To Outsource or Not To Outsource in North-South Trade

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Abstract

This paper investigates outsourcing and FDI decisions in North-South trade when the production activity can be fragmented into two or more independent processes. When factor prices are not equalized internationally, a firm may outsource the process which uses its scarce source intensively. If capital is perfectly mobile and the Southern wage is lower, the Northern firm outsources every fragmentable process to the South. However, if capital can be raised in the domestic market at a lower rate and also the Southern wage is lower, FDI not only dominates outsourcing to an independent foreign outsourcee but also in-house production. If the North has a cheap factor such as land and the South has cheap labor, reciprocal FDI can also occur.

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I. Introduction

It is becoming increasingly evident that many industrial production activities in developed economies are being outsourced to firms in developing countries. R&D activities may occur in the home country, but many production processes seem to be outsourced to China and India with lower manufacturing costs. As Abraham Lincoln (1863) once said, “Government of the people, by the people and for the people shall not perish from the earth,” but the product of the people, by the people and for the people of a single nation may “perish” in a globalizing world. For instance, an electronic dictionary may be designed by Japanese producers and for the Japanese people, but the entire product may be produced in China where the labor cost is lower.

Chao and Yu (1993) considered fragmentation of an industry into two stages. In one industry, an intermediate good is produced using primary goods and a final good is produced in the second stage. They analyzed the welfare effects of domestic content protection which limits outsourcing. Long (2005) observed that the outsourcing firm must balance the marginal gain with the marginal cost. Görg and Hanley (2005) found some evidence of partial outsourcing in Irish Electric Industry. Choi (2007) investigated partial outsourcing under price uncertainty.

The purpose of this paper is to investigate intra-industry outsourcing and FDI decisions of regional firms. Both the Northern and Southern firms are assumed to have a
regional monopoly. Any fragmented process can be outsourced to an independent foreign
government

This paper is organized as follows: Section 2 sets the basic model to consider in-
house production and outsourcing decisions. Section 3 compares outsourcing and FDI
decisions. Section 4 considers the in-house production and FDI decisions. Section 5
investigates the possibility of reciprocal FDI, which occurs when each regional firm
establishes a foreign production plant in the other region. Section 6 contains concluding
remarks.

2. Integrated Production versus Outsourcing

Consider a monopolistic industry in which the output is produced by combining two
processes, 1 and 2. For example, automobile production can be fragmented into two
processes. The engine block is produced in the first process and the rest of the car body in the
second. For simplicity, assume that one unit of the final output requires one unit of the
output from each of the two processes. Process i uses \( a_{L_i} \) units of labor and \( a_{K_i} \) units of
capital, \( i = 1,2 \), and the integrated process uses \( (a_{L_1} + a_{L_2}) \) units of labor and \( (a_{K_1} + a_{K_2}) \)
units of capital.

In each of the fragmented process, the firm must determine whether it is cheaper to
outsourcing or the firm may produce the output in-house or at its foreign production plant.\(^3\)

government

\[ I_{out} = (a_{L_1} + a_{L_2})L + (a_{K_1} + a_{K_2})K \]

\[ I_{in} = a_{L_1}L_1 + a_{K_1}K_1 + a_{L_2}L_2 + a_{K_2}K_2 \]

\[ I_{FDI} = a_{L_1}L_1 + a_{L_2}L_2 + a_{K_1}K_1 + a_{K_2}K_2 \]

...
consider whether that process should be outsourced to a foreign outsourcee or a foreign subsidiary.

If production technologies are identical and factor prices also are equalized between countries, there are no gains from outsourcing or foreign direct investment (FDI) to replace domestic production of any process. *Gains from outsourcing or FDI* exist only if factor prices or production technologies are different. In this case, one process may be less costly and the other more costly abroad. However, technologies can be easily transferred between countries by multinational firms, and hence any technological gap can be bridged sooner or later. Thus, we assume identical technologies between domestic and foreign firms.

If production technologies are identical, outsourcing and FDI can occur only if factor prices are different across countries. In a typical scenario considered, we assume that the foreign country is abundant in labor (*w > w*), where *w* and *r* are the home wage and rent, respectively, and the asterisk (*) indicates foreign variables.

Factor price differential may disappear if factors are mobile between countries. Thus, we assume that labor is an immobile input. In contrast, capital is imperfectly mobile. Specifically, firms can make foreign direct investment (FDI), but each firm pays capital rental to its national capital market.

In order to sharply contrast in-house production and outsourcing or FDI decisions, we assume that there are no transport costs or assembly costs, which tend to work against
outsourcing. Also, we assume constant returns to scale, which ensures constant unit cost, since decreasing costs can obscure the outsourcing and FDI decisions.

These assumptions are summarized below:

(1) Identical Technologies (IT): Production technologies are identical between countries.

(2) Labor is an immobile input whereas capital is an imperfectly mobile input.

(3) One unit of the integrated output requires one unit of output from each of two processes, and the cost of one process is independent of the other.\(^7\)

(4) There are no assembly or transportation costs.

(5) Each production process exhibits constant returns to scale (CRS).

Integrated Production

Consider a monopolist contemplating outsourcing of the first process. The second process production is done in-house. Let \( p(Z) \) denote the inverse demand function and let \( R(Z) = p(Z)Z \) be the revenue function. Marginal revenue is denoted by

\[ m = R'(Z) = p + Zp'(Z). \]

Unit production cost of each process, \( g_i(w, r, X_i) \), depends not only on factor prices but also on its output level, \( X_i \). However, since each process exhibits CRS, unit cost of each process is independent of output. If produced in-house, unit production costs of the two processes are:
where \( g_i \) is the integrated firm’s unit cost of process \( i \).

In the absence of uncertainty, the firm’s problem is to decide whether to integrate the two processes and produce the whole product in-house, or to outsource the first process. Let \( X = X_1 \) be the number of the output (engine block) of the first process produced in-house, and let \( Y \) denote the number of engine blocks outsourced to a foreign outsourcee.

If the two processes are integrated \((X = Z)\), the firm’s profit is:

\[
\pi = p(X)X - (g_1 + g_2)X, \tag{2}
\]

where \( g_2(w,r) \) is the in-house, unit production cost of the second process. The first order condition for integrated production is:

\[
m(X) - g_1(w,r) - g_2(w,r) = 0. \tag{3}
\]

That is, the output of the vertically integrated firm is determined at a point where marginal revenue equals marginal cost, \( g_1 + g_2 \).
Outsourcing versus In-house Production

Next, consider the production and outsourcing decisions when the firm outsources the first process to a foreign firm and pays $p^*_1$ per unit. The outsourcer’s problem is to choose $X$ and $Y$ to maximize the profit

$$\pi = p^*(X+Y) - g_1(w,r)X - p^*_1Y - g_2(w,r)(X+Y).$$

There are three possible solutions. First, the firm produces nothing in-house ($X = 0$) and outsources the entire first process. Second, the firm outsources nothing ($Y = 0$) and produces the entire first stage output in-house, which amounts to integrated no fragmentation. The firm then becomes an integrated producer and its profit reduces to (2). Third, the firm may produce some output of the first process in-house and outsource the rest overseas ($X > 0, Y > 0$). To produce some output of the first process in the home country, the first order condition is:

$$m - g_1(w,r) - g_2(w,r) = 0,$$

which is the same condition in (3) for the integrated production examined earlier.

On the other hand, the first order condition for the firm to outsource the first process activity ($Y > 0$) to a foreign firm is:

$$m - p^*_1 - g_2(w,r) = 0.$$
It follows that:

\[ Y = 0, \quad \text{if} \quad g_1 = a_{l_1}w + a_{k_1}r < a_{l_1}w^* + a_{k_1}r^* = p_1^*, \]

where \( p_1^* = a_{l_1}w^* + a_{k_1}r^* \) is the outsorcerer’s unit production cost in the foreign country. It is evident that no outsourcing is optimal if the outsourcing cost is higher than the in-house unit cost of the first process.

On the other hand,

\[ X = 0, \quad \text{if} \quad g_1 = a_{l_1}w + a_{k_1}r > a_{l_1}w^* + a_{k_1}r^* = p_1^*. \] \hspace{1cm} (6)

That is, if the unit outsourcing cost is less than the in-house unit production cost, the firm has a cost disadvantage in the first process. In this case, outsourcing is optimal. Moreover, an interior solution \((X > 0, \ Y > 0)\) is not optimal. That is, full outsourcing of the first process is optimal. For instance, an automobile producer may completely outsource the production of the engine block to a foreign firm.

By assumption, the South is abundant in labor \((w^* < w)\). If the South is also abundant in capital \((r^* < r)\), then the inequality in (6) is satisfied. On the other hand, if the North is abundant in capital \((r < r^*)\), this inequality may not be satisfied. It is evident that cheap foreign labor \((w^* < w)\) is necessary, but not sufficient to guarantee outsourcing.

Finally, if \( g_1(w, r) = p_1^* \), then the firm is indifferent between outsourcing and in-house production of the first process, and hence there is no need to fragment the production...
activity. We have singled out the first process and considered its outsourcing decision. However, it is evident that the same argument applies to any fragmented process whose production cost is independent of any other process. We summarize this result below:

Proposition 1: Assume that (1) – (5) are satisfied and $r = r^*$.

(i) If foreign wage is lower ($w^* < w$), then the Northern firm outsources every fragmentable process to the South.

(ii) If foreign wage is higher ($w < w^*$), then the Northern firm outsources no fragmented process to the South.

The acid test of outsourcing a process is whether the firm has a cost disadvantage in that process. The firm outsources any process whose in-house production cost is higher than its outsourcing cost. Moreover, it results in full outsourcing of that process, as in Bond (2000).

3. Outsourcing vs. Foreign Direct Investment

If the unit outsourcing cost is less than the in-house unit production cost, the firm engages in full outsourcing of that process, instead of producing some output in-house. However, in this case, the firm still has another option. Consider now the choice between outsourcing and foreign direct investment. Here we investigate only intra-industry FDI as in Baldwin (2001), and assume that the foreign subsidiary does not sell its output to other markets. The FDI firm specializes only in the production of the first process and delivers the output to the parent firm at cost.
By assumption, capital is an imperfectly mobile input in the sense that each firm pays capital rent to its national market. That is, the foreign subsidiary and an outsourcee pay different rents, \( r \neq r^* \). Moreover, these capital inputs are transported to other regions are zero cost.

The firm may outsource the first process to its foreign subsidiary or to an independent outsourcee. However, FDI is required to establish a foreign subsidiary. The FDI firm is simply a foreign production plant. Let \( Q \) denote the output produced by a foreign subsidiary, using own capital and foreign labor inputs. Since the foreign production plant sells its output at cost to the parent firm at cost, the firm’s total profit is

\[
\pi = p^*(Y + Q) - (p_1^*Y + g_1^*(w^*, r)Q) - g_2(w, r)^*(Y + Q).
\]  

(7)

The first order conditions are

\[
m - p_1^* - g_2(w, r) \geq 0, \quad \text{for} \quad Y > 0
\]

\[
m - g_1^*(w^*, r) - g_2(w, r) \geq 0, \quad \text{for} \quad Q > 0.
\]  

(8)

Recall that that the firm uses the same technologies in the home and foreign factories, and hence \( g_1^*(\bullet) = g_2^*(\bullet) \). Recall that the FDI firm raises capital at the domestic rate \( r \). In contrast, the outsourcee rents capital at the foreign rate, \( r^* \). Moreover, the outsourcee and the FDI firm pay the same wage \( w \) in the same labor market. If \( r < r^* \), then

\[
p_1^* = a_{L1}^*w^* + a_{K1}^*r^* < a_{L1}^*w^* + a_{K1}^*r = g_1^*(w^*, r).
\]  

(9)
In other words, the FDI firm has an absolute cost advantage over the outsourcee because it can raise capital at a lower rate than the foreign outsourcee \( r < r^* \). On the other hand, if \( r > r^* \), then the inequality in (9) is reversed. This result is summarized below:

Proposition 2: Suppose that assumptions (1) – (5) are satisfied and foreign wage is lower \( w^* < w \). If \( r < r^* \), then the Northern firm outsources any fragmentable process to its foreign subsidiary, and not to a foreign outsourcee. On the other hand, if \( r > r^* \), then the Northern firm outsources any fragmentable process to a foreign outsourcee.

Cheap foreign wage induces the firm to outsource a fragmentable process to either an independent foreign firm or to its foreign subsidiary. If foreign subsidiary can raise capital in the foreign country at a lower rent \( r^* < r \), then there is no need to set up a foreign factory, because an independent foreign outsourcee will have a cost advantage.

4. In-house Production versus FDI

Under the plausible scenario where the South is not only abundant in labor but also in capital \( w > w^*, r < r^* \), the previous proposition shows that FDI policy dominates outsourcing to a foreign outsourcee. In this case, the option to outsource the first process to an independent foreign outsourcee can be safely eliminated. In this case, we may yet consider in-house production and FDI decisions. The firm’s profit can be written as:

\[
\pi = p^*(X + Q) - \left( g_1(w, r)X + g_1^*(w^*, r)Q \right) - g_2(w, r^*)(X + Q). \tag{10}
\]
The first order conditions are

\[ m - g_1(w, r) - g_2(w, r) \geq 0, \quad \text{for } X > 0, \]  
\[ m - g_1^*(w^*, r) - g_2(w, r) \geq 0, \quad \text{for } Q > 0. \]  

(11)

Note that \((m - g_2(w, r))\) is common to both inequalities in (11). In other words, marginal revenue and the second process production cost are irrelevant to the outsourcing and FDI decisions of the first process. If \(g_1^*(w^*, r) < g_1(w, r)\), both weak inequalities in (11) cannot be satisfied with equality. Recall that the firm pays the same capital rent for in-house production and for its foreign subsidiary. However, the FDI firm in the South faces a lower wage in the foreign labor market \((w^* < w)\). Since the foreign wage is lower,

\[ g_1^*(w^*, r) = a_{L1}(w^*, r)w^* + a_{K1}(w^*, r)r < a_{L1}(w, r)w + a_{K1}(w, r)r = g_1(w, r). \]  

(12)

That is, unit production cost of the FDI firm is lower than that of the parent firm.

Proposition 3: Suppose that assumptions (1) – (5) are satisfied. If \(w^* < w\) and \(r < r^*\), the Northern parent firm produces nothing in-house but outsources every fragmentable process to its foreign subsidiary in the South.
This proposition indicates that under the plausible scenario that prevails in developed and developing countries \((w^* < w, r < r^*)\), FDI policy dominates in-house production. Figure 1 shows the dominance of FDI over outsourcing. Consider the scenario, \((w^* < w, r < r^*)\).

Due to factor price differences, the two unit value iso-cost lines of the two countries intersect each other at point E, \(C_1 = C_2 = 1\). Since the wage-rent ratio is lower in the South, the unit iso-curve \(C_1(w, r) = wL_1 + rK_1 = 1\) in the North is steeper than that of the South, \(C_2(w^*, r^*) = w^* L_1 + r^* K_1 = 1\). If a domestic isoquant, labeled \(X'\), is tangent to \(C_1\) at point A, to the left E, then outsourcing cost will be higher than in-house production cost, and no outsourcing occurs.
If an isoquant, labeled X, is tangent to the Northern unit iso-cost curve at point B, to the right of E, then outsourcing is more cost-effective, because more output can be supplied by the Southern producer \( Y > X \) for the same cost. In this case, however, FDI is even more efficient, because the FDI firm has access to cheaper capital in the home market and cheaper labor in the South. Thus, the unit iso-cost curve shifts further to the right and hence more output \( Q > Y \) can be produced by the foreign production plant at the same cost.

It follows that the firm outsources the first process, not to an independent outsourcee but to an FDI firm. Subsidiaries can build factories to utilize the factors that are cheaper in the markets where they are incorporated.

**5. Reciprocal FDI**

In the preceding section we considered why Northern firms outsource some or all processes to the South. Outsourcing to an independent foreign firm or to an FDI firm in the South occurs because of lower foreign wage. Can a Southern firm outsource some process to the North? We now show that if the North has a cheaper factor in a fragmented production process, a Southern firm may outsource the process to either a Northern firm or to its subsidiary in the North. As before, assume that capital is an imperfectly mobile input.

We now consider a model of reciprocal FDI in a world of three factors: capital (K), labor (L) and land (T). Each process uses all three inputs. Due to imperfections in the market, not all factor prices are equalized. We modify assumption (2) and assume that each region has one cheaper factor. Specifically, the North is abundant in land \( s < s^* \) and the South is
abundant in labor \((w^* < w)\). However, we consider the symmetric case \((r = r^*)\), where capital is perfectly mobile and the Southern firm is not disadvantaged to make FDI in the North. In this case, reciprocal outsourcing and FDI is most likely to occur. Also, assume that each FDI firm is established solely to supply its output of a fragmented process to its parent firm in its home market, and not to sell it in the market where it is incorporated.

Consider a Northern firm’s decision to produce the first component in-house or to outsource it to its foreign subsidiary. The second process is assumed to done in-house. The firm’s profit is

\[
\pi = p^*(X + Q) - \left(g_1(w, r, s)X + g_1^*(w^*, r, s^*)Q\right) - g_2(w, r, s^*)^2.
\]  

(13)

The first order conditions are:

\[
m - g_1(w, r, s) - g_2^*(w^*, r, s^*) \geq 0, \quad \text{for } X > 0,
\]

(14)

\[
m - g_1^*(w^*, r, s^*) - g_2(w, r, s) \geq 0, \quad \text{for } Q > 0.
\]

Note that \(m - g_2^*(w, r, s)\) is common to both inequalities in (14). This implies that marginal revenue or the second process production cost has no effect on in-house production and FDI decisions. The in-house unit cost of the first process, \(g_1(w, r, s)\), can be greater or less than the foreign subsidiary’s unit cost of the same process, \(g_1^*(w^*, r, s^*)\). Lower foreign wage and land rental are a sufficient condition for the following inequality:
Cheap foreign wage is necessary, but not sufficient for (15) to hold. If inequality (15) holds, then the firm outsources the first process to its foreign production plant, i.e., full outsourcing of the first process occurs. Specifically, if \( w^* < w \) and \( s^* \leq s \), then the Northern firm fully outsources the process to its foreign subsidiary.

Next, consider a Southern firm’s outsourcing and FDI decisions of the second process. The firm’s profit is

\[
\pi^* = p^*(X^* + Q^*) - \left( g^*_2(w^*, r^*, s^*)X^* + g_1(w, r, s)Q \right) - g^*_1(w^*, r^*, s^*)X^* + Q^*.
\] (16)

where the asterisk (*) denotes foreign variables. The first order conditions are:

\[
m^* - g^*_2(w^*, r^*, s^*) - g^*_1(w^*, r^*, s^*) \geq 0, \quad \text{for } X^* \geq 0,
\] (17)

\[
m^* - g_2(w, r, s) - g_1^*(w^*, r^*, s^*) \geq 0, \quad \text{for } Z^* \geq 0,
\]

where \( m^* = p^*(X^* + Q^*) + p^* \) is marginal revenue of the Southern firm. Note that

\[
(m^* - g_1^*(w^*, r^*, s^*))\]

is common to both equations. Again, marginal revenue of the unit cost of the first process is irrelevant to the outsourcing and FDI decisions of the Southern firm.
Lower Northern wage and land rental are a sufficient condition for the following inequality, in which case the Southern firm invests in the North:

\[ g_2(w, r^*, s) = a_{t2}(w, r^*, s)w + a_{k2}(w, r^*, s)r^* + a_{r2}(w, r^*, s)s \]

\[ < a_{t2}(w^*, r^*, s^*)w + a_{k2}(w^*, r^*, s^*)r^* + a_{r2}(w^*, r^*, s^*)s^* = g_*(w^*, r^*, s^*). \]  

(18)

If the North is abundant in land \((s < s^*)\), but not in labor \((w > w^*)\), then (18) may not hold. If the North is abundant in capital \((r < r^*)\), even lower Northern wage and land rental \((w < w^*, s < s^*)\) may not induce the Southern firm to invest in the North. For the inequality (18) to hold, it is necessary that \(s < s^*\). Only when the North is abundant in land \((s < s^*)\), the Southern firm may establish a production plant in the North.

If \(g_2^*(w^*, r^*, s^*) > g_2(w, r^*, s)\), then the Southern firm completely outsources the second process to its subsidiary incorporated in the North, in order to take advantage of the cheap land input, despite the high wage.

Proposition 4: Assume that two immobile factors, labor and land, and perfectly mobile capital \((r = r^*)\) are used in two independent processes.

(i) If \(g_1^*(w^*, r, s^*) < g_1(w, r, s), g_2(w, r^*, s) < g_2^*(w^*, r^*, s^*)\), then reciprocal FDI occurs, i.e., each regional firm invests in the other region, and

(ii) for reciprocal FDI to occur, each region must have one cheaper factor than the other.
If capital is perfectly mobile, Then reciprocal FDI can occur in the two regions, i.e., the North outsources the labor-intensive process to its subsidiary in the South, whereas the South outsources the land-intensive process to its subsidiary in the North. If the Northern firm can raise capital at a lower rate \( r < r^* \), it is more difficult to satisfy the second condition, \( g_2(w, r^*, s) < g_2^*(w^*, r^*, s^*) \). In this case, it is more likely to observe asymmetric FDI pattern, i.e., the Northern firms are more likely to invest in the South than conversely.

6. Concluding Remarks

In this paper we considered three options for a monopolist when the production activity can be fragmented into two or more independent processes. Whether to insource or outsource a fragmented process is not affected by marginal revenue and production costs of other processes. If production technologies are identical between regions and factor prices are equalized, there is no need for outsourcing or FDI.

When the South has a cheaper input such as labor and land, it is profitable for a Northern firm to outsource a process to an independent foreign firm or its foreign production plant. Reciprocal FDI can occur when each region has at least one cheaper input. However, land and labor inputs are cheaper in most developing countries. In this case, an asymmetric outsourcing or FDI pattern is more likely to be observed. For example, furniture producers in high income countries of Europe, America and Japan buy timbers or secure them from their subsidiaries or joint ventures in developing countries because not only labor is cheaper but also land rental is lower. This also explains the decline of rainforests in tropical countries.
It should be noted that when outsourcing or FDI occurs, the parent firm does not produce any output of any process in-house. That is, when the South has a cheaper factor, no partial outsourcing or partial FDI occurs. However, such razor sharp decisions are likely to be moderated in the real world. In practice, there may be a high start-up cost for entering the foreign production stage, which will discourage FDI. In addition to production costs, the parent firm may also bear risk and operate foreign production plants under conditions of uncertainty. Depending on the source of uncertainty and conditions that prevail in developing countries, FDI may be riskier than in-house production or outsourcing. Uncertainty may originate from fluctuating exchange rates, unstable political conditions or varying factor prices. Further research is needed to study the firm behavior under high entry costs and uncertain foreign environment.
References


Endnotes

1 For related papers on fragmentation, see Deardorff (2001), Jones and Kierzkowski (2001) and Zhao (2001).
2 Bond (2001) used a specific factors model and delineated the conditions under which partial or full outsourcing is optimal.
3 There is some confusion in the definition of the “outsourcer.” In this paper, the outsourcing firm is called the outsourcer, and the firm that provides the outsourcing service is called the outsourcee. For example, infertile would-be mothers who would rent the uteri of young mothers (outsourcees) in developing countries are outsourcers.
4 If the production cost of one process depends on another process, the division is not well defined. In this case, the two processes can be combined to form a single process.
5 This assumption follows the tradition of the Hescher-Ohlin model.
6 If domestic factor prices \( w \) and \( r \) are both higher or lower than their foreign counterparts, one country exports all goods to the other country.
7 The theory is not materially affected as long as a Leontief production function is used, requiring a fixed relationship between the outputs of the two processes.
8 In this case, partial outsourcing is also a feasible solution in a mathematical sense. However, for an integrated firm, there is no need to fragment the production activity.