4
Multinational Corporations

1 Introduction

A multinational corporation (MNC) is a firm or enterprise that has production operations in more than one countries.\footnote{There are other names of MNC; for example, transnational corporation (or firm).} This section analyzes the reasons for the existence of MNCs and some economic issues related to the operations of MNCs.

This and the previous two sections provide analyses on different types of foreign direct investment in different environments. The previous two sections consider the roles of capital services that serve as a factor in a production process. Capital owners are price takers and seekers of the best location for their capital that offers the highest return. Their action of placing their capital in different countries would impact the economies of the source and host countries.

This section, however, focuses on the action of firms that have the options of producing in more than one countries. The firm will make a production decision such as how much to produce in each of the locations in order to maximize its profit. As a result, the focus of the analysis in this section is on the firm and its production decision. Furthermore, the following analysis considers firms that are of considerable sizes so that their production decision could have important impacts on countries concerned. In other words, the firms considered in this section have monopoly power, which the firms are happy to take advantage of in making their production decision.

The investment of a firm in another country can take on different forms. For example, a firm can move its entire production operation to another country. In this case, the firm feels that foreign production dominates local production. Another form of investment is that the firm keeps production operation in both countries. There are reasons why the firm does not want to produce in only one location. For simplicity, the operation unit in the initial country is called the headquarter of the firm while that in a new country its subsidiary.

2 The OLI (Eclectic) Paradigm

One fundamental question concerning MNC is, why would a firm choose to invest and produce in another country? This question is asked because it is believed that if a firm is going to sell its output to a market in its own or another country, it
prefers to produce the output in its own town. Not only is it familiar with the local environment, it could also have good relations with the suppliers, distributors, and labor unions. If it plans to sell the output in a foreign country, it can simply export the product to the foreign market. Then why would a firm choose to give up its home field advantage but to produce in a foreign country?

One of the earliest answers to the above question is the OLI (eclectic) paradigm proposed by John Dunning and others. They consider a firm that is capable of producing a product in either the home country or the foreign country. The firm is aware of the conditions in both countries, and will choose a country for producing the product. The criterion for choosing the right production is to maximize its profit or to minimize its cost. Transportation costs are not assumed and uncertainty is ruled out.

The OLI paradigm consists of three parts, which describe three characteristics of the firm and the market. These three parts are summarized by the three letters in the name of the paradigm: O (standing for ownership advantage), L (standing for location advantage), and I (standing for internalization of technology transfer). The paradigm recognizes the disadvantages a firm faces when producing in another country. The O, L, and I parts explain the three factors behind the firm’s decision of foreign investment.

The paradigm is explained below.

2.1 The Ownership Advantage

To overcome the disadvantages for producing in a foreign country, the incoming firm must possess some tangible or intangible factors that can help the firm improve the competitiveness of its output. Examples of ownership advantages are

- *technology advantage* – The investing firm possesses a technology that allows it to produce a product at a lower cost, or a technology that allows it to produce a product different from or more advanced in quality than the products produced by other local firms.

- *good reputation* – This is the positive reputation of a firm in terms of the quality of its products and services. Such reputation will help convince consumers to have confidence in the quality of the firm’s products and services. Examples of firms that have built up international good reputation are chains like McDonald’s restaurants, Starbucks coffee, Hilton Hotels, and Samsung smartphones. Such good names can help firms promote business in other countries and to compete with local firms.

- *possession of a specific factor* - For example, a firm has access to some raw materials that allow the firm to improve its production productivity or lower its production costs, or a firm owns a managerial team that can manage the workers and the production process in a more efficient and less costly way.
These ownership advantages play an important role in a firm’s investment and production in another country. These advantages obviously help make a firm more competitive, and help reduce the disadvantages it may face when producing in another country. A firm, when facing the option of producing abroad, has one more reason to invest in improving these ownership advantages. This is because some of these advantages possess the so-called public-good feature. For example, the use of a newly developed technology by a subsidiary does not affect its use by the headquarter. This is the non-rivalous feature of a public good. Also, the use of the technology by the headquarter of the firm does not exclude its use by a subsidiary. This is the non-excludable feature of a public good.

The technology advantage is similar to a public good, as it is generally nearly costless to transfer a technology from the headquarter to a subsidiary in another country.\(^2\) The good-reputation advantage is not so similar to a public good; for example, the reputation of a firm may have smaller effects in promoting the product of an MNC in other countries as the consumers there may not be so familiar with the products of the firm. The specific-factor advantage is more like a private good than a public good, especially if the specific factor is of a fixed quantity in the short run.

However, possessing ownership advantages is only a necessary but not a sufficient condition for foreign production by a firm: The firm that possesses ownership advantages has the option of producing the product in its own country. This will allow the firm to take advantage of the ownership advantages but to avoid facing the disadvantages for producing abroad. After producing in its own country, the firm can export the product to foreign countries. This means that possessing ownership advantages is not sufficient to explain why a firm chooses to invest and produce in another country.

### 2.2 Location Advantage

The second factor in the OLI paradigm is the location advantage. This represents the advantage a location is able to offer to firms coming from other locations. An MNC can compare what it can get in different locations and then decide where it wants to produce.

A location may have one of more of the following four main types of location advantages: (a) low costs of one or more factors; e.g., low labor costs; (b) availability of specific factors; e.g., workers with certain skills, some raw materials, and so on; (c) low tax burden or other investment incentives offered by the local governments; e.g., low profit tax imposed by the host government; (d) closer to the consumers’ markets.

Different locations usually have different characteristics. Some locations may have abundant low-cost workers, and some may have a government that is willing to offer attractive tax and investment packages to foreign firms willing to invest and produce locally. Some locations may be close to the consumers markets, and thus can appeal

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\(^2\)For example, the cost of allowing a subsidiary to use a technology may be the cost of sending a copy of blueprints electronically.
to those firms that need to get quick and close feedbacks from the consumers and markets.

Ownership advantage and location advantage are two important factors for firms in choosing the right location for their production facilities. However, in the OLI paradigm, these two factors are generally not sufficient for the existence of MNCs.

2.3 Internalization

To understand why ownership advantage and location advantage may not be sufficient to explain why a firm would want to invest abroad, consider a firm that has an advanced technology to be used to improve the competitiveness of its product. There is a location that has the right characteristics for producing the product there. Then should the firm choose to produce in that location?

Not necessarily, according to the OLI paradigm. The reason is that there is another option for the firm: It can license its technology to a local firm. Let the firm uses the technology and then asks the local firm to pay royalty. In this case, the firm can avoid producing the product itself in the foreign environment, i.e., it will not have to face the disadvantages of producing the product in a foreign country but can still make use of its ownership advantage and the location advantage.

However, licensing has its limitation. For example, consider firm A licenses its technology to firm B for producing passenger car X to be sold in a market. Because technology, like a public good, is non-rivalous, once firm A transfers technology to firm B, it will be difficult to prohibit firm B from using the technology in ways that will hurt firm A’s profit; for example, firm B may use the technology to produce a similar car, say passenger car Y, to compete with car X in the same market. Of course, before the transfer of technology, firms A and B can sign a contract to prohibit firm B from using the technology to produce anything that can compete with car X. However, sometimes it is difficult to effectively control the actions and production of firm B, and even if it is known that firm B has done something it is not supposed to do, proving that in court is another matter. For example, suppose that firm B uses the technology to produce not a passenger car, but a truck, which is a close substitute of passenger cars. How can firm A prove in court that firm B has used the technology that hurts firm A’s profit?

Investing and producing in another country is then a safer approach, i.e., the firm sets up a subsidiary in another country, and let the subsidiary use the technology. Since it can better control the production of the subsidiary, it can better protect the technology and will not do something to hurt the profit of the firm.

Such approach is said to internalize the market for technology licensing.
3 Multi-Location Monopoly

The OLI paradigm explains how an MNC chooses between the local market and a foreign location for producing a product. One implication is that generally the firm will decide to produce either at home or in a foreign country, but not both.

This section introduces another approach to MNC, which allows the possibility that under certain conditions, it is profitable for a firm to produce a product both at home and in another country simultaneous to serve a common market. In other words, there are cases in which an MNC chooses to export and invest at the same time.

Consider a firm that is capable of producing a homogeneous product either in an economy called S (the source country), or in another economy called H (the host country), or both. There is a demand for the product in country H. For simplicity, assume no demand for the product in country S or elsewhere. It is further assumed that there is no firm in country H producing the same product or close substitutes. Therefore, the firm is a monopoly in market H.

There are two options for the firm to supply the product to the market: (a) export — to produce it in country S and then export to country H; or (b) invest — to set up a subsidiary in country H, produce the product there and then supply it to the market. Which option will the firm choose?

Denote the demand for the product in H by the inverse demand function, \( p^* = \pi^*(q^*) \), where \( p^* \) is the market price and \( q^* \) the quantity demanded. It is assumed that the demand curve is downward sloping and not too convex to the origin. The firm in country S (headquarter) produces the product with a cost function \( C = C(x) \), where \( x \geq 0 \) is its output. If the firm sets up a subsidiary in country H and produces there, it faces a cost function given by \( C^* = C^*(x^*) \), where \( x^* \geq 0 \) is the output. In the present case, the value of \( x^* \) is interpreted as the level of investment by the firm in country H. Denote the marginal costs of the cost functions by \( MC = MC(x) \) and \( MC^* = MC^*(x^*) \), respectively. Both cost functions have positive and rising marginal costs, i.e., \( MC, MC^* > 0 \) and \( MC' \) and \( MC'^* > 0 \), where a prime represents a derivative. In equilibrium, the demand is equal to the total output, \( q = x + x^* \). For the time being, assume no government intervention. If the firm chooses to have \( x = 0 \), it means that the firm decides not to export, or if \( x^* = 0 \), it decides not to invest.

The total profit of the firm that comes from the sales of the headquarter and subsidiary to the market is
\[
\Pi = p(x + x^*) - C(x) - C^*(x^*). \tag{1}
\]

The firm chooses the optimal outputs to maximize the total profit. The two first-order

\[3\text{ An asterisk is used to denote a variable of country H.} \]
conditions are
\[
\frac{\partial \Pi}{\partial x} = p + (x + x^*)p' - MC \leq 0 \quad (2a)
\]
\[
\frac{\partial \Pi}{\partial x^*} = p + (x + x^*)p' - MC^* \leq 0 \quad (2b)
\]
The second-order condition is assumed to be satisfied. In (2), \( p + (x + x^*)p' \) is the marginal revenue, \( MR \). If both the headquarter and the subsidiary produce a positive output, the inequalities in (2) are replaced by equality, and the conditions reduce to
\[
MR(x + x^*) = MC(x) = MC^*(x^*). \quad (3)
\]
The conditions in (3) can be solved for the optimal outputs, \( x^0 \) and \( x^{*0} \), where the superscript “0” is used to denote the value of a variable with no government intervention. The value \( x^0 \) denotes the firm’s optimal export and \( x^{*0} \) is the optimal output of the subsidiary, with the latter being interpreted as investment.

Can both \( x^0 \) and \( x^{*0} \) be positive? In other words, are there cases in which the firm chooses to export and invest at the same time? Before a formal analysis is presented to answer this question, let us provide an intuitive examination of the situation. Suppose that the firm wants to produce a small amount of output, \( x^0 \). If this output is produced by the headquarter, the total cost is \( x^0 MC(x^0) \). If it is produced by the subsidiary in another country, the total cost is \( x^0 MC^*(x^0) \).

\[
MC(x') < MC^*(x'), \quad (4)
\]
for small values of \( x' \), which means that initially it is cheaper to produce at home than in another country. This reflects the disadvantages that the subsidiary may face for producing in a foreign country. Condition (4) implies that it is cheaper to produce that amount of output by the headquarter.

If more and more outputs are to be produced by the headquarter, its marginal cost will rise, until the output is \( q^0 \). With this output, headquarter’s marginal cost is equal to that of subsidiary for very small output level, i.e., \( MC(q^0) = MC^*(0) \). For greater output levels, both the headquarter and the subsidiary will have positive output in such a way that the following condition holds:
\[
MC(x) = MC^*(x^*). \quad (5)
\]
Condition (5) shows that both the headquarter and the subsidiary will produce to offer a big supply to the market.

The profit-maximizing equilibrium can be illustrated in Figure 4.1. Curves labeled \( D^* \) and \( MR^* \) represent the demand curve and the marginal revenue curve of the market in country H, respectively. Curves \( MC \) and \( MC^* \) describe the marginal costs

4For a small output \( x' \), the total cost \( TC \) is marginally equal to \( x'MC \).
for the headquarter (in S) and the subsidiary (in H), respectively. That curve \( MC^* \) is higher than curve \( MC \) reflects the disadvantageous situation that the MNC faces when producing in country H. According to the first-order condition (3), the firm chooses \( x \) and \( x^* \) (if both are positive) in such a way to keep \( MC \) and \( MC^* \) equalized.

Graphically, this means that the effective marginal cost is given as the horizontal summation of \( MC \) and \( MC^* \). For example, at a level equal to OT, the headquarter produces an output of \( x^n \) while the subsidiary chooses an output of \( x^{*n} \). The total output is equal to \( q^n = x^n + x^{*n} \). The effective marginal cost curve is curve \( MC^e \), which is the horizontal summation of curves \( MC \) and \( MC^* \).

The equilibrium is the intersection between the MR curve and the effective MC curve, or point N in the diagram. The market price in H, \( p^{*o} \), is the corresponding point on the demand curve.

The equilibrium can also be derived graphically using a different approach. Rewrite the first-order conditions in (3) (assuming positive outputs by the headquarter and the subsidiary) as:

\[
\begin{align*}
MR(x + x^*) &= MC(x) \quad (6a) \\
MR(x + x^*) &= MC^*(x^*) \quad (6b)
\end{align*}
\]

Condition (6a) comes from the headquarter in S and (6b) from the subsidiary in H. These two conditions can be represented by curves SS and HH, respectively, in Figure 4.2. The intersection between these two curves gives the optimal values of the outputs of the headquarter and subsidiary that satisfy the two conditions in (6).

The properties of curves can be derived by differentiating conditions (6):

\[
\begin{align*}
MR'(dx + dx^*) &= MC'dx \quad (7a) \\
MR'(dx + dx^*) &= MC^{*'}dx^* \quad (7b)
\end{align*}
\]
These two conditions can be rearranged to give the slopes of curves SS and HH, respectively,

\[
\frac{dx^*}{dx} \bigg|_{SS} = \frac{MC'' - MR'}{MR'} < 0 \quad (8a)
\]
\[
\frac{dx^*}{dx} \bigg|_{HH} = \frac{MR'}{MC'' - MR'} < 0, \quad (8b)
\]

where the signs of the slopes of the curves are based on the assumptions about the derivatives of $MC$ and $MR$. Furthermore, conditions (8a) and (8b) imply that, in magnitude, the slope of SS is greater than 1 while that of curve HH is less than 1. In the diagram, curve SS is steeper than curve HH. Once the optimal values of $x$ and $x^*$ have been determined, the values of other variables can be obtained.

The above result depends crucially on rising marginal costs. This property implies that the firm generally wants to avoid relying too much on only one plant as the location of production. The firm wants to have either plant not producing too much in order to keep the marginal cost low.

4 Tariff-Jumping FDI

The above model can be used to explain a phenomenon called \textit{tariff-jumping FDI}, which is foreign investment induced by a protective trade policy such as a tariff. Suppose that the government of country H imposes a tariff on the import of the good from country S. Denote the specific tariff rate by $\tau^*$. The tax applies to the firm’s export to H but not to the local sale of the subsidiary. Thus, the profit function of the firm (1) reduces to

\[
\Pi = p(x + x^*) - C(x) - C^*(x^*) - \tau^* x. \quad (9)
\]
The first-order conditions (assuming positive outputs) are

\[ MR(x + x^*) = MC(x) + \tau^* \quad (10a) \]
\[ MR(x + x^*) = MC^*(x^*). \quad (10b) \]

Condition (10a) implies that \( MC(x) + \tau^* \) is the new marginal cost for the headquarter to export the good to H. By condition (10b), the marginal cost for the subsidiary in H remains unchanged.

The equilibrium can be illustrated in Figure 4.3. Condition (10a) means that the tariff shifts the \( MC \) curve upward by an amount of \( \tau^* \), while that of the subsidiary remains unchanged. The new effective marginal cost curve of the firm is the horizontal summation of the curves \( MC^* \) and \( MC + \tau^* \). The intersection point between the effective \( MC^e \) curve and the \( MR \) curve is the new equilibrium point. The diagram shows that the new equilibrium gives a smaller quantity of consumption, i.e., \( (x + x^*) \) drops. It can also be noted from the diagram that the marginal cost faced by the subsidiary is higher, implying that its output \( x^* \) increases. As a result, \( x \) drops. Since \( x^* \) is interpreted as the firm’s investment in H, the result implies that an increase in the tariff rate induces more foreign direct investment (FDI). The increase in FDI that is due to the increase in tariff is called \textit{tariff-jumping FDI}.

Furthermore, a lower quantity of consumption implies a rise in the market price, \( p^* \). How is the rise in \( p^* \) compared with the tariff rate? To answer this question, note that the new effective marginal cost curve is obtained by “bending” down the marginal cost curve faced by the headquarter. Therefore, the vertical rise in the effective marginal cost curve, indicated as \( h \) in the diagram, is less than \( \tau^* \). Furthermore, as long as the demand curve is a downward-sloping straight line, or a curve close to a straight line, the rise in the market price is less than the rise in the marginal revenue, or the rise in the effective marginal cost curve. Thus, we have

\[ \Delta p^* < h < \tau^*, \quad (11) \]
i.e., the rise in the market price is less than the tariff.

The new equilibrium can also be derived using an alternative approach. Condition (10b) implies that the tariff imposed by country H shifts curve SS down and to the left. Let the new curve be $S'S'$, which cuts curve HH at point M, the new equilibrium point. The diagram shows that $x^*$ rises but $x$ drops, meaning that the tariff discourages export but encourages investment by the MNC. Furthermore, since curve SS has a slope less than $-1$, it is steeper than a line with a slope of $-1$. As a result, a shift of the equilibrium point down curve HH will represent a drop in the sum of $x$ and $x^*$, implying that the price will go up.

5 Transfer Pricing

Transfer price is the price of a commodity, service, or asset that is transferred between different branches or divisions in different locations of a firm. Transfer pricing is an especially important topic for economists and the governments concerned if the locations of the firm’s branches are subject to different tax scales (corporate profit taxes, value-added taxes, and so on) and if the tax revenues are collected by different governments. For example, for multinational corporations, the branches are in different countries, and generally these countries have different tax rates on the profits of the firms. Therefore, the transfer pricing chosen by the MNCs may affect their profits and thus the tax revenues received by the governments.

To see how transfer pricing works, let us consider two examples.

Example 1. Consider a firm in country A, which wants to sell $x$ units of a product to country B at a price of $p_B$. If the cost is $C$, the firm’s (before-tax) profit is equal to $\pi = p_Bx - C$. All transport costs are neglected. Let the profit tax rate imposed by the government in A be $t_a$. Then the firm has to pay a tax of $T = t_a\pi$. Suppose that
there is country C where the profit tax rate is \( t_c \), which is lower than \( t_a \), \( t_c < t_a \). The firm can set up a subsidiary in C, sell the product produced in A to the subsidiary in C at a price of \( p_c \), which is lower than \( p_b \), \( p_c < p_b \), but greater than or equal to the average cost, \( C/x \). The subsidiary then sells the product to B at a price of \( p_b \). The profit of the headquarter is \( \pi_a = p_c x - C \) and it pays a tax of \( T_a = t_a(p_c x - C) \). The subsidiary receives a profit of \( \pi_c = (p_b - p_c)x \), which implies a tax of \( T_c = t_c x (p_b - p_c) \).

Under this arrangement, the total profit of the firm is the same as before, \( \pi = \pi_a + \pi_c \) while the total tax that it has to pay is \( T' = t_a(p_c x - C) + t_c x (p_b - p_c) \), which depends on what the transfer price is. To minimize the tax, the firm can set the transfer price as \( p_c = C/x \). As a result, the headquarter’s profit is \( \pi_a = p_c x - C = 0 \), while the subsidiary’s profit is \( \pi_c = (p_b - p_c)x = p_b x - C \). The firm pays a tax of \( T' = t_c(p_b x - C) \).

What are the implications of the firm’s arrangement? First, the firm’s (before-tax) profit remains the same, but because country C has a lower profit tax rate, the firm pays less tax. Second, country A loses the tax revenue. Third, country C gets a tax revenue although it is less than what country A originally receives. Country B, as a consumption country, is not affected.

In Example 1, there is no implication on resource allocation, as long as the total output of the firm does not change. In the following example, transfer pricing has implications on production and resource allocation.

**Example 2.** Consider again the multi-location monopoly described earlier. Suppose that country S (where the headquarter is located) and country H (location of the subsidiary) have ad valorem profit tax rates equal to \( t \) and \( t^* \), respectively. The firm is required to report to the respective governments its profits generated by its headquarter and subsidiary. Let the (before-tax) profit received by the firm’s headquarter and that by its subsidiary be \( \pi \) and \( \pi^* \), respectively. The after-tax profits then become \((1 - t)\pi\) and \((1 - t^*)\pi^* \), respectively. Taking the profit taxes are given, how can the firm choose its optimal outputs?

Denote the outputs of the headquarter and subsidiary by \( x \) and \( x^* \), and their costs of production be \( C = C(x) \) and \( C^* = C^*(x^*) \), respectively. Recall that market demand is \( p = p(x + x^*) \). International transport costs are ignored. The pre-tax profits of the firm’s headquarter and subsidiary are equal to:

\[
\begin{align*}
\pi &= px - C(x) \\
\pi^* &= px^* - C^*(x^*).
\end{align*}
\] (12a)

Therefore the total after-tax profit is

\[
\Pi = (1 - t)(px - C) + (1 - t^*)(px^* - C^*). \tag{13}
\]

The firm is to choose optimal outputs \( x \) and \( x^* \) to maximize the total after-tax profit,
taking the tax rates as given. The first-order conditions are

\[
\frac{\partial \Pi}{\partial x} = (1 - t)(p + p'x - MC) + (1 - t^*)p'x^* \leq 0 \tag{14a}
\]

\[
\frac{\partial \Pi}{\partial x^*} = (1 - t)p'x + (1 - t^*)(p + p'x^* - MC^*) \leq 0. \tag{14b}
\]

Define \( \theta = (1 - t^*)/(1 - t) \). The two first-order conditions reduce to (assuming positive outputs):

\[
p + p'(x + \theta x^*) = MC \tag{15a}
\]

\[
p + p' \left( \frac{x}{\theta} + x^* \right) = MC^*. \tag{15b}
\]

The optimal outputs can be obtained by solving conditions (15). Graphically, the equilibrium can be determined in a way similar to what was described before. In Figure 4.5, condition (15a) is illustrated by curve SS while condition (15b) is described by curve HH. As described before, the intersection between the curves gives the optimal outputs. Both curves are negatively sloped, but in magnitude, the slope of curve SS is greater than 1 but that of curve HH is smaller than 1.

Suppose initially both governments impose the same tax rate: \( t = t^* \), implying that \( \theta = 1 \). Denote the initial equilibrium point by N. Assume now that there is a rise in \( t \) while \( t^* \) does not change. Then \( \theta \) increases. If the demand curve is approximately a straight line, then in Figure 4.5, curve SS shifts to the left and curve HH shifts upward. Let the new curves be \( S'S' \) and \( H'H' \), respectively. The new equilibrium point is at point M, showing that \( x \) drops and \( x^* \) goes up. In other words, a rise in country H’s profit rate or a drop in country S’s profit rate will encourage investment but discourage export.
6 Outsourcing and FDI

The previous analysis examines the production of a final product, which can be carried out either in the source country, in a host country, or in both. Suppose now that the production process can be broken up into several stages, which have to be taken, usually in a fixed order, before the production is completed and the product is sold. The breaking-up of the entire production process into several stages is called fragmentation. Fragmentation can be caused by an emergence of a new production process/technology, or can be due to the effort of the firm to break up a production process into several stages.

The existence of fragmentation means that the original production process can be replaced by several production processes; i.e., instead of having one production function for a product, the firm can consider having several production functions for different components of the product plus a step of putting the components together to form the final product. For example, consider the production of chairs. The whole production process requires designing, the purchase of raw materials (such as wood, nails, wheels, leather, and may be steel as well), wood preparation (such as sawing wood into the right shapes and sanding), cushion preparation (such as cutting leather into the right shapes), cushion preparation, the work of putting the wood, cushion, and so on together, quality control, transporting to the market, and marketing and promotion. Initially, a firm hires workers and uses machines to carry out all these processes.

Fragmentation is to break the whole production process into different stages. The reason for fragmentation is that some of these stages can be done by some other firms, which may be located in other locations. For example, suppose that cushion preparation requires some special techniques and the firm finds that it is costly to do so because of the lack of workers of the right skill. Then it may instead buy cushion produced by other firms. The rest of the production process will remain the same as before. The work of delicating part of the original production process to other firms is called outsourcing. If the firm that produces the cushion is located in another country, the process can be called offshoring.

Fragmentation offers the firm the option of outsourcing or offshoring. However, outsourcing may involve the transportation of components, whether a firm will choose outsourcing the production of these components to another firm will depend on the saving in cost that it can get and the costs of transportation. Transportation costs can be a even more important factor in the outsourcing/offshoring decision if the other firm is in another country.

Sometimes offshoring can generate externality, which the firm will take into consideration in finding the optimal output. For example, the presence of a subsidiary of an MNC may generate good will to the consumers in the host country, helping the sale of its final product. In this case, the firm will have a bigger incentive to set up a subsidiary and produce some components there. In this case, offshoring very likely
involves foreign direct investment (FDI).

Some recent examples of offshoring can be presented. For example, consider Apple Inc., which recently designed a new iPhone model. Apple asked Foxconn to produce iPhones in China, using intermediate inputs imported from countries like South Korea and Japan. Apple did not actually produce the phones in China, nor did it manufacture the intermediate inputs. In some sense, Apple imported the assembled phones from China, without much direct investment there.

Another example is the manufacturing of some Boeing aircrafts. To produce 787 model of aircrafts, Boeing used wings and other components produced in other countries as the intermediate inputs of each aircraft. Planning, coordination of the supply of intermediate inputs, supervision, and the assembling of the parts are all done in the United States. In this case, there is not much direct investment by Boeing in other countries. More recently, Boeing formed a joint venture with Commercial Aircraft Corp. of China (COMAC) in 2017 to set up a completion plant for 737 aircrafts in Zhoushan, near Shanghai, China. In this case, direct investment by Boeing was involved.

A formal analysis of outsourcing is provided here. Consider an initial production process of a firm, in which a final product is produced. Denote the output of the product by \( y \), its price by \( p \), and the cost of production by \( C(y) \). Then the profit of the firm is

\[
\pi = py - C(y). \tag{16}
\]

The production process consists of two stages, which are labeled 1 and 2. In stage 1, an intermediate input is produced, while stage 2 involves using the intermediate input, and possibly other inputs as well, to produce a final product, which can be sold in a domestic or foreign market. Denote the output of stage 1 by \( y_1 \), and the cost by \( C_1(y_1) \). The output of stage 2 is simply the final product, \( y \). Denote the cost of production in stage 2 by \( C_2(y) \). The profit function in (16) can be written as

\[
\pi = py - C_1(y_1) - C_2(y). \tag{17}
\]

If the firm carries out the entire production process and if no other costs are involved, then \( C_1(y_1) + C_2(y) = C(y) \). In this case, equation (17) is the same as (16).

With fragmentation of the production process, the firm can consider outsourcing either stage, or both stages, to other firms. Assume for simplicity that stage 1 will have to be done by the firm itself (the headquarter), while stage 2 may be outsourced to another firm. One example is the production of iPhones by Apple Inc. Stage 1 is the development of new technology and planning, while stage 2 is the physical production of iPhones. Stage 1 is skilled-labor intensive and capital intensive. It is cheaper to develop new technology in the United States, while stage 2 is unskilled-labor intensive. Apple would then like to outsource stage 2 to a firm where unskilled labor is abundant and cheap. In this case, Apple outsources the production of iPhones to Foxconn, which produces the phones in China.
Denote the cost of the production in stage 2 by another firm by $C^*(y)$, which includes the cost of transporting the produce back to the headquarter or to the market. In other words, $C^*(y)$ is what the firm has to pay for the production of the output $y$ in stage 2. Outsourcing will exist if $C^*(y) < C(y)$. The profit of the firm is

$$\pi = py - C_1(y_1) - C_2^*(y).$$

(18)

The above two-stage model can be extended to models with more stages. Consider the production of 787 aircrafts by Boeing. The whole production can be broken up into three stages: (i) development of new technology; (ii) production of intermediate inputs and aircraft parts; and (iii) assembling the parts. As in the case of production of iPhones by Apple, stage 1 of producing 787 aircrafts is also skilled-labor and capital intensive. So, it is produced by Boeing in the United States. Stage 3 is also skilled-labor intensive: It is also done in the United States. The production of intermediate inputs and aircrafts in stage 2 is outsourced to many firms all over the world. The products in this stage are shipped to the United States and are assembled together.

Both the iPhone and the 787-aircraft cases involve not much foreign direct investment since the production of the parts of the products is done by foreign firms.\(^5\) In a sense, the outsourcing by Apple and that by Boeing are similar to importing the intermediate inputs and parts from other countries, although these foreign firms are producing the parts specifically for Apple and Boeing.

\(^5\)Both Apple and Boeing do have foreign offices and these represent not much foreign investment.