transfer

$$T_{O_B} = \begin{cases} \frac{1}{4}A\beta(1 - \beta^2) & \text{if } A < \frac{4}{\beta(1 - \beta^2)} \\ 1 & \text{if } A \geq \frac{4}{\beta(1 - \beta^2)}. \end{cases} \quad (23)$$

Comparing equations (17) and (23) we see that technology transfer is higher with spillovers than without:  $T_{O_B} = T_{O_A}(1 + \beta)$ . The MNE will give full technology transfer at a smaller market size with spillovers than without. The reason is that transferring better technology to the outsourcing partner also lowers the costs of the firm that benefits from spillovers. Lower costs for the potential entrant improves the MNE's fallback in its negotiations with the incumbent, and gives the MNE a larger share of the surplus.

By the same approach as in case A, the profit levels with spillovers are

$$\Pi_{O_B}^{MNE} = \begin{cases} T_{o_B}^2 + \beta^2 \pi_V - I & \text{if } T_{o_B} < 1 \\ \frac{1}{2}A\beta(1 - \beta)(1 + \beta) + \beta^2 \pi_V - 1 - I & \text{if } T_{o_B} = 1 \end{cases} \quad (24)$$



$$\Pi_B^S = \begin{cases} \frac{1}{4}\beta^2 AT_{O_B}(2\beta - 1) - \beta^2\pi_V & \text{if } T_{O_B} < 1 \\ \frac{1}{4}\beta^2 A(2\beta - 1) - \beta^2\pi_V & \text{if } T_{O_B} = 1. \end{cases} \quad (25)$$

### 3.5. Outsourcing with complete contracts

In order to illustrate the effect of the contracting environment on the profits from outsourcing, assume that the two firms are able to sign an efficient outsourcing contract. Our interpretation of complete contracts here is that before technology transfer, the two firms bargain over how to share the surplus net of technology transfer and input production costs. Thereafter technology transfer and input production take place. We use the same general Nash-bargaining solution as with incomplete contracts and no spillovers. So the MNE has a positive fallback equal to  $\pi_V$  in equation (3). With complete and binding contracts the possibility of spillovers will not affect the bargaining result or the decisions of the two firms. The supplier's problem is  $\max \Pi^S(x) = \beta \left( \sqrt{Ax} - \frac{1}{T}x - T^2 - \pi_V \right)$ , which results in the following input production  $x = \frac{1}{4}AT^2$ . The share for MNE is  $(1 - \beta) \left( \sqrt{Ax} - \frac{1}{T}x - T^2 \right) + \beta\pi_V$  which leads to  $T = \frac{A}{8}$ , which means there will be full technology transfer when  $A > 8$ . Compared to the level of technology transfer under incomplete contracts in both (17) and (23), it is clear that with complete contracts it takes a smaller market to give incentives to full technology transfer than under incomplete contracts. The hold-up problem that affects both the MNE's technology transfer decision and the supplier's production decision is eliminated with complete contracts. The resulting profit functions are

$$\Pi^{MNE} = \begin{cases} (1 - \beta) \left( \frac{A^2}{64} \right) + \beta\pi_V - I & \text{if } A < 8 \\ (1 - \beta) \left( \frac{1}{4}A - 1 \right) + \beta\pi_V - I & \text{if } A > 8 \end{cases} \quad (26)$$

$$\Pi^{Supp} = \begin{cases} \beta \left( \frac{A^2}{64} - \pi_V \right) & \text{if } A < 8 \\ \beta \left( \frac{1}{4}A - 1 - \pi_V \right) & \text{if } A > 8 \end{cases} \quad (27)$$

#### 4. Mode of entry choice

The MNE chooses how to serve the new market by comparing profit levels from different modes of entry. The mode of entry choice is affected by the value of the following parameters: market size ( $A$ ), the costs of investment ( $I$ ), costs of transporting final goods and inputs ( $\tau_E$  and  $\tau_V$ ), the cost disadvantage of internal production ( $\tau_H$ ), and the bargaining power of the supplier ( $\beta$ ). In the following I will show how mode of entry varies with market size and costs of trading inputs ( $\tau_V$ ), with given values of the other parameters.

To find the preferred mode of entry, I calculate isoprofit curves for each mode of entry pair. Four possible modes of entry give rise to six different isoprofit curves. With outsourcing it is not enough to consider how the profits of the MNE compare to the other modes of entry. It is also important to check whether the supplier would want to produce inputs for the MNE under the conditions dictated by the outsourcing contract. We assume that the supplier declines an outsourcing contract unless it expects non-negative profits from producing inputs. The general expressions for the different isoprofit curves and participation constraints are derived in appendix B.

Sections 4.1-4.4 illustrate how the isoprofit-curves combine to determine the MNE's mode of entry choice. The isoprofit curves are drawn in the  $A\tau_V$ -plane for given values of the other parameters. In section 4.1, I start with two general cases while ignoring the possibility of outsourcing. In sections 4.2-4.4, I consider all four modes of entry and show the MNE's mode of entry choice for the three

different outsourcing cases: 4.2) outsourcing with incomplete contracts and no spillovers, 4.3) outsourcing with incomplete contracts and vertical spillovers, and 4.4) outsourcing with complete contracts.

#### 4.1. Mode of entry without outsourcing

The relevant isoprofit curves from appendix B are now the exporting-versus-vertical FDI-curve (EV-curve) in (28), the EH-curve (29), and the HV-curve (30). The first letter in the names of the isoprofit curves corresponds to the mode of entry preferred to the left of the curve (or below the curve in the case of horizontal isoprofit curves).

When comparing profits from exporting in (2) to profits from horizontal FDI in (6), note that if  $\tau_H \leq \tau_E$  exporting will always dominate horizontal FDI. When  $\tau_H \leq \tau_E$ , integrated internal production in the new market is costly relative to exporting to the new market from the home plant. For short, I call this first general case *costly integration*. Under costly integration the isoprofit curves including mode H become irrelevant. When E, V, and H are the possible modes of entry, the only relevant isoprofit curve is the EV-curve in the upper panel of figure 1. Here, and in all later figures, I use the following parameter values in the *costly integration* case:  $\tau_H \leq \tau_E$ ,  $\tau_E = \frac{1}{2}$ ,  $I = 1$ . The EV-curve has the level of trade costs for final goods,  $\tau_E$ , as its vertical asymptote (not drawn in the figure). When  $\tau_V < \tau_E$ , the loss from exporting inputs is larger than from exporting the final good, and vertical FDI would never be better for the MNE than exporting the final good.

By contrast, the second general case is called *efficient integration*. If  $\tau_H > \tau_E$  internal production of inputs in the new market is relatively efficient compared

to exporting. For the *efficient integration* case I only increase the efficiency of internal production and keep the other parameters equal to the costly integration case:  $\tau_H = \frac{3}{4}$ ,  $\tau_E = \frac{1}{2}$ ,  $I = 1$ . The three isoprofit curves are shown in the lower left panel of figure 1. As long as  $\tau_H > \tau_E$  the three curves will intersect as shown in the figure. The point in the  $A\tau_V$ -plane where intersection occurs will of course depend on the parameter values. The HV-curve has  $\tau_H$  as its vertical asymptote. When  $\tau_V > \tau_H$  the inefficiency from internal production is larger than the loss from exporting inputs, and vertical FDI is preferred to horizontal FDI. The lower right panel of figure 1 shows the same isoprofit curves as in the left panel. To focus on the mode of entry choice, I have removed the parts of the curves that become irrelevant when comparing profit levels from all three modes of entry.

#### 4.2. Outsourcing with incomplete contracts and no spillovers

With outsourcing as a possible mode of entry in addition to E, V, and H, all six isoprofit curves must be considered. The new parameter of interest when introducing outsourcing is the bargaining power of the supplier in the outsourcing negotiations with the MNE. For each of the two general cases; *costly integration* and *efficient integration*, I will show the mode of entry choice for two values of bargaining power. As in the right panel of figure 2, I show only the undominated parts of the relevant isoprofit curves.

**Costly integration** Since horizontal FDI is dominated by exporting when integrated production is costly relative to exporting, the relevant isoprofit curves are the combined participation constraint and OV-curve (31), the EV-curve (28), and the EO-curve (32). The upper panel of figure 2 shows the mode of entry choice

for  $\beta = \frac{1}{2}$  and for  $\beta = \frac{2}{3}$ . Since the supplier is better off with larger bargaining power it is willing to accept the outsourcing contract for larger values of input trade costs ( $\tau_V$ ). In addition, the improved incentives for the supplier from larger bargaining power makes it produce more inputs. The MNE gets a smaller share of a larger surplus, but profits increase because the surplus-effect dominates.

**Efficient integration** As the costs of internal production fall, horizontal FDI also becomes a possible choice for the MNE. We must now consider all 6 isoprofit-curves (28, 29, 30, 31, 32, 33). The lower part of figure 2 shows the mode of entry choice for  $\beta = \frac{1}{2}$  and for  $\beta = \frac{2}{3}$ . From the figure we see that outsourcing is not chosen when  $\beta = \frac{1}{2}$ . When internal production of inputs in the new market is relatively efficient ( $\tau_H = \frac{3}{4}$ ), horizontal FDI dominates outsourcing with incomplete contracts. The inefficiency arising from the hold-up problem under outsourcing is worse than that coming from internal cost disadvantages. As the bargaining power of the supplier increases, the hold-up problem is reduced and this also increases the MNE's profits from outsourcing. When  $\beta = \frac{2}{3}$ , outsourcing is chosen for intermediate values of input trade costs. If  $\tau_V$  gets larger than  $\frac{2}{3}$  the fallback of the MNE in the outsourcing negotiations is so large that the supplier expects negative profits and declines the contract. For  $\tau_V$  smaller than  $\frac{11}{24}$ , the fallback for the MNE is so low that it prefers horizontal FDI.

#### 4.3. *Outsourcing with incomplete contracts and vertical spillovers*

**Costly integration** The relevant isoprofit curves shown in the upper part of figure 3 are the EV-curve (28), the combined participation constraint and OV-curve (34), and the EO-curve (35). From the participation constraint it is clear

that with  $\beta = \frac{1}{2}$  it will not be possible for the MNE to outsource production of the input. Even if spillovers increase MNE profits by improving its fallback, this results in such a low share for the supplier that it can't cover its input production costs when  $\beta = \frac{1}{2}$ . The MNE will not be able to outsource at all, unless it can commit itself not to exploiting the fact that there are spillovers. With more than half the bargaining power the supplier may accept an outsourcing contract, but the possible outsourcing area is clearly smaller than when there are no spillovers due to a tighter participation constraint.

**Efficient integration** In addition to the isoprofit curves from the costly integration case, we must also consider the EH-curve (29), the HV-curve (30), and the HO-curve (36). The mode of entry choice is shown in the lower part of figure 5. Note the difference between the outsourcing area when  $\beta = \frac{2}{3}$  under costly and efficient integration. Since profits from horizontal FDI are larger in the lower part of figure 3, the MNE would prefer horizontal FDI to outsourcing if input trade costs are very large (here  $\tau_V < \frac{1}{48}$ ). Large input trade costs give the MNE a small fallback in the outsourcing negotiations and thus lower profits from outsourcing.

#### 4.4. Outsourcing with complete contracts

**Costly integration** Figure 4 shows the preferred modes of entry when outsourcing contracts are complete. The relevant isoprofit curves when integration is costly are the EV-curve (28), the combined participation constraint and OV-curve (37), and the EO-curve (38). There are two important differences to the similar case with incomplete contracts (figures 2 and 3). With complete contracts the outsourcing area is larger than with incomplete contracts, the reason is that eliminating

the hold-up problem increases efficiency and thus profits from outsourcing. The second difference is that with complete contracts, the outsourcing area decreases when the bargaining power of the supplier increases from  $\frac{1}{2}$  to  $\frac{2}{3}$ , while the opposite is the case under incomplete contracts. The reason is that under complete contracts, input production is the same regardless of  $\beta$ , thus the surplus is the same but the MNE gets less of it when the supplier has higher bargaining power. Naturally, the MNE will be less interested in outsourcing. Under incomplete contracts, the surplus increases because the supplier faces better incentives, and this effect dominates the fact that the MNE gets a smaller share of the surplus.

**Efficient integration** In addition to the isoprofit curves from the costly integration case, we must also consider the EH-curve (29), the HV-curve (30), and the HO-curve (39). The mode of entry picture is shown in the lower part of figure 4. Again note the difference to the similar cases with incomplete contracts (figure 2 and 3). With complete contracts outsourcing is possible also when  $\beta = \frac{1}{2}$ , while with incomplete contracts outsourcing is dominated by the other modes of entry. The reason is the same as in the costly integration case: profits from outsourcing with complete contracts are larger than with incomplete contracts because the hold-up problem is eliminated. When  $\beta = \frac{2}{3}$ , the MNE is less interested in outsourcing since it gets a smaller share of the same surplus.

## 5. Conclusion

When multinationals consider how to enter a foreign market, their decision might be affected by how their technology may spill over to other firms under different modes of entry. The mode of entry versus spillover tradeoff has typically

been considered in models of horizontal FDI where competitors (new or existing) of the MNE acquire the knowledge of how to produce the MNE's product. The possibility of such ex-post competition may induce the MNE to export their product, rather than to establish a subsidiary in the foreign market. This paper departs from the horizontal spillover assumption and considers how the MNE's mode of entry choice is affected by vertical spillovers of intermediate input technology.

I have presented a model where the MNE chooses between four different modes of entry. Spillovers occur only under the outsourcing mode where the MNE establishes a subsidiary for assembly of the final good and outsources intermediate input production to a host country firm. Spillovers in this case generate threat of entry of a new supplier for the MNE. Outsourcing contracts are assumed to be incomplete. Since both the supplier and the MNE make relation-specific investments (input production and technology transfer), outsourcing suffers from a double hold-up problem. Threat of entry works as an improvement in the bargaining position of the MNE in the outsourcing negotiations with the incumbent supplier. If knowledge of how to produce the input spreads to another firm, the MNE can threaten the incumbent supplier with getting inputs from the potential entrant, and thus get a larger share of the surplus generated from getting the inputs from the incumbent. Thus, MNE profits from outsourcing are higher with spillovers than without.

Despite the fact that vertical spillovers improve outsourcing profits for the MNE, the MNE will in many cases be unable to reap these benefits because it will have difficulties in finding an outsourcing partner if the local firm expects spillovers to take place. Unless the MNE can commit itself not to exploit an increase in competition upstream, potential outsourcing partners may decline an incomplete



outsourcing contract. It is also the case that MNE profits from outsourcing will be higher when the supplier expects to get two thirds of the surplus than when the two firms share 50-50. The reason is that the effect from improved incentives to produce inputs dominates the fact that the MNE gets a lower share of the surplus.

The results when assuming incomplete outsourcing contracts are compared to a situation where the two firms are able to write complete, binding and efficient outsourcing contracts. In this setting spillovers have no effect, since the MNE by definition is unable to exploit an increase in upstream competition. With complete contracts the outsourcing area is larger than with incomplete contracts, the reason is that eliminating the hold-up problem increases efficiency and thus profits from outsourcing. MNE profits from outsourcing are lower when the supplier gets two thirds of the surplus than when the two firms share 50-50. The reason is that under complete contracts, input production is the same regardless of the sharing rule.

### **Acknowledgments**

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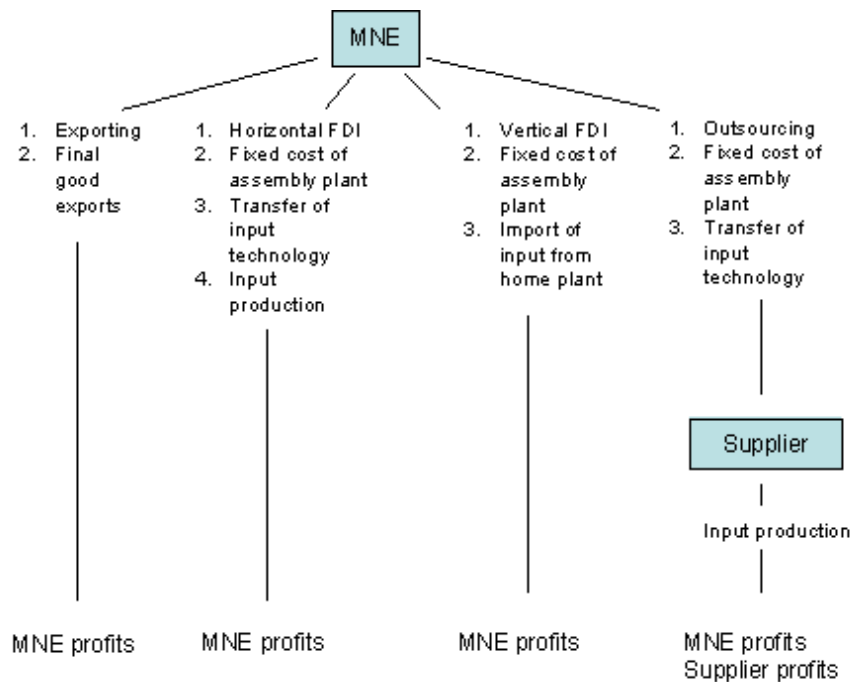
### **Notes**

<sup>1</sup>The export versus FDI tradeoff with horizontal spillovers is modelled in Fosfuri, Motta and Rønde (2001), Glass and Saggi (2002), Markusen (2001), Petit and Sanna-Randaccio (2000) and Siotis (1999). See Markusen (1995) for a discussion

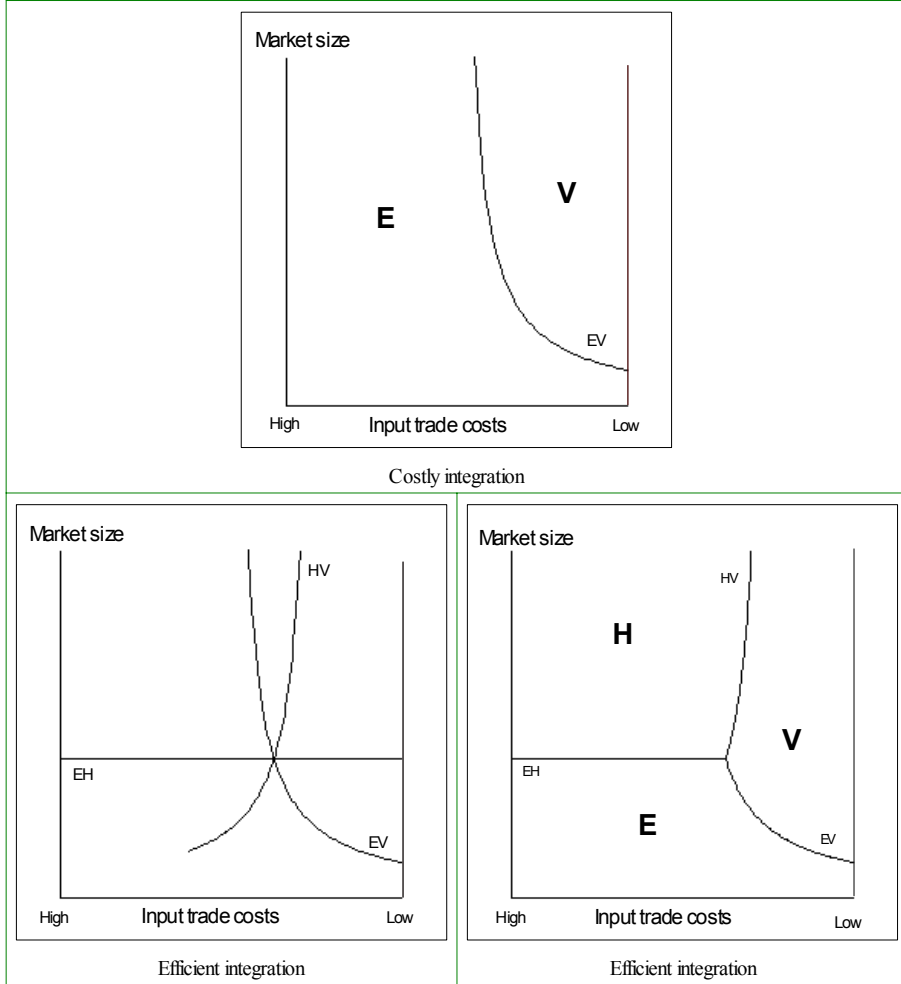
of the licensing versus FDI tradeoff .

<sup>2</sup>The authors suggest that problems with data and methodology are possible reasons for the lack of evidence for positive spillovers. See also Görg and Strobl (2001). For an earlier survey of spillovers from FDI, see Blomström and Kokko (1994).

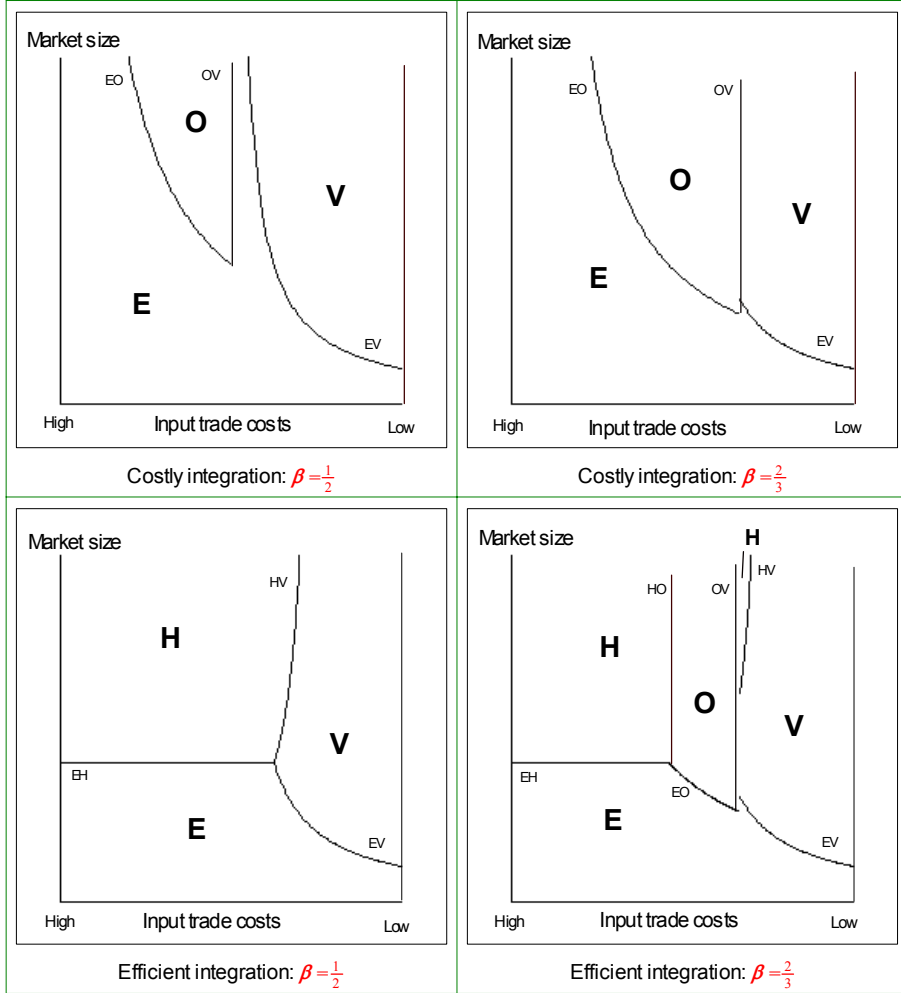
<sup>3</sup>There is little empirical work testing whether mode of entry affects the extent of spillovers to host country firms. Dimelis and Louri (2002) find in a study from Greece that spillovers from minority owned foreign firms are larger than from majority owned firms, while Blomström and Sjöholm (1999) find that the degree of foreign ownership does not affect the extent of spillovers in Indonesia.



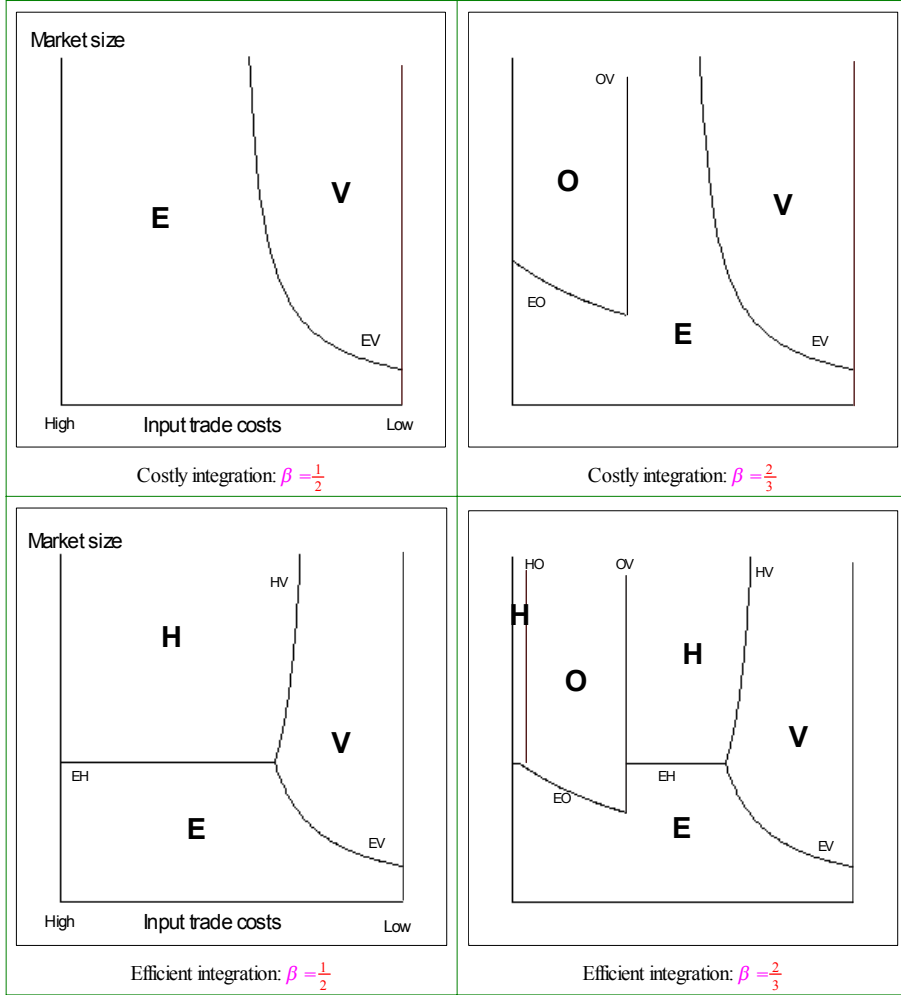
Sequence of decisions under different entry modes.



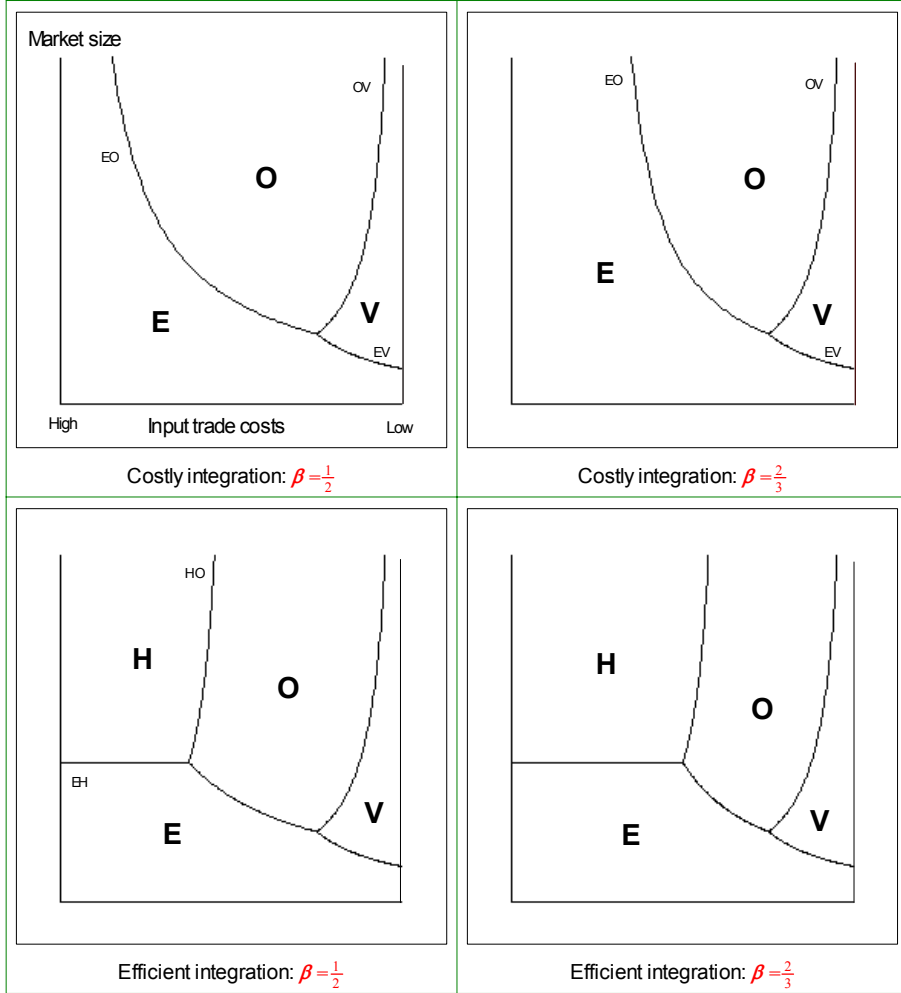
Mode of entry without outsourcing



Mode of entry: Incomplete contracts and spillovers



Mode of entry: Incomplete contracts and spillovers



Mode of entry: Complete contracts

## A Derivation of isoprofit curves

### A1. Exporting versus vertical FDI

Compare profits from exporting to profits from vertical FDI in equations (2) and (4). The isoprofit curve is given by

$$A = \frac{4I}{\tau_V - \tau_E}, \quad (28)$$

where  $\Pi_E > \Pi_V$  to the left of the EV-curve in (28).

### A2. Exporting versus horizontal FDI

When comparing profits from exporting (2) with profits from horizontal FDI (6) we must consider both the case where the market is too small to give full technology transfer under horizontal FDI ( $A < \frac{8}{\tau_H}$ ) and the full technology transfer case. As noted before, if  $\tau_H < \tau_E$  exporting is always preferred to horizontal FDI. I assume that the cost of full technology transfer for input production is smaller than the fixed cost of investment in the assembly plant. As I have normalized the cost of full technology transfer to 1, the resulting restriction on  $I$  is  $I \geq 1$ . When  $\tau_H > \tau_E$ , the assumption that  $I \geq 1$  ensures that exporting dominates horizontal FDI when  $A < \frac{8}{\tau_H}$ . We are left with the following isoprofit curve when  $\tau_H > \tau_E$  and  $A \geq \frac{8}{\tau_H}$

$$A = \frac{4(1+I)}{\tau_H - \tau_E}. \quad (29)$$

The EH-curve in (29) is a horizontal line in the  $A - \tau_V$ -plane where exporting is preferred below the curve.



### A3. Horizontal versus vertical FDI

From the derivation of the EH-curve we know that exporting dominates horizontal FDI when  $A < \frac{8}{\tau_H}$ . Thus, we only need to compare profits under horizontal FDI (6) and vertical FDI (4) when  $A \geq \frac{8}{\tau_H}$ . The isoprofit curve is

$$A = \frac{4}{\tau_H - \tau_V}, \quad (30)$$

where horizontal FDI is preferred to vertical FDI above and to the left of the HV-curve in (30).

### A4. Outsourcing with incomplete contracts and no spillovers

#### A4.1. Participation constraint

The supplier will only accept an outsourcing contract if it expects non-negative profits. From (19) we find that the participation constraint holds if  $A \geq 4 \frac{\tau_V}{\beta^2(1-\beta)}$  when the market is too small for full technology transfer, and for  $\beta \geq \tau_V$  otherwise.

#### A4.2. Outsourcing versus vertical FDI

Compare profits from outsourcing in (18) to profits from vertical FDI in (4) to find that outsourcing is preferred to vertical FDI whenever the participation constraint for the supplier holds. The MNE would prefer outsourcing to vertical FDI also for other parameter values, but is constrained by the participation constraint. The feasible OV-curve equals the participation constraint:

$$\begin{cases} A = 4 \frac{\tau_V}{\beta^2(1-\beta)} & \text{if } A < \frac{4}{\beta(1-\beta)} \\ \beta > \tau_V & \text{if } A \geq \frac{4}{\beta(1-\beta)}. \end{cases} \quad (31)$$

Outsourcing is preferred to the left of the OV-curve defined by (31).

#### A4.3. Outsourcing versus exporting

Profits from outsourcing (18) with less than full technology transfer is larger than profits from exporting (2) when  $(\frac{1}{4}A\beta(1-\beta))^2 + \beta\frac{1}{4}A\tau_V - \frac{1}{4}A\tau_E - I > 0$ . The solution to this inequality is of the form  $A \in (-\infty, a_1) \cup (a_2, \infty)$ , where  $0 < a_1, a_2 < \frac{4}{\beta(1-\beta)}$ , and

$$a_1 = \frac{2}{\beta^2(1-\beta)^2} \left( -(\beta\tau_V - \tau_E) - \sqrt{(\beta\tau_V - \tau_E)^2 + 4\beta^2(1-\beta)^2 I} \right)$$

$$a_2 = \frac{2}{\beta^2(1-\beta)^2} \left( -(\beta\tau_V - \tau_E) + \sqrt{(\beta\tau_V - \tau_E)^2 + 4\beta^2(1-\beta)^2 I} \right)$$

It turns out that  $a_1 > 0$  implies  $\beta\tau_V < \tau_E$ , while  $a_1 < \frac{4}{\beta(1-\beta)}$  implies  $\beta\tau_V > \tau_E$ . This contradiction eliminates  $a_1$ , and we are left with  $A = a_2$  as the isoprofit curve when  $A < \frac{4}{\beta(1-\beta)}$ . The second part of the EO-curve is defined where the market is large enough to give full technology transfer under outsourcing. In sum, the EO-curve is:

$$\begin{cases} A = a_2, \beta\tau_V > \tau_E & \text{if } A < \frac{4}{\beta(1-\beta)} \\ A = 4\frac{1+I}{2\beta-2\beta^2+\beta\tau_V-\tau_E} & \text{if } A \geq \frac{4}{\beta(1-\beta)}. \end{cases} \quad (32)$$

where outsourcing is preferred to exporting above and to the right of the EO-curve.

#### A4.4. Outsourcing versus horizontal FDI

From the isoprofit condition in (29) we have that horizontal FDI will not be preferred over exporting before the market has a certain size;  $A > 4\frac{1+I}{\tau_H-\tau_E}$ . It is only relevant to compare profits from outsourcing to profits from horizontal FDI above this market threshold.

Two possibilities must be considered. The first is that even though  $A > 4\frac{1+I}{\tau_H-\tau_E}$ , the market is not large enough to give full technology transfer under

outsourcing, i.e.  $4\frac{1+I}{\tau_H-\tau_E} < A < \frac{4}{\beta(1-\beta)}$ . Then profits from outsourcing are larger than horizontal FDI if  $(\frac{1}{4}A\beta(1-\beta))^2 + \beta\frac{1}{4}A\tau_V - \frac{1}{4}A\tau_H + 1 > 0$ . The solution to this inequality is of the form  $A \in (-\infty, a_1) \cup (a_2, \infty)$ , where  $0 < a_1, a_2 < \frac{4}{\beta(1-\beta)}$ , and

$$a_1 = \frac{2}{\beta^2(1-\beta)^2} \left( -(\beta\tau_V - \tau_H) - \sqrt{(\beta\tau_V - \tau_H)^2 - 4\beta^2(1-\beta)^2} \right)$$

$$a_2 = \frac{2}{\beta^2(1-\beta)^2} \left( -(\beta\tau_V - \tau_H) + \sqrt{(\beta\tau_V - \tau_H)^2 - 4\beta^2(1-\beta)^2} \right).$$

It turns out that requiring both  $a_1$  and  $a_2 < \frac{4}{\beta(1-\beta)}$  implies  $4\beta^2(1-\beta)^2 > (\beta\tau_V - \tau_H)^2$ , which does not ensure that  $a_1$  and  $a_2$  are real numbers. The conclusion is that outsourcing can never be better than horizontal FDI if the market is too small for full technology transfer under outsourcing, but big enough for full technology transfer with horizontal FDI.

The second possibility to consider is when the market is large enough to give full technology transfer under outsourcing. Then  $A > 4\frac{1+I}{\tau_H-\tau_E}$  and  $A \geq \frac{4}{\beta(1-\beta)}$ . The isoprofit curve is then

$$\tau_V = \frac{\tau_H - 2\beta(1-\beta)}{\beta} \tag{33}$$

The HO-curve is a vertical line in the  $A-\tau_V$ -plane. Horizontal FDI is preferred to the left of the line, when  $\tau_V$  is smaller than the condition in (33). The reason is that the MNE's fallback in the outsourcing negotiations is so small that profits from horizontal FDI are larger than for outsourcing. As input trade costs fall ( $\tau_V$  increases) profits from outsourcing increase and when  $\tau_V$  becomes larger than in (33) the MNE prefers outsourcing to horizontal FDI.

### A5. Outsourcing with incomplete contracts and vertical spillovers

#### A5.1. Participation constraint

From supplier profits in (25) we find that the participation constraint holds if  $A \geq \frac{4\tau_V}{\beta(1-\beta^2)(2\beta-1)}$  when there is less than full technology transfer, while the requirement is  $\beta > \frac{1}{2}$ , and  $\tau_V < (2\beta - 1)$  otherwise. The supplier needs larger bargaining power to accept an outsourcing contract when there are spillovers that generate threat of entry than without spillovers.

#### A5.2. Outsourcing versus vertical FDI

Compare profits from outsourcing in (24) to profits from vertical FDI in (4) to find that outsourcing is preferred to vertical FDI whenever the participation constraint for the supplier holds. The MNE would prefer outsourcing to vertical FDI also for other parameter values, but is constrained by the participation constraint. The feasible OV-curve equals the participation constraint:

$$\begin{cases} A = \frac{4\tau_V}{\beta(1-\beta^2)(2\beta-1)} & \text{if } A < \frac{4}{\beta(1-\beta^2)} \\ \beta > \frac{1}{2}, \tau_V < (2\beta - 1) & \text{if } A \geq \frac{4}{\beta(1-\beta^2)}. \end{cases} \quad (34)$$

Outsourcing is preferred to the left of the OV-curve defined by (34).

#### A5.3. Outsourcing versus exporting

Profits from outsourcing (24) with less than full technology transfer are larger than profits from exporting (2) when  $(\frac{1}{4}A\beta(1-\beta^2))^2 + \beta^2\frac{1}{4}A\tau_V - \frac{1}{4}A\tau_E - I > 0$ . Note the similarity to the same comparison without spillovers. The solution to this inequality is also of the form  $A \in (-\infty, b_1) \cup (b_2, \infty)$ , where  $0 < b_1, b_2 < \frac{4}{\beta(1-\beta^2)}$ . The same structure of argument as in the no-spillover case can be applied. The

resulting isoprofit curve is

$$\begin{cases} A = b_2, \beta^2 \tau_V > \tau_E & \text{if } A < \frac{4}{\beta(1-\beta^2)} \\ A = \frac{4(1+I)}{2\beta(1-\beta^2) - \tau_E + \beta^2 \tau_V} & \text{if } A \geq \frac{4}{\beta(1-\beta^2)}, \end{cases} \quad (35)$$

where outsourcing is preferred to exporting above and to the right of the EO-curve defined in (35), and

$$b_2 = \frac{2}{\beta^2 (1 - \beta^2)^2} \left( -(\beta^2 \tau_V - \tau_E) + \sqrt{(\beta^2 \tau_V - \tau_E)^2 + 4\beta^2 (1 - \beta^2)^2 I} \right).$$

#### A5.4. Outsourcing versus horizontal FDI

We can use exactly the same type of argument as in the no spillover case to find the isoprofit curve with spillovers. The result is similar: outsourcing can never be better than horizontal FDI if the market is too small for full technology transfer under outsourcing, but big enough for full technology transfer with horizontal FDI.

When  $A > 4\frac{1+I}{\tau_H - \tau_E}$  and  $A > \frac{4}{\beta(1-\beta^2)}$ , the isoprofit curve is

$$\tau_V = \frac{\tau_H - 2\beta(1 - \beta^2)}{\beta^2}. \quad (36)$$

As in the no spillover case, the HO-curve is a vertical line in the  $A - \tau_V$ -plane, and horizontal FDI is preferred to outsourcing when  $\tau_V$  is smaller than the condition in (36).

#### A6. Outsourcing with complete contracts

##### A6.1. Participation constraint

Requiring supplier profits in (27) to be non-negative requires  $A > 16\tau_V$  when  $A < 8$ , and  $A > \frac{4}{1-\tau_V}$  otherwise.

### A6.2. Outsourcing versus vertical FDI

The MNE compares profits from outsourcing with complete contracts in (26) to profits from vertical FDI in (4). The isoprofit curve turns out to be the same as the participation constraint

$$\begin{cases} A = 16\tau_V & \text{for } A < 8 \\ A = \frac{4}{1-\tau_V} & \text{for } A \geq 8. \end{cases} \quad (37)$$

Outsourcing is preferred to vertical FDI above the OV-curve defined in (37).

### A6.3. Outsourcing versus exporting

When  $A < 8$  profits from outsourcing in (26) are larger than profits from exports if  $(1 - \beta)\frac{A^2}{64} + \beta\pi_V - I - \frac{1}{4}A\tau_E > 0$ . The solution to this inequality is of the form  $A \in (-\infty, d_1) \cup (d_2, \infty)$ , where  $0 < d_1, d_2 < 8$ , and

$$d_1 = \frac{8}{(1-\beta)} \left( -(\beta\tau_V - \tau_E) - \sqrt{(\beta\tau_V - \tau_E)^2 + (1-\beta)I} \right)$$

$$d_2 = \frac{8}{(1-\beta)} \left( -(\beta\tau_V - \tau_E) + \sqrt{(\beta\tau_V - \tau_E)^2 + (1-\beta)I} \right).$$

It turns out that  $d_1 > 0$  is impossible, and this eliminates  $d_1$  as a relevant solution. In order for  $d_2 < 8$  we get the condition that  $1 \leq I < (1 - \beta) + 2(\beta\tau_V - \tau_E)$ . We end up with the following isoprofit curve:

$$\begin{cases} A = d_2, 1 \leq I < (1 - \beta) + 2(\beta\tau_V - \tau_E) & \text{if } A < 8 \\ A = \frac{4(1-\beta+I)}{1-\beta-\tau_E+\beta\tau_V} & \text{if } A \geq 8. \end{cases} \quad (38)$$

Outsourcing is preferred to exporting above the EO-curve in (38).

A6.4. *Outsourcing versus horizontal FDI*

As in the incomplete contracting cases, it is not of any interest to compare outsourcing profits to horizontal FDI unless H is preferred over exporting, which again means  $A > 4 \frac{1+I}{\tau_H - \tau_E} > \frac{8}{\tau_H}$ . Since  $\frac{8}{\tau_H} > 8$ , we also know that when the market is this big there is full technology transfer with outsourcing. The relevant isoprofit curve is then

$$\begin{cases} \tau_V = \frac{\tau_H - (1-\beta)}{\beta} & \text{if } 1 - \beta - \tau_H + \beta\tau_V > 0 \\ A = \frac{-4\beta}{1 - \beta - \tau_H + \beta\tau_V} & \text{if } 1 - \beta - \tau_H + \beta\tau_V < 0. \end{cases} \quad (39)$$

Outsourcing is preferred to horizontal FDI when  $\tau_V$  is larger than the first condition in (39), or outsourcing is preferred to horizontal FDI below the curve from the second condition.

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