Lecture 14

Multinational Firms

1. Review of empirical evidence
2. Dunning's OLI, joint inputs, firm versus plant-level scale economies
3. A model with endogenous multinationals
4. Pattern of trade in goods and services
5. Motives for internalization
6. A model of internalization

Firm and Industry Characteristics

(1) Multinationals are associated with high ratios of R&D relative to sales.

(2) Multinationals employ large numbers of scientific, technical, and other "white collar" workers as a percentages of their work forces.

(3) Multinationals tend to have a high value of "intangible assets"; roughly, market value minus the value of tangible assets such as plant and equipment.

(4) Multinationals are associated with new and/or technically complex products.

(5) Evidence suggests that multinationality is negatively associated with plant-level scale economies.

(6) Multinationals are associated with product-differentiation variables, such as advertising to sales ratios.

(7) A minimum or "threshold" level of firm size seems to be important for a firm to be a multinational, but above that level firm size is of minimal importance.

(8) Multinationals tend to be older, more established firms.

Country Characteristics

(1) The high-income developed countries are not only the major source of direct investment, they are also the major recipients. Most direct investment seems to be horizontal.

(2) There has been a major boom of direct investment into the developing countries in the 1990s, but most of it has gone to the more advanced LCDs and to China. Little goes to the least developed countries.

(3) Direct investment stocks have grown significantly faster than trade flows over the last two decades, even though trade barriers have fallen dramatically.

(4) High volumes of direct investment are associated with similarities among countries in terms of relative factor endowments and per capita incomes, not

differences.

(5) A high volume of outward direct investment is positively related to a country's endowment of skilled labor and insignificantly or negatively related to its physical capital endowment.

(6) There is little evidence that direct investment is primarily motivated by tariff avoidance or measurable transport costs,

(7) There is mixed evidence that tax avoidance and/or risk diversification are important motives for direct investment. Some evidence does suggest that political risk discourages inward investment.

(8) Infrastructure, skill levels, and a minimum threshold level of per capita income seem to be very important determinants of direct investment.

(9) There is evidence that agglomeration effects are important in direct investment. But it is admittedly difficult to distinguish agglomeration effects from firms being drawn to the same (unobserved) site-specific resources.

Table 1

	Annual growth rate (%), all countries		
	1986-1990	1991-1995	1996-1999
FDI inflows	24.7	20.0	31.9
FDI stocks	18.2	9.4	16.2
Sales of foreign affiliates	15.8	10.4	11.5
Gross product of foreign affiliates	16.4	7.1	15.3
Royalties and fees receipts	22.0	14.2	3.9
GDP at factor cost	11.7	6.3	0.6
Gross fixed capital formation	13.5	5.9	-1.4
Exports of goods and non-factor services	15.0	9.5	1.5

<u>Table 2</u>

FDI inflows and outflow, share in total

Year	Developed		Developing		CEE	
	in	out	in	out	in	out
1983-1987	76	95	24	5	0	0
1988-1992	78	93	21	7	1	0
1993	62	85	35	15	3	0
1994	59	83	39	17	3	0
1995	65	85	32	15	4	0
1996	58	85	38	15	3	0
1997	58	86	38	14	4	1
1998	71	95	26	5	3	0
1999	74	91	24	8	1	0

Source: UNCTAD World Investment Report, 2000 and earlier years

Point of Departure for Theory: Firms incur significant costs of doing business abroad relative to domestic firms in those countries.

Therefore, for a firm to become a multinational, it must have offsetting advantages.

Dunning (OLI): There are three necessary conditions for firms to be willing to undertake investments abroad

Ownership Advantage: the firm must have a product or a production process such that the firm enjoys some market power advantage in foreign markets.

Location Advantage: the firm must have a reason to want to locate production abroad rather than concentrate it in the home country, especially if there are scale economies at the plant level.

Internalization Advantage: the firm must have a reason to want to exploit its ownership advantage internally, rather than license or sell its product/process to a foreign firm.

Ownership Advantages, Firm-Specific Assets, and Knowledge Capital

Multinationality related to R&D, marketing, scientific and technical workers, product newness and complexity, product differentiation.

MNEs intensive in knowledge capital, knowledge-based assets

1. services of knowledge capital easily transported to distant plants
2. joint input or "public goods" nature of knowledge capital.

Physical capital intensity by itself should not give rise to multinationality.

What is being traded? Multinationals are exports of the services of knowledge-based assets: managerial and engineering services, financial services, reputations and trademarks.

Location advantages.

Horizontal multinationals producing the same goods and services in each location: Large markets and high trade costs.

Vertical multinationals geographically fragmenting the production process by stages: factor-price differences across countries are linked to the factor intensities of different stages, low trade costs.

Internalization advantages.

The same joint-input, public-goods property of knowledge that makes it easily transferred to foreign locations makes it easily dissipated. Firms transfer knowledge internally in order to maintain the value of assets and prevent dissipation.

Here are the principal elements of a single-firm model.

There are two countries, i and j.

There are two goods, *X* and *Y*.

There is one factor of production, *L*.

Y is produced with constant returns by a competitive industry in both countries.

X is produced by a single firm, headquartered in country i. Country j does not produce good *X*.

The *X* firm can have either

a single plant in country i:	a type-d (domestic or national) firm,
plants in both countries:	a type-h (horizontal multinational) firm, or
a single plant in country j:	a type-v (vertical multinational) firm.

Markets are segmented so that the *X* firm can price independently in the two markets without threat of arbitrage.

Double subscripts are used for X and Y, with the first indicating the country of *production* and the second the country of *consumption*. X_{ii} is the amount of X produced and sold in country i, positive if the firm is type-d or h.

X_{ij} is the amount produced in country i and sold in j, positive only if the firm is type-d.

X_{jj} is the amount produced and sold in country j, positive only if the firm is type-h or v.

X_{ji} is the amount produced in country j and sold in i, positive only if the firm is type-v.

$$U_{mi} = \alpha(X_{ii}/L_i) - (\beta/2)(X_{ii}/L_i)^2 + (Y_{ii} + Y_{ji})/L_i \qquad (1)$$

Aggregating across individuals, total utility in country i is given by:

$$U_i = L_i U_{mi} = \alpha X_{ii} - (\beta/2)X_{ii}^2/L_i + (Y_{ii} + Y_{ji}) \qquad (2)$$

Production of Y in country i is given by a simple linear function.

$$Y_{ii} + Y_{ij} = \gamma L_{yi} \tag{3}$$

Let Y be numeraire The national budget constraint requires that the value of the labor endowment plus profits of the national firm (Π_i) equals consumption.

$$\gamma L_i + \Pi_i = p_i X_{ii} + (Y_{ii} + Y_{ji}) \tag{4}$$

The representative consumer:

$$Max(X) \;\; U_i = \alpha X_{ii} - (\beta/2)X_{ii}^2/L_i + \gamma L_i + \Pi_i - p_i X_{ii} \tag{5}$$

Optimization yields a linear inverse-demand curve for X with demand independent of income.

$$p_i = \alpha - (\beta/L_i)X_{ii} \tag{6}$$

Let Π_{ii} denote profits for a domestic firm on domestic sales minus fixed costs. c_i

is the marginal cost of production, *G* is a plant-specific fixed cost, and *F* is a firm-specific fixed cost.

$$\Pi_{ii} = p_i X_{ii} - c_i X_{ii} - G - F = [\alpha - (\beta / L_i) X_{ii}] X_{ii} - c_i X_{ii} - G - F \quad (7)$$

The first-order condition with respect to X_{ii} is:

$$\frac{d\Pi_i}{dX_{ii}} = \alpha - 2(\beta / L_i) X_{ii} - c_i = 0 \quad (8)$$

This gives equilibrium supply of *X* to the local market.

$$X_{ii} = \frac{\alpha - c_i}{2\beta} L_i \quad (9)$$

If the firm exports to country j, its profit equation for export sales Π_{ij} (arbitrarily imputing fixed costs to the domestic profit equation (7)) is as follows.

$$\Pi_{ij} = p_j X_{ij} - (c_i + t) X_{ij} = [\alpha - (\beta / L_j) X_{ij}] X_{ij} - (c_i + t) X_{ij} \quad (13)$$

Maximization of (13) yields the equilibrium export supply.

$$X_{ij} = \frac{\alpha - c_i - t}{2\beta} L_j \tag{14}$$

We can now summarize the total profits the firm would obtain from each of its three alternative modes of serving market j. Superscripts refer to types d, h, and v.

$$\Pi_i^d = \Pi_{ii} + \Pi_{ij} = \beta\left[\frac{\alpha - c_i}{2\beta}\right]^2 L_i + \beta\left[\frac{\alpha - c_i - t}{2\beta}\right]^2 L_j - G - F \tag{16}$$

$$\Pi_i^h = \Pi_{ii} + \Pi_{jj} = \beta\left[\frac{\alpha - c_i}{2\beta}\right]^2 L_i + \beta\left[\frac{\alpha - c_j}{2\beta}\right]^2 L_j - 2G - F \tag{17}$$

$$\Pi_i^v = \Pi_{ji} + \Pi_{jj} = \beta\left[\frac{\alpha - c_j - t}{2\beta}\right]^2 L_i + \beta\left[\frac{\alpha - c_j}{2\beta}\right]^2 L_j - G - F \tag{18}$$

Figure 1: Relative Size Differences and Choice of Regime, the Base Case

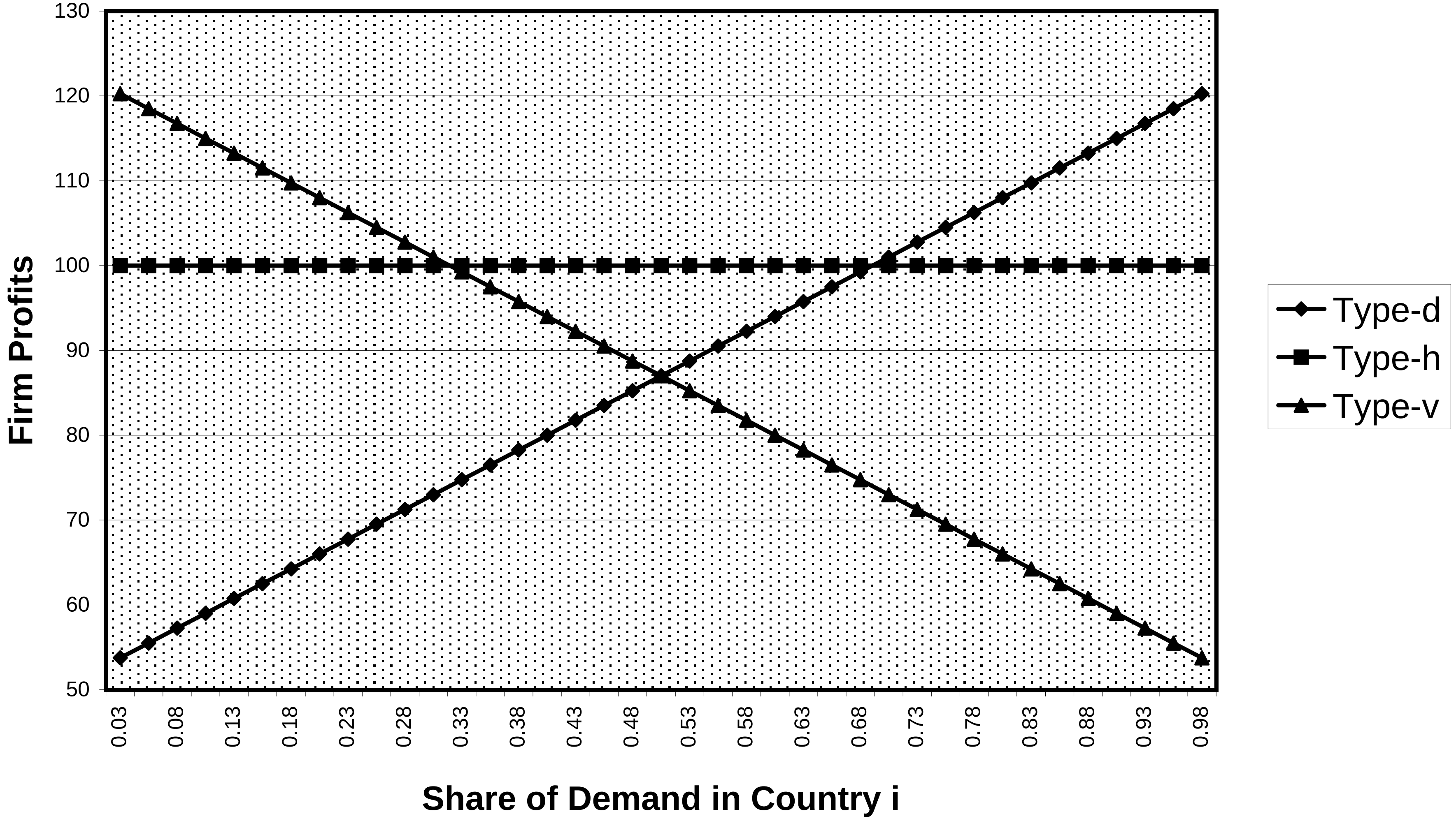
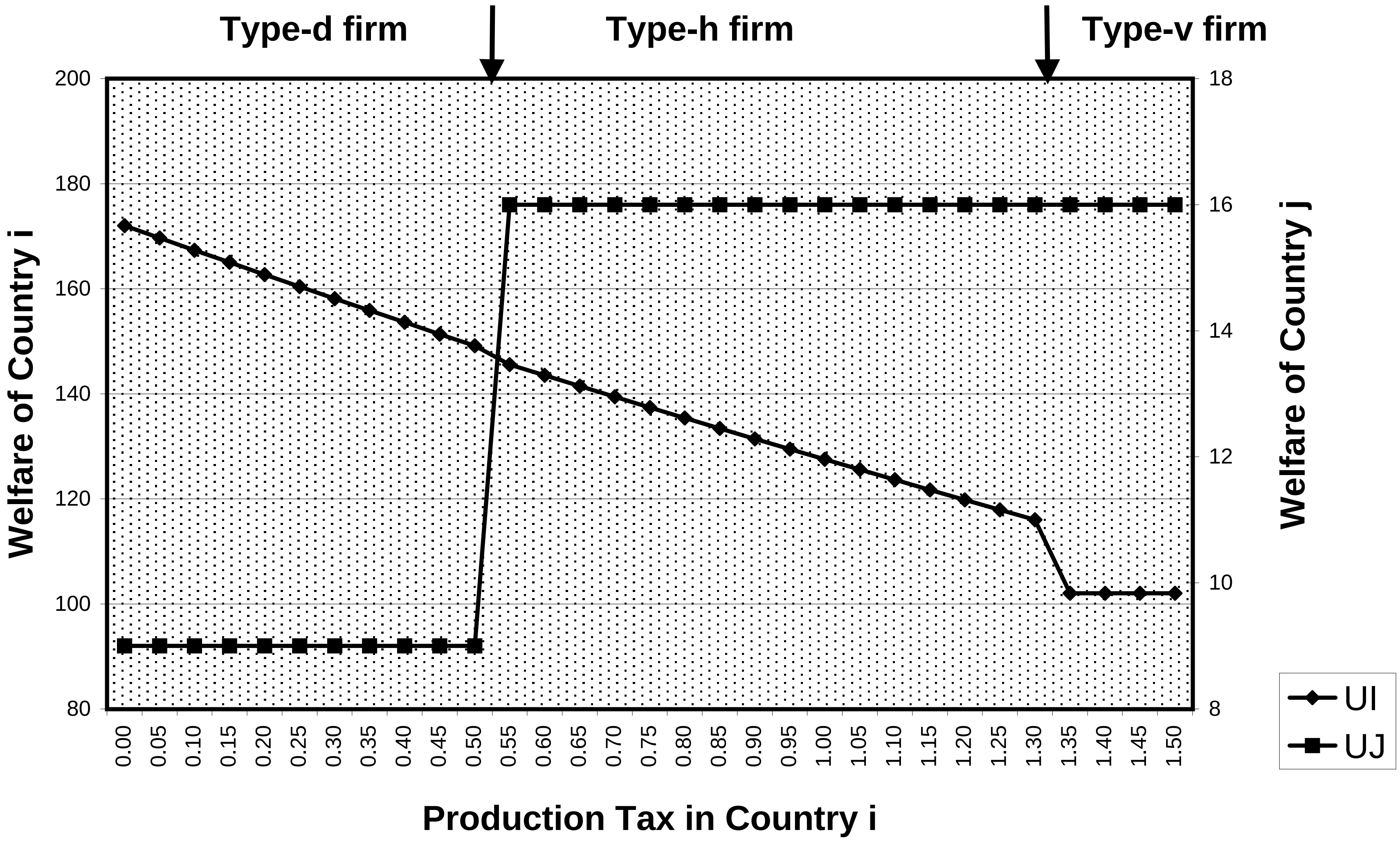


Figure 11: Welfare Effect of a Production Tax in Country i (country i four times the size of country j)



Version 2:

There are two identical countries with one (potential) firm in each country. Each firm can chose between serving the foreign market by exports or by a branch plant.

Let c = 0 and b = 1 for simplicity.

$\Pi_i(a, b)$ equal the profits of firm i when firm i has a plants and firm j has b plants.

$$\Pi_i(2,2) = 2\left[\frac{\alpha}{3}\right]^2 - 2G - F = \Pi_j(2,2) \tag{23}$$

$$\Pi_i(1,1) = \left[\frac{\alpha + t}{3}\right]^2 + \left[\frac{\alpha - 2t}{3}\right]^2 - G - F = \Pi_j(1,1) \tag{24}$$

$$\Pi_i(2,1) = \left[\frac{\alpha}{3}\right]^2 + \left[\frac{\alpha + t}{3}\right]^2 - 2G - F = \Pi_j(1,2) \tag{25}$$

$$\Pi_i(1,2) = \left[\frac{\alpha}{3}\right]^2 + \left[\frac{\alpha - 2t}{3}\right]^2 - G - F = \Pi_j(2,1) \tag{26}$$

$$\Pi_i(2,0) = 2\left[\frac{\alpha}{2}\right]^2 - 2G - F = \Pi_j(0,2) \tag{27}$$

$$\Pi_i(1,0) = \left[\frac{\alpha}{2}\right]^2 + \left[\frac{\alpha - t}{2}\right]^2 - G - F = \Pi_j(0,1) \tag{28}$$

In the first stage of the game, each firm selects its number of plants: 0, 1, 2

In the second stage, the firms play a Cournot output game in each (segmented) market

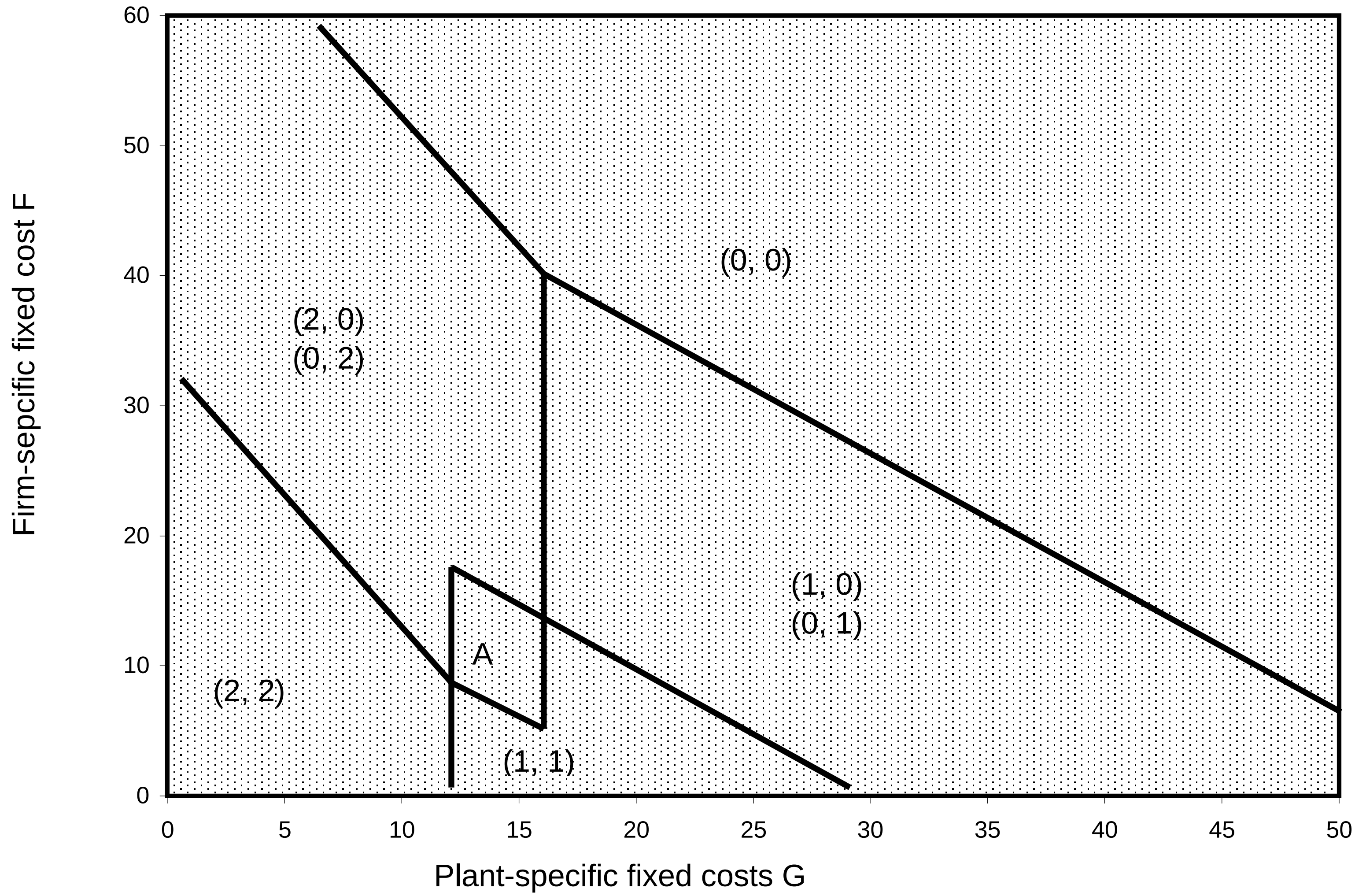
We have just solved the second-stage problem, now the first stage: The normal form is:

		Firm j number of plants		
		0	1	2
Firm i number of plants	0	0, 0	0, $\Pi_j(0,1)$	0, $\Pi_j(0,2)$
	1	$\Pi_i(1,0)$, 0	$\Pi_i(1,1)$, $\Pi_j(1,1)$	$\Pi_i(1,2)$, $\Pi_j(1,2)$
	2	$\Pi_i(2,0)$, 0	$\Pi_i(2,1)$, $\Pi_j(2,1)$	$\Pi_i(2,2)$, $\Pi_j(2,2)$

Note that with full symmetry, if an off diagonal element ij is a Nash equilibrium, then element ji must be as well.

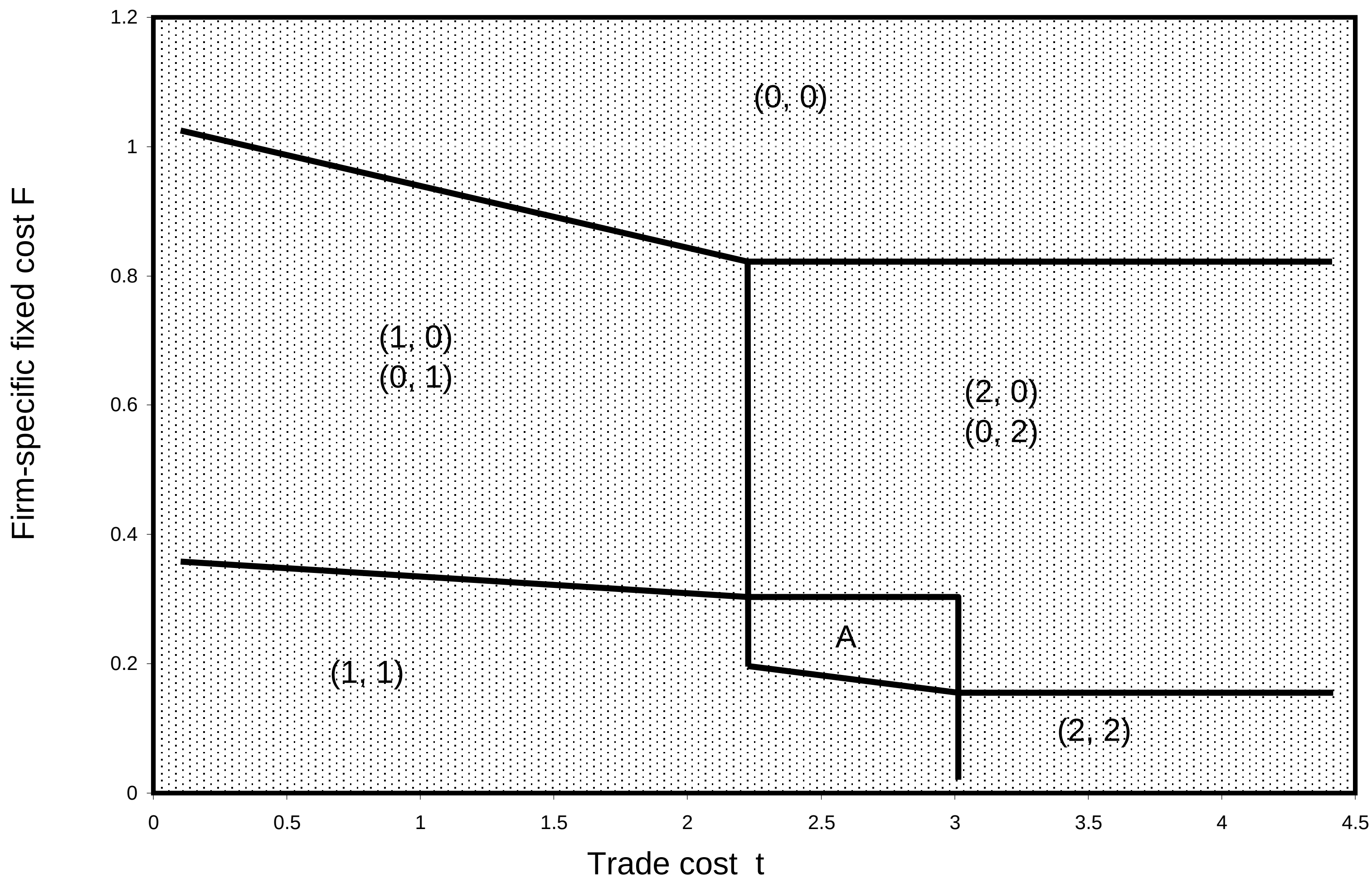
Here are some examples of how the equilibrium depends on key parameters.

Figure 3.1: Regime as a function of F and G (t = 3)



Region A: (1, 1), (2, 0), (0, 2)

Figure 3.3: Regime as a function of F and t (G = 12)



Region A: (1, 1), (2, 0), (0, 2)

Figure 3.6: Regime shift induced by an increase in country j's trade cost tc_j (tc_i = 1), (1,1) to (2,1)

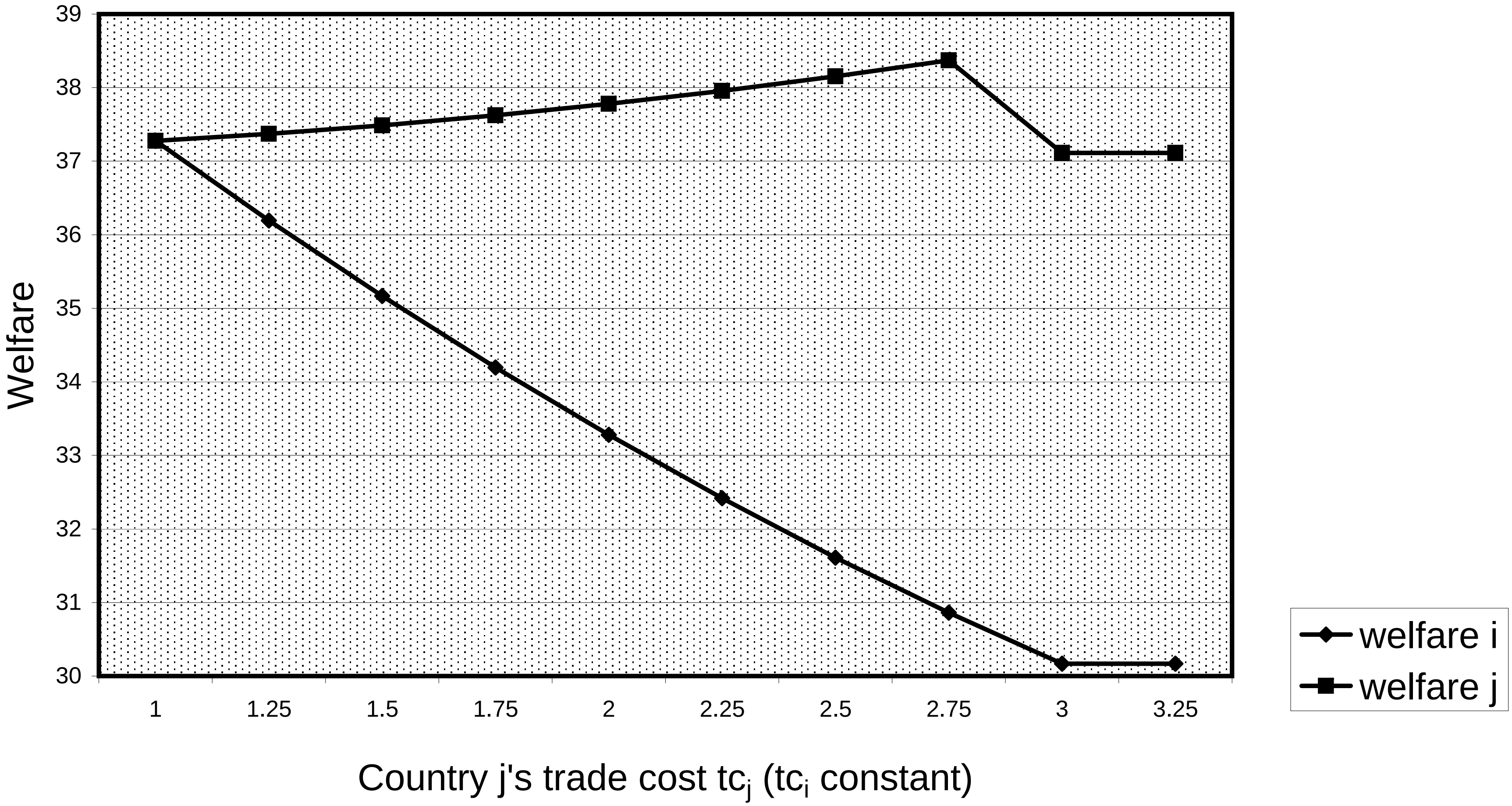
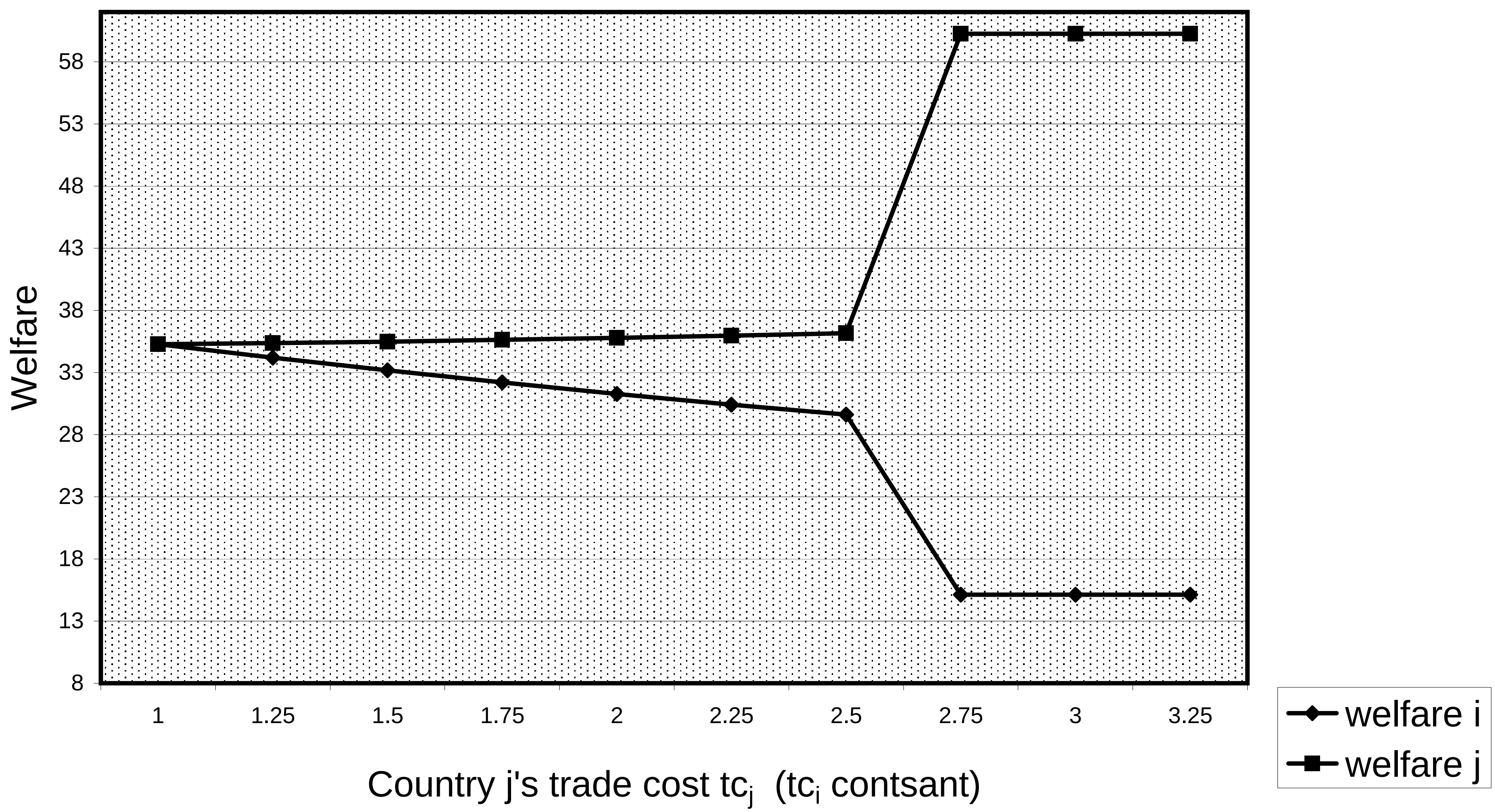


Figure 3.8: Regime shift induced by an increase in country j's trade cost tc_j (tc_i = 1), (1,1) to (0,1)



The Knowledge-Capital Model:

A general-equilibrium approach that incorporates both horizontal and vertical motives for multinationals

Two goods, X and Y
Two factors, skilled and unskilled labor, S and L
Two countries i and j.

Y is produced with constant returns by a competitive industry and unskilled-labor intensive.

X is produced with increasing returns by imperfectly competitive firms. There are both firm-level and plant-level fixed costs and trade costs.

Firm level fixed costs result in the creation of "knowledge-based assets".
There are three defining assumptions for the knowledge-capital model.

(A) Fragmentation: the location of knowledge-based assets may be fragmented from production. Any incremental cost of supplying services of the asset to a single foreign plant versus the cost to a single domestic plant is small.

(B) Skilled-labor intensity: knowledge-based assets are skilled-labor intensive relative to final production.

(C) Jointness: the services of knowledge-based assets are (at least partially) joint ("public") inputs into multiple production facilities. The added cost of a second plant is small compared to the cost of establishing a firm with a local plant.

There are six possible firm "types" that can exist in equilibrium, and there is free entry an exist into and out of firm types.

Type h_i - horizontal multinationals which maintain plants in both countries, headquarters is located in country i.

Type h_j - horizontal multinationals which maintain plants in both countries, headquarters is located in country j.

Type d_i - national firms that maintain a single plant and headquarters in country i. Type d_i firms may or may not export to country j.

Type d_j - national firms that maintain a single plant and headquarters in country j. Type d_j firms may or may not export to country i.

Type v_i - vertical multinationals that maintain a single plant in country j, headquarters in country i. Type v_i firms may or may not export to country i.

Type v_j - vertical multinationals that maintain a single plant in country i, headquarters in country j. Type v_j firms may or may not export to country j.

Assumptions on the skilled-labor intensity of activities are:

<u>Activities</u>

[headquarters only] > [integrated X] > [plant only] > [Y]

When countries are similar in size and in relative endowments, horizontal firms will have the advantage over type-d or type-v.

When countries differ substantially in relative endowments, vertical firms will have an advantage over type-n firms, because they can locate the headquarters and plant independently on the basis of factor prices.

The greatest advantage occurs when the skilled-labor-abundant country is also small. The headquarters is placed in the skilled-labor-abundant country and the single plant is placed in the large unskilled-labor abundant country, serving the small country by exports.

I do not construct this type of model as a game, but as a complementarity problem due to the free entry and continuum of firms assumptions. We looked at this type of model earlier when we did a Cournot model with free entry.

There are:

MR = MC inequalities with complementary variables output, and

p =AC (or profits = zero) inequalities with complementary variables the number of firms of that type active in equilibrium.

The full model is thus a set of non-linear inequalities with associated non-negative complementary variables.

Inequalities	Complementary Variable	Number of inequalites
pricing inequalities	activity level	number
$q_i \le c_{iy}$	Y_i	2
$p_{ui} \le c_{iu}$	U_i	2
$p_i(1 - m_{ii}^d) \le c_i(w_i, z_i)$	X_{ii}^d	2
$p_j(1 - m_{ij}^d) \le c_i(w_i, z_i)(1 + \tau)$	X_{ij}^d	2
$p_i(1 - m_{ii}^h) \le c_i(w_i, z_i, w_j, z_j)$	X_{ii}^h	2
$p_j(1 - m_{ij}^h) \le c_j(w_j, z_j, w_j, z_j)$	X_{ij}^h	2
$p_i(1 - m_{ii}^v) \le c_j(z_i, w_j, z_j)(1 + \tau)$	X_{ii}^v	2
$p_j(1 - m_{ij}^v) \le c_j(z_i, w_j, z_j)$	X_{ij}^v	2

$p_{fci}^{k} \leq fc_i^{k}$	N_i^k	6

<u>market clearing inequalities</u>	<u>price</u>	<u>number</u>
$\sum_i demand\ Y_{ic} \leq \sum_i supply\ Y_i$	q	1
$demand\ U_i \leq supply\ U_i$	p_{ui}	2
$demand\ X_{jc} \leq \sum_{k,i} supply\ X_{ij}^k$	p_j	2
$demand\ N_i^k \leq supply\ N_i^k$	p_{fci}^k	6
$demand\ L_i \leq supply\ L_i$	w_i	2
$demand\ S_i \leq supply\ S_i$	z_i	2

income balance	incomes	number
$expend\ cons_i = income\ cons_i$	$income\ cons_i$	2
$demand\ N_i^k = mkrev_i^k$	$income\ entre_i^k$	6

auxiliary constraints	markups	number
$m_{ij}^k \leq (cournot\ formula)_{ij}^k$	m_{ij}^k	12

The general-equilibrium model is thus solving 57 equations and inequalities for 57 unknows.

Figure 8.1: Volume of affiliate production, investment liberalized, high trade costs (IL)

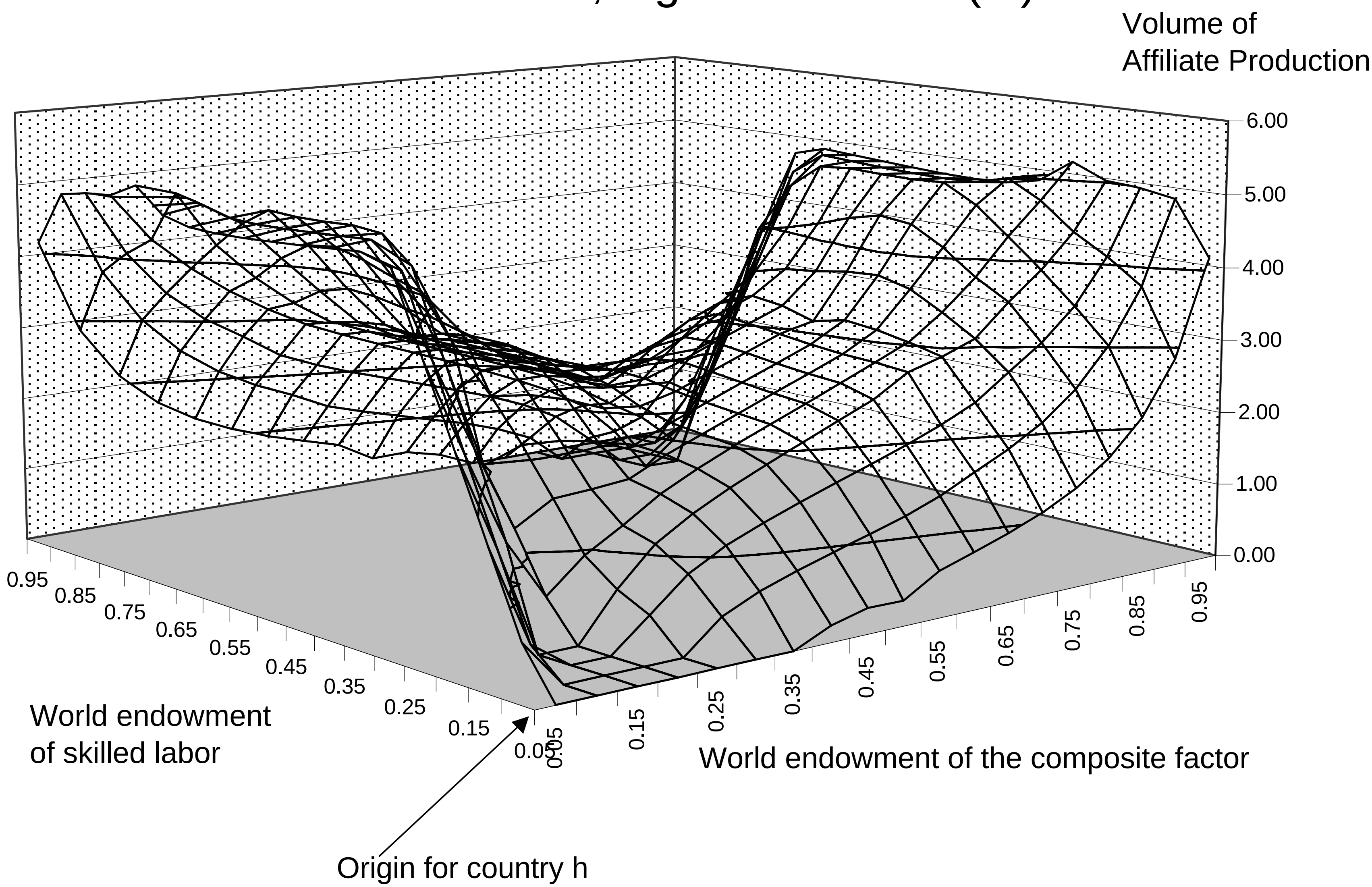


Figure 8.2: Volume of affiliate production, investment liberalized, low trade costs (FL)

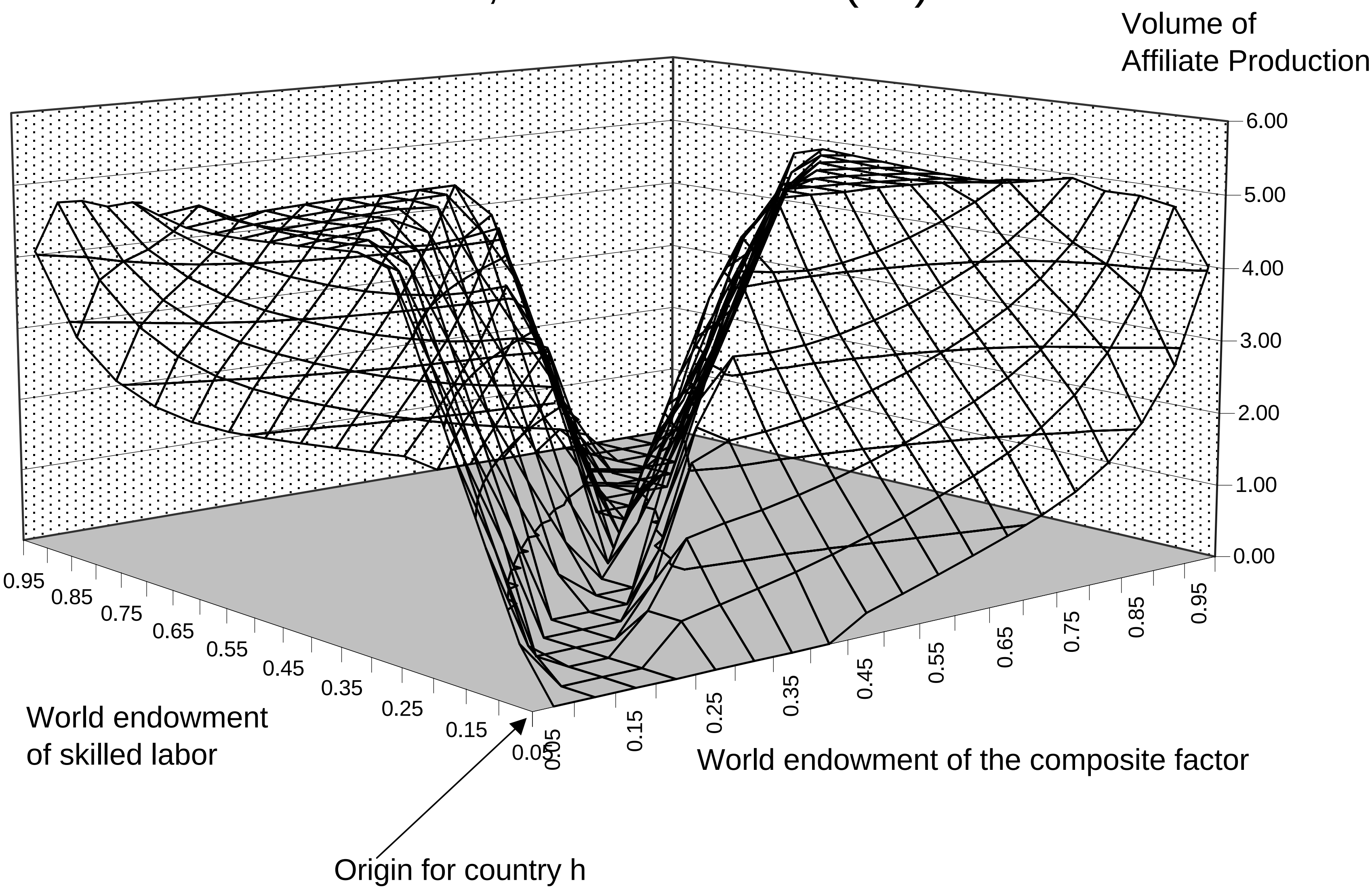
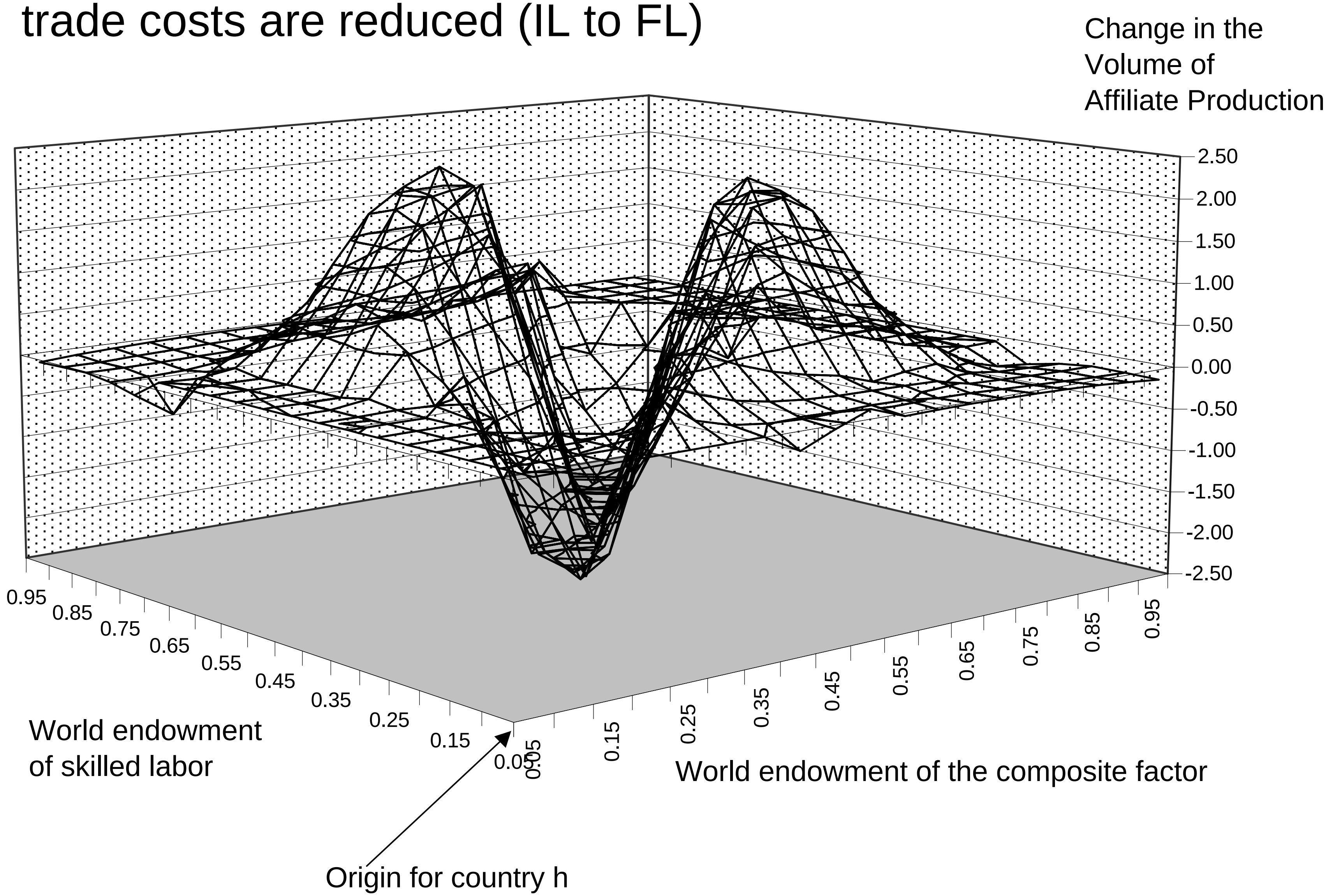


Figure 8.3: Change in affiliate production when trade costs are reduced (IL to FL)



Extension to the heterogeneous firm model of Helpman, Melitz and Yeaple (AER 2004) using our first simple monopoly model.

Firms "draw" different values of productivity or cost. We will use cost, so high productivity firms have low values of c.

$F,\ F_d,\ F_e,\ F_i$ are respectively the fixed costs of taking a draw (ignored here), the fixed cost of entering domestic production, the fixed cost of exporting, and the fixed cost of producing abroad. Normalize market sizes L to one.

First, a firm will produce domestically if:

$$\Pi_i^d = \beta\left[\frac{\alpha - c_d}{2\beta}\right]^2 - F_d \geq 0$$

normalize

$$4\beta = 1 \quad (\beta = 1/4)$$

which requires a cost

$$c_d \leq \alpha - F_d^{1/2}$$

A firm will add exporting if

$$\Pi_e = \beta \left[\frac{\alpha - c_e - t}{2\beta} \right]^2 - F_e \geq 0$$

which requires a cost $c_d \leq \alpha - t - F_e^{1/2}$

Exporting firms larger, more productive if $t + F_e^{1/2} \geq F_d^{1/2}$

Firms will break even producing abroad if:

$$\Pi_i = \beta \left[\frac{\alpha - c_{i0}}{2\beta} \right]^2 - F_i = 0$$

which requires a cost $c_{i0} \leq \alpha - F_i^{1/2}$

Assume costs such that $F_i^{1/2} > t + F_e^{1/2} > F_d^{1/2}$

The first inequality implies that $c_{i0} < c_e$, the break-even cost for producing abroad is less than the break-even cost for producing domestically. So if a firm can just break even producing abroad $(c = c_{i0})$, profits from exporting are strictly positive $(c < c_e)$

But profits from producing abroad rise faster with further falls in c, and the two profit curves eventually cross, and we denote the crossing cost as c_i

$c \geq c_d$	don't produce
$c_d \geq c \geq c_e$	produce for the domestic market only
$c_e \geq c \geq c_i$	produce for the domestic and export markets
$c_i \geq c$	produce abroad as a multinational

More productive firms export, even more productive produce abroad. Even in terms of domestic sales, exporters are larger than mnes, which are larger than exporters.

Similarly, value added per worker is higher in mnes than in exporters which is higher than in domestic firms.

HMY all lot more complicated: have to consider the cost of producing abroad rather than at home. Have to allow for free-entry, demand for each firm depends on the number of firms, and so forth.

Internalization

General Idea: some of the same properties of knowledge capital that create ownership advantages create internalization advantages. These arise from the jointness property of knowledge along with moral hazard, asymmetric information, and the infeasibility of complete and/or enforceable contracts.

Some internalization models involving the stylized facts on knowledge capital, product newness and complexity.

(1) A firm is reluctant to reveal its product or process to a licensee, who may reject the proposal, but now has the knowledge. But the potential licensee is not going to sign an agreement without knowing what it is buying.

(2) The licensee knows that the firm may not have an incentive to truthfully reveal the product's quality.

(3) The newness of the product may create an informational asymmetry in the opposite direction: the potential licensee may have a much better idea of how the product will sell in its local market, while the MNE does not. The licensee

extracts rent to reveal the information.

(4) Bi-lateral uncertainty over stat-up problems, worker productivity and learning rates.

(5) Knowledge is easily learned by new employees. The licensee may be able to defect, starting a new firm in competition with the MNE.

(6) Product quality is an intangible asset. A licensee may have an incentive to reduce quality, capturing a short-run gain at the expense of losing the contract.

(7) Difficulties in choosing between costly monitoring and suffering the costs of moral hazard when employing licensees.

(8) Parties must make relation-specific investments (implies investments are sunk and cannot be used for other uses).

(9) Differences in objectives and goals between the firm and the licensee.

Elements of the Model (Markusen, JIE 2001)

(1) The MNE introduces (or attempts to introduce) a new product every second time periods. Two periods are referred to as a "product cycle". A product is economically obsolete at the end of the second period (end of the product cycle).

(2) The probability of the MNE successfully developing a new product in the next cycle is $1/(1+r)$ if there is a product in the current cycle, zero otherwise (i.e., once the firm fails to develop a new product, it is out of the game). The probability of having a product in the third cycle is $1/(1+r)^2$ etc. Ignore discounting.

(3) The MNE can serve a foreign market by exporting, or by creating a subsidiary to produce in the foreign market.

(4) Because of the costs of exporting, producing in the foreign country generates the most potential rents.

(5) But any local manager learns the technology in the first period of a cycle

and can quit (defect) to start a rival firm in the second period. Similarly, the MNE can defect, dismissing the manager and hiring a new one in the second period. The (defecting) manager can only imitate, not innovate and compete in the next product cycle.

(6) Initially, no binding contracts can be written to prevent either partner from undertaking such a defection.

(7) Initially, I will assume that the MNE either offers a self-enforcing contract or exports. The possibility that defection occurs as an equilibrium is allowed later in the paper.

(8) Notation is as follows.

R-   Total per period licensing rents from the foreign country.

E-   Total per period exporting rents ($E < R$).

F-   Fixed cost of transferring the technology to a foreign partner. These include physical capital costs, training of the local manager, etc.

T- Training costs of a new manager that the MNE incurs if it dismisses the first one (i.e., if the MNE defects).

G- Fixed cost that the manager must incur if he/she defects. This could include costs of physical capital, etc.

L_i- Licensing or royalty fee charged to the subsidiary in period i (i = 1,2).

(a) Rents earned by the manager in one product cycle: $V = (R-L_1) + (R-L_2)$.

V/r- Present value of rents to the manager of maintaining the relationship.

The manager ("a" for agent) has an "individual rationality" constraint (IR): the manager must earn non-negative rents. The manager also has an incentive-compatibility constraint: the manager must not want to defect in the second period.

(1) $(R - L_1) + (R - L_2) \geq 0$ $\quad$ IR_a

(2) $(R - L_2) + V/r \geq (R - G)$ $\quad$ IC_a

where $V = (R - L_1) + (R - L_2)$

V/r is the present value to the manager of the future rents, if there are any. (R - G) is the payoff to unilaterally defecting.

The MNE similarly has an "individual rationality" constraint (IR): the MNE must earn non-negative rents. The MNE also has an "incentive-compatibility constraint: the MNE must not want to defect (fire the manager) in the second period.

(3) $L_1 + L_2 - F \geq 2E$ $\quad$ IR_m

(4) $L_2 \geq R - T$ $\quad$ IC_m

Combine the IC constraints.

(5) $R - T \leq L_2 \leq G + V/r$

Firm's objective is to minimize V subject to this incentive compatibility. Solving this problem yields:

(6) $2R - L_1 - L_2 = V = r(R - T - G) > 0$ (rent share to the manager)

<u>Result 1</u>:

If R $\leq$ G + T, the MNE captures all rents in a product cycle, henceforth referred to as a rent-capture (RC) contract. This situation occurs when

(1) The market is relatively small.
(2) Defection costs for the MNE (T) are high.
(3) Defection costs for the manager (G) are high.

If R > T + G, there is no single-product fee schedule that will not cause one party to defect.

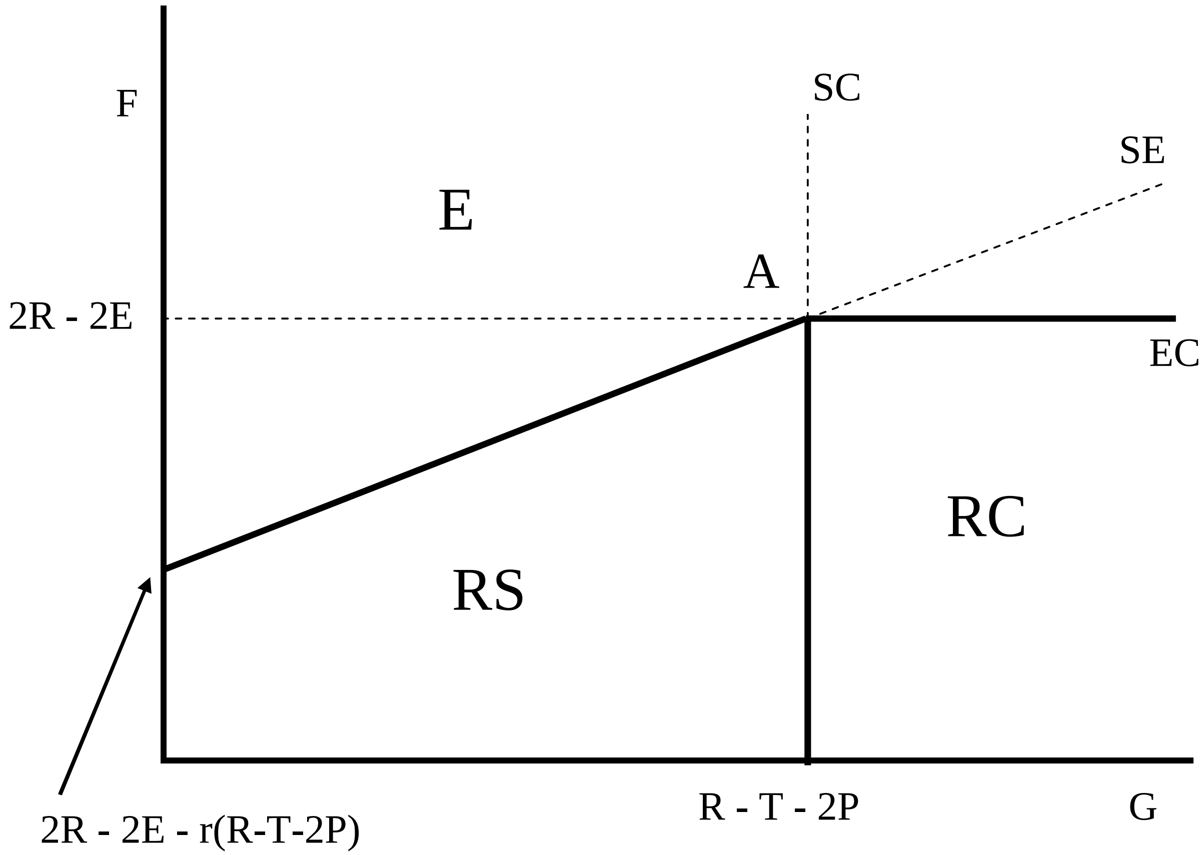
Now consider the case where the manager's IR constraint does not hold; that is, the MNE shares rents with the manager.

Result 2:

If R > G + T, the MNE can credibly offer a long-term commitment, but must share rents with the subsidiary. This is henceforth referred to as a rent-sharing (RS) contract. The one-period rents earned by the subsidiary are smaller as

(1) r is small (future rents are more valuable)
(2) G is large (the incentive to defect is smaller)
(3) T is larger (the MNEs incentive to defect is smaller).
(4) R is larger (the subsidiary's share increase faster than R).

Figure 14.1: Values of F and G supporting alternative Modes



Property-rights theory of firm organization - Antrás QJE 2003

Much simplified version

Relies on several key assumptions

relation specific investments required of the principal and agent
non-contractibility or non-enforcement of contracts

Suppose the mne wishes to produce an intermediate input abroad and form a relationship with a local supplier.

(1) The mne provides the capital and the local agent provides the labor.

$$X = \left[\frac{K}{\beta}\right]^{\beta}\left[\frac{L}{1-\beta}\right]^{1-\beta}$$

(2) After production, there is a "hold-up" problem in that the intermediate good has no use outside the relationship for the agent and limited use for the mne.

$0 < \delta < 1$ - effect proportion of the value of X that can be used by the mne outside the relationship.

(3) After production, the hold-up problem is resolves by a general Nash bargaining game.

$1/2 < \phi < 1$ - bargaining weight for the multinational.

Let $R(X(K,L))$ denote the total profits earned by the application of L and K. R strictly concave function of X.

Let s_v denote the share of R that goes to the mne in the vertical integration equilibrium ($\bar{\phi}$ in Antrás)

"Gains from trade" in maintaining the relationship: $R - \delta R = (1 - \delta)R$

Vertical Integration (internalization). The mne owns the capital and is the "residual claimant" to any value that exists if an agreement cannot be reached

Generalized Nash bargaining maximizes the product, with weights ϕ and $(1 - \phi)$ of the returns to the two parties minus the value of their outside options.

$$\max U = (s_v R - \delta R)^{\phi}((1 - s_v)R)^{1-\phi} \quad wrt \quad s_v$$

Solution to this optimization problem is:

$$s_v = \delta + \phi(1 - \delta) > \phi \qquad s_v R = \delta R + \phi(1 - \delta)R$$

In words, the mne gets its outside option, plus a share ϕ of the total gains from trade

MNE max: $s_v R(K, \bar{L}) - rK$ Agent max: $(1 - s_v)R(\bar{K}, L) - wL$

First best max: $R(K,L) - rK - wL$

Nash bargaining: $s_v R_k = r \qquad (1 - s_v) R_l = w$

First best: $R_k = r \qquad R_l = w$

Relationship between K/L ratios in Nash eq and first best:

$$\frac{K}{L} = \frac{s_v}{1 - s_v} \frac{\beta}{1 - \beta} \frac{w}{r} > \frac{K*}{L*} = \frac{\beta}{1 - \beta} \frac{w}{r} \qquad \text{since } s_v > \frac{1}{2}$$

The first two four equations suggest:

For any L, the use of K by the mne is too low in the Nash solution
For any K, the use of L by the agent is too low in the Nash solution

Production will be *relatively* more capital intensive than is optimal.

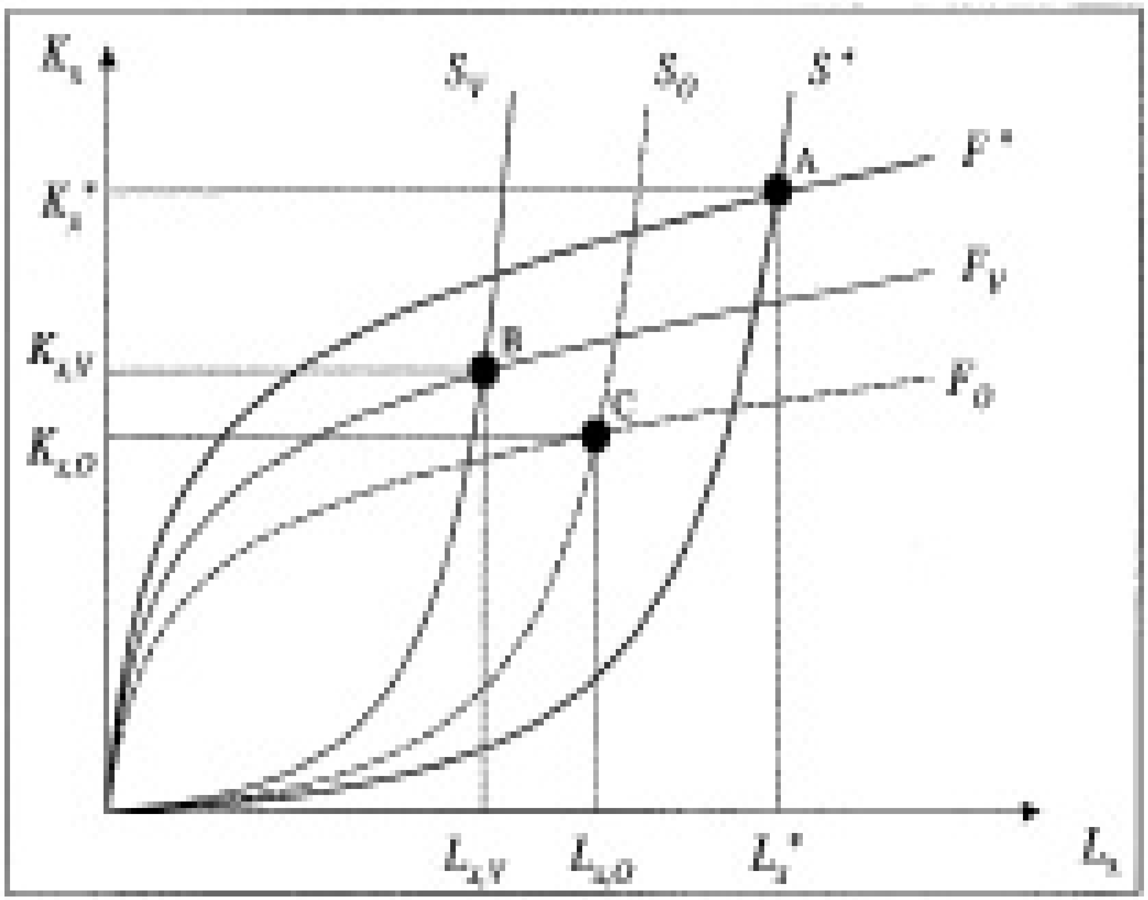


FIGURE IV
Complete Versus Incomplete Contracts

A - first best
B - vertical integration (internalization)
C - outsourcing

Outsourcing: the agent owns the capital (the mne simply gives the agent the capital at the beginning of production), and is the residual claimant to anything left is an agreement cannot be reached.

But by earlier assumption, the agent has no use for the ex post output outside the relationship, so now the outside option of both parties is zero.

$$\max U = (s_o R)^{\phi}((1 - s_o)R)^{1-\phi} \quad wrt \quad s \quad \Rightarrow \quad s_o = \phi < s_v$$

Nash bargaining: $s_o R_k = r \qquad (1 - s_0)R_l = w$

First best: $R_k = r \qquad R_l = w$

Capital/Labor: $\left[\frac{K}{L}\right]_o < \left[\frac{K}{L}\right]_v$

So both outsourcing and vertical integration involve losses from the first best.

Outsourcing: more under provision of capital relative to labor:

Vertical integration: more under provision of labor relative to capital.

Which option is least bad for the mne?

Antrás shows that

(A) the relative profit advantage of vertical integration is increasing in the capital intensity β of the industry.

(B) there is a critical value of β such that industries with higher βs choose vertical integration and those with lower βs choose outsourcing.

Empirical hypothesis: more capital intensive industries choose vertical integration (owned subsidiaries) and less capital intensive industries choose outsourcing.

Intuition: Note from the first-order conditions for Nash relative to the first best that Nash bargaining is equivalent to having a tax of s on K and a tax of (1-s) on L.

The cost functions for integration and outsourcing are:

$$c_v = \left(\frac{r}{s_v}\right)^{\beta}\left(\frac{w}{1-s_v}\right)^{1-\beta} \qquad c_o = \left(\frac{r}{s_o}\right)^{\beta}\left(\frac{w}{1-s_o}\right)^{1-\beta} \qquad s_v > s_o$$

$$\frac{c_v}{c_o} = \left(\frac{s_o}{s_v}\right)^{\beta}\left(\frac{1-s_o}{1-s_v}\right)^{1-\beta}$$

At $\beta = 1$: $$\frac{c_v}{c_o} = \left(\frac{s_o}{s_v}\right) < 1$$ integration preferred

At $\beta = 0$: $$\frac{c_v}{c_o} = \left(\frac{1-s_o}{1-s_v}\right) > 1$$ outsourcing preferred.