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Multinational firms and the new trade theory

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Abstract

A model is constructed in which multinational firms arise endogenously. Multinationals are more important in total activity when countries are similar in incomes (size) and in relative factor endowments, and when total world income is high. These predictions are consistent with empirical evidence, and our results help point to more formal tests. The standard oligopoly model of international trade is a special case of our model when multinationals are suppressed, and this allows us to provide an explicit comparison to the national-firm model with respect to the location of production, welfare, and the volume of trade.

Keywords: Multinationals; New trade theory; Endogeneous location

JEL classification: F12; F23

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

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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 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, chemicals and pharmaceuticals, 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 indicates that direct investment has grown faster than international trade among the developed countries. A large proportion of direct investment is two-way investment among similar developed economies.[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 (Markusen, 1984). 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.

Our model has several antecedents, in particular Brainard (1993a); Horstmann and Markusen (1992); Markusen and Venables (1996). These 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 geographi-

[1]These stylized facts are documented and discussed in Markusen (1995) review article. Please see that paper for an extensive list of references. See also Caves (1996) and Dunning (1993).

cal separation of headquarters and a single production facility multi-plant production does not arise because of the assumption of zero trade costs combined with plant-level scale economies.

The present paper moves beyond Brainard, Horstmann and Markusen, and Markusen and Venables in important respects. The first two papers focus almost entirely on symmetric economies, in terms of country size, factor endowments, and technologies.[2] 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. The present paper extends Markusen and Venables (1996) in several respects. (1) We show the relationship of our MNE model to the standard oligopoly model of trade with NE firms only, especially with respect to the location-of-production, welfare, and volume-of-trade predictions of these alternative models. (2) We examine more precisely the regions of parameter space where convergence in country size and in relative endowments do or do not lead to more MNE firms relative to NE firms. (3) We clarify the difference between convergence in incomes and total world income growth. (4) We note the relationship between trade and investment costs. (5) We allow more flexibility in the model by allowing multinationals to choose their headquarters country instead of requiring an equal splitting of fixed costs between the countries irrespective of factor prices. (6) We try to identify testable hypotheses.

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. Key relationships of the model are used to generate intuition as to 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, relative endowments, and as world income grows. Relative to the NE model where MNEs are excluded by assumption, the inclusion of MNEs shifts production toward the country which is smaller and/or scarce in the factor used intensively in the MNE sector. Such a country always gains from MNEs (relative to their exclusion), and generally both countries gain. Trade volumes depart systematically from those predicted by the standard oligopoly model (in turn similar to predictions from the standard monopolistic-competition model) especially when countries are similar and when world income grows.

Before proceeding, we present a few summary statistics in Table 1 which help motivate the paper. The top section of Table 1 shows the growth of world direct

[2]Brainard conjectures (correctly we believe) that multinationals are more likely to exist when countries are similar in size and in relative endowments, but there is no formal analysis of this point in her paper. Helpman and Krugman consider country asymmetries of course, but zero trade costs exclude multi-plant production (''horizontal'' MNEs) as we just noted.

Table 1
Growth of direct investment

	Annual growth rate (% nominal), all countries	
	1986–1990	1991–1994
FDI inflows	24.7	12.7
FDI stocks	19.8	8.8
Sales of foreign affiliates	17.4	5.4
Royalties and fees receipts	21.8	10.1
GDP at factor cost	10.8	4.3
Gross fixed capital formation	10.6	4.0
Exports of goods, non-factor services	14.3	3.8

Ratio of inward and outward FDI stock to gross domestic product

	1980	*1985*	*1990*	*1994*
World				
Inward	4.6	6.3	8.3	9.4
Outward	4.9	5.9	8.1	9.7
Developed countries				
Inward	4.8	6.0	8.4	8.6
Outward	6.5	7.5	9.8	11.2
Western Europe				
Inward	5.7	8.4	11.0	13.0
Outward	6.7	10.7	12.3	15.9
Developing countries				
Inward	4.3	7.7	8.3	12.5
Outward	0.2	0.8	1.7	3.5
Least developed countries				
Inward	3.4	4.7	4.5	5.9
Outward	0.2	0.6	0.7	0.7

Source: UNCTAD world investment report, 1996. ''Least developed countries'' is a UN definition, consisting of 48 countries.

investment by four measures in the top four lines, compared with world GDP, capital formation, and exports in the last three lines. There was a slow down in the early 1990s, but by all measures direct investment grew faster than income and trade. The lower section of Table 1 shows related evidence, the ratio of inward and outward direct investment to GDP. The evidence illustrates that direct investment has grown relative to income everywhere, and that the developing countries as a whole have caught up with the developed countries as a whole with respect to inward investment. However, this increase in inward investment into the developing countries is concentrated in China and in some other East Asian economies, notably Taiwan, Hong Kong, Singapore, Malaysia, Indonesia, and Thailand. The least developed countries (a UN definition consisting of 48 countries) have lagged far behind. Direct investment stocks, relative to a country's income, are thus concentrated among the high income countries and the more prosperous or large (China) developing countries.

In other evidence, recent studies by Ekholm (1995), (1997) find that country i's direct investment in country j and country j's employment by country i MNEs are positively related to both countries' GDP and negatively related to their difference in GDP. The employment relationship is elastic: doubling both countries' GDP levels much more than doubles MNE employment. Related results about country size and similarity are found in Brainard (1993b), (1993c). While it is not the principal focus of their paper, Eaton and Tamura (1994) have results for the US and Japan suggesting that, while both trade and direct investment increase with a partner's population, income per capita and human capital, direct investment is generally more responsive to these variables than is trade. We will argue that our model sheds light on these results and on the summary statistics presented in Table 1.

2. Specification of the model

As noted above, the model has two countries (h and f) producing two homogeneous goods, Y and X. Y will be used as numeraire throughout the paper. There are two factors of production, L (labor) and R (resources). L is mobile between industries but internationally immobile. R is a specific factor used only in the Y industry. 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. There are no shipping costs for good Y.[3]

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. The production function for Y is

$$Y_i = L_{iy}^{\alpha} R_i^{1-\alpha}, \quad i = h, f. \tag{1}$$

The wage rate, w_i, and rental rate on R, r, are given by the value marginal products of these factors in Y production.

$$w_i = \alpha(L_{iy}/R_i)^{\alpha-1}, \; r_i = (1-\alpha)(L_{iy}/R_i)^{\alpha} \quad i = h, f. \tag{2}$$

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. The supply of labor to the X sector is thus upward sloping in the wage rate, adding some ''convexity'' to the model.

[3]The assumption of no transport costs in Y is frequently made in both the oligopoly and monopolistic-competition literatures, and we make that assumption here to facilitate comparisons with those models. Although it has been pointed out that this assumption is important in some models (e.g., those with agglomeration economies), we do not think that it is important to the principal results of this paper.

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

$$cX^n_{ii} + (c+\tau)X^n_{ij} + G + F, \quad i, j = h, f, \quad i \neq j. \tag{3}$$

where c is the constant marginal production cost and G and F are the plant-specific and firm-specific fixed costs both measured in units of labor. τ is the amount of labor needed to transport one unit of X from country i to country j. All of these cost parameters are the same for both countries.

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, 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,[4]

$$cX^m_{ii} + G + F, \quad i = h, f. \tag{4}$$

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

$$cX^m_{ij} + G, \quad i, j = h, f. \tag{5}$$

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:

$$\bar{L}_i = L_{iy} + n_i(cX^n_{ii} + (c+\tau)X^n_{ij} + G + F) + m_i(cX^m_{ii} + G + F) + m_j(cX^m_{ji} + G) \tag{6}$$

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

$$M_i = w_i L_i + r_i R_i \quad i = h, f. \tag{7}$$

[4]The fact that MNEs do not ship between markets is imposed as an *assumption* in the computer simulation model. But it is also a *result*, given MNEs view factor prices as fixed. If an MNE supplies market i from both a local plant and by exports from j, optimality requires that the delivered marginal cost from i and j are equal. But if this is true (given constant marginal cost), then the MNE should shut the plant in i, saving the fixed cost G, and becoming a type n_j firm.

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,

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

giving demands

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

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):[5]

$$p_i(1 - e_{ii}^{n}) \leq w_i c, \qquad (X_{ii}^{n}) \tag{10}$$

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

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

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

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 Eq. (9)), reducing the firm's markup to its market share. This gives, (also using demand Eq. (9)),

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

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

[5] We use the segmented markets assumption simply because most of the oligopoly literature has done so, and we want to make a clear comparison with that literature. In general, arbitrage constraints are not binding, but we are unsure if this is always the case. If NE firms in i export to j, they will have market share in j no larger than in i due to the transport costs. Eqs. (10)–(13) then imply that their markups are at least as large in i as in j, which in turn implies that the type n_i firms absorb some of the transport costs in their pricing and arbitrage constraints do not bind.

$$X_{ii}^{n} \geq \beta M_i \frac{p_i - w_i c}{p_i^2} \tag{15}$$

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

$$X_{ii}^{m} \geq \beta M_i \frac{p_i - w_i c}{p_i^2} \tag{17}$$

$$X_{ij}^{m} \geq \beta M_j \frac{p_j - w_j c}{p_j^2} \tag{18}$$

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

The production regime refers to the combination of firm types that operate in equilibrium. This is determined by free entry of firms of each type, which can be represented by four zero-profit conditions. Given inequalities Eqs. (10)–(13), zero profits can be written as the requirement that markup revenues are less than or equal to fixed costs. Complementary variables are the number of firms of each type.

$$p_h e_{hh}^{n} X_{hh}^{n} + p_f e_{hf}^{n} X_{hf}^{n} \leq w_h (G + F), \qquad (n_h) \tag{19}$$

$$p_f e_{ff}^{n} X_{ff}^{n} + p_h e_{fh}^{n} X_{fh}^{n} \leq w_f (G + F), \qquad (n_f) \tag{20}$$

$$p_h e_{hh}^{m} X_{hh}^{m} + p_f e_{hf}^{m} X_{hf}^{m} \leq w_h (G + F) + w_f G, \qquad (m_h) \tag{21}$$

$$p_f e_{ff}^{m} X_{ff}^{m} + p_h e_{fh}^{m} X_{fh}^{m} \leq w_f (G + F) + w_h G, \qquad (m_f) \tag{22}$$

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

$$\beta \left[M_h \left(\frac{p_h - w_h c}{p_h} \right)^2 + M_f \left(\frac{p_f - w_h (c + \tau)}{p_f} \right)^2 \right] \leq w_h (G + F), \ (n_h) \tag{23}$$

$$\beta \left[M_h \left(\frac{p_h - w_f (c + \tau)}{p_h} \right)^2 + M_f \left(\frac{p_f - w_f c}{p_f} \right)^2 \right] \leq w_f (G + F), \ (n_f) \tag{24}$$

$$\beta \left[M_h \left(\frac{p_h - w_h c}{p_h} \right)^2 + M_f \left(\frac{p_f - w_f c}{p_f} \right)^2 \right] \leq w_h (G + F) + w_f G, \ (m_h) \tag{25}$$

$$\beta \left[M_h \left(\frac{p_h - w_h c}{p_h} \right)^2 + M_f \left(\frac{p_f - w_f c}{p_f} \right)^2 \right] \leq w_f (G + F) + w_h G, \ (m_f) \tag{26}$$

To summarize the X sector in the model, the eight inequalities Eqs. (15)–(18) are associated with the eight output levels (two each for four firm types), and the

four inequalities in Eqs. (23)–(26) are associated with the number of firms of each type. Additionally goods prices are given by Eq. (9), income levels from Eq. (7) and factor prices from factor market clearing equation Eq. (6) together with labor demand from the Y sector, Eq. (2).

3. Intuition from impact effects

In this section, we will use inequalities Eqs. (23)–(26) to conduct some ''thought experiments'' to help provide intuition to the general-equilibrium results to follow. These are ''impact effects'' in which we change one variable holding other endogenous variables constant. The inequalities Eqs. (23)–(26) have markup revenues on the left-hand side and fixed costs on the right-hand side. Moving all terms to the left gives firm profits (recall that markup revenues are total revenues minus variable costs). Let Π denote the (potential or actual) profit of a type i firm headquartered in country j. Inequalities Eqs. (23)–(26) can be written as:

$$\Pi_{\mathrm{h}}^{\mathrm{n}} = a_{\mathrm{h}}M_{\mathrm{h}} + b_{\mathrm{f}}M_{\mathrm{f}} - d_{\mathrm{h}} \leq 0 \tag{27}$$

$$\Pi_{\mathrm{f}}^{\mathrm{n}} = b_{\mathrm{h}}M_{\mathrm{h}} + a_{\mathrm{f}}M_{\mathrm{f}} - d_{\mathrm{f}} \leq 0 \tag{28}$$

$$\Pi_{\mathrm{h}}^{\mathrm{m}} = a_{\mathrm{h}}M_{\mathrm{h}} + a_{\mathrm{f}}M_{\mathrm{f}} - d_{\mathrm{h}} - e_{\mathrm{f}} \leq 0 \tag{29}$$

$$\Pi_{\mathrm{f}}^{\mathrm{m}} = a_{\mathrm{h}}M_{\mathrm{h}} + a_{\mathrm{f}}M_{\mathrm{f}} - d_{\mathrm{f}} - e_{\mathrm{h}} \leq 0 \tag{30}$$

where (a,b,d,e) are all positive and $a_{\mathrm{i}} > b_{\mathrm{i}}$. Suppose that we assume initially that the countries are identical, so that commodity prices, factor prices, and incomes are the same in both countries. Then $a_{\mathrm{h}} = a_{\mathrm{f}} > b_{\mathrm{h}} = b_{\mathrm{f}}$, $d_{\mathrm{h}} = d_{\mathrm{f}}$, $e_{\mathrm{h}} = e_{\mathrm{f}}$ and $M_{\mathrm{h}} = M_{\mathrm{f}}$.

Consider first the effects of raising total world income holding all prices constant. Because $a_{\mathrm{i}} > b_{\mathrm{i}}$, we have the following result.

Change in Total Income: $\mathrm{d}M_{\mathrm{h}} = \mathrm{d}M_{\mathrm{f}} > 0$.

$$\mathrm{d}\Pi_{\mathrm{h}}^{\mathrm{m}} = \mathrm{d}\Pi_{\mathrm{f}}^{\mathrm{m}} > \mathrm{d}\Pi_{\mathrm{h}}^{\mathrm{n}} = \mathrm{d}\Pi_{\mathrm{f}}^{\mathrm{n}} \geq 0$$

Because of the transport costs, an increase in total world income raises multinationals' markup revenues more than national firms' (potential or actual) revenues, suggesting that multinationals will be associated with higher world income. Intuitively, a branch plant is a high fixed costs option, while exporting is a high

variables costs option. The increase in equilibrium firm scale associated with higher world income will induce some shift toward multinationals.[6]

Next, hold total world income fixed but change the distribution of income.

Change in the Distribution of Income: $dM_h = -dM_f > 0$

$$d\Pi_h^n > d\Pi_h^m = d\Pi_f^m = 0 > d\Pi_f^n$$

This change is most favorable to (potential or actual) type-n_h firms since their sales, due to transport costs, are concentrated in the large country. Multinational are ''indifferent'' to the change under the maintained assumption that commodity and factor prices are the same in the two countries. Type-n_f firms ''lose'' since their sales are concentrated in country f, now the smaller country.

Next consider a rise in one wage rate and an equal fall in the other. Given the assumption that $p_h = p_f$ and $w_h = w_f$ initially, we have:

Change in w: $dw_f = -dw_h > 0$

$$d\Pi_h^n > d\Pi_h^m > 0 > d\Pi_f^m > d\Pi_f^n$$

Type-n_h firms benefit the most, since they have their markup revenues raised and their fixed costs fall. Next comes multinationals headquartered in country h: their markup revenues are unaffected given the equality of prices initially, and their fixed costs fall (but by less than those of type-n_h firms). Type-m_f firms have their revenues unaffected, but their fixed costs rise. Type-n_f firms are affected the worst, losing markup revenues and bearing a larger increase in fixed costs than are borne by type-m_f firms. We can summarize this and the previous point by saying that differences between countries in size and in relative endowments is disadvantageous to multinationals, not so much because they are directly affected, but because national firms located in the ''favored'' (size, endowments) country have an advantage.

Now suppose that firm-level scale economies become more important relative to plant-level scale economies. Or suppose that the transactions costs of being a multinational fall, so that $(F+2G)/(F+G)$, the ratio of type-m to type-n fixed costs falls. These changes could occur in several different ways, all of which seem to lead to the same result. We present the following definition:

Change in Firm versus Plant Cost Ratio: $dF = -dG > 0$

$$d\Pi_h^m = d\Pi_f^m > 0 = d\Pi_h^n = d\Pi_f^n$$

[6]Note that this effect would not occur in a Dixit-Stiglitz, Helpman-Krugman type monopolistic-competition model. Higher world income has no effect on firm scale, and would not induce a shift to multinational production.

Fixed costs of national firms are unaffected under this change, while multinational firms have their fixed costs lowered.

Finally, consider a change in transport costs, which yields an obvious result.

Change in Transport Costs: $d\tau > 0$

$$d\Pi_h^m = d\Pi_f^m = 0 > d\Pi_h^n = d\Pi_f^n$$

An increase in transport costs improves the relative profitability of multinational firms.

Now let us summarize these results.

Multinational firms will have an advantage relative to type-n_h and/or type-n_f firms when:

1. The overall market is large.
2. The markets are of similar size.
3. Labor costs are similar.
4. Firm-level scale economies are large relative to plant-level scale economies. (The added fixed costs of becoming a multinational firm are low.)
5. Transport costs are high.

These are impact effects derived by treating wages and prices as exogenous. We now endogenize these, computing the full general-equilibrium model (41 non-linear inequalities) using Rutherford (1994) solver MPS/GE, now a subsystem of GAMS.

4. The equilibrium regime

Figs. 1 and 2 present the world Edgeworth box familiar to most readers, where the vertical dimension is the total world endowment of R (''resources'') and the horizontal dimension is the total world endowment of L (labor). Any point within the box is a division of the world endowment between the two countries, with country h measured from the southwest (SW) corner and country f from the northeast (NE) corner. Along the SW–NE diagonal of the box, the two countries have identical relative endowments but differ in size, while along the NW-SE (northwest-southeast) diagonal they differ in relative endowments.

Fig. 1 presents a general characterization of equilibrium regime over this parameter space. We will refer to this simulation as the ''base case'': it has a transport cost of $\tau = 0.15$ (expressed as a proportion of marginal cost) and a ratio of MNE fixed costs to NE fixed costs of 1.60 if wages are equalized between countries. In the center of the box, there is a region in which all firms are type-m

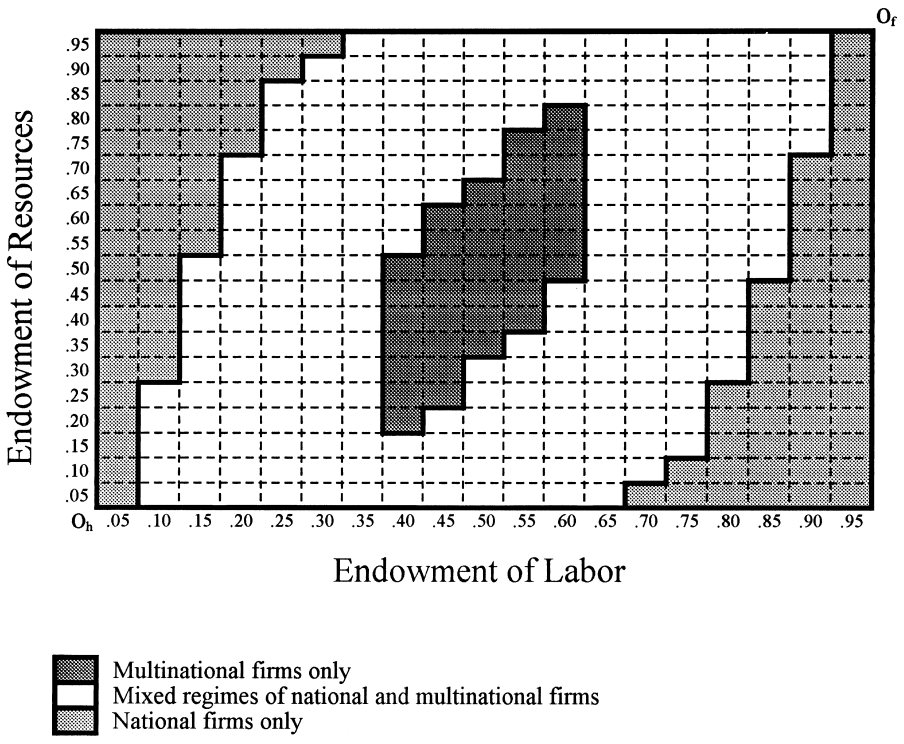

Fig. 1. Equilibrium regimes, $t = 0.15$.

in equilibrium. At the edges of the box, there are regions in which only national firms are active in equilibrium. In between are regions of mixed regimes of national and multinational firms. We see that in a qualitative sense, multinationals are associated with similarities in country size and in relative endowments.

Consider first moving from the NW corner of Fig. 1 to the center. The sequence of regimes in this convergence in relative endowments is:

$$n_f, (n_f m_f), m_f, (m_f m_h)$$

When the countries are very different, type-n_f firms have a great advantage due to the lower wage rate in country f. As convergence proceeds, this advantage is eroded and some type-m_f firms can enter. With further convergence, all firms are type-m_f. Finally, when the countries approach symmetry the regime shifts to intra-industry direct investment, (m_f m_h).

Now consider moving from the SW corner of Fig. 1 to the center, so that countries are converging in size. The result is now a bit more complicated. Once multinationals enter, the *share* of multinationals in all firms increases monotonically until all firms are multinationals. However the *location* of headquarters (type-m_f versus m_h) is complicated. The sequence of firm types is:

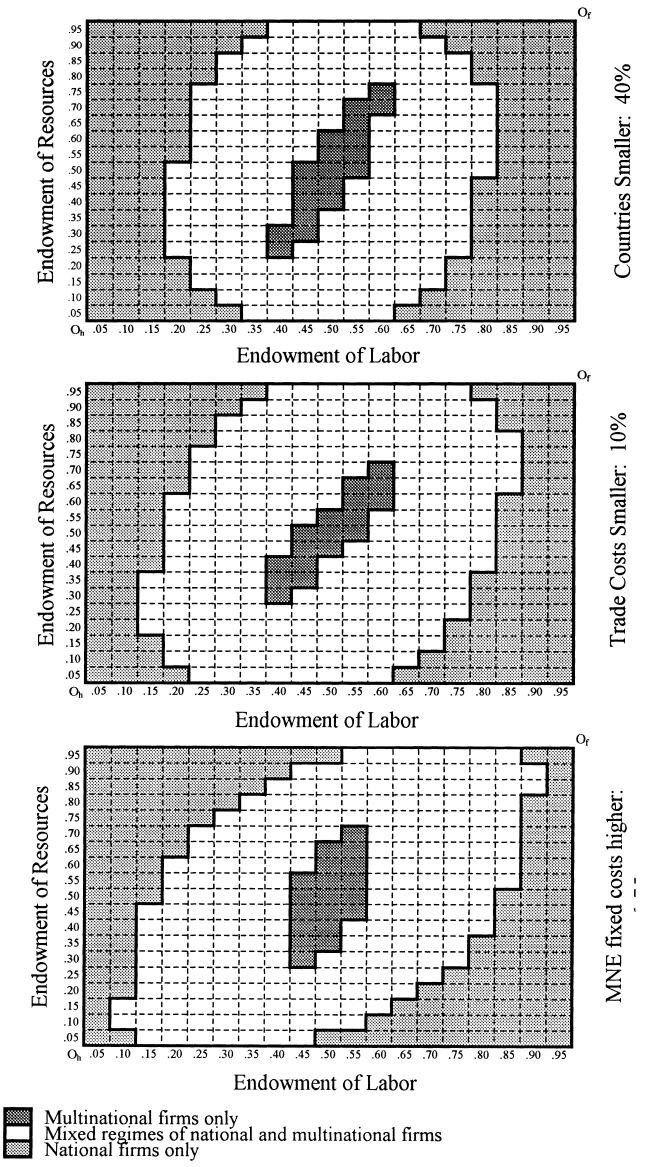

Fig. 2. Comparative statics.

n_f, ($n_f m_h$), ($n_f m_f m_h$), ($n_f m_f$),m_f, ($m_f m_h$)

The entry, then exit, and then reappearance of type-m_h firms is due to two effects that pull in opposite directions. Multinationals, if they enter, will locate their

headquarters (i.e., become type-m_h or type-m_f multinationals) solely on the basis of which country offers a lower wage rate. One effect when the countries differ in size, country h small, is competition from type-n_f firms. This raises the wage in country f and implies that if multinationals enter, they will headquarter in country h.

The other effect follows from the structure of fixed costs. Each multinational firm has the same factor demands for plant-specific fixed costs in both countries. If only multinational firms existed, this would imply that a larger share of the small country's endowment must be devoted to plant-specific fixed costs relative to its income than in the large country, raising the wage in the small country, ceteris paribus. Note that this imbalance in factor demands would occur even if the numbers of types m_h and m_f were in proportion to country size, leading to a concentration of headquarters in the large country more than in proportion to size differences. This second effect dominates when the countries are relatively similar in size, but the first effect dominates when the difference is large (type-n_f firms have their maximum advantage). In any case, the *share* of multinationals in all firms $(m_h+m_f)/(m_h+m_f+n_h+n_f)$ increases monotonically moving up the SW–NE diagonal between when multinationals first enter and when they are the only firms active.

Fig. 1 illustrates, in a qualitative sense, a principal idea of this paper. Convergence of countries h and f in either size or in relative endowments (a movement toward the center of the Edgeworth box) shifts the regime from national to multinational firms. The poorest, smallest countries do not receive direct investment, suggestive of the statistics in the lower panel of Table 1.

Fig. 2 illustrates other comparative-statics propositions with respect to the equilibrium regime. In the top diagram of Fig. 2, we make countries smaller (endowments reduced to 40% of their base-case size) resulting in a shrinking of the region with type-m firms only and an expansion of the region with type-n firms only. Conversely therefore, an increase in world income, expands the set of points for which some multinationals operate in equilibrium and the set in which all firms are multinational. For point which are mixed regimes both before and after growth, the share of MNEs in all firms increases with growth. Growth in the world economy thus produces a result in the model reminiscent of data in the top panel of Table 1.[7]

The middle diagram of Fig. 2 gives the results for a reduction in trade costs from 15% to 10%. The set of points in which only type-n firms exist expands and

[7]In general, growth in world income (total world endowments) will not increase both trade and investment in this model, since there is only one industry, two countries, and no ''vertical'' trade in goods within the firm, and so the model cannot capture this aspect of the data in Table 1. The model is suggestive of some bilateral relationships, however. For example, EU-US trade has been quite stagnant since 1980, while direct investment (particularly by European firms into the US) has grown tremendously.

the set in which only type-m exists contracts. The bottom diagram notes that a similar effect occurs if the costs of being a multinational increase. In this bottom diagram, we increase multinational's fixed costs (at equal wage rates) from 1.60 to 1.75 relative to those of national firms. Again, the region in which some multinationals operate and the region in which only multinationals operate shrinks. Conversely, a fall in this ratio can be interpreted as a fall in investment costs which, of course, stimulates investment.

Movements within Fig. 1 and a comparison of the three experiments in Fig. 2 with Fig. 1 seem to confirm the intuition suggested at the end of the previous section. All five conjectures in that section receive support in the general-equilibrium simulations.

5. Assessing the consequences of multinationals by counter-factual

Answers to the question ''what are the effect of multinationals'' requires some sort of counterfactual or standard of comparison. In our case, a relatively obvious counterfactual is provided by running the model with multinationals suppressed. We refer to this as the ''NE model'', and it is essentially a two-factor version of the (free entry) models of Brander and Krugman (1983) and Venables (1985). Figs. 3 and 4 present comparisons of our model with endogenous multinationals (referred to as the MNE model) with the restricted NE model along the NW-SE diagonal (Fig. 3) and SW–NE diagonals (Fig. 4) of the Edgeworth box of Fig. 1.

The top panel of Fig. 3 shows the share of world X production located in country h minus its share of the world labor endowment with multinationals permitted and with multinationals suppressed. At 1 on the horizontal axis (the NW corner of the Edgeworth box), country h is very labor scarce and conversely very labor abundant at 19. To the left of point 10 on the horizontal axis (the center of the Edgeworth box), country h produces a much smaller share of X than its share of the world labor endowment in the absence of multinationals, importing X from country f (the curves are initially negatively sloped because the country h's share of world labor is increasing, but there is not yet any X production). Both the price of X and the wage rate are high in country h. When multinationals are allowed to enter, it is rather obvious that they should be type-m_f, locating their headquarters where labor is cheap. This involves a substitution of type-n_h firms by type-m_f, economizing on labor demand in country h and permitting a higher production level in equilibrium.[8]

[8]It may seem counter-intuitive and counter-empirical to have headquarters concentrating where labor is cheap, but that may be due to the fact that there is only one type of labor in the model, and that the X sector is indeed the labor-intensive sector. Our intuition may derive from an implicit richer model in which there are multiple types of labor. Note also that transport costs play no role in headquarters location, so that the wage rate is the only consideration.

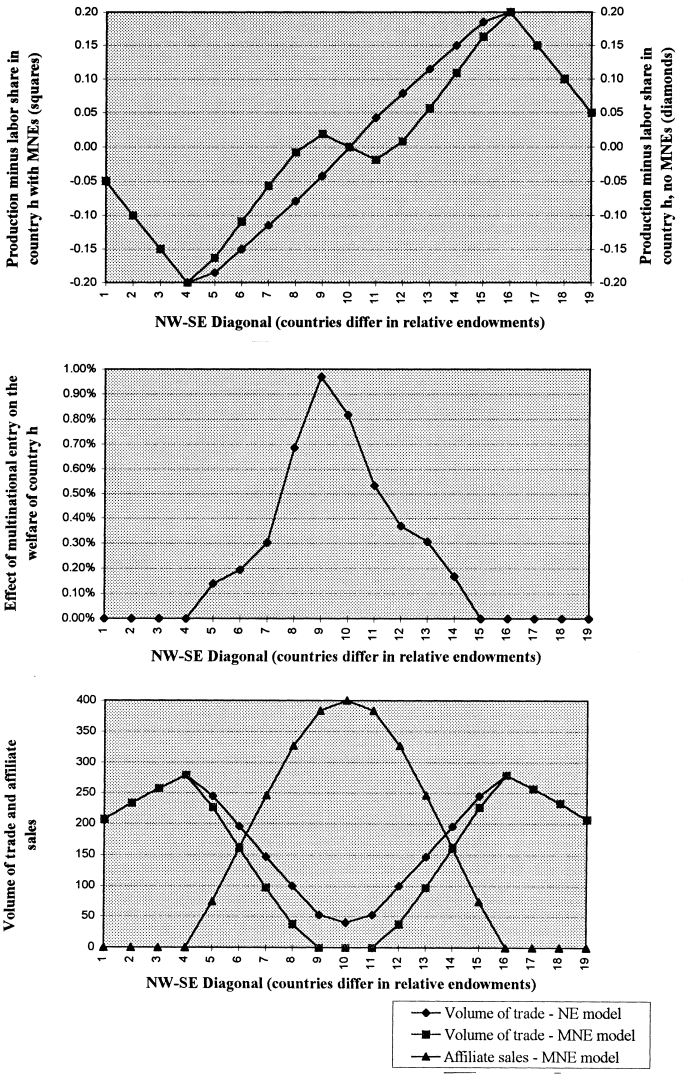

Fig. 3. Effect of multinational Entry on the location of production, welfare, and the volume of trade: NW–SE diagonal.

The second panel of Fig. 3 considers the welfare of country h; note that there is no reason for this to be symmetric around the mid-point. Country h always gains or is no worse off from liberalization, but gains somewhat more when it is the smaller country. The gains are small, but we do not want to attach very much importance to the cardinal value of numbers in this simulation model. The gain is

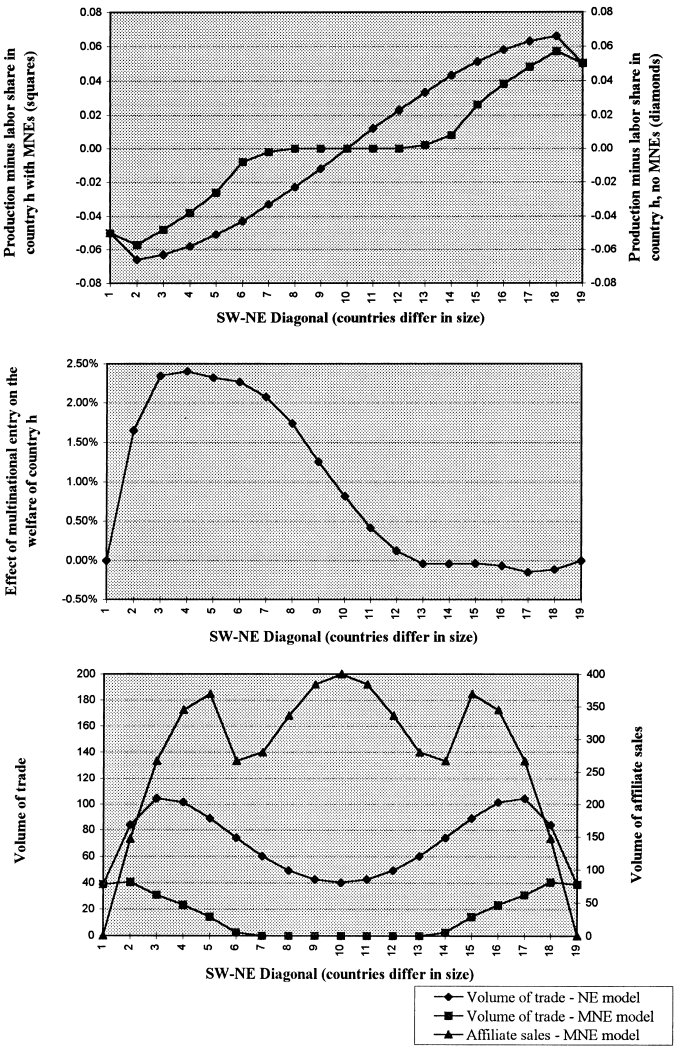

Fig. 4. Effect of multinational entry on the location of production, welfare and the volume of trade: SW–NE diagonal.

due to the price-index falling, reflecting a fall in the average cost of production through the exploitation of multi-plant economies of scale.

The bottom panel of Fig. 3 shows the volume of trade in X with and without multinationals, and the volume of affiliates sales with multinationals (i.e., the production and sales of type-m_h firms in country f and type-m_f firms in country h). The volume of trade in the NE model is ''M'' shaped as per a standard

factor-proportions model, except that here positive trade remains when the countries are identical, a Brander-Krugman ''reciprocal dumping'' effect. Multinational entry reduces the volume of trade over the region in which multinationals are active, and substitutes affiliate sales. Affiliate sales are very high at the center of the box because only type-m firms are active there, and each of them has an equal share of production at home and abroad. Thus in the center, exactly half of all world X production is affiliate sales.

Fig. 4 shows the corresponding results for the SW–NE diagonal where countries differ in size. Country h is small at 1 and large at 19. The pattern for production shifts following investment liberalization is very similar to that in Fig. 3. Now it is the small country that gains production share due to liberalization. The reason is a ''home market effect'' created by transport costs in the absence of multinationals. Firms in the small country are disadvantaged by the combination of their small domestic market and having to bear transport costs to the large foreign market. Production of X in the smaller country is proportionately much less than its share of the world factor endowment in the absence of multinationals. Liberalization increases the small country's initially-small production share; but it does not increase it to more than its share of the world endowment.

Welfare effects of permitting multinational entry are shown in the middle panel of Fig. 4. The small country is the big gainer due to a fall in its price index. The large country can in fact loose, due to an increase in its price index, but this is extremely small in the simulations. Investment liberalization causes the large country to lose its ''home market advantage'' which keeps the price index low in country h in the absence of multinationals.

The lower panel of Fig. 4 completes the discussion by plotting trade volumes and affiliate sales. The trade-volume curves with and without multinationals are similar in shape to those in Fig. 3, but the volume is smaller.[9] The volume-of-affiliate sales curve exhibits some non-monotonicity. The fall in affiliate sales between points 5 and 6 is due to the replacement of type-m_h firms by type-m_f firms we discussed with respect to headquarters locations in the previous section. Only a type-m firm's overseas sale are defined as affiliate sales. When country h is small and a type-m_f firm replaces a type-m_h, identical except to headquarters location, affiliate sales will fall (e.g., most of the type-m_h firm's sales were in f and therefore ''affiliate sales''). This is an artifact of the definition and is consistent with total production by type-m firms growing between 5 and 6.

We can summarize this section by saying that permitting multinational firms to

[9]The m-shape of the volume-of-trade curve with no multinationals contrasts with the result of Helpman and Krugman (1985) for the monopolistic-competition model with zero trade costs. In their model, this curve reaches a maximum at the mid-point. Here trade costs create a home-market advantage for the larger country. Trade is maximized at an intermediate level of size differences. When one country is near zero in size, trade must be near zero, and when the countries are identical, only Brander-Krugman reciprocal dumping remains.

enter shifts production to the smaller country and/or the country scarce in the factor used intensively in the multinational sector (L in this case). Welfare always improves in this country but could possibly decrease for a very large country which loses its home-market advantage when multinationals enter. Affiliate sales displace trade following investment liberalization.

6. 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 the 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 (1993a) 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 is that multinationals become more important relative to trade as countries become more similar in size, relative endowments, and as world income grows. 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.

We believe that the model points the way for formal empirical work insofar as the results embody testable hypotheses on the volume of investment (or affiliate sales) relative to GDP or exports as a function of cross-section and time-series variables. Cross-section variables are differences in country size and in relative endowments, and levels of trade and investment costs. Time-series evidence will help establish the hypothesized role of growth in world income: the displacement of trade by affiliate sales.[10] As noted earlier, existing studies including Ekholm (1995), (1997); Eaton and Tamura (1994); Brainard (1993b), (1993c) along with

[10]We note again that the model ignores vertical trade in goods within multinational firms, a factor that may tend to produce complementarities between investment and trade in a more complete model. Similar results to this model, although due to very different causes, are found in Ethier (1986).

studies referenced in Markusen (1995) provide encouragement. Other hypotheses derive from Figs. 3 and 4, suggesting that investment liberalization in the world economy should shift production to economies which are smaller and poorly endowed with the factor used intensively in the multinationalized sector.

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