



Horizontal FDI: Part II

This version: September 8, 2016

[*This note has been revised. The two numerical examples have been changed.*]

In part one of these notes we developed a model of identical firms competing in a market. We focused on firm outcomes — in particular profits — taking as given the number of firms operating in each country. The key to solving the model was finding the share of total expenditure that each firm earns, s_i . With these shares in hand, we computed profits. For example, in the two-country model with exporting, the profits of a firm located in country 1 are

$$\pi_1 = \frac{s_1 E_1}{\epsilon_1} + \frac{\rho s_2 E_2}{\epsilon_2} - w_1 f^h - w_1 f^p. \quad (1)$$

The first term on the right-hand side is the profit earned by selling in the home country. The second term is the profit earned by selling in the foreign country — exporting. The last terms are the fixed costs.

In this note, we will add multinational production to the model and study how differences in economy size and exporting frictions influence the decision to serve a market by exporting or by multinational production.

The world economy consists of two countries: $i = 1, 2$. Each country's total expenditure is E_i . We will consider two kinds of firms: 1) *domestic firms*, which only produce in their home country and serve foreign markets by exporting and 2) *multinational firms*, which produce in the home country and in the foreign country. There are many firms of each type in each country. Let m_i be the number of multinational firms producing in country i and let n_i be the number of domestic firms operating in i .

We continue to hold fixed the number of each type of firm in each country and study how prices and quantities are determined. Later, we will study how the number of firms of each type is determined.

Multinational production

A multinational firm's nationality is determined by its headquarters location. For example, we say that a multinational firm is *from country 1* (or is a *country-1 multinational*), if its headquarters is located in country 1.

A multinational firm serves the foreign country by producing in and selling to the foreign country. This means that a multinational selling in a foreign country has the same costs as a domestic firm in that country. Since the multinational has the same costs as the domestic firm, it will also have the same market share. For example, a country-1 multinational firm has market share s_2 . Notice that this is a larger market share than an exporter from country 1 selling in country 2, ρs_2 . This is the advantage of being a multinational. By not paying the extra transportation and tariff costs, the multinational firm is more competitive, and, compared to an exporter, earns a larger market share.

Compared to exporting, producing as a multinational earns the firm a larger market share in the foreign country. The cost of becoming a multinational is the extra fixed cost it must pay to produce in the foreign country. An exporter pays the headquarters fixed cost and the production fixed cost

for its plant in its home country, $f_i = w_i f^h + w_i f^p$. A multinational pays the headquarters fixed cost, the production fixed cost for its plant in its home country, and the production fixed cost for its plant in the foreign country

$$f_i = w_i f^h + w_i f^p + w_j f^p. \quad (2)$$

Notice that we now have to be careful about the “cost” of the fixed costs. The fixed production cost incurred in the foreign country is paid in the foreign country’s marginal cost, w_j . We do not have to make this assumption, but it will make the math easier later on. [Note: When we are considering a generic country i , the other country is denoted country j .]

The profit earned by a country-1 multinational is

$$\pi_1^m = \frac{s_1 E_1}{\epsilon_1} + \frac{s_2 E_2}{\epsilon_2} - w_1 f^h - w_1 f^p - w_2 f^p. \quad (3)$$

The first term on the right-hand side is the profit from selling in country 1, the second term is the profit from selling in country 2 (notice that the share is s_2), and the fixed costs are one headquarters cost, one production cost in country 1, and one production cost in country 2. The profit for a country 2 exporter is similar,

$$\pi_2^m = \frac{s_1 E_1}{\epsilon_1} + \frac{s_2 E_2}{\epsilon_2} - w_2 f^h - w_2 f^p - w_1 f^p. \quad (4)$$

As in the other models, the key to computing profit is finding the market shares of the firms. In this model, we have exporting domestic firms (n_1, n_2) and multinationals (m_1, m_2). These shares must sum to one. In country 1, this implies that

$$1 = (n_1 + m_1 + m_2)s_1 + n_2 \rho s_1 \quad (5)$$

and in country 2,

$$1 = (n_2 + m_1 + m_2)s_2 + n_1 \rho s_2. \quad (6)$$

As before, we solve these equations for s_1 and s_2 ,

$$s_1 = \frac{1}{n_1 + m_1 + m_2 + n_2 \rho}, \quad s_2 = \frac{1}{n_2 + m_1 + m_2 + n_1 \rho}. \quad (7)$$

Numerical example. Consider a two-country world with exporting firms and multinationals. Let $w_1 = w_2 = 2$, $E_1 = E_2 = 1000$, $\epsilon_1 = \epsilon_2 = 2$, $f^h = 0.5$, $f^p = 0.05$, and $\rho = 0.75$. What are the country-1 domestic firm’s profits and multinational firm’s profits when $n_1 = 10$, $n_2 = 10$, $m_1 = 2$, and $m_2 = 2$?

We find that the domestic (and multinational) firm’s market share in country 1 is $s_1 = 0.0465$ and the domestic firm’s market share in country 2 is $\rho s_2 = 0.0349$. The domestic firm’s total profits are $\pi_1 = 39.598$ and the multinational firm’s profits are $\pi_1^m = 45.317$.

Why do multinational firms earn greater profits than domestic firms?

The proximity-concentration tradeoff

We now know how to compute profits for domestic and multinational firms conditional on the number of each type. This was the second stage of the model. Now, we can work on the first stage of the model and ask: When would a firm want to be a multinational rather than a domestic firm?

Suppose that there are n_1 , n_2 , m_1 , and m_2 firms in the economy. How do profits change if one domestic firm in country 1 decides to become a multinational? This decreases the number of domestic firms in country 1 to $n_1 - 1$ and increases the number of multinationals from country one to $m_1 + 1$. The new market shares are

$$s_1 = \frac{1}{(n_1 - 1) + (m_1 + 1) + m_2 + n_2\rho}, \quad s_2 = \frac{1}{n_2 + (m_1 + 1) + m_2 + (n_1 - 1)\rho}. \quad (8)$$

Notice that the country-1 market share does not change. The new multinational just replaces the domestic firm that it once was. In country 2, a less-competitive exporter is replaced by a more competitive multinational. This decreases the market share of all firms in country 2, since $\rho < 1$.

How does this change the profit of the firm that was domestic and is now a multinational? Let $\pi_1(n_1, n_2, m_1, m_2)$ be the profit of the domestic firm when there were n_1 , n_2 , m_1 , and m_2 firms in the economy. This profit is

$$\begin{aligned} \pi_1(n_1, n_2, m_1, m_2) = & \left(\frac{1}{n_1 + m_1 + m_2 + n_2\rho} \right) \frac{E_1}{\epsilon_1} \\ & + \left(\frac{\rho}{n_2 + m_1 + m_2 + n_1\rho} \right) \frac{E_2}{\epsilon_2} \\ & - w_1 f^h - w_1 f^p, \end{aligned} \quad (9)$$

where we have substituted the market shares given the number of firms.

The profit of the new multinational in an economy with $n_1 - 1$, n_2 , $m_1 + 1$, and m_2 firms, $\pi_1^m(n_1 - 1, n_2, m_1 + 1, m_2)$, is

$$\begin{aligned} \pi_1^m(n_1 - 1, n_2, m_1 + 1, m_2) = & \left(\frac{1}{(n_1 - 1) + (m_1 + 1) + m_2 + n_2\rho} \right) \frac{E_1}{\epsilon_1} \\ & + \left(\frac{1}{n_2 + (m_1 + 1) + m_2 + (n_1 - 1)\rho} \right) \frac{E_2}{\epsilon_2} \\ & - w_1 f^h - w_1 f^p - w_2 f^p. \end{aligned} \quad (10)$$

We can compute the increase in profit for the firm by subtracting the old domestic profit from the new multinational profit,

$$\begin{aligned} \pi_1^m(n_1 - 1, n_2, m_1 + 1, m_2) - \pi_1(n_1, n_2, m_1, m_2) = & \\ & \left[\frac{1}{n_2 + (m_1 + 1) + m_2 + (n_1 - 1)\rho} - \frac{\rho}{n_2 + m_1 + m_2 + n_1\rho} \right] \frac{E_2}{\epsilon_2} \\ & - w_2 f^p. \end{aligned} \quad (11)$$

Since the firm's market share in its home country did not change, the terms involving the home market have canceled out. The first term on the right-hand side is the increase in the firms profits

from selling to country 2. This term is positive since $\rho < 1$: The firm's market share in country 2 has increased because it no longer has to pay the extra marginal costs to export. The second term on the right-hand side is negative, and it is the extra fixed production cost that the firm pays because it now produces in country 2.

Numerical example. Consider a two-country world with exporting firms and multinationals. Let $w_1 = w_2 = 2$, $E_1 = E_2 = 1000$, $\epsilon_1 = \epsilon_2 = 2$, $f^h = 0.5$, $f^p = 0.05$, and $\rho = 0.75$.

If there are originally $n_1 = 10$, $n_2 = 10$, $m_1 = 2$, and $m_2 = 2$ firms in the economy, what is the extra profit a country-1 domestic firm would earn if it became a multinational?

The increase in profit is 5.45. You could have found this by using (11) directly, or by computing the profit for each case, using (9) and (10), and then subtracting.

Equation 11 encapsulates the tensions inherent in horizontal multinational activity. On the one hand, becoming a multinational provides better access to the foreign market, but, on the other hand, the firm pays more fixed costs to set up production. We can summarize this idea as the proximity-concentration tradeoff.

The proximity-concentration tradeoff. The number of multinational firms, relative to domestic firms is larger

1. the larger is the foreign market (larger E_j).
2. the larger are export costs (smaller ρ).
3. the smaller are production fixed costs (smaller $w_j f^p$).

Proximity. Firms would like to be close to the markets they serve. Producing in the foreign market saves on transportation, tariff, and other costs of exporting. The gain to market proximity is larger when export costs are large or when the foreign market is large.

Concentration. Firms would like to concentrate their production in one facility so that they minimize fixed production costs. When fixed production costs ($w_j f^p$) are small, the penalty to replicating production in other countries is small, so firms are more likely to be multinationals. [How does this relate to economies of scale?]