

Alternatives

Suppose a firm located in one country wishes to sell its output in another country. We have been assuming that a firm would serve a market in another country by exporting to that country. In fact, such a firm has three main choices of how to serve another market:¹

1. export,
2. license a firm there to produce,
3. or form a subsidiary there to produce.

Now, we consider these two additional options, and the choice between them. The firm will choose its best alternative, the mode that maximizes its profits. What factors determine the firm's choice?

When a firm forms a subsidiary, the firm becomes a multinational, as it then has operations in more than one country. The process of multinationalization is also known as foreign direct investment (FDI) or direct foreign investment (DFI). Like trade, FDI is often two-way: firms from two countries invest in each other's countries by forming subsidiaries there.

FDI and licensing share the trait that production is shifted abroad. A key distinction between FDI and licensing is that with FDI the subsidiary is part of the multinational firm, whereas with licensing the licensee is a separate firm. Hence the interests of the licensee and licensor can (and often do) clash. Opportunistic behavior occurs when a licensee takes an action that raises its own profits but lowers the profits of the licensor.

¹Even more options such as joint ventures exist, but these three suffice to emphasize the key distinctions between the alternatives.

OLI Framework

Certain considerations make forming a subsidiary more attractive than other alternatives. For FDI to be more attractive than licensing or exporting, a firm needs to have three advantages:

- **OWNERSHIP** advantage exists when the firm has patent or exclusive ability to do something well, so that the firm should sell to markets abroad (rather than local firms there).
- **LOCATIONAL** advantage exists when tariffs, transportation costs or comparative advantage make exporting unattractive.
- **INTERNALIZATION** advantage exists when imperfect contracts make licensing unattractive, so profits from producing and selling in several countries greatest if all activities occur within one firm, thus eliminating opportunistic behavior.

If only ownership and locational advantages are present, a firm chooses to license its technology to a local firm. If only ownership and internalization advantages are present, a firm chooses to export.

Internalization

Transactions are internalized due to complications of exchanging information between firms. With arms-length use of markets, one firm has to tell another firm its production secrets. Once the second firm has the knowledge necessary to produce the product, it may become a competitor. The licensee might not renewing the contract at its conclusion and yet continue to sell, or might sell output in another market not permitted in the contract.

How can a contract be constructed to extract the full profits from selling in the foreign market? Suppose the licensor charges license fee equal to the profits from foreign production in one period. At the end of the first period, the contract can be renewed for the second period. However, the licensee may

refuse to pay the license fee for the second period, but continue to use the knowledge. If the licensor were to license a different firm in the second period, the fee it could charge would be reduced due to the competition from the first period's licensee (who produces without a contract in the second period).

To avoid the problems inherent in renewal, the licensor could charge license fee equal to present value of the profits from foreign production. However, the potential licensee will likely be unwilling to pay the fee for fear that the licensor might improve product and damage the profitability of the licensee. Thus, the licensee would insist on some clause about right of access to product or technological improvements, but the nature of R&D means assessing the value of these improvements in advance is very hard. Neither firm knows how big the improvements will be or when they might arrive.

Firms experience difficulty in writing complete contracts specifying actions and payoffs for all states of nature due to the vast number of states of nature (having positive probability). Even if it were possible to write complete contracts, then firms find it especially difficult to enforce contracts in an international arena. Other countries (especially developing countries) often do not enforce intellectual property rights as well as the United States and other developed countries. Even developed countries are known to favor their own firms and thus imperfectly protect the interests of licensors from other countries. An inherent conflict between firms' profits occurs unless profits are all in one firm. These informational and enforcement issues are central to modeling the formation of multinational firms.

Markusen *JEP* 1995

FDI has expanded rapidly recently, so the causes and effects of FDI is a particularly important issue. Much FDI occurs between similar countries (with similar factor endowments) and is often two-way. Markusen provides an excellent survey emphasizing these stylized facts of FDI.

- FDI has grown rapidly, with a large share of world trade (30%) occurring within firms.
- Most FDI (70%) has developed countries as both the host

and the source countries, and much of this FDI is two-way.

- FDI is mostly horizontal, where multinationals create local production facilities in each country and sell most of their output within each country. This structure contrasts with vertical FDI, where multinationals allocate production processes across countries in accordance with factor intensity or other sources of comparative advantage.
- Multinational firms tend to arise in industries with large R&D expenditures relative to sales and substantial product differentiation. Thus multinational firms have substantial intangible assets (including brand recognition/reputation).
- Trade barriers and transport costs generate a substitution effect toward FDI while decreasing the overall level of both investment and trade.

Prior to Ethier (1986), most formal models of FDI were based on factor endowments (and thus could yield only one-way FDI) and failed to model internalization advantage.

Ethier *QJE* 1986

- Two countries: home and foreign (*)
- Two goods: wheat (W) and manufactures (M)
- Two factors: land (T) and labor (L), internationally immobile
- Land is specific to wheat production, while labor is used to produce both goods, earning the wage (w).

Wheat Pro-
duction

Land (T) and labor (L) produce wheat (W) according to the production function for wheat

$$W = F(L_W, T) \tag{7.1}$$

where L_W is labor allocated to the wheat sector.

Manufacturing Stages

Manufacturing occurs in three stages:

1. research,
2. upstream production,
3. downstream production.

Timing

The timing is:

1. Labor allocated between research and production.
2. Research outcome realized.
3. Quality levels chosen.

Research Stage

Research determines the variable costs for upstream production, the unit labor requirement a . The realized research outcome dictates whether costs will be high (a_H) or low (a_L), with $a_L < a_H$. Labor devoted to research R increases probability $p(R)$ that costs low $a = a_L$. Assume $p' > 0$ and $p'' < 0$. The cost of research is paying the wage w to the R units of labor hired: wR . The technology for producing a variety of manufactures at high or low cost provides an *ownership advantage*. The attribute that this ownership advantage is private information will contribute to the *internalization advantage*.

Upstream Stage

Upstream varieties produced in different quality levels Q , where $0 \leq Q \leq \bar{Q}$ and \bar{Q} is the maximum quality. Given the wage w , the variable cost of producing one unit of manufactures of quality Q and any variety is aQw , which increases with quality Q based on research outcome $a \in \{a_L, a_H\}$. Given the research outcome a , the firm chooses its optimal quality choice as $Q_H = Q(a_H)$ when costs are high or $Q_L = Q(a_L)$ when costs are low ($Q_L > Q_H$). The expected cost of upstream production is thus

$$p(R)a_LQ_Lw + [1 - p(R)]a_HQ_Hw \quad (7.2)$$

where the first term represents the possibility that costs will be low and the second term the possibility that costs will be high.

Downstream Stage

The nontraded downstream output creates *locational advantage* as production must be located where the consumption is located by assumption. The labor requirement q in downstream production is invariant to variety, quality and location. Assume consumers tastes are identical across countries. One unit of each good is consumed worldwide of each variety that is produced in equilibrium. The domestic consumption fraction of manufactures is μ , and the foreign fraction is $1 - \mu$. Consumers view a unit of manufactures of quality Q as a perfect substitute for Q units of wheat. The cost of downstream production is qw_0 , where $w_0 \equiv \mu w + (1 - \mu)w^*$ is the average world wage (a convex combination of the two country's wages weighted by consumption shares).

Integrated Equilibrium

Assume relative efficiency of labor across activities is the same across countries. Suppose firms are risk neutral and take the wage as given. We examine what happens when all activities are concentrated in one (multinational) firm. Denote the wage of an efficiency unit of foreign labor w^* and suppose the domestic wage is lower than the foreign wage $w < w^*$. A firm's expected revenue (prior to realization of the research outcome) is

$$p(R)Q_L + [1 - p(R)]Q_H \quad (7.3)$$

where the first term is revenue if low costs and the second term is revenue if high costs. Note that $P_W = 1$ by normalization and so $P_M(Q) = Q$ due to perfect substitutability. The firm's problem to pick labor allocated to research and qualities conditional on high or low cost research outcome $\{R, Q_H, Q_L\}$ to maximize expected profits

$$E\pi = p(R)Q_L(1 - a_L w) + [1 - p(R)]Q_H(1 - a_H w) - (wR + qw_0) \quad (7.4)$$

The first two terms are revenues minus upstream costs (under low and high cost outcomes) and the last two terms are research costs and downstream costs. The parameters are $\{a_L, a_H, w, w^*, \mu, q\}$.

The firm's optimal decision depends on wages and potential research outcomes. A firm may decide to never enter, always enter, or enter only if enjoy the good research outcome (low cost).

1. *STATE INDEPENDENT NONENTRY (NEVER ENTER)*.

If the wage exceeds even the highest possible marginal

product

$$w > \frac{1}{a_L} > \frac{1}{a_H} \quad (7.5)$$

then profits would be negative even if the firm realized the best research outcome. Thus, the firm will never want to produce and will never conduct any research.

$$R = Q_L = Q_H = 0 \quad (7.6)$$

2. *STATE DEPENDENT ENTRY*. If the wage exceeds the lower marginal product but not the higher marginal product,

$$\frac{1}{a_L} > w > \frac{1}{a_H} \quad (7.7)$$

then profits will be positive only if the firm realizes the best research outcome. Here research expenditure depends on the wage, and the firm produces only if it enjoys low costs as a result of its research.

$$R > 0, Q_H = 0, Q_L = \bar{Q} > 0 \quad (7.8)$$

3. *STATE INDEPENDENT ENTRY*. If even the lower marginal product exceeds the wage,

$$\frac{1}{a_L} > \frac{1}{a_H} > w \quad (7.9)$$

then profits will be positive regardless of the research outcome. Here research expenditure does not depend on the wage.

$$R > 0, Q_H = Q_L = \bar{Q} > 0 \quad (7.10)$$

Whether entry is state dependent generates reason to form multinational firms

Manufacturing Equilibrium

Expected profits (7.4) must equal zero due to free entry. With state dependent entry ($Q_H = 0$) must have expected profits from low cost production be zero

$$E\pi = p(R)\bar{Q}(1 - a_L w) - (wR + qw_0) = 0 \quad (7.11)$$

while with state independent entry must have expected profits from both types of production be zero

$$\begin{aligned} E\pi &= \bar{Q} \{p(R)(1 - a_L w) + [1 - p(R)](1 - a_H w)\} - (wR + qw_0) = 0 \\ &= \bar{Q} \{1 - p(R)a_L w - [1 - p(R)]a_H w\} - (wR + qw_0) = 0 \end{aligned} \quad (7.12)$$

The zero profit conditions gives relationship between w and w^* through w_0 . Similarly, require zero foreign profits if research and upstream production more profitable there.

General Equilibrium

Let n denote the number of (domestic) firms with research and upstream production at home and let n^* denote the number of (foreign) firms with research and upstream production abroad. Labor market equilibrium has domestic labor paid its marginal product in terms of wheat (which is value of marginal product as $P_W = 1$)

$$\begin{aligned} w &= F_L(L_W, T) = F_L(L - L_M, T) \\ &= F_L(L - n[a(w)Q + R(w) + \mu q] - n^*\mu q, T) \end{aligned} \quad (7.13)$$

and similarly for foreign labor

$$\begin{aligned} w^* &= F_L^*(L_W^*, T^*) = F_L^*(L^* - L_W^*, T^*) \\ &= F_L^*(L^* - n^*[a(w^*)Q + R(w^*) + (1 - \mu)q] - n(1 - \mu)q, T^*) \end{aligned} \quad (7.14)$$

These equations give relation between the domestic and foreign wages $\{w, w^*\}$ and either n^* (as $n = 0$ when $w > w^*$) or n (as $n^* = 0$ when $w < w^*$). That is, the equations determine the domestic and foreign wage and the number of domestic or foreign firms.

International Equilibrium

Both labor market equilibrium and manufacturing equilibrium must hold, creating three possibilities:

1. $w < w^*$: all research and upstream production takes place at home $n > 0$ and $n^* = 0$
2. $w > w^*$: all research and upstream production takes place abroad $n = 0$ and $n^* > 0$
3. $w = w^*$: research and upstream production occur both at home and abroad $n \geq 0$, $n^* \geq 0$ and $n + n^* > 0$

R&D and upstream production are located wherever costs are lower. The production process is vertically split across countries - called vertical FDI.

Arms-Length Contracting

Now consider an arm's length contract between a research/upstream firm and two downstream firms (home, foreign). Contract replicates $\{R, Q_H, Q_L\}$ choices made by fully integrated firm. Downstream firms pay P per unit such that downstream firms earn zero profit. How much downstream firm can pay depends on success of research effort. Pays P_H for $a = a_H$ but P_L for $a = a_L$ where

$$P = p(R)P_L + [1 - p(R)]P_H \quad (7.15)$$

The downstream firm cannot observe research expenditure R or success. Any contract must be incentive compatible to ensure upstream firm keeps its side of the deal. Payments

$$P_L = P + [1 - p(R)]Q_L \quad (7.16)$$

in the event of low cost research outcome and

$$P_H = P - p(R)Q_H \quad (7.17)$$

in the event of the high cost research outcome are incentive compatible.

Role of Multinationals

State contingent contracts may be difficult to implement. Suppose arms length contracts cannot be state contingent. Forming a multinational firm is a way to avoid writing state contingent contracts. Joining firms brings their profit objectives in line, removing opportunistic temptations. Direct investment substitute for interindustry trade, compliment to intraindustry trade. Similar factor endowments gives rise to direct investment, possibly two-way.

Glass and Saggi JIE 1999

Constructs a model that examines the consequences of FDI across countries. By shifting labor demand across countries and raising the wage in the host at the expense of the wage in the source, FDI not only benefits host workers at the expense of source workers, it also reduces profits of host firms by raising wages abroad. Thus, a tension arises between worker interests and firm profits in the two countries.

Model

The key assumptions of the model are (note symmetry):

- one factor, skilled labor, available in fixed supply in each country
- $n \geq 1$ industries with homogeneous goods
- one unit of each good is produced using one unit of skilled labor
- m identical source firms and M identical host firms in each industry
- market for skilled labor is competitive

Output market

Let y_j denote the output of a representative source firm in industry j (so total industry output of source firms is my_j). Let capital letters denote the host analogues of each variable: in particular, the output of a representative host firm in industry j is Y_j (so total industry output of host firms is MY_j). Total output in industry j is $Q_j \equiv my_j + MY_j$, the sum of source and host production by firms in industry j . Let the demand function in some third country be given by $P_j = p_j(Q_j)$ where $p'_j(Q_j) < 0$ and $p''_j(Q_j) \leq 0$.

Each source firm decides whether to produce each unit at home or abroad. Let α_j denote the share of skilled labor demanded abroad by a source firm in industry j , which provides a measure of the extent of FDI. Host firms do not undertake FDI in the source country. FDI seeks lower production costs, so in equilibrium FDI occurs in only one direction.

Suppose source firms in industry j are offered a subsidy σ_j for each unit of output that they produce in the host country.¹⁰ If $\sigma_j > 0$, the subsidy acts like a reduction in the host wage for skilled labor hired by source firms. Negative values of subsidies are taxes.

The wage for skilled labor in the source country is z and in the host country is Z . The net marginal cost of a source firm in industry j is $c_j \equiv (1 - \alpha_j)z + \alpha_j(Z - \sigma_j)$ and the marginal cost of a host firm is $C \equiv Z$. All firms take the source and host wage for skilled labor as given.

If the source wage is less than the host wage minus the subsidy $z < Z - \sigma_j$, then all production by source firms remains in the source $\alpha_j = 0$. If the source wage is greater than the

host wage minus the subsidy $z > Z - \sigma_j$, then all production by source firms occurs in the host $\alpha_j = 1$. Hence, the source wage must equal the host wage minus the subsidy

$$z = Z - \sigma_j \quad (7.18)$$

for production by source firms to be split across countries $0 < \alpha_j < 1$. The FDI subsidy places a wedge between the source and host wages.

As Cournot oligopolists, each firm picks its quantity to maximize its profits, given the quantity chosen by the other firms. The profits of a source firm equal $\pi_j = [p_j - c_j] y_j$ while the profits of a host firm equal $\Pi_j = [p_j - Z] Y_j$. The first order conditions (simplified using $z = Z - \sigma_j$) are

$$\frac{\partial \pi_j}{\partial y_j} = p_j + y_j p'_j - c_j = p_j + y_j p'_j - z = 0 \quad (7.19)$$

$$\frac{\partial \Pi_j}{\partial Y_j} = p_j + Y_j p'_j - Z = 0 \quad (7.20)$$

In a symmetric equilibrium, all industries are identical and thus source firms split production across countries to the same extent regardless of industry.

Labor market

Only a fixed supply k of skilled labor per industry is available in the source country, so the wage must adjust to equate the demand for skilled labor with the supply of skilled labor. The source labor constraint is

$$(1 - \alpha) my = k \quad (7.21)$$

The source labor constraint relates production of each source firm to the extent of FDI and implicitly the source wage. Similarly, only a fixed supply K of skilled labor per industry is available in the host country. The host labor constraint is

$$\alpha my + MY = K \quad (7.22)$$

Adding the source and host labor constraints dictates that the total production of each industry is constant.

$$Q \equiv my + MY = k + K \quad (7.23)$$

With symmetric industries, the fixed availability of skilled labor in each country *fixes total output* in each industry. This aspect

of the model greatly simplifies the analysis since, in equilibrium, price and total output in each industry are unaffected by government policy – only FDI responds to policy and thus FDI affects the equilibrium through the changes in wages induced by FDI.

General equilibrium

An equilibrium must specify the output of a representative source firm y , the output of a representative host firm Y , the source wage z , the host wage Z , and the extent of FDI α of a representative source firm. Let $\{y^*, Y^*, z^*, Z^*, \alpha^*\}$ denote the solution to the system of equations: the FDI equilibrium condition (7.18), the first order conditions (7.19, 7.20), and the labor constraints (7.21, 7.22). The key parameters are the source skilled labor supply per industry k , the host skilled labor supply per industry K , the number of source firms in each industry m , and the number of host firms in each industry M .

Let $f \equiv m/M$ denote the ratio of source firms to host firms in each industry and $r \equiv k/K$ denote the ratio of skilled labor in the source relative to the host. Abbreviate p for $p(Q^*)$ and p' for the slope of the demand function at the equilibrium industry output Q^* given by (7.23), where $p' < 0$. Further let $\psi \equiv -p' > 0$.

Solving the system of equations gives the equilibrium extent of FDI

$$\alpha^* = \frac{\psi K(f - r) + \sigma f M}{(\sigma M + \psi K(r + 1)) f} \quad (7.24)$$

source wage

$$z^* = \frac{[(f + 1)pM - (r + 1)\psi K] - \sigma M}{(f + 1)M} \quad (7.25)$$

host wage

$$Z^* = \frac{[(f + 1)pM - (r + 1)\psi K] + \sigma f M}{(f + 1)M} \quad (7.26)$$

representative source firm output

$$y^* = \frac{\psi K(r + 1) + \sigma M}{\psi(f + 1)M} \quad (7.27)$$

and representative host firm output.

$$Y^* = \frac{\psi K(r + 1) - \sigma f M}{\psi(f + 1)M} \quad (7.28)$$

Next investigate the properties of the above equilibrium and then the welfare consequences of FDI policies.

Equilibrium analysis

FDI exists between asymmetric countries even in the absence of subsidies since autarkic wages would differ, providing the firms facing higher wages an incentive to shift production to the low wage country. Substituting $\sigma = 0$ in (7.24) gives the initial equilibrium extent of FDI

$$\alpha_0^* = \frac{f - r}{f(r + 1)} > 0 \iff f > r \quad (7.29)$$

Therefore, in the absence of any subsidy to FDI, FDI occurs $\alpha_0^* > 0$ iff $f > r$, when host skilled labor (measured in efficiency units) per firm is higher abroad than at home.

Assume $f > r$ (satisfied trivially by labeling the countries accordingly). In the absence of FDI, the host wage would be lower than the source wage due to lower demand for skilled labor relative to the fixed supply. Since an incentive for FDI exists as long as wages abroad are lower, FDI equalizes wages across the two countries in the absence of any taxes or subsidies to FDI.

The extent of FDI (7.24) increases with the number of source firms relative to host firms. The greater source labor demand due to the increased number of source firms puts upward pressure on the source wage, which encourages source firms to engage in more FDI. Since part of the increase in labor demand is shifted abroad through FDI, host wages increase. Thus source wages (7.25) as well as host wages (7.26) increase with the relative number of source firms. An increase in the relative number of source firms reduces the output of each firm, (7.27) and (7.28). As noted in (7.23), total production of each country is fixed by the world supply of skilled labor per industry, regardless of the number of firms in each industry. Thus, as the number of firms expands, industry output must be spread across more firms. The impact of relative source resources is exactly opposite that of the relative number of source firms.

Proposition 1 *An increase in the number of source relative to host firms increases both the source and the host wage, decreases both source and host output of each firm, and increases the extent of FDI. An increase in source relative to host skilled labor supply decreases both the source and the host wage, increases both source and host output of each firm, and decreases the extent of FDI.*

What are the consequences of FDI subsidies? A subsidy to FDI directly increases the incentive for source firms to shift

production to the host country. This production shifting transfers labor demand from the source to the host thereby raising host wages and lowering source wages. This movement of wages implies that the source firms enjoy a lower cost of production relative to host firms and therefore gain market share and enjoy higher profits.

Proposition 2 *A subsidy to FDI leads to a greater extent of FDI, a lower source wage, a higher host wage, larger output by each source firm and smaller output by each host firm.*

The effect of a subsidy to FDI on the equilibrium follows immediately from simple differentiation of the equilibrium values. A wage differential arises between the two countries (host wage exceeds source wage) that exactly equals the magnitude of the subsidy. According to (7.23), the increase in the source output exactly offsets the decrease in the host output, leaving total output of each industry unchanged.