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ABSTRACT

A model is constructed in which multinational firms may arise endogenously. Multinationals exist in equilibrium when transport and tariff costs are high, incomes are high, and firm-level scale economies are important relative to plant-level scale economies. Less obvious, multinationals are more important in total economic activity when countries are more similar in incomes, relative factor endowments, and technologies. The model may thus be useful in explaining several stylized facts, including (a) the growing importance of direct investment relative to trade among the developed countries over time and (b) the greater ratio of investment to trade among the developed countries relative to this ratio for "north-south" or "south-south" economic relationships. The model offers predictions about the volume of trade that contrast with those of the "new trade theory", predicting that trade at first rises and then falls as countries converge in incomes, relative endowments, and technologies. Welfare is also considered, and it is shown that direct investment makes the smaller (or high cost) country better off, but may make the larger (or low cost) country worse off.

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1. Introduction

The industrial-organization approach to trade (the "new trade theory") and the literature on "geography and trade" have enriched our understanding of the causes and consequences of trade by adding elements of increasing returns to scale, imperfect competition, and product differentiation to the more traditional comparative-advantage models of international trade. Although formal empirical work is still scarce, at an informal level the industrial-organization approach to trade seems to be consistent with a wide range of stylized facts. These include the observation of large volumes of trade between relatively similar economies and two-way trade in similar products.

The dominant assumption in both positive and normative models in the new trade theory and the geography-and-trade theory is one of single-plant, national firms: a firm is a unit that produces one product in one location. The normative literature (the "strategic trade-policy literature") assumes that any profits earned by these firms enter into the income stream of the country in which they are located. Thus trade policy involves countries acting as agents in support of national champions competing with the champions of foreign countries in the international market place.

Other stylized facts call into question this dominant assumption of national enterprises (henceforth NEs, referring to single-plant firms). Many of the industries which form the stuff of the new-trade-theory and strategic-trade-policy literatures such as autos, aircraft, and electronics, are dominated by multinational enterprises (MNEs). Firms endogenously choose the number and location of production facilities, making both horizontal and vertical investment decisions in foreign markets. At an aggregate level, evidence clearly indicates that direct investment has grown considerably faster than international trade among the developed countries. A very large proportion of direct investment is two-way investment among similar developed economies.[1] Data relating to

[1]These stylized facts are documented and discussed in Markusen's (1995) review article. Please see that paper for an extensive list of references.

these last two stylized facts are presented in Table 1.

The purpose of this paper is to construct a flexible model that allows both NE and MNE firms to arise endogenously depending on underlying parameter values. The model structure is deliberately chosen to be similar to a standard class of models in the new trade theory, both positive and normative, in order to facilitate a clear comparison of how the existence of multinationals (multi-plant firms) affects key results. In maintaining this consistency with the new trade theory, we focus on horizontal direct investment in which a MNE produces the same product in multiple plants.

Our model has several antecedents, in particular Brainard (1992) and Horstmann and Markusen (1992). Both of the latter papers have key elements of the model developed here including distinguishing between plant and firm-level scale economies and the existence of trade barriers such as tariffs and transport costs. The decision to engage in multinational (multi-plant) production is a tension between the added fixed costs of a second plant versus the trade costs of serving the foreign market by exporting. This approach has less in common with Helpman (1984) and Helpman and Krugman (1985) who focus on the geographical separation of headquarters and production facilities: multi-plant production does not arise because of the assumption of zero trade costs and assumptions ensuring factor-price equalization.

The present paper moves beyond Brainard, and Horstmann and Markusen in important respects. These papers focus almost entirely on symmetric economies, in terms of country size, factor endowments, and technologies. They focus on the trade-off between firm and plant-level fixed costs and trade costs. Yet many of the stylized facts that we seek to understand involve asymmetries among countries, in particular why direct investment is more important among countries that are similar in size, endowments, and technologies. Our model explicitly solves for the equilibrium "regime" as a function both of technology and country characteristics, where the term regime denotes the types of firms active in equilibrium. We also analyze how technology and country characteristics

affect trade volumes and welfare.

There are four firm types in the two-country (Home (h) and Foreign (f)) model, (1) NE firms located in h, (2) NE firms located in f, (3) MNE firms headquartered in h, and (4) MNE firms headquartered in f. We use partial equilibrium methods to illustrate how the regime depends on technology, country characteristics, and trade costs, and for a complete characterization of regimes we solve the model numerically. The general result on regimes is that multinationals become more important relative to NE firms as countries become more similar in size, endowments, and technologies. We have referred to this as the "convergence hypothesis", and believe that it is closely consistent with some of the stylized facts discussed above.[2]

After showing how the equilibrium regime depends on trade costs and country characteristics, we analyze the volume of trade and the volume of affiliate sales over the parameter space. The NE models of the new trade theory predict that intra-industry trade volume should rise as countries converge in size. Our model predicts a non-monotonic relationship between the intra-industry trade volume and the size difference. Beginning with countries that are very different in total income, a convergence in country characteristics at first leads to an increase in the volume of trade and then to a reduction in the volume of trade as MNEs begin to displace NEs. However, the sum of the trade volume and the volume of affiliate sales (e.g., production and sales by country h MNEs in country f) continues to rise as the countries converge. These results are reminiscent of the numbers in Table 1. Related results are found when the countries differ in relative endowments or in

[2]A more primitive version of the present model is presented in Markusen and Venables (1994). This paper differs from the earlier paper in three main respects. First, the model expands the number of firm types in order to permit MNEs to be associated with countries (i.e., the earlier paper could not address ownership of multinational firms). Second, the range of questions addressed is broadened to include the volume of trade, the welfare effects of permitting/excluding direct investment, and how these effects differ from those predicted by the NE models of the new trade theory. The equilibrium regime, ownership, trade volume, and welfare are all related to country asymmetries. Third, principal results are derived analytically.

technologies.

Finally, we analyze welfare and compare the results to those generated by an NE model in which MNEs are exogenously excluded. The general result is that the introduction of (previously prohibited) MNEs increases the welfare of both countries if they are initially relatively similar in size, endowments, and technologies, and if transport costs are relatively large. However, if these differences are initially large and transport costs are relatively low, the introduction of MNEs slightly reduces the welfare of the large, well endowed and/or more productive country, and increases the welfare of the small, poorly endowed, and/or less productive country. In a long-standing debate, the model thus comes down on the side which suggests that MNEs are a vehicle for transferring economic benefits from the large richer nations to the poorer nations.

Table 1

(A) Ratio of Direct Investment Stocks to Trade Flows: Total of US to Europe, Europe to US, US to Japan, Japan to US[3]

1991	1.73
1989	1.61
1987	1.44
1985	1.19
1983	1.25
1981	1.03
1979	0.96
1975	1.03
1974	0.88

(B) Direct Investment and Export Flows by Source and Recipient Countries, Classified as Developed and Less Developed: 1987-1991. Presented as Shares of all Direct Investment Flows and Trade Flows[4]

	Investment	Exports
Developed to other Developed	80%	61%
Developed to less Developed	17%	15%
Less Developed to Developed	2%	15%
Less Developed to less Developed	1%	8%

[3]Specifically, the numerator of the following ratio is the sum of four direct investment stocks: investment by US firms in Europe, European firms in the US, US firms in Japan, and Japanese firms in the US. The denominator is the sum of four bilateral export flows US-Europe, Europe-US, US-Japan, Japan-US. All figures are in current US dollars, and direct investment stocks include reinvested earnings. Source: trade data is taken from the United Nations Yearbook of International Trade Statistics, and direct investment data is taken from the Survey of Current Business, various years.

[4]Source: investment from Ethier and Markusen (1994), compiled from UNCTAD Programme on Transnational Corporations data. Export data from United Nations Yearbook of International Trade Statistics.

2. Specification of the Model

As noted above, the model has two countries (h and f) producing two homogeneous goods, Y and X. There are two factors of production, L (labor) and R. L is mobile between industries but internationally immobile. R is a specific factor used only in the Y industry. R acts partly to "convexify" the model. Expansion of the X sector draws labor from the Y sector, raising the R/L ratio in the Y sector, thereby raising the cost of labor measured in terms of Y. Y will be used as numeraire throughout the paper. Labor is used for both the fixed and the variable costs in producing X and in addition there are transport costs between countries, specified as units of labor per unit of X exported.

Subscripts (i,j) will be used to denote the countries (f,h). The output of Y in country i is a Cobb-Douglas function, where R_i is country i's endowment of R and θ_i is the country specific efficiency parameter. The production function for Y is

$$(1) \qquad Y_i = \theta_i L_{iy}^{\alpha} R_i^{1-\alpha}, \qquad i = h, f.$$

Labor demand in the Y sector is given by equality of the wage, w_i, to the value marginal product of labor,

$$(2) \qquad w_i = \alpha \theta_i (L_{iy}/R_i)^{\alpha-1}, \qquad i = h, f.$$

Superscripts (n,m) will be used to designate a variable as referring to national firms and multinational firms respectively. (m_i, n_i) will also be used to indicate the number of active m firms and n firms based in country i. Hopefully, it will always be clear from the context what is being represented (e.g., n_i as a variable in an equation always refers to the number of national firms in country i).

X^n_{ij} denotes the sales in country j of a national firm based in country i. A national firm undertakes all its production in its base country, so the labor used by one national firm in country i is given by

$$c_i X^n_{ii} + (c_i + \tau)X^n_{ij} + G_i + F_i, \qquad i,j = h,f, \quad i \neq j. \tag{3}$$

where c_i is the constant marginal production cost and G_i and F_i are the plant-specific and firm-specific fixed costs both measured in units of labor. In one experiment, we let these costs vary across countries, but we assume that these costs are common across all firms operating within a country. τ is the amount of labor needed to transport one unit of X from country i to country j, which we assume to be the same in both directions, so τ is not subscripted by country.

A multinational based in country i has sales in country j, X^m_{ij}. It operates one plant in each country, but incurs its firm specific fixed cost, F_i, in its base country. Sales are met entirely from local production not trade, so a country i multinational has demand for country i labor given by,

$$c_i X^m_{ii} + G_i + F_i, \qquad i = h,f. \tag{4}$$

Operating a plant in the host country means that a country i multinational has demand for country j labor,

$$c_j X^m_{ij} + G_j, \qquad i,j = h,f. \tag{5}$$

Notice that we assume that the technology used by the MNE is determined by the location of its plants, not of its headquarters. We change this assumption in one of our experiments and let the plant technology be determined by firm nationality (headquarters location) not plant location.

Let $\bar{L}_i$ denote the total labor endowment of country i. Adding labor demand from n_i national firms,

m_i multinationals based in country i, and m_j multinationals based in country j, gives country i factor market clearing:

$$\bar{L}_i = L_{iy} + n_i(c_i X_{ii}^n + (c_i + \tau)X_{ij}^n + G_i + F_i) + m_i(c_i X_{ii}^m + G_i + F_i) + m_j(c_i X_{ji}^m + G_i) \tag{6}$$

In equilibrium, the X sector makes no profits so country i income, denoted M_i, is

$$M_i = w_i L_i + (1 - \alpha)Y_i \qquad i = h,f. \tag{7}$$

p_i denotes the price of X in country i, and X_{ic} and Y_{ic} denote the consumption of X and Y. Utility of the representative consumer in each country is Cobb-Douglas,

$$U_i = X_{ic}^{\beta} Y_{ic}^{1-\beta}, \qquad X_{ic} \equiv n_i X_{ii}^n + n_j X_{ji}^n + m_i X_{ii}^m + m_j X_{ji}^m \tag{8}$$

giving demands

$$X_{ic} = \beta M_i / p_i, \qquad Y_{ic} = (1-\beta)M_i. \tag{9}$$

Equilibrium in the X sector is determined by pricing equations (marginal revenue equals marginal cost) and free-entry conditions. We denote proportional markups of price over marginal cost by e_{ij}^k, (k = n,m), so, for example, e_{ji}^m is the markup of a country j multinational in market i. Pricing equations of national and multinational firms in each market are (written in complementary-slackness form with associated variables in brackets):

$$p_i(1 - e_{ii}^n) \le w_i c_i \qquad (X_{ii}^n) \tag{10}$$

$$p_j(1 - e_{ij}^n) \le w_i(c_i + \tau) \qquad (X_{ij}^n) \tag{11}$$

(12) $p_i(1 - e_{ii}^m) \leq w_i c_i \qquad (X_{ii}^m)$

(13) $p_j(1 - e_{ij}^m) \leq w_j c_j \qquad (X_{ij}^m)$

In a Cournot model with homogeneous products, the optimal markup formula is given by the firm's market share divided by the Marshallian price elasticity of demand in that market. In our model, the price elasticity is one (see equation (9)), reducing the firm's markup to its market share. This gives, (also using demand equations (9)),

(14) $$e_{ij}^k = \frac{X_{ij}^k}{X_{jc}} = \frac{p_j X_{ij}^k}{\beta M_j} \qquad k = n,m, \qquad i,j = h,f.$$

Using these expressions in pricing equations gives expressions for output in terms of price,

(15) $$X_{ii}^n \geq \beta M_i \frac{p_i - w_i c_i}{p_i^2}.$$

(16) $$X_{ij}^n \geq \beta M_j \frac{p_j - w_i(c_i+\tau)}{p_j^2},$$

(17) $$X_{ii}^m \geq \beta M_i \frac{p_i - w_i c_i}{p_i^2}$$

(18) $$X_{ij}^m \geq \beta M_j \frac{p_j - w_j c_j}{p_j^2}$$

Each of these holds with equality if the right hand side is positive, otherwise output equals zero.

There are four zero-profit conditions corresponding to the numbers of the four firm types. Given equations (10)-(13), zero profits can be written as the requirement that markup revenues equal fixed costs.

(19) $p_h e^n_{hh} X^n_{hh} + p_f e^n_{hf} X^n_{hf} \le w_h(G_h + F_h) \qquad (n_h)$

(20) $p_f e^n_{ff} X^n_{ff} + p_h e^n_{fh} X^n_{fh} \le w_f(G_f + F_f) \qquad (n_f)$

(21) $p_h e^m_{hh} X^m_{hh} + p_f e^m_{hf} X^m_{hf} \le w_h(G_h + F_h) + w_f G_f \qquad (m_h)$

(22) $p_f e^m_{ff} X^m_{ff} + p_h e^m_{fh} X^m_{fh} \le w_f(G_h + F_h) + w_h G_h \qquad (m_f)$

If outputs are positive, then using (14)-(18), these free entry conditions can be expressed as:

(23) $$\beta\left[M_h\left(\frac{p_h - w_h c_h}{p_h}\right)^2 + M_f\left(\frac{p_f - w_h(c_h+\tau)}{p_f}\right)^2\right] \le w_h(G_h+F_h), \qquad (n_h)$$

(24) $$\beta\left[M_h\left(\frac{p_h - w_f(c_f+\tau)}{p_h}\right)^2 + M_f\left(\frac{p_f - w_f c_f}{p_f}\right)^2\right] \le w_f(G_f+F_f), \qquad (n_f)$$

(25) $$\beta\left[M_h\left(\frac{p_h - w_h c_h}{p_h}\right)^2 + M_f\left(\frac{p_f - w_f c_f}{p_f}\right)^2\right] \le w_h(G_h+F_h) + w_f G_f, \qquad (m_h)$$

(26) $$\beta\left[M_h\left(\frac{p_h - w_h c_h}{p_h}\right)^2 + M_f\left(\frac{p_f - w_f c_f}{p_f}\right)^2\right] \le w_f(G_f+F_f) + w_h G_h, \qquad (m_f)$$

To summarize the X sector in the model, the eight inequalities (15)-(18) are associated with the eight output levels (two each for four firm types), and the four inequalities in (23)-(26) are associated with the number of firms of each type. Additionally goods prices are given by (9), income levels from (7) and factor prices from factor market clearing equation (6) together with labor demand from the Y sector, (2).

3. Analytical Results in Partial Equilibrium

A partial equilibrium variant of the model can be illustrated diagrammatically. Suppose that the Y sector uses labor alone, and has constant returns to scale ($\alpha = 1$ in equation (1)). Wages and income are then determined directly by parameters and endowments, so:

$$(27) \qquad w_h = \theta_h, \quad w_f = \theta_f, \qquad M_h = w_h\bar{L}_h, \quad M_f = w_f\bar{L}_f$$

For the partial equilibrium analysis of this section, we do not distinguish type-m firms by base country. There is therefore only one type of multinational, which divides its F equally between the two countries (i.e., the type-m firm's fixed costs are $[w_h(G_h + F_h/2) + w_f(G_f + F_f/2)]$. We also drop the subscript denoting type-m firms' base country so that m is the number of type-m firms and X_h and X_f refer to an MNE's output in each country.

With these assumptions, there are three zero profit conditions and they contain only two endogenous variables, p_h and p_f. These are illustrated as the curves of Figure 1, drawn for the case of symmetric economies. Thus the curve $\pi_m = 0$ is the zero profit locus for type-m firms; above it type- m profits are positive and below negative. If countries are identical, its gradient on the 45° line is unity. Curve $\pi_h = 0$ is the zero profit locus for a national firm located in h; it is relatively steeply sloped, since, if $\tau > 0$, home profits are affected more by changes in p_h than p_f. $\pi_f = 0$ is the analogous condition for a type-f firm.

In addition to zero profit loci we need supply and demand information determining prices p_h and p_f. We include this on Figure 1 as follows. Suppose that only type-m firms are active ($n_h = n_f = 0$). Then, setting the supply equal to demand for good X in each country gives,

$$(28) \qquad mX_h^m = \beta M_h/p_h, \qquad mX_f^m = \beta M_f/p_f$$

Eliminating m from these equations and using the supply equations (17) and (18) ($X_{ii}^m = X_i^m$, $X_{ij}^m = X_j^m$ we derive,

$$(29) \qquad p_h/(w_h c_h) = p_f/(w_f c_f).$$

Proceeding analogously for the case in which only n_h firms are active ($n_f = m = 0$) gives:

(30) $$p_h/c_h = p_f/(c_h + \tau).$$

and for the case in which only n_f firms are active ($n_h = m = 0$):

(31) $$p_f/c_f = p_h/(c_f + \tau).$$

These relationships are illustrated as the three straight lines, m, n_h, n_f on Figure 1. Thus, if only type m firms are active equilibrium prices must lie on m. If both type m and n_h firms are active we can show that prices must lie between lines m and n_h, with proximity to these lines depending on the relative numbers of type-m and type-h firms.[5]

3.1 Symmetric Equilibria

Consider first a situation in which the countries are identical, referred to as the symmetric case. From Figure 1 we see that -- in the symmetric case -- two sorts of equilibrium are possible. If the zero-profit loci for the national firms intersect beyond point M, the equilibrium is at point M. Only type m firms are active, since M is below the $\pi_h = 0$ and $\pi_f = 0$ contours meaning that prices are low enough that national firms would make a loss[6]. At M there is no intra-industry trade, as supply is met entirely by production by multinationals' plants in each country.

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[5]The proof involves a few lines of algebra and runs as follows. If both type-m and type-h firms are active, then a type-m firm will have a lower share of total sales in country h than in country f. Let s_{mh} and s_{mf} denote the share of sales held by type-m firms in markets h and f respectively. $s_{mh} < s_{mf}$ due to the transport costs faced by type-h firms in exporting to country f. Weighting the equations in (28) by these shares, we can determine using (28) and (17)-(18) that the price ratio p_f/p_h must exceed that along line m in Figure 1. A similar procedure for type-h firms shows that this price ratio must be less than that along line n_f in Figure 1.

[6]Notice that points A and B are not equilibria. At A multinationals and national firms in f make zero profits, but since A does not lie between lines n_f and m no non-negative combination of n_f and m can give supplies consistent with prices at A; an analogous argument applies to point B.

The other type of equilibrium occurs if the intersection of the $\pi_h = 0$ and $\pi_f = 0$ loci lies inside $\pi_m = 0$. This is illustrated by the zero-profit loci for the national firm types intersecting at point N. There are no multinational firms, an equal number of national firms in each country (with symmetric economies), and all firms engage in trade, supplying both their domestic and export markets.

We have a number of results for the symmetric case. First, multinational and national firms do not co-exist, except in the borderline case in which parameters are such that all three zero profit loci intersect at the same point. This is clear from Figure 1 for the partial equilibrium case, and is also true in general equilibrium. We can thus think of there being two firm types, high fixed-cost, low variable cost firms (type m) and low fixed-cost, high variable cost firms (types h and f). Except in borderline cases, one "technology" will dominate and free entry and exit will ensure that only multinational or national firms will survive.

The dividing line between cases is determined by magnitudes of transport costs, plant and firm economies of scale, and market size. The results are relatively intuitive and are discussed in detail in Markusen and Venables (1994), so we shall only state them here. (1) An increase in transport costs makes the equilibrium with type-m firms more likely. Geometrically, an increase in τ shifts the zero-profit loci for h and f firms out, while leaving that for m firms unchanged. (2) An (symmetric) increase in incomes makes the equilibrium with type-m firms more likely. The larger the total market, the more likely it is that the high fixed-cost option of two plants dominates the high variable-cost option of exporting. (3) A higher proportion of F in the (constant) sum of (F + G) makes the equilibrium with type-m firms more likely, as plant-level scale economies diminish relative to firm-level scale economies.

To summarize the symmetric case, multinational firms should become less likely as transport costs and tariffs fall which, if we believe they have done so, makes it hard to understand the stylized

facts presented at the beginning of the paper. However, falling transport costs and tariffs can be outweighed by a general increase in income levels, and perhaps shifts in technology in the direction of firm-level scale economies, away from plant-level scale economies (e.g, production becomes more R&D intensive).

3.2. The Convergence of Asymmetric Countries

Many of the stylized facts about multinationals, such as those alluded to in the introduction, have to do with countries that are asymmetric with respect to incomes, relative factor endowments, and technologies. This section will examine how these asymmetries affect the equilibrium regime. The major finding is that multinationals increasingly dominate international economic activity as countries converge (become more similar) in these three characteristics, which we have referred to as the "convergence hypothesis".

Begin with the two countries identical, and assume that country sizes, fixed costs, and transport costs are such that the initial equilibrium is at point M in Figure 1 (point C lies to the northwest of M). There are no national firms and no trade initially. Retain for now the partial-equilibrium assumptions of the previous section. Now transfer some amount of income from country f to country h, so in equations (23)-(26), we have $\Delta M_h = -\Delta M_f > 0$. Note first that along the m-locus ($p_h = p_f$) in Figure 1, the set of prices at which $\pi_m = 0$ does not change. The MNE is indifferent as to the distribution of income <u>if all firms are type-m.</u> But now consider relative prices given by the slope of the n_h locus in Figure 1. At these relative prices, the transfer of income from f to h reduces profits for the type-m firms (equation (25) or (26)) since $p_f > p_h$. In short, the transfer of income from country f to country h "rotates" the $\pi_m = 0$ locus clockwise around the point M in Figure 1. This movement is illustrated in Figure 2, where $\pi_m^0 = 0$ rotates to $\pi_m^1 = 0$.

Now consider type-h firms, and consider how the transfer of income from f to h affects type-h

firms at the relative prices given by the n_h locus in Figures 1 or 2. If we substitute equation (30) into (23), the latter becomes

$$(32) \qquad \beta\left[M_h\left(\frac{p_h - w_h c_h}{p_h}\right)^2 + M_f\left(\frac{p_h - w_h c_h}{p_h}\right)^2\right] \leq w_h(G_h + F_h), \qquad (n_h)$$

As was the case along the m-locus where there are only type-m firms, the type-h firms are indifferent to the transfer of income if all firms are type-h. Intuitively, if there are only type-h firms, equation (30) tells us that their (proportional) markups are the same in the two markets, and hence the firms are indifferent to losing \$1 of sales in country f and gaining \$1 of sales in country h. Thus the shift of income has no effect on profits and the number of firms if all firms are of the same type. Finally, consider the effect of the income transfer on the profits of type-h firms along the m-locus in Figure 2 ($p_h = p_f$). From (23), we see that the income transfer from country f to country h must increase the profits of type-h firms at these relative prices. Thus the income transfer rotates the $\pi_h = 0$ locus around point H in Figure 2, from $\pi_h^0 = 0$ to $\pi_h^1 = 0$.

A sufficient transfer in income must shift the regime. As illustrated in Figure 2, the equilibrium shifts from type-m firms only at point M to a regime in which type-m and type-h firms coexist at point A. As the transfer process continues, eventually the equilibrium prices converge to point H in Figure 2, and only type-h firms exist in equilibrium. Beginning in the symmetric equilibrium, the profits (initially negative) for potential type-h firms are improved by the transfer at the initial (type-m firms only) prices $p_h = p_f$ in Figure 2. At these prices, the type-h firms benefit by a transfer of income (and therefore sales) to the market in which they have a larger markup. If the income transfer is sufficiently large, the $\pi_h = 0$ locus will lie inside of the $\pi_m = 0$ locus along line m in Figure 2.

Consider reversing the process beginning with countries of very unequal incomes, motivated by the convergence of North America, Western Europe, and Japan over the last few decades. Figure 2 suggests a movement from an initial situation with only national firms in the larger (e.g., US) economy serving the foreign market by exports, followed by a mixed equilibrium of national and multinational firms, followed by the disappearance of national firms and of trade. Thus as countries converge, we expect to see multinationals eventually begin to displace trade.

Alternatively, countries might have similar total incomes, but have different technologies or different relative factor endowments. An examination of equations (23) to (26) reveals that increasing a country's wage rate, a reflection of changing its R/L endowment ratio, is the same as a uniform increase in all of its cost coefficients, (c, τ, F, and G). Thus in the present model, a factor-proportions experiment in which we change a country's R/L ratio holding its total income constant is the same as a Ricardian experiment in which we alter its technology.

Consider therefore an experiment in which we raise w_f a small amount and lower w_h an identical small amount ($dw_f = -dw_h > 0$) beginning again in the symmetric equilibrium, and holding income levels constant. Given our partial-equilibrium assumptions in (27), this is accomplished by a change $d\theta_f = -d\theta_h > 0$, compensated for by a labor shift $d\bar{L}_f = -d\bar{L}_h < 0$ to keep incomes constant. In this case, the wage changes have no effect on the profits of type-m firms if only type-m firms exist ($p_h = p_f$). But the changes generally reduce the profits of type-m firms along the n_h-locus in Figure 2, where $p_f > p_h$. Subject to a plausible restriction, the $\pi_m = 0$ locus rotates clockwise around point M in Figure 2 just as it did with the income transfer experiment.[7] Rotation of the $\pi_m = 0$ locus is

[7]Equations (25) and (26) are highly non-linear with respect to the wage rates. Differentiation of (25) and (26) for $dw_f = -dw_h > 0$, implies $d\pi_m < 0$ if and only if $(e^m_{hh} + e^m_{ff}) < 1$, where $e^m_{hh} = (p_h - w_h c_h)/p_h$ and $e^m_{ff} = (p_f - w_f c_f)/p_f$. In words, the comparative-statics change $dw_f = -dw_h > 0$ reduces the multinationals profits along the n_h-locus in Figure 2 if and only if the sum of the multinationals markups in the two countries is less than one. The result shown in Figure 2 can only be reversed if the average markup exceeds 50%. The parameterizations in our examples result in markups that are significantly smaller.

shown in Figure 3.

The movement of the $\pi_h = 0$ locus is however different from the income transfer experiment. In the present case the change in relative wage rates moves the $\pi_h = 0$ locus inward at all output prices, since the type-h firms use only home country labor. The $\pi_h = 0$ in Figure 3, initially through point H in Figure 3, shifts it to its new position through point H'. Conversely, the $\pi_f = 0$ locus in Figure 3 shifts out from its position through point F to its position through point F'. Beginning at M with only type-m firms in Figure 3, we move to a mixed equilibrium and then eventually to an equilibrium with type-h firms only. Reversing the argument and beginning with very different countries, we move from an initial equilibrium with only type-h firms, to a mixed equilibrium and finally to a multinational-only equilibrium in which trade disappears. We referred to this as the "convergence hypothesis" in our earlier paper as we noted above: an countries become more similar in income levels, relative endowments, and technologies, trade is gradually replaced with multinational firms and branch-plant production.

3.3 Welfare

Much has been written on the welfare effects of direct investment, including a great volume of informal analysis. One difficulty with this literature is that it is often not clear what the alternative to direct investment is; that is, the welfare effects of direct investment as compared to what? Our model provides a vehicle for examining the welfare question by solving for the equilibrium numbers and types of national firms when multinational firms are exogenously excluded.

A convenient feature of the simple partial-equilibrium version of the model outlined above is that a country's welfare depends only on p_i, the relative price of X in terms of Y. The income of country i is fixed at $M_i = \theta_I^i \bar{L}_i$, and there are no profits, so the budget line of the representative consumer is fixed in terms of good Y. Welfare is inversely related to p_i. In the experiments of

Figures 1-3, some results can be inferred as to how the exclusion of type-m firms affects prices. Consider first the situation shown in Figure 1, assuming that the zero-profit loci for type-h and type-f firms cross at C. In this case, the exclusion of multinational firms will result in equilibrium at C rather than at M, higher prices in both countries, and a loss of welfare for both countries. The higher transport costs (and perhaps change in competitive conditions) outweigh the higher fixed costs in the multinational equilibrium at point M.

But with countries asymmetric, more complex outcomes can occur. Continue with the examples of Figures 1-3 in which, without loss of generality, we assume that country f is always disadvantaged in the relevant sense compared to country h. From Figure 1, we see that if the degree of asymmetry is small such that point C still lies to the Northeast of point M, then the result just derived continues to hold: excluding multinational firms makes both countries worse off by raising the price of X in both countries. But now consider the experiment in which we transfer income from country f to country h. Figure 4 is the same as Figure 2, except that we have added the zero-profit loci for type-n_f firms. Using a similar analysis to that used to shown the $\pi_h = 0$ locus rotated clockwise around point H, it can easily be shown that the $\pi_f = 0$ locus rotates clockwise ("outward") around point F in Figure 4. In the initial symmetric situation, the $\pi_h = 0$ and $\pi_f = 0$ loci intersect on the m-locus, and intersect at point N following the transfer. In the situation shown in Figure 4, the countries are sufficiently different that the intersection of the $\pi_h = 0$ and $\pi_f = 0$ loci lies to the Northwest of the intersection of the $\pi_m = 0$ locus with the m-locus. Indeed, in the case drawn in Figure 4, the equilibrium when multinationals are permitted is at point A in which both type-m and type-h are active in equilibrium. In cases such as this one, the exclusion of multinationals results in a shift in the equilibrium from point A in Figure 4 to point N. The result is that p_h falls and p_f rises with the exclusion of multinationals. Let us put it the other way around in order to be more consistent with the literature: the introduction of multinationals in this case (the movement from N

to M in Figure 4) results in a fall in welfare for country h (p_h rises), the "advantaged" country, and to a rise in welfare for country f (p_f falls), the "disadvantaged" country.

Figure 3 indicates a similar outcome for the case where the countries differ in relative endowments or technology (costs). If type-m firms are excluded, the equilibrium is at point N. If multinationals are permitted to enter, the equilibrium shifts to point A, with the result similar to Figure 4 that p_h rises and p_f falls.

Contrary to many suggestions in the literature, the "host" country always gains from the introduction of multinationals, but Figures 3 and 4 display cases in which the "home" country loses. Note that if we increase transport costs in Figures 3 and 4 , point N moves to the Northeast and point A converges to the intersection of $\pi_m = 0$ and the m-locus at point M. Eventually, point N will lie to the Northeast of the latter (equilibrium) point, and both countries will be better off from the introduction of multinationals. In summary, the introduction of previously excluded multinationals will make both countries better off if the countries are relatively similar and transport costs are relatively high, but may make the "advantaged" country worse off if the countries are sufficiently different and transport costs are relatively low. Specifically, a <u>sufficient</u> condition for the advantaged country to lose is that the equilibrium with multinationals permitted involves both type-m and type-h firms active in equilibrium. In such a case, the exclusion of multinationals must move the equilibrium up (northwest) the $\pi_h = 0$ locus, implying $dp_h < 0$.

The intuition behind this last result can be stated as follows. If multinationals enter and type-h firms exist in the new equilibrium, the price (p_f) will fall in country f and type-h firms can only continue to break even if there is a compensating rise in p_h.

4. General Equilibrium

The full general-equilibrium model generates somewhat more complicated effects, due to

general-equilibrium effects on wages and incomes and due to the fact that there are four firm types, not three. For example, in the first experiment in which income is transferred, point A in Figure 2 involves a larger share of labor in country h in the X sector than in country f, implying that $w_h > w_f$. This complicates the outcome in two possible ways. First, the zero-profit locus for type-m_f firms may sometime lie inside of the zero-profit locus for type-m_h multinationals, other things equal. Second, the lower wage in country f makes type-n_f firms more profitable, other things equal. Thus beginning with very unequal countries, a convergence may involve type n_f and/or type-m_f firms active at some parameter values.

Because of these complicated general-equilibrium effects, we simulated the model numerically using Rutherford's non-linear complementarity solver, MPS/GE (now a subsystem of GAMS). The results of three experiments are shown in Figures 5, 6, and 7. In the first experiment (Figure 5), we hold the total factor endowment of country h constant and increase the factor endowment of country f beginning at only 2% of country h's endowment. This is similar to the size experiment in Figure 2, but is somewhat more reflective of history than the experiment of transferring income holding the total constant. Relative factor endowments of the two countries are equal and technologies are identical. The factor endowment of country f as a proportion of country h's endowment is graphed on the vertical axis of Figure 5 while transport costs as a proportion of marginal costs are graphed on the horizontal axis.

We see that quite a complicated picture emerges. For very low transport costs, we have the oligopoly of national firms that is the dominant regime usually assumed in the new trade theory. When the countries are very different and transport costs are moderate, we find only national firms of country h. Moving up a column such as $\tau = .10$, we move to a mixed national-multinational equilibrium and finally to a multinational only equilibrium. In columns $\tau = .05$ and $\tau = .10$ we see some of the complication introduced in general equilibrium. Moving up column $\tau = .05$, we see type-

n_f firms at first entering and then exiting. Moving up the column for $\tau = .10$ we see that the first MNEs that enter are headquartered in country f, because country f's wage rate is lower in this region as suggested above (with reference to Figure 2, the $\pi_{mf} = 0$ locus lies inside the $\pi_{mh} = 0$ locus). But although the full characterization of the equilibrium regime is complicated, the general intuition of the partial-equilibrium analysis holds. Beginning with countries very different, we generally move from a regime with only national firms to a mixed regime, to a multinationals-only regime.

Figure 6 shows the results for an experiment in which the relative factor endowments differ between the countries, generating wage differences and producing a general-equilibrium analog of Figure 3. As in the case, of Figure 5, the countries are identical in the top row, with their differences maximized in the bottom row. As we move down a column, we transfer factor R from country h to country f and factor L from country f to country h. With the endowment ratio R/L of country f initially normalized to 1, the vertical axis of Figure 6 gives R/L for country f with R/L for country h being the reciprocal of this value. For unequal endowment ratios, equal labor demand in X in both countries would result in a higher wage rate in country f as can be seen from equation (2) above.

The results in Figure 6 are much less complex than those in Figure 5 and quite similar to those of the partial-equilibrium analysis of Figure 3. The reason is that the higher wage in country f (other things equal) disadvantages type-n_f and type-m_f firms, so that the former only exist when transport costs are very low and the latter only exist when the countries are nearly identical. But we see the same general results in that, for moderate transport costs, we move from national firms only to a mixed equilibrium to multinationals only as we move up a column.

Figure 7 presents a slight variation of the technology experiment discussed in Figure 3. We assume that multinationals' fixed costs are national not location specific, so that the right-hand sides of equations (25) and (26) are respectively:

$$w_h(G_h + F_h) + w_f G_h \qquad w_f(G_f + F_f) + w_h G_f$$

This is motivated by a plausible conjecture that there exists firm-specific know-how in building plants. Beginning with equal costs in the top row of Figure 7, we then increase (c_f, G_f, and F_f) in proportion, with the factor of proportionality shown on the vertical axis. The horizontal axis gives transport costs as a proportion of marginal costs in country h.[8]

The results in Figure 7 are very similar to those of Figure 6 as we would expect them to be. For moderate levels of transport costs, we see the same movement from national firms to a mixed equilibrium to a multinationals only equilibrium as the countries converge in technologies. Ownership of firms is dominated by the home country as it is in Figure 4.

The general results of these three experiments are summarized in a stylized composite diagram in Figure 8. The vertical axis measures the degree of similarity of the countries in terms of income levels, endowments, and technologies while the horizontal axis is transport costs. The West and Southwest section of the Figure is a region of only national firms, subdivided into a region of n_h firms only and a region of national firm oligopoly in the Midwest and Northwest. Note that this subsection of the diagram is the region where the dominant model of the new trade theory, oligopoly between national firms of the two countries, is the equilibrium regime. In the Center and Southeast regions of Figure 8, we have equilibria with a mix of national and multinational firms. In the Northwest, we have the multinationals only equilibria. If the difference measured on the vertical axis is in endowments or technologies, the ownership of firms in the MNE and MNE/NE regions is dominated by the home country, while if the difference is based on country size there are points in which some firms are headquartered in country f. Ownership is therefore tied to comparative costs

[8]Note that, since we are increasing c_f but holding τ the same in both directions, transport costs as a proportion al marginal are no longer the same in both directions. The horizontal axis of Figure 7 gives transport costs as a proportion of marginal costs in country h as we noted.

much more than it is to comparative GNP levels.

The welfare results from the partial-equilibrium analysis in section 3 are confirmed in our numerical simulations (not presented). Country h sometimes loses a small amount if we permit (previously excluded) multinationals to enter, but only if the difference between the countries is relatively large and transport costs are relatively modest. With reference to Figures 5-7, losses to country h from the introduction of multinationals only occur at points on or near the boundary between the region with multinationals (typically mixed national and multinational firms) and the region with no multinationals. For points significantly to the Northeast of this boundary (i.e., countries more similar, τ larger), both countries gain.

5. The Volume of Trade

The new trade theory with national firms makes interesting predictions about the volume of trade in increasing-returns sectors. Indeed, this theory was partly developed in response to empirical observations about the volume of trade that appeared to contradict more traditional factor-proportions trade theory. In particular, the volume of trade could increase between two countries as they become more similar. This can be due to either the "reciprocal dumping" of identical products or to increased trade in differentiated products.

The present paper offers contrasting predictions to the body of new trade theory with national firms. In particular, our model predicts that while trade may at first rise as countries become more similar, trade in X will subsequently decrease (or decrease faster than with national firms) as international economic activity becomes increasingly dominated by multinationals.

But before going into more detail, we should note several caveats regarding applying this result to a time series of trade between two countries. First, tariff and transport costs may be falling over time, which biases activity toward increased trade rather than investment. Second, aggregate

data involves many industries, which may be at many different stages in their "life cycles". Some industries may be in the region where trade is being displace by multinationals, while others may be in a region where trade is just beginning to appear. Third, our analysis only covers final goods trade and excludes intra-firm goods trade as well as the implicit intra-firm trade in the services of firm-specific capital, F. Nevertheless, some of the numbers presented at the end of the first section of the paper should at least suggest that formal empirical work on this question is needed. In our earlier paper, we report that while European exports to the US grew by 104% between 1981 and 1989, the stock of European direct investment in the US grew by 354%.

The experiments shown in Figures 5-7 produce three slightly different results and since analytical results are difficult to obtain, we will simply report on the numerical simulations shown. Moving up a column in Figure 5 (countries converging in size), results indicate a monotonic increase in the volume of trade in X if multinational firms are excluded (corresponding to the new trade theory). If multinational firms are allowed to enter, the result is non-monotonic. Thus beginning at the bottom of a column in which some multinational activity occurs, trade in X at first increases as we move up the column, and then abruptly begins to decrease when multinationals first appear.

This result is shown schematically in Figure 9. The vertical axis of this Figure measures the relevant difference between the two countries as in Figure 8. The horizontal axis plots the volume of trade in X by national firms and sales by the foreign branch plants ("affiliate sales") of multinational firms. Moving up a column of Figure 5, trade volume at first increases and would continue to increase in the absence of multinationals (the broken line in Figure 9). But with endogenous multinationals, the volume of trade begins to decrease once the countries are sufficiently similar for multinationals to enter. Once the countries are nearly identical, the volume of affiliate sales actually exceeds what the volume of trade would have been in the absence of multinationals, because the affiliates have lower marginal costs of serving the foreign market (they do not pay τ).

Results for the volume of trade corresponding to the relative-endowments experiment in Figure 6 are somewhat different. In this case, change in the volume of trade moving up columns corresponding to modest transport costs are non-monotonic even when multinationals are excluded. This is because of the tension between inter-industry ("Heckscher-Ohlin") trade in X and intra-industry ("reciprocal dumping") trade in X. As we move up a column, the first type of trade diminishes as the endowments converge while the second type of trade increases. It turns out that the latter effect dominates when the countries are very different but the former dominates as they converge in relative endowments. We have not felt another version of Figure 9 is needed, but the result is that in the case of convergence of relative endowments, the curve for the volume of X trade in the absence of multinationals is itself backward bending (negatively sloped) after some level. But the same qualitative difference is caused by the endogenous introduction of multinationals as shown in Figure 9. As multinationals enter, the volume-of-trade curve lies increasingly to the left of curve for no multinationals as it does in Figure 9, and the volume of affiliate sales rises with further country convergence.

For the experiment in Figure 7, the volume of trade in X monotonically decreases as we move columns with multinationals excluded. The difference between the experiments in Figures 7 and 5 may lie in the fact that, as we noted above, τ/c_f is not held constant in Figure 7, but rather increases as we move down a column. This difference between Figures 6 and 7 tends to encourage the creation of more X trade as we move down a column in Figure 7 relative to Figure 6 and that is indeed the result that we found in the numerical simulations. But again, the qualitative difference induced by the endogenous entry of multinationals is the same. While the curve for the volume of trade in the absence of multinationals (corresponding to that in Figure 5) is now negatively sloped throughout, the curve with multinationals permitted splits with the no-multinationals curve, and opens up the same sort of gap shown in Figure 7 as the countries converge (move up the vertical axis).

Trade is displace by affiliate sales.

7. Summary and Conclusions

This paper develops a model in which multinational (multi-plant) firms may arise endogenously in competition with national (single-plant) firms. In many respects, the model is deliberately constructed to be similar to a standard oligopoly model of the "new trade theory" in which multinational firms are excluded by assumption. This permits a clear comparison between that literature and the present paper. We believe that the need to do this is clearly motivated by extremely large and growing proportion of international economic activity carried out by multinational firms.

Some of the key elements of the model have been discussed in previous papers, in particular the distinction between firm-level and plant-level scale economies. We obtain the general results, found also in papers by Horstmann and Markusen (1992) and Brainard (1992) that multinationals tend to be found in equilibrium when firm-level scale economies and tariff/transport costs are large relative to plant-level scale economies. The present paper departs from these earlier works by explicitly considering the role of asymmetries between countries, an important exercise in that many of the stylized facts concerning trade and investment have to do with differences among countries. Our general finding here is labelled the "convergence hypothesis": multinationals become more important relative to trade as countries become more similar in size, relative endowments, and technologies.[9] It is interesting to note that the "new trade theory" concentrates on competition between national firms of similar countries, and the present paper notes that this is precisely the place where we expect activity to be dominated by multinationals, not national firms. Statistics presented in the introduction and in Markusen (1995) provide support for this assertion.

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[9]Similar results, although due to very different causes, are found in Ethier (1986).

Although not a primary focus of the paper, the model also provides some results on the national ownership of firms, by which we mean the country in which the firm's firm-specific capital (F) is located. Results indicate that, if the difference between the countries is in relative factor endowments or technology, then firm ownership tends to reside exclusively in the "advantaged" country (country h in our analysis) unless transport costs are very small. If the difference is in country size, however, there are many more parameterizations in which firms owned in the smaller country exist in equilibrium.

The paper then examines the old question of the welfare effects of direct investment. The model has the advantage of explicitly solving for the alternative market structure when multinational firms are exogenously excluded. Our result is that, if previously excluded multinationals are allowed to enter, both countries are made better off if their initial differences are not large and transport costs are high. However, the advantaged (in size, endowments, or technology) country may be made worse off by multinational activity if the asymmetries are large and transport costs are relatively modest. In such circumstances, the disadvantaged country unambiguously gains.

The final section of the paper looks at the volume of trade as a function of country asymmetries. Our model predicts that, while trade in X may initially increase as the countries become more similar, trade will be displaced by affiliate sales of multinational firms as the convergence continues. This prediction, which differs significantly from that of the new trade theory, has sufficient support in simple statistics to warrant more formal empirical work.

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[10]Rutherford has added to pieces of software as sub-systems of GAMS. MILES (mixed inequality and non-linear equation solver) solves systems of non-linear inequalities. MPS/GE is a higher-level language for solving economic equilibrium problems, including those involving inequalities.

Figure 1

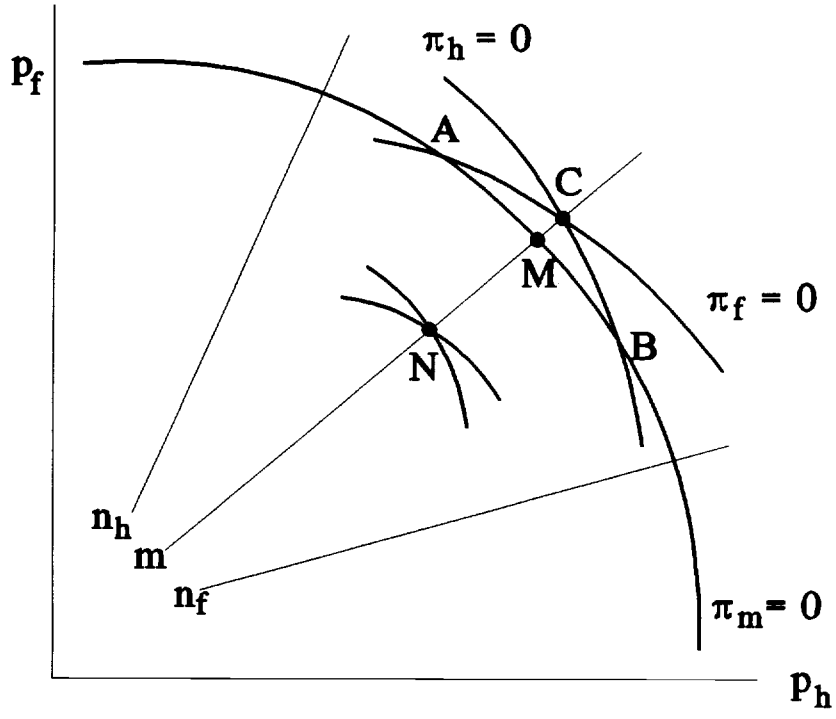


Figure 2

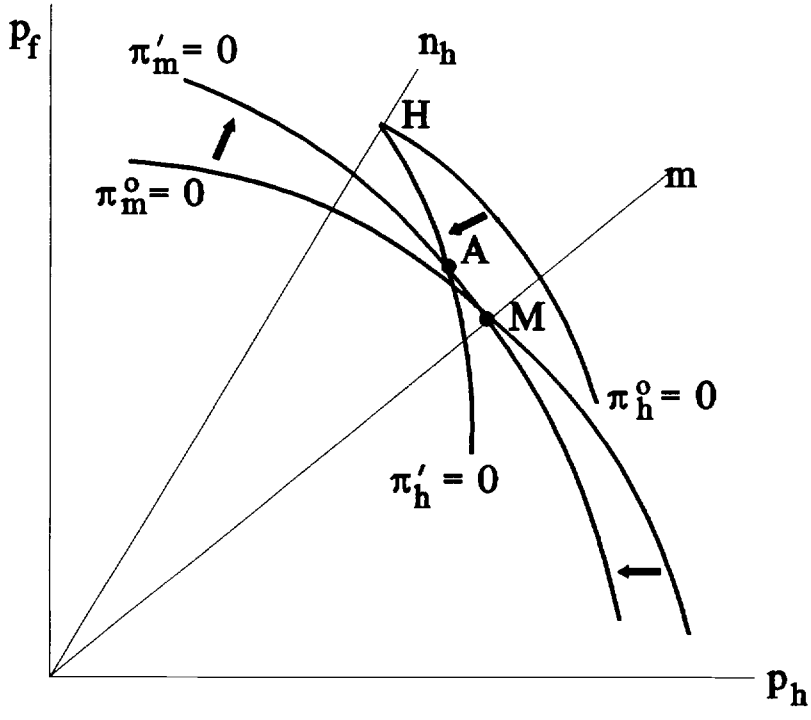


Figure 3

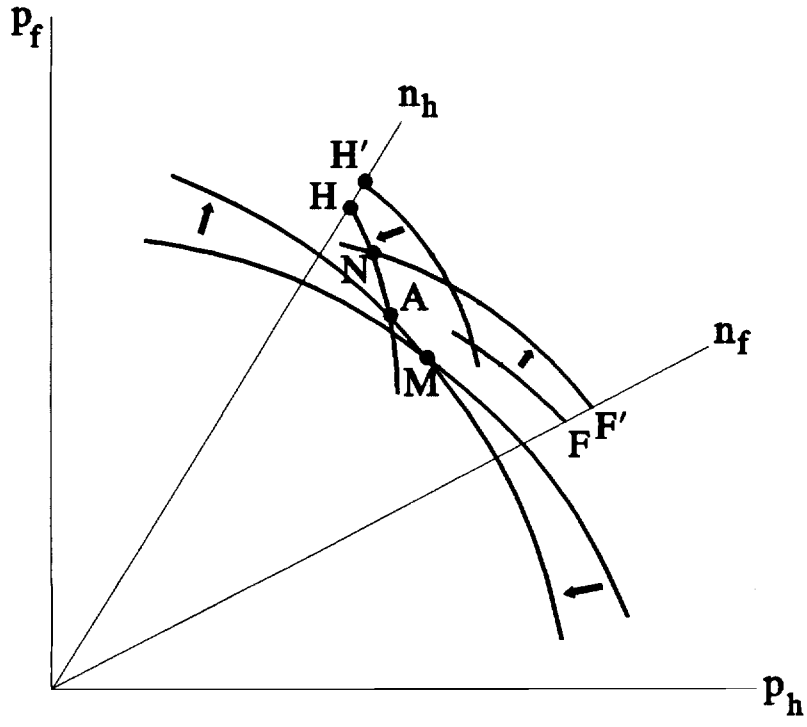


Figure 4

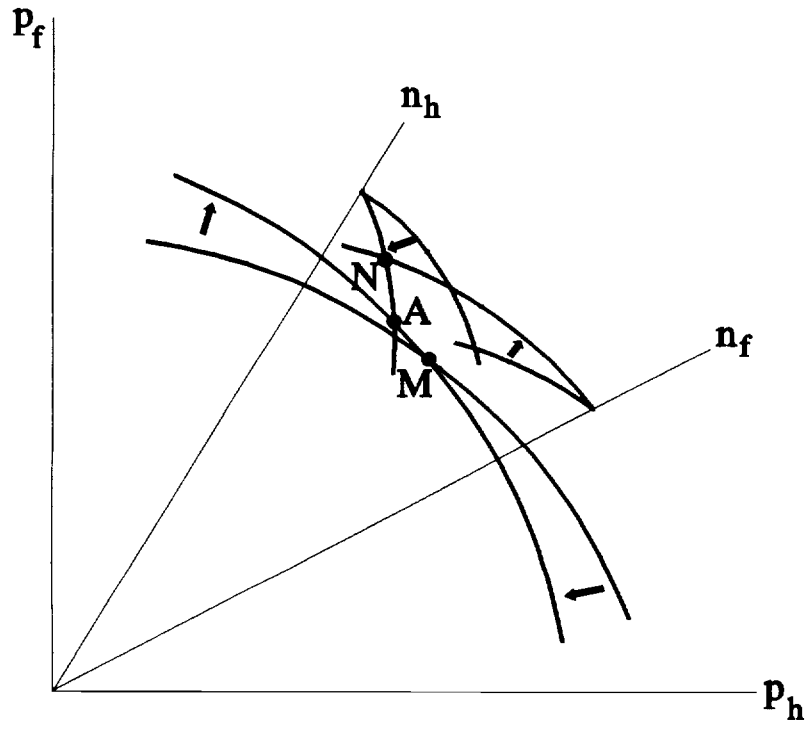


Figure 5

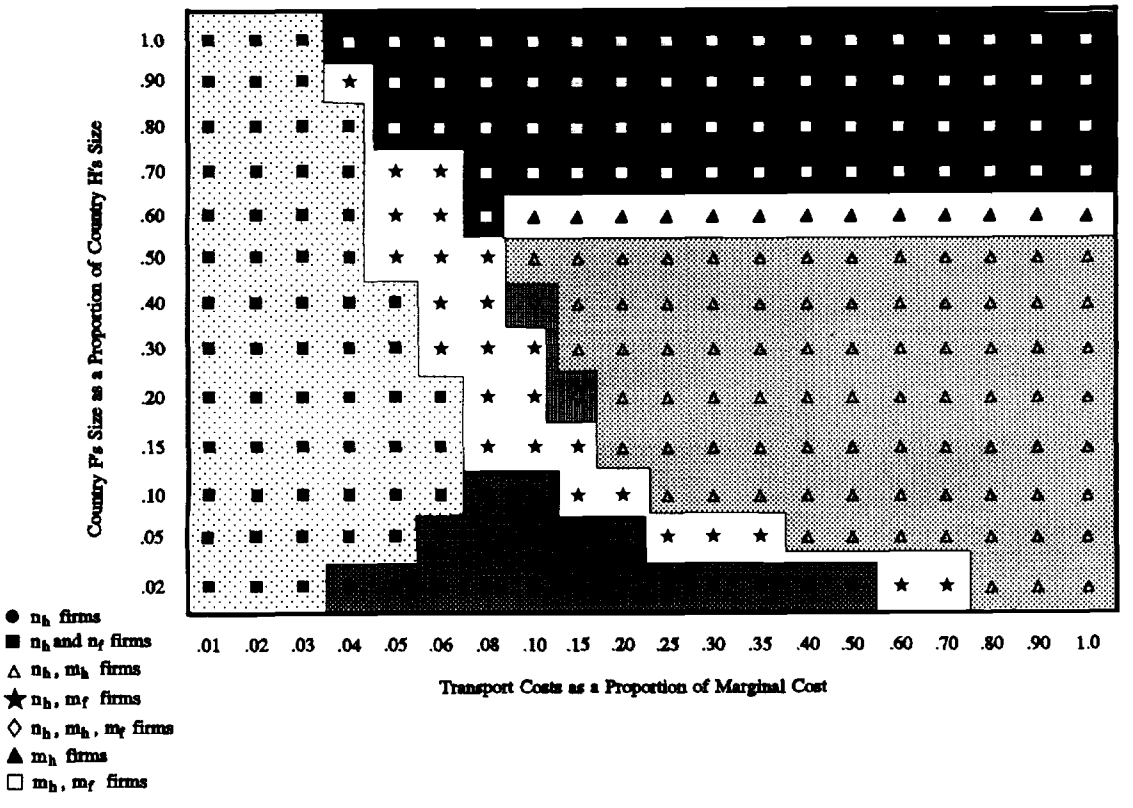

Country F's Size as a Proportion of Country H's Size
1.0
.90
.80
.70
.60
.50
.40
.30
.20
.15
.10
.05
.02
.01 .02 .03 .04 .05 .06 .08 .10 .15 .20 .25 .30 .35 .40 .50 .60 .70 .80 .90 1.0
Transport Costs as a Proportion of Marginal Cost
● n_h firms
■ n_h and n_f firms
△ n_h, m_h firms
★ n_h, m_f firms
◇ n_h, m_h, m_f firms
▲ m_h firms
□ m_h, m_f firms

Figure 6

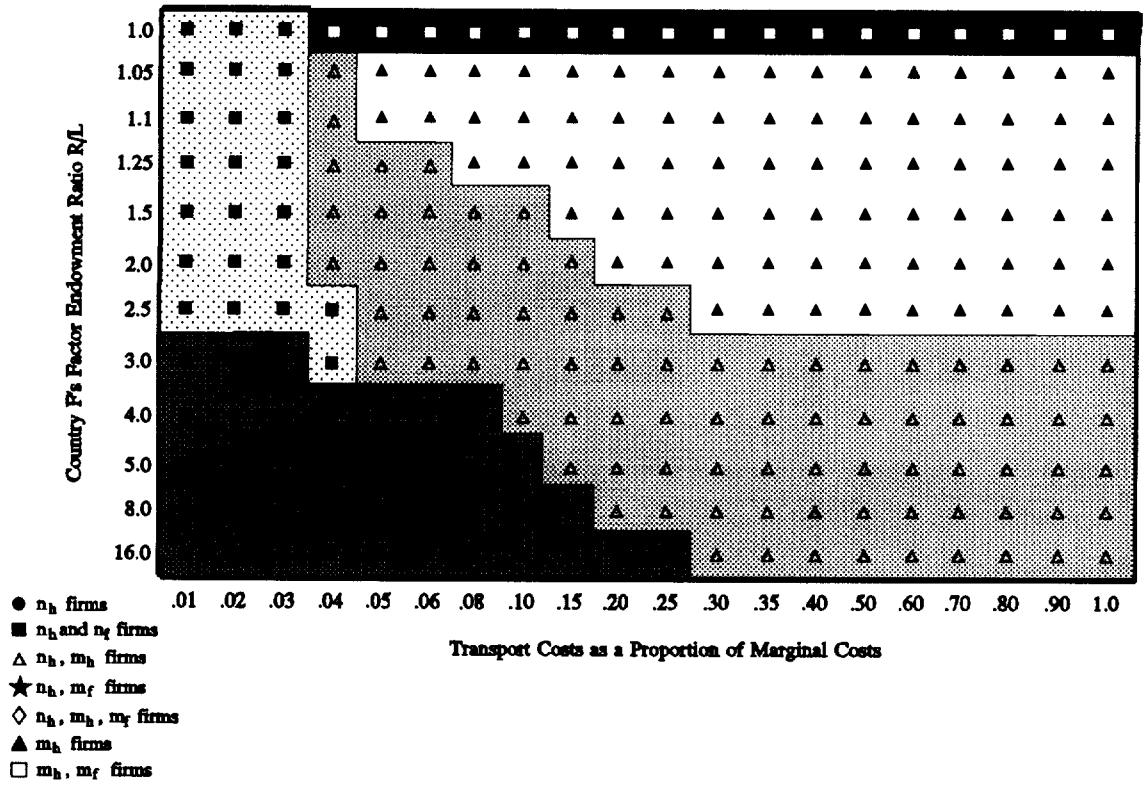

Country F's Factor Endowment Ratio R/L
1.0
1.05
1.1
1.25
1.5
2.0
2.5
3.0
4.0
5.0
8.0
16.0
.01 .02 .03 .04 .05 .06 .08 .10 .15 .20 .25 .30 .35 .40 .50 .60 .70 .80 .90 1.0
Transport Costs as a Proportion of Marginal Costs
● n_h firms
■ n_h and n_f firms
△ n_h, m_h firms
★ n_h, m_f firms
◇ n_h, m_h, m_f firms
▲ m_h firms
□ m_h, m_f firms

Figure 7

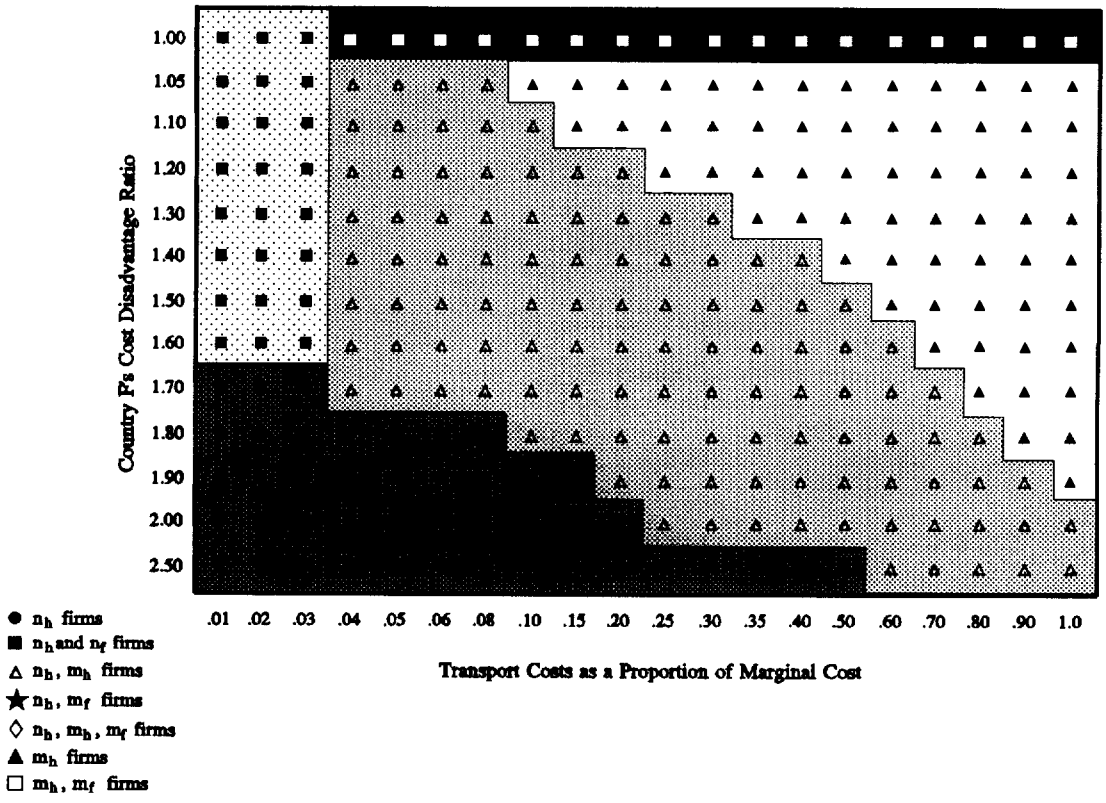

Country F's Cost Disadvantage Ratio
1.00
1.05
1.10
1.20
1.30
1.40
1.50
1.60
1.70
1.80
1.90
2.00
2.50
.01 .02 .03 .04 .05 .06 .08 .10 .15 .20 .25 .30 .35 .40 .50 .60 .70 .80 .90 1.0
Transport Costs as a Proportion of Marginal Cost
● n_h firms
■ n_h and n_f firms
△ n_h, m_h firms
★ n_h, m_f firms
◇ n_h, m_h, m_f firms
▲ m_h firms
□ m_h, m_f firms

Figure 8

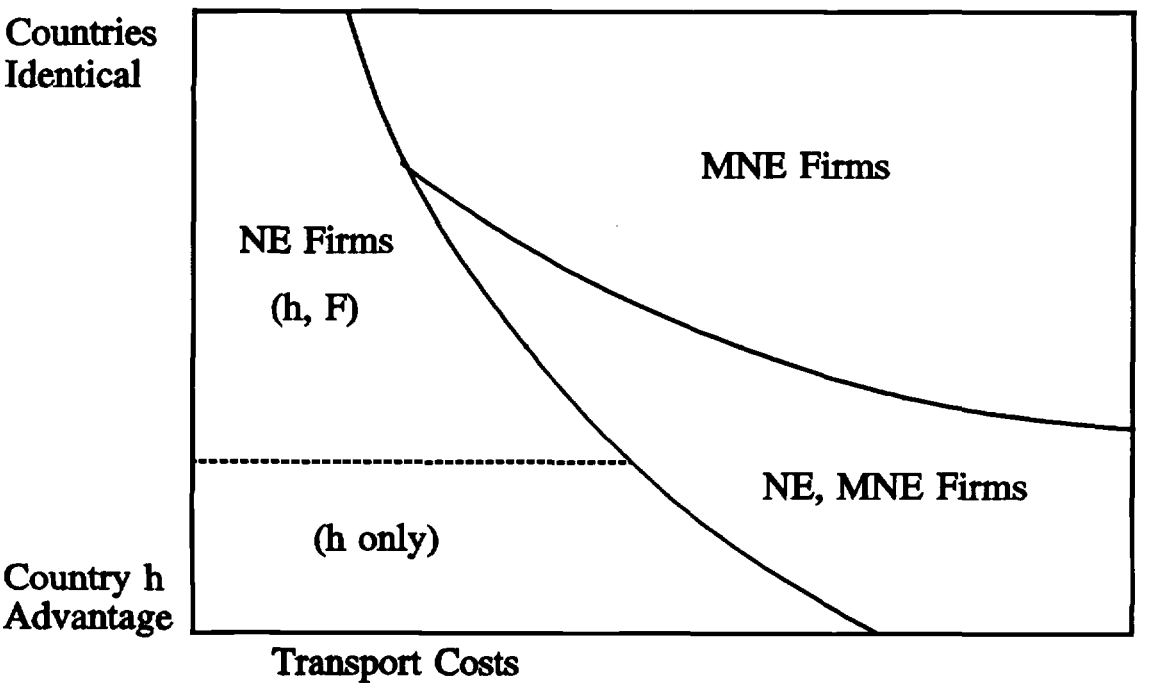
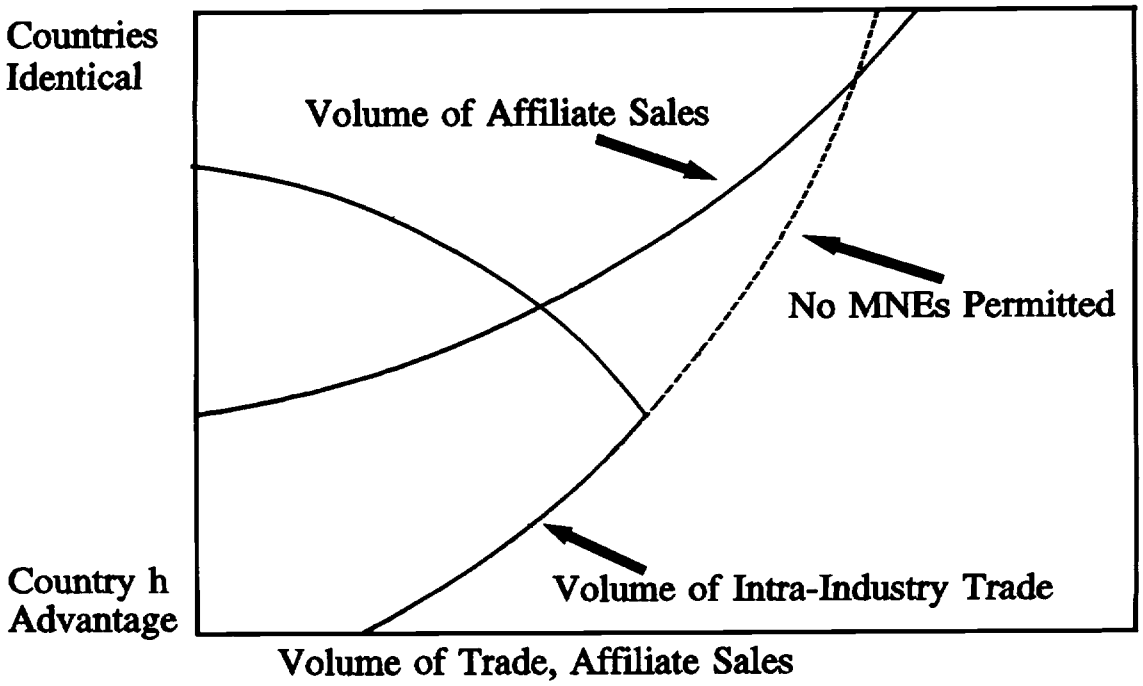

Countries
Identical
MNE Firms
NE Firms
(h, F)
NE, MNE Firms
(h only)
Country h
Advantage
Transport Costs

Figure 9


Countries Identical
Volume of Affiliate Sales
No MNEs Permitted
Volume of Intra-Industry Trade
Country h Advantage
Volume of Trade, Affiliate Sales