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MULTINATIONALS AND THE GAINS FROM TRADE:

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I. Introduction

For many years, there has existed a debate as to the allocative and distributive effects of multinational corporations. Virtually all of the conceptual arguments put forward in this literature are non-formalised, which makes comparisons of the various positions very difficult. Space does not permit a detailed review of the literature here, but perhaps I can simply suggest that the first question is whether or not multinational enterprises (MNEs) have any significant effects at all on world economic activity. One position is that "the MNE's linkage of production establishments in different countries is a transactional phenomenon with no first-order effects."[1] The volumes and types of goods produced in a country (and therefore factor prices) continue to be determined by traditional comparative advantage principles despite the presence of MNE activity. This proposition is discussed, though not necessarily supported by McManus (1972), Buckley and Cassan (1976), Dunning (1977), and Caves (1980). Empirical tests of this proposition by Caves (1980) tend to reject this point of view.

Authors who do believe that the MNE does lead to significant allocative and distributive effects put forward a wide variety of arguments.[2] At a great risk of giving offence, I would suggest that those arguments often (but not exclusively) fall into one or more of four categories. First, MNEs may lead to a different degree of exercised market power relative to a situation in which there are only national enterprises (NEs). Some argue that MNEs inevitably reduce world competition while others (e.g. Kindleberger (1969)) note that competition by MNEs may improve the performance of otherwise inefficient and monopolistic NEs.

Second, it is argued that MNEs may significantly affect both the volume and especially the direction of trade. For example, a MNE might move semiconductor production from a high wage to a low wage country and then ship the output back to the high wage country. This action increases the volume of world trade and creates a new export for the low wage country. Vague arguments about the "international division of labour" (e.g., Hymer (1970)) would seem to fall into this category.

Third, it is often argued that MNEs are, other things being equal, more efficient. The MNE offers potential gains to the world economy via the capture of certain scale economies which cannot be exploited by the NE. Empirical evidence certainly does suggest that plants owned by MNEs are on average larger and have a higher degree of value added per worker than plants owned by NEs (see, for example, Caves (1980)).

Finally, authors such as Kindleberger (1969) point out that the MNE provides a vehicle for the transfer of production technology and worker and managerial skills. From this point of view, the MNE has the beneficial effect of spreading knowledge in a world of imperfect information.

The purpose of this paper is to construct a general-equilibrium model which allows us to assess the first three of these four points. Factors relating to the transfer of technology and other forms of knowledge will not be considered. With respect to the first three arguments (market power, the pattern of trade, and returns to scale), a satisfactory model should meet four conditions. For one thing, the model should provide a rationale as to why a firm wishes to engage in direct rather than in portfolio investment. Similarly, the model should not rely on factor movements or factor price differences insofar as the MNE literature stresses that the MNE often provides for much of its needs from local factor markets. Both requirements imply that the general-equilibrium literature on factor movements is of little use.[3] The model should also explain why monopoly control is superior to a collusive agreement among independent producers. Finally, the model must justify the fact that a monopoly corporation might produce in more than one country rather than centralise production.

The model developed below is a two-good, two-country, general-equilibrium model in which one good (Y) is produced with constant returns to scale. The production function for the other industry (X) is characterised by economies of multi-plant operation (a maximum of two plants in our case).[4] By "economies of multi-plant operation" we will mean technical or pecuniary advantages possessed by a single owner of two production facilities over an industry in which there are two independent (though possibly collusive) owners of the same two production facilities. With respect to the above, these economies of multi-plant operation provide rationales for (a) the preference for direct over portfolio investment, (b) the independence of the results from factor mobility and factor price differences, and (c) the superiority of monopoly over industrial collusion.

Geographical diversity in production is assured by assuming that returns to scale are weak relative to the usual pecuniary diseconomies caused by factor intensity effects. That is, an attempt to supply both countries from a single production facility is assumed to lead to unfavourable factor prices relative to geographically diversified production. This result could also be assured by tariffs or transportation costs. While these barriers are surely important, they are not necessary. Second, they make the comparison of certain trading equilibria difficult since, as hinted above, MNEs may lead to an increase in the volume of world trade.

Subsequent sections of the paper develop and compare two versions of the basic model. In the first version, there exists an independent monopoly producer of X in each country. This formulation will be referred to as the NE case. Four equilibria are examined: (a) an autarky equilibrium, (b) a trading equilibrium in which both monopolists (or rather duopolists) collude to maximise joint profits, (c) a non-cooperative market-shares trading equilibrium, and (d) a Cournot-Nash trading equilibrium.

The second version of the model analyses an equilibrium in which there exists a single monopolist or MNE which maintains production facilities in both countries. Unless otherwise indicated, the equity owner or owners of the MNE are assumed to reside only in one country, which is henceforth referred to as the MNE's home country.

Results of the model include the following. First, it is demonstrated that the MNE equilibrium results in unambiguous gains in both world and home country real incomes relative to the autarky, collusive, and market-shares NE equilibria. Positive gains for the host country in the MNE equilibrium cannot, however, be guaranteed relative to any of the four NE equilibria. As will be pointed out, these results are very much subject to the assumption that all of the MNE's profits are included in the income of the home country.

Second, it is shown that the MNE equilibrium cannot be ranked relative to the Cournot-Nash NE equilibrium with respect to world real income or to the real income of either country. The MNE, as always, produces more efficiently due to its ability to capture multi-plant economies of scale. On the other hand, the MNE has the unfavourable effect of exercising more market power than is present at the Cournot-Nash equilibrium.

Third, unambiguous results can be domonstrated with respect to the volume of trade. The MNE equilibrium involves a larger volume of trade than any of the four NE equilibria. Thus multinational activity, unlike the portfolio capital movements of traditional trade theory, can serve as a compliment rather than as a substitute to trade in commodities.

The paper concludes with a short section which adds the assumption that firms have monopsony as well as monopoly power. The results here are that the MNE will introduce an inter-country factor market distortion not found in the NE solutions. This makes it less likely that the MNE will lead to an improvement in world and national real income.

II. Economies of Multi-Plant Operation

Economies of multi-plant operation as defined above refer to the advantages of a single owner of two or more production facilities over independent (even if joint-profit maximising) owners of the same production facilities. Some sources of these economies are listed as follows (see Scherer (1975) and (1980)).

Product Design, Research and Development: Expenditures on designing better products and/or processes to produce these products have a "public-goods" aspect. Once an innovation is made, it can be incorporated into additional plants without reducing the marginal product of that innovation in existing plants.

Advertising, Marketing and Distribution: Expenditures on market research, fixed costs of advertising (e.g., producing a commercial message), etc., share a related property. Once certain initial expenditures are made, new geographic areas can be added for at most a marginal cost which is significantly less than average cost. These economies are thought to be extremely important in certain consumer industries such as beer brewing.

Management Services: There is some evidence that there are economies of scale relating to management services.[5] Large-scale operation permits a greater degree of division of labour. Second, when the various plants are producing the same goods ("horizontal" MNEs) as in the present model, there are probably scale economies in certain management areas. For example, cost accountants might be able to monitor two identical plants for less than double the resources that are needed for a single plant.

Capital Market and other Pecuniary Economies: There is likewise some evidence that large-scale operation permits the firm to acquire capital and other inputs at lower cost. This argument borders on monopsony power (but also on risk) which is discussed in the final section of the paper.

Economies of multi-plant operation not only involve the existence of these "intangibles", but must also rely on an imperfect ability of joint-profit-maximising duopolists to transfer these intangibles among themselves.[6] The idea is that to share fully in these economies, two independent firms would have to be fully integrated in everything but name. Thus in what follows, we shall assume without further comment an inability to effect such an interfirm transfer.

We should also note that the MNE often tends to centralise activities relating to these intangibles; that is, R and D, marketing, finance, etc. are often centralised in a particular location. It is easy to think of reasons as to why this might be the case. The total output of two scientists working independently may, for example, be less than their output working cooperatively in the same location. Similarly, communication among different managerial and technical departments is more efficient in a centralised location. The model presented below will attempt to capture this "centralisation" aspect as well as the "public-goods" or "jointness" aspect mentioned above.

The model consists of two goods (X and Y) and two countries (m and h). Superscripts m and h will denote countries throughout the model, with m denoting the MNE's home country and h denoting the host country in the MNE version of the problem. Other features of the model are summarised as follows:

(a) X and Y are each produced from labour and sector-specific capital. Only labour is mobile between sectors and the total endowments of all factors are fixed.

(b) Countries m and h have identical factor endowments, identical technology, and identical, homothetic community utility functions.

(c) Good Y is produced with constant returns to scale by a perfectly competitive industry.

(d) There is only a single domestic (and perhaps international) producer of X, which is produced with increasing returns to scale. Until the final section of the paper, producers of X are assumed to have no monopsony power.[7]

(e) Returns to scale in X are assumed to be weak relative to factor intensity effects such that the production set of each country is convex.

(f) The output of X is the product of the outputs of two activities: activity C (for corporate or control) and activity F (for factory). C and F may be geographically separated in the production of X.

(g) Capital which is sector specific to X is used in F but not in C, which uses only labour. F is characterised by non-decreasing returns to scale. No restrictions are placed on C per se, but C times F must not exhibit strongly increasing returns as per assumption (e) above.

(h) For the multi-plant firm, the C activity has a "public goods" or "jointness" aspect in that additional geographic locations of F activities may be added to the firm without reducing the marginal product of C in existing F activities.

(i) For the multi-plant firm, the C activity is also characterised by a "centralization" aspect in that for a fixed total allocation of labour to C activities, the output of C is maximized by undertaking C at a single location.

(j) Equity ownership may cross international borders, but factors of production are immobile.

(k) There are no barriers to trade and producers of X may not price discriminate.

The C activity in producing X is intended to represent the R and D, marketing and managerial factors referred to above. F is intended to represent the physical transformation of inputs into outputs. Assumption

(b) is made in order to neutralize the usual Heckscher-Ohlin, Ricardian, and demand bases for trade. The reason for this is that I wish to show how the MNE and economies of multi-plant operation per se can form a basis for trade.

The jointness and centralization aspects of C have been briefly discussed above. Geometrically, the centralization characteristic will mean that isoquants for C in L^m and L^h space are concave to the origin. Only the results having to do with the volume and direction of trade depend on the centralisation property as will be discussed from time to time. Gains from trade and welfare results will depend only on the jointness aspect of C.

Given the specification (A)-(K) production functions for the single-plant and 2-plant enterprises are given as follows:

$$(1)\quad X^i = C(L_c^i)F(L_f^i) \qquad i = m,\ h$$

$$(2)\quad X^m + X^h = C(L_c^m,\ L_c^h)\ [F(L_f^m) + F(L_f^h)]$$

Given the sector specific nature of capital, we can simply omit the capital arguments in the F functions which as a result are assumed to be characterised by $F'' < 0$.[8] The jointness aspect of the C activity is captured in (2) by $[F^m + F^h]$: changes in physical production (F) in one location do not affect the marginal product of C in the other location. F^m and F^h are also assumed to be independent in that there are no externality effects between geographically separated production facilities.

The centralisation property of C is modelled by allowing the C isoquants to be concave as noted above. An analysis of (2) presented in a short appendix to the paper shows that this concavity property is not sufficient to ensure that C will be carried on in only one country by a profit-maximising MNE. Since centralization of C implies unequal levels of F^m and F^h (shown below), strongly diminishing returns to labour in F may outweigh the centralizing tendency. Both cases will be discussed below but unless otherwise indicated, we will assume that the concavity of the C isoquants in L^m and L^h dominates the convexity of the $[F^m + F^h]$ isoquants in L^m and L^h such that C is carried on in only one country.[9] Since countries are identical, it is arbitrarily assumed that C is located in the home country (country m). The assumption that C uses only labour ((G) above) is simply to ensure that there is no unemployed capital in country h.

Full specification of the production sectors for the NE version of the model can be summarized as follows:

(3) <u>NE Production Sectors</u>

$$Y^i = G(L_y^i) \qquad \bar{L} = L_y^i + L_c^i + L_f^i$$

$$X^i = C(L_c^i)F(L_f^i) \qquad i = m, h.$$

$\bar{L}$ is the same for both countries by assumption. L_y, L_c, and L_f are the labour allocations to the Y, C, and F activities respectively. Sector-specific capital in Y is omitted from G, implying that $G'' < 0$.

For the case in which C is centralized, the MNE version is given as follows:

(4) <u>MNE Production Sectors</u>

$$Y^i = G(L_y^i) \qquad \bar{L} = L_y^h + L_f^h$$

$$X^m = C(L_c^m)F(L_f^m) \qquad \bar{L} = L_y^m + L_c^m + L_f^m$$

$$X^h = C(L_c^m)F(L_f^h) \qquad i = m, h.$$

$$X^m + X^h = C(L_c^m)[F(L_f^h) + F(L_f^m)]$$

As noted in (4), country i's "production" of X is defined to equal CF^i. In both (3) and (4), the assumption that F is characterized by non-decreasing returns is simply to ensure that there will be a single domestic production facility. Non-decreasing returns in F imply of course that X is characterized by increasing returns to scale. However, as noted earlier, convexity and geographic diversity of production ($F^m, F^h > 0$) is assured provided that these returns to scale are relatively weak or that factor intensity effects are relatively strong (i.e., $|G''|$ and $|F''|$ are large).[10]

III. The National Enterprise Equilibria

Before dealing explicitly with the NE equilibria, it is first necessary to examine the conditions which characterize the efficient world production frontier and thus the efficient production frontier of each country. The relevant programming problem (maximizing $X^m + X^h$ for a fixed level of $Y^m + Y^h$) and resulting first-order conditions are given as follows:

(5) $$\text{Max } C(L_c^m)F(L_f^m) + C(L_c^h)F(L_f^m) \text{ subject to}$$

$$\bar{Y} = G(\bar{L}-L_c^m-L_f^m) + G(\bar{L}-L_c^h-L_f^h)$$

(6) $$\frac{G^{m'}}{C^{m'}F^m} = \frac{G^{h'}}{C^{h'}F^h} = \frac{G^{m'}}{C^mF^{m'}} = \frac{G^{h'}}{C^hF^{h'}} = MRT$$

The value of the equations in (6) is the marginal rate of transformation (MRT) along the efficient world and national production frontiers.

Turning to the monopoly or duopoly solutions, it is assumed as noted above that all consumers including the monopolist have identical, homothetic utility functions and that monopolists maximise profits rather than the utility of their consumption bundles (it does make a difference; see Markusen (1980a)). With distributional and scale effects thus removed, prices are simply a function of the relative outputs of X and Y, (X/Y). If production takes place along the efficient production frontier (as shown below) the prices or price ratio can be specified even more simply as just a function of X, since Y is uniquely related to X.

Let p denote the price of X in terms of Y and let w denote the price of labour in terms of Y. The monopolists are assumed until the last section to view w as parametric. We can assume that sector-specific capital in X is either owned by the monopolist or else paid a zero price because it is in inelastic supply to that sector. The programming problem and first order conditions for a monopolist operating in autarky are then given by:

$$(7)\quad \text{Max } p^i[C(L_c^i)F(L_f^i)] - w^i(L_c^i+L_f^i); \qquad p = p(X), \qquad w = \overline{w}$$

$$(8)\quad p^i(1-1/\eta_X^i)C^{i'}F^i - w^i = 0 \qquad \eta_X^i = -\frac{p}{X}\,\frac{dX}{dp} > 0$$

$$p^i(1-1/\eta_X^i)C^iF^{i'} - w^i = 0 \qquad i = m,h,$$

where η_X^i is minus the elasticity of demand for X in country i. w^i, the price of labour in terms of Y^i is equal to $G^{i'}$, the marginal product of labour in Y^i by virtue of the assumption that Y is competitive. This allows us to rewrite (8) as

$$(9)\quad p^i(1-1/\eta_X^i) = \frac{G^{i'}}{C^{i'}F^i} = \frac{G^{i'}}{C^iF^{i'}} = MRT^i \qquad i = m,\ h$$

Equation (9) satisfies the conditions in (6) for the efficient use of inputs, which implies that production takes place on the efficient national production frontiers. Second-order conditions for (7) will be satisfied if η_X^i is less than one and is a decreasing function of X (or more correctly of X/Y). Melvin and Warne (1973) and Markusen (1980a) show that these conditions will be satisfied by any C.E.S. utility function with an elasticity of substitution greater than one. In what follows, we will assume without further comment that η_X^i and therefore $p(1-1/\eta_X^i)$ are everywhere decreasing functions of (X/Y). Convexity of the production set is then sufficient for there to exist a unique solution to (7) (Markusen (1980a)).

Given our assumptions of identical tastes, technology, and factor endowments, it should be apparent that the solutions to (7)-(9) must be identical for the two countries. Autarky outputs, commodity prices, elasticity of demand, and factor prices will be the same in each country. With p^i and η^i_X the same in each country, (9) will also satisfy (6), implying that production takes place on the efficient world production frontier.

The equilibrium given by (9) is shown in Figure I by point A. The production frontier $\overline{YX}$ can represent either the domestic or world production frontiers, with the latter simply being a radial blow-up of the former. Similarly, U_a can represent either the world or the national community indifference curve given the symmetry in the solution. p_a represents the identical autarky price ratios of the two countries. Factor prices are also equalised in the autarky equilibria.[11]

Suppose now that the two countries can trade, but the two producers of X collude to maximise joint profits. In this case, the duopolists' programming problem and resulting first-order conditions are given as follows:

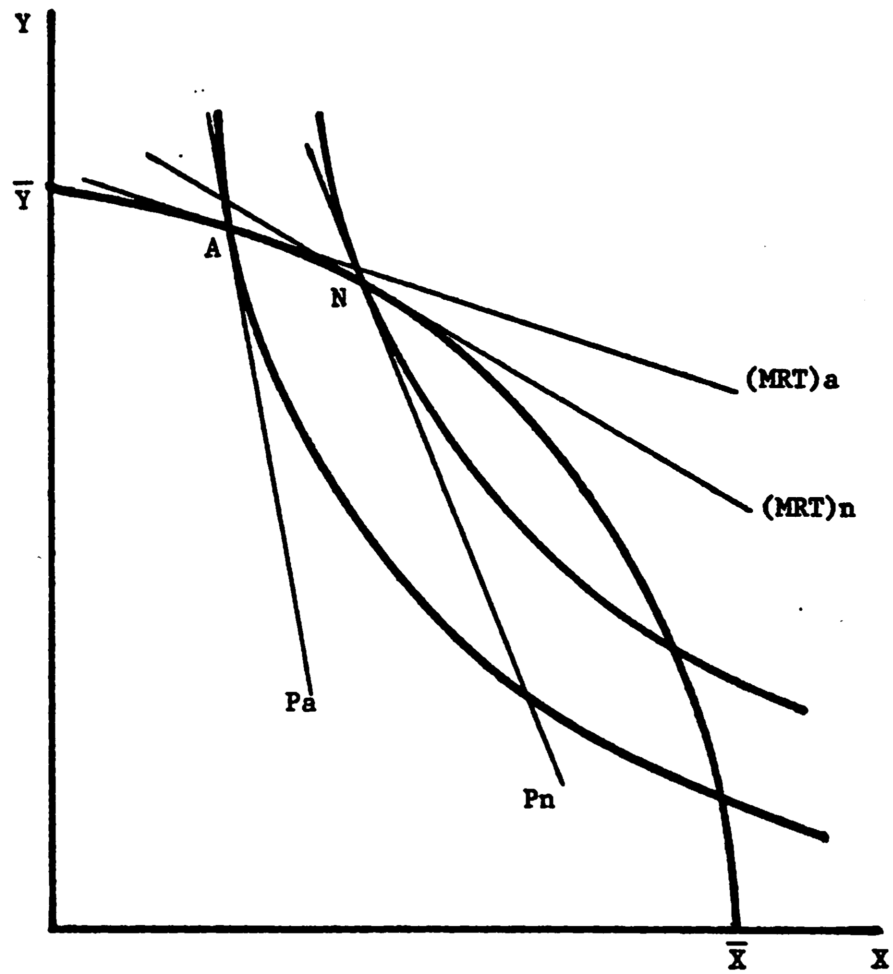
$$(10)\ \text{Max}\ p[C(L^m_c)F(L^m_f)+C(L^h_c)F(L^h_f)] - w^m(L^m_c+L^f_c) - w^h(L^h_c+L^f_c)$$

where $p = p(X^m+X^h)$ and $w^i = G^{i'}$

$$(11)\ p(1-1/\eta_x) = \frac{G^{i'}}{C^{i'}F^i} = \frac{G^{i'}}{C^iF^{i'}} \qquad i = m,\ h.$$

p now denotes the world free trade price of X in terms of Y and η denotes the corresponding world elasticity of demand. (11) satisfies the restrictions in (9), implying that the collusive equilibrium lies on the national and world production frontiers. This again allows us to specify the world price as simply a function of the total production of X as noted. Further, the demand assumptions together with the identical convex production sets imply that the solution to (11) is the same as

FIGURE I



the solution to (9). The joint-profit-maximising and autarky equilibria are identical. There are neither gains or losses from trade and despite the ability to trade, no trade takes place since commodity prices are equalized without trade.

Consider next the case in which each duopolist acts in a non-cooperative fashion to maintain his market share and each knows that the other is behaving in this fashion. Suppose that in equilibrium, the market share of the monopolist in country m is given by $\sigma^m = X^m/(X^m+X^h)$. This can also be written as $X^h = (1-\sigma^m)X^m/\sigma^m$. Market shares behaviour implies for example that h believes that if he increases his output by one unit, m will respond with an increase in output of $\sigma^m/(1-\sigma^m)$. The two duopolists therefore each face the following programming problem.

$$(12)\ \text{Max } p[C(L_c^i)F(L_f^i)] - w^i(L_c^i+L_f^i) \text{ where } p = p(X^m + X^h) \text{ and } X^h = (1-\sigma^m)X^m/\sigma^m$$

Revenue (R) and marginal revenue (MR) for m are then given by

$$\begin{aligned}(13)\ R^m &= p(X^m+X^h)X^m = p(X^m+(1-\sigma^m)X^m/\sigma^m)X^m \\ MR^m &= p + (1+(1-\sigma^m)/\sigma^m)\,\frac{dp}{dX}X^m = p + (X^m+X^h)\,\frac{dp}{dX} \\ &= p(1+\frac{(X^m+X^h)}{p}\,\frac{dp}{dX}) = p(1-1/\eta_x),\end{aligned}$$

where η_x is again the world elasticity of demand for X. Similar equations hold for h. The first-order conditions for (12) are therefore given as follows:

$$(14)\ p(1-1/\eta_x) = \frac{G^{i'}}{C^{i'}F^i} = \frac{G^{i'}}{C^iF^{i'}} \qquad i = m, h.$$

The first-order conditions and corresponding solution for the market-shares case is then identical to the joint-profit-maximising and autarky solutions. All three equilibria yield the same equilibrium at A in Figure I.

Finally, consider the case in which each duopolist behaves in a Cournot-Nash fasion; that is, each duopolist views his rival's output as fixed and unresponsive to the former's actions. The programming problem facing the duopolist in country m is thus given as follows:

$$(15)\ \text{Max } p[C(L_c^m)F(L_f^m)] - w^m(L_c^m+L_f^m)$$
$$p = p(X^m+X^h) \text{ and } X^h = \overline{X}^h,$$

where $\overline{X}^h$ represents the behavioural assumption that m regards h's output as fixed. Similar comments and equations apply to h. Revenue and marginal revenue as viewed by the duopolist in m are now given by

$$(16)\ R^m = p(X^m+\overline{X}^h)X^m \qquad MR^m = p + X^m \frac{dp}{dX}$$
$$MR^m = p + (X^m+X^h)\ \frac{dp}{dX} \cdot \left(\frac{X^m}{X^m+X^h}\right) = p\ (1-\sigma^m/\eta_x)$$

where σ^m again represents m's market share and η_x continues to represent the world elasticity of demand for X. The first-order conditions for (15) are as follows:

$$(17)\ p(1-\sigma^i/\eta_x) = \frac{G^{i'}}{C^{i'}F^i} = \frac{G^{i'}}{C^iF^{i'}} \qquad i = m,\ h$$

As in the previous three cases, the solutions to (17) must be symmetric for m and h. Each country must have the same outputs, market shares, consumption levels, factor prices, and so forth. If m's market share exceeds h's for example, then m's marginal revenue would be less than h's at the same time that m's marginal cost would be greater. The latter effect comes from the fact that with $X^m > X^h$, m must be producing at a higher MRT given the identical, concave production frontiers.

Thus once again, the equilibria are symmetric and no trade takes place.

Note however that there are gains from trade in the sense that welfare levels will be higher than in autarky. The symmetric equilibria in (17) must imply a market share of one-half for each duopolist. Thus at the autarky equilibrium (point A in Figure 1), each duopolist will now find that the marginal revenue exceeds marginal costs. The national or world equilibrium must now be at a point like N in Figure 1, which given our demand assumptions, constitutes an unambiguous improvement in welfare relative to A.[13]

In summary, all of the four NE equilibria examined in this section are symmetric and involve no trade. The joint-profit-maximizing equilibrium and the market share equilibrium are identical to the autarky equilibrium for each country. The Cournot-Nash equilibrium on the other hand, involves an unambiguous increase in welfare relative to the other equilibria due to a reduction in exercised market power. A more formal analysis of this welfare effect is postponed until Section V below.

IV. The Multinational Enterprise Equilibrium

Similar procedures allow us to solve for the efficient world production frontier and monopoly equilibrium in the MNE version of the model. It now makes little sense to talk about national production frontiers since the position of country h's production frontier will for example be determined by the level of C activities carried on in country m. A similar problem confronted Ethier (1979) in dealing with international externalities.

Assuming that it is optimal to centralize the C activity in country m, the relevant programming problem and first-order conditions are given as follows:

$$(18)\quad \text{Max } C(L_c^m)[F(L_f^m) + F(L_f^h)] \qquad \text{subject to}$$

$$\bar{Y} = G(\bar{L}-L_c^m-L_f^m) + G(\bar{L}-L_f^h)$$

$$(19)\quad \frac{G^{m'}}{C^{m'}(F^m+F^h)} = \frac{G^{m'}}{C^mF^{m'}} = \frac{G^{h'}}{C^mF^{h'}} = \text{MRT}$$

If, as noted in the appendix, it is not optimal to centralize C, equation (2) above gives the relevant production function. Replacing the production function in (18) with (2), the first-order conditions become

$$(20)\quad \frac{G^{m'}}{C_m(F^m+F^h)} = \frac{G^{h'}}{C_h(F^m+F^h)} = \frac{G^{m'}}{CF^{m'}} = \frac{G^{h'}}{CF^{h'}} = \text{MRT}$$

where C_i represents the partial derivative of C in (2) with respect to L_c^i. Note that the conditions in (19) and (20) are not the same as those in (6) above. Further discussion of the difference is postponed until section V, which shows that the efficient MNE production frontier lies everywhere outside the corresponding NE production frontier except at the Y axis.

If centralization of C is optimal, the MNE's programming problem and first-order conditions are given as follows:

$$\text{(21) Max } pC(L_c^m)\,[F(L_f^m) + F(L_f^h)] - w^m(L_c^m + L_f^m) - w^h L_f^h$$

$$p = p(X),\ w^m = G^{m'},\ w^h = G^{h'}$$

$$\text{(22) } p(1-1/\eta_x) = \frac{G^{m'}}{C^{m'}(F^m+F^h)} = \frac{G^{m'}}{C^m F^{m'}} = \frac{G^{h'}}{C^m F^{h'}}$$

Again, $w^i = G^{i'}$ follows from the assumption that factor markets and the y industry are competitive. If centralization is not optimal, a replacement of the production function in (21) with (2) gives us different first-order conditions.

$$\text{(23) } p(1-1/\eta_x) = \frac{G^{m'}}{C_m(F^m+F^h)} = \frac{G^{h'}}{C_m(F^m+F^h)} = \frac{G^{m'}}{CF^{m'}} = \frac{G^{h'}}{CF^{h'}}$$

Equations (22) and (23) satisfy the conditions given in (19) and (20) for the efficient use of inputs. Thus the MNE equilibrium lies on the efficient MNE world production frontier. If $\overline{XY}$ in Figure 1 were now to represent this frontier, then the MNE equilibrium would be at a point like A.

The national resource allocations in countries m and h corresponding to (22) and (23) are rather different. Presumably L_c^m and L_c^h should enter C symmetrically in (2) given that the two economies are identical in all respects. If this is true, then the solution to (23), the non-centralized equilibrium will be symmetric in certain respects. Once again, countries will have the same allocations of labour among sectors, and thus factor prices will be equalized. However, the incomes of the two countries will not be the same if the MNE was able to enter country h costlessly, and if all of the MNE's profits are included in the income of country m.[14] Both assumptions are made for the remainder of the paper. With positive profits, the income of country m will exceed that of country h. This does not of course preclude the possibility that the incomes of both countries will be higher than in some or all of the NE equilibria. This question is treated in the next section of the paper.

In the centralized equilibrium (22), the intra-country labour allocations cannot be the same. Suppose for example that $L_y^m = L_y^h$ then it must be the case that $L_f^m < L_f^h$ since some of L^m must be used in C. Such an allocation cannot satisfy (22) since $L_f^m < L_f^h$ implies $F^{m'} > F^{h'}$. A similar argument implies that L_f^m cannot equal L_f^h. In short, we must have the following:

$$(24) \quad \frac{G^{m'}}{C^m F^{m'}} = \frac{G^{h'}}{C^m F^{h'}} \text{ if and only if } L_y^m < L_y^h,\ L_f^m < L_f^h.$$

The centralized equilibrium must imply that country m has less resources in both Y and F such that both $G^{m'}$ and $F^{m'}$ exceed $G^{h'}$ and $F^{h'}$. Country m has more total resources in X ($L_y^m < L_y^h$) but the distribution of these resources between C and F differs from that in country h.

As a result, I don't think its possible to offer any obvious comparison of the relative income levels in the two countries. Profits are repatriated to country m, but the value of production may be higher in country h. A formal analysis is thus postponed until the following section. Similarly, whether or not country m's production ratio (X/Y) differs from country h's ratio depends on the concavity of G and F. If, for example, G'/F' depended only on L_y/L_x and not on the levels of L_i, then the solution to (22) would involve identical production ratios in m and h.

The implication of this dependence on the concavity of G and F is that the direction and volume of trade cannot be fully predicted in the model. If the solution to (22) involves $(X^m/Y^m) = (X^h/Y^h)$ as just noted, then trade will consist simply of a one-way profit repatriation of both commodities in the same production ratio. If the solution involves very different production ratios, then there can exist two-way trade with m exporting Y for example if $(X^m/Y^m) < (X^h/Y^h)$.

These findings suggest that MNE activity as modelled above does affect the inter-sectoral allocation of economic activity in a country (i.e. $L_y^m < L_y^h$) and does therefore provide a basis for trade. It does not however offer a simple prediction as to the direction of trade. Nevertheless, there will always exist some trade (profit repatriation at a minimum) in the MNE equilibrium as opposed to the no-trade NE equilibria.

V. Comparing the MNE and NE Equilibria

Consider a fixed allocation of resources between the X and Y sectors for the NE version of the model. First-order conditions imply an optimal allocation of labour in X between the C and F activities. Denoting these labour allocations as $\overline{L}_j^i$, the maximum value of world X production given the fixed level of Y production is given by

$$(25)\quad \overline{X} = C(\overline{L}_c^m)F(\overline{L}_f^m) + C(\overline{L}_c^h)F(\overline{L}_f^h)$$

where $\overline{L}_i^m = \overline{L}_i^h$ by virtue of the symmetry of all of the NE equilibria.

The MNE producer of X can, however, produce $\overline{X}$ from $\overline{L}_c^m$, $\overline{L}_f^m$, and $\overline{L}_f^h$ and still have $\overline{L}_c^h$ left over.

$$(26)\quad \overline{X} = C(\overline{L}_c^m)\,[F(\overline{L}_f^m) + F(\overline{L}_f^h)]$$

Indeed, the MNE can do even better by optimally reallocating labour among the four X-sector activities so as to satisfy the MNE first-order conditions given either in (22) or (23). Thus producing $\overline{X}$ with $\overline{L}_c^h$ left over is the <u>minimum</u> improvement in productive efficiency that the MNE can realize.

In a sense, production by the MNE thus represents a technical improvement in the world production function for X. The efficient MNE world production frontier must lie everywhere outside the efficient NE world production frontier, (except at X = 0). This is shown in Figure II where $\overline{YX}_m$ represents the world MNE production frontier and $\overline{YX}_n$ represents the world NE production frontier. Along any ray from the origin, the MRT along $\overline{YX}_m$ must be less than the MRT along $\overline{YX}_n$. Along such a ray, there must be a greater allocation of labour to Y on $\overline{YX}_m$ than on $\overline{YX}_n$. Given diminishing marginal products of labour in both sectors, the MRT along $\overline{YX}_m$ (equations (19) or (20)) must be less than the MRT along $\overline{YX}_n$ (equation (6)).

FIGURE II

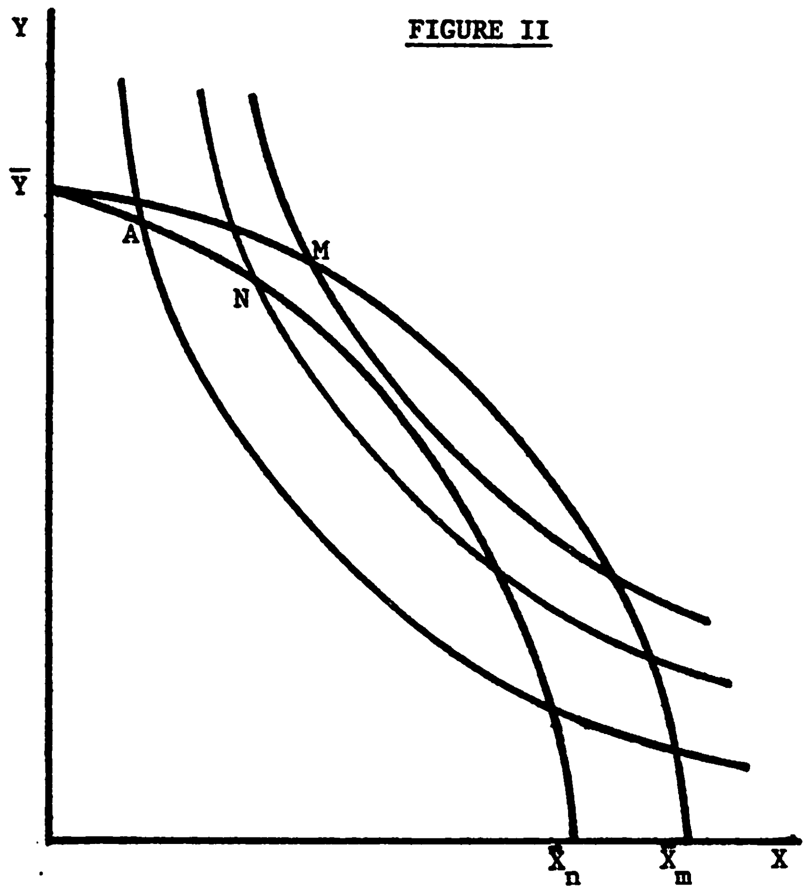
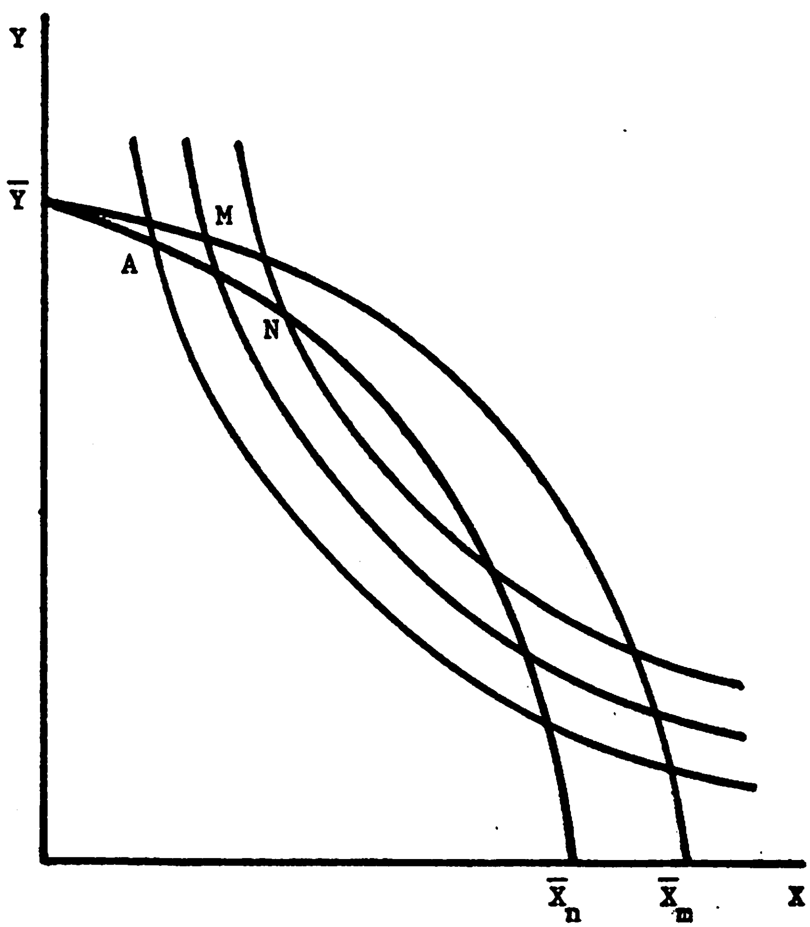


FIGURE III



Given our demand assumptions, the MNE and NE producers face the same field of community indifference curves in Figure II. Demand prices and elasticities continue to depend only on the production ratio (X/Y). The autarky, collusive, and market shares NE equilibria can thus be compared to the MNE equilibrium via a comparison of the first-order conditions (9), (11), (14), and (22) or (23).

$$(27)\quad p_a(1-1/\eta_x) = (MRT)_a,\ p_m(1-1/\eta_x) = (MRT)_m,$$

where subscripts m and a denote the MNE and NE (autarky, collusive, and market shares) equilibria respectively. If the NE equilibria are at point A in Figure II, then the MNE equilibrium must be at a point like M in that diagram. M must be "downhill" of the point on $\overline{XY}_m$ which lies on the same ray from the origin as point A. On such a ray, the MNE would face the same marginal revenue as the NE firms (since (X/Y) is the same) but a lower MRT as noted above. From the point of view of community indifference curve, revealed preference, or compensation principle criteria, M is unambiguously superior from the point of view of the world as a whole.

A comparison of the Cournot-Nash NE equilibrium and the MNE equilibrium yields the following:

$$(28)\quad p_n(1-\sigma^1/\eta_x) = (MRT)_n,\ p_m(1-1/\eta_x) = (MRT)_m$$

where n denotes the Cournot-Nash equilibrium value. Given the autarky NE equilibrium at A, the Cournot-Nash equilibrium must be at a point like N in Figures II and III, since at A marginal revenue exceeds marginal cost for the Cournot-Nash duopolists.

The relation between N and M is ambiguous. Along the same ray from the origin as that through N, the MRT on $\overline{XY}_m$ is less than on $\overline{XY}_n$, but marginal revenue for the MNE is also less than the marginal revenue for the Cournot-Nash duopolists. Thus the MNE may continue to achieve a gain in welfare over the NE equilibrium (Figure II) or may result in a deterioration in welfare relative to the Cournot-Nash equilibrium (Figure III).

Relative to the Cournot-Nash equilibrium, the MNE equilibrium enjoys greater productive efficiency at the expense of a higher degree of exercised market power. About all we can say is that the MNE equilibrium is more likely to enjoy a higher welfare level the greater the degree of economies of multi-plant operation and the greater the elasticity of demand for X.

An analysis of the distribution of gains between m and h is more subtle. Normally the process is begun by noting that with a convex production set, the value of free trade production evaluated at a price ratio tangent to the production frontier at that production point must exceed the value of any other feasible production bundle evaluated at that same price ratio (in our case $p_m(1-1/\eta_x)$) (see Kemp (1969) and Markusen (1980b)). This procedure is of little use to us here since the production sets of the two countries are inter-related as noted above. It remains true, however, that the competitive and efficient use of inputs implies that the value of free trade factor earnings is greater than or equal to the value of any other feasible factor allocation evaluated at those same free trade prices (or more correctly marginal revenues). In our case, the value of factor earnings (including the imputed earnings of sector-specific capital) in X^m for the MNE case is given by

$$(29)\quad p_m(1-1/\eta_x)[(MP_{1c})L_c^m + (MP_{1f})L_f^m + (MP_{kf})\bar{K}_x]$$

where $\bar{K}_x$ denotes the sector-specific capital in X and MP_{ij} denotes the marginal product of factor i in activity j. (29) notes that factor earnings in X^m equal the sum of marginal revenue products times employment levels.

Now assume that X is homogeneous of degree T. It follows from the well-known Euler property of homogeneous functions that (29) is equal to $p(1-1/\eta_x)X^T$, where $T > 1$ by the assumption that X is characterized by increasing returns to scale. "Pure" monopoly profits, or profits due only to market power and not to the ownership of sector specific capital are then given by revenue minus actual and imputed factor payments.

$$(30)\quad \pi^m = pX^m - p(1-1/\eta_x)(X^m)^T$$

which is assumed positive.

Now denote autarky values with a subscript a. Since factor payments in Y exhaust all output, the earlier statement that the value of factor earnings exceeds the value of any other factor allocation (e.g. the autarky allocation) at those same MNE equilibrium prices becomes

$$(31)\quad Y_m^m + p_m(1-1/\eta_x)(X_m^m)^T \geq Y_a^m + p_m(1-1/\eta_x)(X_a^m)^T$$

$$Y_a^m = C_{ay}^m,\ X_a^m = C_{ay}^m$$

$$Y_m^m + p_m X_m^m + \pi^* = C_{my}^m + p_m C_{mx}^m$$

where π^* denotes the profits repatriated from country h and C_{ij} denotes the consumption of good j in allocation i (i=m,a). The second line of (31) is the autarky market clearing conditions while the third line is the free trade balance of payments constraint. Related expression in the presence of distortions can be found in Kemp (1969), Markusen and Melvin (1981) and Markusen (1980b).

Substituting the second and third lines of (31) into the first, (31) becomes

$$(32)\quad [C^m_{my} + p_m C^m_{mx}] - \pi^* - p_m X^m_m + p_m(1-1/\eta_x)(X^m_m)^T >$$

$$[C^m_{ay} + p_m C^m_{ax}] + p_m(1-1/\eta_x)(X^m_a)^T - p_m X^m_a \quad \text{or}$$

$$(33)\quad [C^m_{my} + p_m C^m_{mx}] \geq [C^m_{ay} + p_m C^m_{ax}] + [p_m X^m_m - p_m(1-1/\eta_x)(X^m_m)^T]$$

$$- [p_m X^m_a - p_m(1-1/\eta_x)(X^m_a)^T] + \pi^*.$$

Substituting from equation (30), we have:

$$(34)\quad [C^m_{my} + p_m C^m_{mx}] \geq [C^m_{ay} + p_m C^m_{ax}] + [\pi^* + \pi^m_m - \pi^m_{am}]$$

where π^m_{am} denotes autarky "pure" profits in m evaluated at the MNE equilibrium prices. (34) shows that country m will unambiguously gain at the MNE equilibrium relative to autarky if $[\pi^* + \pi^m_m - \pi^m_{am}]$ is positive (i.e., the MNE consumption bundle will be revealed preferred). Even if the MNE were only able to repatriate pure profits from h, this expression must be positive.[15] This is because the sum of pure profits in m and h at the MNE equilibrium must be at least double the profits of a single national monopolist in autarky. "Technical change" of the type modelled here cannot lead to a decrease in world profits.

The procedure for country h is the same but with the sign of π^* reversed in the third line of (31). This gives us an equation for h which corresponds to (34).

$$(35)\quad [C^h_{my} + p_m C^h_{mx}] \geq [C^h_{ay} + p_m C^h_{ax}] + [\pi^h_m - \pi^h_{am} - \pi^*]$$

Country h will thus unambiguously gain if (but not only if) $[\pi^h_m - \pi^h_{am} - \pi^*]$ is positive. But even if only pure profits were repatriated ($\pi^* = \pi^h_m$), this would be negative. With the foreign country capturing profits that belonged to country h in the autarky equilibrium, country h is not assured of gains at the MNE equilibrium relative to autarky.

A similar procedure does not permit a simple comparison of the MNE and Cournot-Nash equilibria, since the second line of (31) must be replaced with the Cournot-Nash balance of payments constraint. This gives us an expression equivalent to (32), but with Cournot-Nash prices on the right-hand side. While this makes the standard technique not very useful, I suspect that the distributional advantage still lies with the multinational enterprise's home country due to the capture of profits otherwise accruing to the host country.

Two caveats should be offered before closing. First, equation (35) in no sense shows that country h will lose at the MNE equilibrium relative to autarky. It only states that positive gains cannot be proven. Second, the above analysis assumes that the MNE entered country h costlessly. If on the other hand, the MNE had to buy out a local entreprenuer, or grant him equity participation, then (34) and (35) would have to be modified accordingly. If equity participants in h are able to capture all of π^*, then (34) and (35) suggest that both countries should unambiguously gain.

VI. Monopsony Power

In this section, we will briefly consider the case in which producers of X are assumed to have monopsony power with respect to labour. This is modelled by simply replacing the fixed wage rate with the marginal product of labour in Y (i.e, with G') in the monopolist's programming problem. For the autarky case, this programming problem and first-order conditions are given as follows:

$$(36)\ \text{Max}\ p^i[C(L_c^i)F(L_f^i)] - w^i(L_c^i + L_f^i)\ \text{where}$$

$$p^i = p^i(X),\ w^i = G^{i'} = G^{i'}(\overline{L} - L_c^i - L_f^i)$$

$$(37)\ p^i(1-1/\eta_x)C^{i'}F^i = G^{i'}(1+1/\varepsilon^i) \qquad \varepsilon^i = \frac{w}{L_x}\frac{dLx}{dw} = -\frac{G^{i'}}{L_x G^{i''}}$$

$$p^i(1-1/\eta_x)C^iF^{i'} = G^{i'}(1+1/\varepsilon^i)$$

ε^i is thus the elasticity of labour supply to the X industry with respect to w ($G^{i'}$) and is positive by virtue of the concavity of G ($G'' < 0$). (37) can be rewritten as

$$(38)\ p^i(1-1/\eta_x) = \frac{G^{i'}(1+1/\varepsilon^i)}{C^{i'}F^i} = \frac{G^{i'}(1+1/\varepsilon^i)}{C^iF^{i'}} \qquad i = m,f.$$

Given the identical nature of the two countries, $\varepsilon^m = \varepsilon^h$ in the solutions to (38), and thus the autarky equilibria satisfy the conditions in (6) for production on the efficient production frontier. The autarky equilibria will not be at A in Figure I however, bur rather "uphill" from A since the "wedge" between p and the MRT is larger in (38) than in (9). Thus the monopoly-monopsony equilibrium is more distortionary than the simple monopoly equilibrium as one would expect.

The fact that production continues to take place on the efficient production frontier is true for all of the symmetric equilibria, including the non-centralized MNE equilibrium.[16] It is not however true for the centralized MNE equilibrium. In that case, the monopsony first-order conditions equivalent to (22) are

$$(39)\quad p(1-1/\eta_x) = \frac{G^{m'}(1+1/\varepsilon^m)}{C^{m'}(F^m+F^h)} = \frac{G^{m'}(1+1/\varepsilon^m)}{C^m F^{m'}} = \frac{G^{h'}(1+1/\varepsilon^h)}{C^m F^{m'}}$$

these conditions will satisfy the efficiency conditions in (19) only if ε^m equals ε^h. But we also noted in (24) that the efficiency conditions can be satisfied if and only if $L_y^m < L_y^h$. Since ε^i is in fact a variable in L_y^i for most neo-classical production functions it therefore follows that ε^m generally cannot equal ε^h at the solution to (39). Thus the centralized equilibrium will involve production interior to the efficient MNE world production frontier in addition to the type of monopsony distortion mentioned above.

The implication is that the centralized equilibrium cannot be ranked relative to any of the NE equilibria. If economies of multi-plant operation are small, then the centralized MNE equilibrium may involve a decrease in world real income relative to all of the NE equilibria considered.

VII. Summary and Conclusions

1. The purpose of this paper was to develop a general-equilibrium model which explains the allocative and distributive effects of multinational corporations. In doing so, it was noted that an adequate model should meet four pre-conditions: (a) the model should provide rationale for direct versus portfolio investment, (b) the model should preferably not rely on international factor movements, factor price differences, or barriers to international trade, (c) it should explain why monopoly production is superior to collusion among independent producers, and (d) it should explain why a multinational corporation might wish to diversify geographically, yet possibly carry on different activities in otherwise identical countries. I argued that these conditions could be met by a model based on the industrial-organization concept of economies of multi-plant operation.

2. Two versions of the basic model were developed and compared. In one version, world production of a good was monopolized by a multinational enterprise (MNE) while in the other version there was a single independent national enterprise (NE) producing the good in each of two countries. It was demonstrated that the MNE led to an increase in world real income relative to situations in which two NEs (a) produced in autarky, (b) colluded to maximize joint profits, or (c) engaged in a market-share rivalry. The MNE equilibrium could not however be ranked relative to a situation in which the NEs engage in Cournot-Nash behaviour. In such a case, the MNE produces with greater technical efficiency at the expense of a higher degree of exercised market power.

3. When the MNE does increase world real income, it was shown that the distribution of gains between countries depends, not surprisingly, on the distribution of monopoly profits. If the MNE can enter the host country costlessly, and if all profits are repatriated and enter the home country's income stream, then gains relative to autarky cannot be guaranteed for the host country. The reason is that in such a situation, the MNE

and the home country capture monopoly rents that in autarky would accrue to the host country entrepreneurs. An equal division of profits on the other hand guarantees bilateral gains from trade.

4. When the MNE finds it efficient to concentrate certain activities in the home country (the "centralized" case), the equilibrium involves a larger volume of trade than any of the NE equilibria. Thus MNE activity can, per se, form a basis for trade. Alternatively, this finding notes that direct investment, unlike portfolio capital movements, can act as a compliment rather than as a substitute to commodity trade.

5. Under the same circumstances, the MNE equilibrium will involve unequal factor prices between countries whereas the NE equilibria all involve factor price equalization. In general terms, this notes that MNE activity can in certain respects make countries more unequal.

6. Monopsony power in addition to monopoly power adds a second type of distortion to all the MNE and NE equilibria. However, in this particular model most equilibria continue to lie on the efficient production frontiers. The one exception is the centralized MNE equilibrium which lies interior to the efficient production frontier. In that case, the welfare effects described in (2) above may not hold and the MNE may in fact decrease world real income relative to autarky.

Appendix

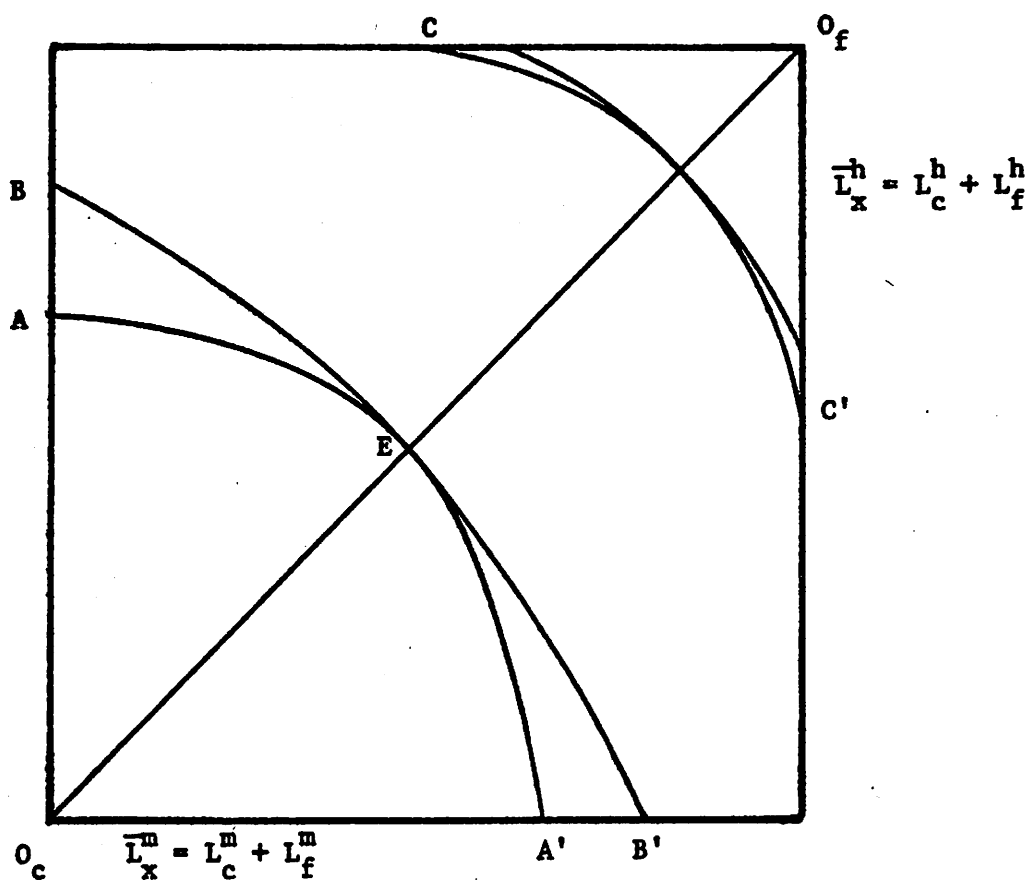
The purpose of this appendix is to briefly discuss the circumstances under which it is or is not optimal for the MNE to centralize the C activity in one country. Given the MNE production function in (2) above, the first-order conditions for the MNE are given in (20). As noted in section IV, the solution to these conditions is symmetric for m and h. Let $\bar{L}_x^i$ denote the allocation of labour to X in country i that solves (A1). This gives us the factor box in Figure IV with a horizontal dimension of $\bar{L}_x^m$ and a vertical dimension of $\bar{L}_x^h$ $(\bar{L}_x^m = \bar{L}_x^h)$. The lower-left and upper-right hand corners are the origins of $C(L_c^m, L_c^h)$ and $[F(L_f^m) + F(L_f^h)]$ respectively. The contract curve is the diagonal by virtue of the symmetry in the model. Suppose that the solution to (A1) is given by E in Figure IV. As noted earlier, it is assumed that the C isoquants are concave to the origin whereas the F isoquants have the usual shape.

If the elasticity of substitution in F is globally greater than that in C, then AEA' represents an F isoquant while BEB' represents a C isoquant. In this case, E is indeed a maximum and the equilibrium is "non-centralized". If the C isoquant is more elastic however, (i.e., AEA' is the C isoquant), then E is a minimum and the maximum lies on the side of the factor box at a point like A or A'.

A' is not of course the final "centralized" solution since total labour supplies to the X sector will be reallocated. Figure IV does not therefore prove that the true maximum must involve X_c^h (or X_c^m) equal zero. This is made as an additional assumption, but it can be guaranteed if the elasticity of substitution in C approaches zero $(C = \text{Max } [L_c^m, L_c^h])$. This corresponds to the case in which running the C activity in both countries is simply redundant.

It is also assumed that the centralized solution involves only one country producing C rather than only one country producing F. In other words, the equilibrium in Figure IV could be at a point like C' where both m and h engage in C and only h engages in F. This would not change the results in any substantial way, and we can rule it out by simply assuming that F is the relatively more important activity. That is, for $L_c^m + L_c^h = L_f^m + L_f^h$, the marginal product of labour in F exceeds its marginal product in C.

FIGURE IV



Footnotes

1. Caves (1980). As noted below, Caves presents evidence which rejects this idea.

2. In addition to the works just mentioned, see Kindleberger (1969, 1970), Caves (1971, 1974), Vernon (1971), Horst (1976), Hymer (1970), Gorecke(1976), and Parry (1980) to name just a very few of many articles and monographs on this topic.

3. Recent analysis of general-equilibrium theory of factor movements can be found for example in Jones (1967), Kemp (1969), Brecher and Alejandro (1977), Bhagwati and Brecher (1980), and Markusen and Melvin (1979). These articles provide no motivation as to why foreign investment might be concentrated in certain sectors much less why it might direct rather than portfolio investment. Caves (1971) provides a motivation for sectors specific investment but not for direct versus portfolio investment. All of these works rely on physical factor flows generated by ex ante factor price differences.

4. Technological assumptions presented below ensure that there will be only a single plant in each country. Also, I should point out that the types of MNE modelled here would probably be termed a "horizontal" MNE in that production facilities in the two countries are concerned with producing only one good. On the other hand, countries will be partially specialized as to the activities they perform in the production of this good, and thus there is something of a "vertical" (or "hierarchical") dimension to this MNE as well.

5. Scherer (1975, pp.321-340) suggests these economies are slight and that they are exhausted beyond some modest threshold due to coordination problems.

6. "Intangibles" is a term from the industrial origanization literature. Caves (1980) notes that "a number of studies have established that the importance of intangible assets to an industry is an excellent predictor of horizontal direct investment".

7. The assumption that firms have no monopsony power may seem strained in a two-good model. However, none of the results to follow rely on the fact that there are only two goods. All results continue to hold if there are many competitive sectors such that we could more reasonably assume that the X sector is a smaller employer of labour. Recent general-equilibrium models of monopsony include Feenstra (1980), McCulloch and Yellen (1980), and Markusen and Robson (1980).

8. See Jones (1971) for a discussion of sector-specific-capital model.

9. Centralization of C could also be assured by increasing returns to L^m and/or L^h. This would however be a bit hard to believe. It would imply that a doubling of inputs to C activities could more than double output with F held constant. Centralization of C could also be achieved by differences in factor endowments between countries m and h. But the result would then be due to a Heckscher-Ohlin basis for trade. While such factor proportions effects may be empirically very important, one purpose of the paper is to suggest an entirely different basis for trade as noted above.

10. See Herberg and Kemp (1969) for an analysis of some local properties of the production frontier with increasing returns to scale. By assuming CES production functions, Markusen and Melvin (1980) are able to derive some global properties. Herberg and Kemp note that the production set must be non-convex in a small neighbourhood about X = 0, but we shall show that all of our equilibria lie outside this region.

11. The commodity price and factor price equalization property of the autarky equilibrium breaks down if countries are of different size. With increasing returns to scale in X, the production frontier of the larger country will be flatter along any ray from the origin. This implies a lower autarky price ratio in the large country, and a world production bundle which is interior to the world production frontier (see Markusen and Melvin (1980) and Markusen (1980b)).

12. This result will generally not hold if there are strongly increasing returns in X such that the production frontiers of m and h are convex (i.e. the production sets are non-convex). In that case, the joint maximum will involve a non-symmetric equilibrium in which countries specialize (see Melvin (1969), Kemp (1969), or Markusen and Melvin (1980)).

13. I should be a bit careful in talking about "social welfare", since there are of course distributional differences between A and N in Figure I (e.g. the monoplists are worse off at N). From either a revealed preference or a compensation-principle approach however, N is superior to A.

14. By the MNE costlessly entering country h, I simply mean that the MNE entered without having to buy out or compete with an existing producer. We are therefore just comparing two equilibria without considering the possible costs of moving from one to the other.

15. The MNE could only repatriate "pure" profits as defined in (30) if, for example, it had to pay foreign sector-specific capital the value of its marginal product.

16. This result does not generally hold if there is more than one factor mobil between sectors (see Markusen and Robson (1980)).

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