Multinational Firms, Integration and Economic Growth

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The importance and the impacts of horizontal multinational corporations in the context of integration and economic growth processes are examined. A noncooperative game with two firms that choose to have either one or two plants located in two asymmmetric countries is used. The firms compete purely through location. Economic integration has an ambiguous impact upon foreign direct investment. On one hand, it decreases trade costs and easies the access to foreign markets through exports. On the other hand, through economic growth, it increases the size of the markets with relation to plant fixed costs and makes multinationals economicallly feasible. The latter effect, entails a decentralization of production towards the smaller country.

Keywords: Multinationals, Location, Noncooperative games.

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1 Introduction

This paper deals with the role of multinationals as countries and regions integrate economically or when the size of the markets increases. Usually the literature (see EKHOLM and FORSLID, 1997 and GAO TING, 1999) distinguishes between horizontal and vertical multinational firms. An horizontal multinational has usually several plants, according to a trade-off between exporting to a market and creating a plant there. This trade-off is determined by the interplay between trade costs and fixed costs of settling a new plant. In order that the multiple plants form a single multinational corporation, it is assumed that there are fixed costs at the firm level (in the form of knowledge capital, patents or blueprints).

On the other hand, a vertical multinational firm contains a headquarter that supplies specialized services without transport cost (such as R&D, financial and strategic planning) to a plant. The plant is unique because transport costs are low with relation to plant fixed costs. Rather than the creation of multiple plants, the decision to become a multinational consists in locating the plant far away from the headquarter. It is assumed that the headquarter and the plant use productive factors in different proportions, so that their locations express the relative scarcity of factors in different countries.

In this paper, only the case of horizontal multinationals will be treated. However, PONTES (2000) attempts a unified treatment of both kinds of multinationals.

The following questions will be addressed here. First, do multinational firms become more important during a process of economic integration, when trade costs among countries fall consistently? Then, we address the other issue: when economic integration has been achieved, so that trade costs are low, does economic growth promote the rise of multinational firms and the settling of the productive activity in peripheral areas?

The main results on the multinational horizontal corporation that can be found in the current literature can be summarized in the following way. Multinational firms are important with relation to purely national firms when transport costs and firm specific fixed costs are high with relation to plant level fixed costs (MARKUSEN and VENABLES,1998). There are two ways of supplying a foreign market: through exports, which implies to support the transport and tariff costs, and by the settling of an additional plant in the new market, thereby supporting an additional fixed cost. Foreign direct investment is by its nature "tariff jumping"[1], so that its importance decreases with the fall of trade costs.

Multinationals are the most important with relation to national firms the more symmetric the countries are in size and factor endowments. Therefore, the impact of the economic integration of two countries on the relative importance of multinationals is ambiguous, as it decreases trade costs and promotes economic equality of the partners involved.

Multinational corporations appear as a powerful device of decentralization of production to peripheral areas (MARKUSEN and VENABLES, 1998 and 1999, EKHOLM and FORSLID, 1997). In general, in a location game with two asymmetric countries, if the Nash equilibria are computed, the region of the space of parameters where all production is concentrated in the largest country shrinks when the possibility of multinational production is introduced.

All these aspects correspond to a consensus in the literature. However, the issue of the relation between trade and foreign direct investment is controversial. The "tariff jumping" model insists that foreign direct investments substitutes trade. It is argued that foreign direct investment has increased faster than output and trade in every region of the world economy since 1980. But trade and investment appear often as complements, namely in two different situations. Subsidiaries of multinational corporations exchange intermediate goods among themselves and with national firms, thus "catalyzing" the host economy (MARKUSEN and VENABLES, 1999). A second situation of association between trade and investment is the one where a firm has several plants each one producing a differentiated variety of a good. Each differentiated product is then sold in all the countries where the firm has plants. The spatial separation of the plants relaxes price and product competition among them (BALDWIN and OTTAVIANO, 1998).

In this paper, foreign direct investment is approached through a non cooperative game of two firms that choose to locate in two countries. Each firm can choose to have either one or two plants. The firms produce homogeneous goods, so that the model is a "spatial competition model" in the tradition of HOTELLING (1929). However, in order to ensure, for the sake of simplicity, that the game has only one stage, it is assumed that each firm charges a parametric price, so that firms compete only through location (as in EATON and LIPSEY, 1975).

[1] It also "jumps" non tariff barriers.

The model that is used here is of a "tariff jumping" nature. Trade and foreign direct investment are substitutes. Multinationals do not create trade, either through the exchange of intermediate goods or differentiated consumer goods.

2 A location game with single plant firms

To present the subject in an order of increasing complexity, we begin to assume a spatial economy where each firm is constrained to have a single plant. It is described by the following assumptions:

1. There are two countries (or regions inside the same country), that are labelled A and B, whose populations of consumers are n_a and n_b. Country A is larger than country B, so that $n_a > n_b$.[2] However, the asymmetry of the countries is bounded from above so that $n_a < 2n_b$.[3]

2. Two firms produce a homogeneous good and sell it at a parametric price $\overline{p}$ [4].

3. Each firm has a unique plant.

4. Each plant has a constant unit production cost c and a fixed cost G.

5. Each consumers travels to the nearest shop to buy the product. Let t be the unit transport cost . The sum of the mill price $\overline{p}$ and the transport cost between the firms is named the "full price" and is given by

$$\text{fullprice} \equiv \overline{p} + td\left(s_f, s_c\right) \tag{1}$$

[2] $n_a = n_b$ would be an exceptional event with zero probability. On the other hand, the exclusion of $n_a < n_b$ does not entail loss of generality.

[3] The important fact is that the asymmetry is bounded from above. Otherwise, the location problem would be trivial: the firms would locate in the largest country for whatever value of transport costs. The specific value of the bound which is assumed here follows only from the remaining assumptions of the model.

[4] That means that price competition is abstracted is order to make the problem more tractable. This model fits therefore in the framework of the "pure spatial competition models", where firms compete only through locational choices keeping prices fixed.

where s_f is the location of the firm $(s_f \epsilon \{A, B\})$ and s_c is the location of the consumer $(s_c \epsilon \{A, B\})$. $d(,)$ is a distance function that is given by

$$d(s_f, s_c) = \begin{cases} 0 & if \quad s_f = s_c \\ 1 & if \quad s_f \neq s_c \end{cases} \tag{2}$$

6. Each consumer has a 0-1 demand function with a reservation price v. This means that the individual demand function $q(s_f)$ is

$$q(s_f) = \begin{cases} 1 & if \quad \min\limits_{s_f} [\overline{p} + td(s_f, s_c)] \leq v \\ 0 & otherwise \end{cases} \tag{3}$$

7. If the consumer buys the product, she patronizes the supplier with the lower full price, that is to say, the nearest seller, so that $d(s_f, s_c)$ is minimized If two sellers have the same location, the consumer purchases the product to each one with probability $\frac{1}{2}$.

By definition, $\overline{p} < v$. The strategic interaction of the firms is described by two classes of games.

The first class is the one where

$$\overline{p} + t \leq v \tag{4}$$

In this class, transport costs are relatively low so that a firm which is located in a country can sell the product to a customer located in another country. The demand addressed to firm 1as a function of the locations of the firms is

$$\begin{aligned} D_1(A, A) &= \frac{n_a + n_b}{2} \\ D_1(B, A) &= n_b \\ D_1(A, B) &= n_a \\ D_1(B, B) &= \frac{n_a + n_b}{2} \end{aligned} \tag{5}$$

The demand function addressed to firm 2 is symmetric, so that

$$D_2(s_i, s_j) = D_1(s_j, s_i) \tag{6}$$

where $s_i, s_j = A, B$ and $i \neq j$, are the firms' locations.
The payoff of firm 1 (respectively of firm 2) when the locations are i, j is

$$P_1(i,j) = (\overline{p} - c)\, D_1(i,j) - G \tag{7}$$

It is easy to understand that a game with payoff functions 7 can suffer a linear positive transformation that changes it to a game having as payoffs the demand functions defined by 5.

As the game is symmetric, the payoff matrix will be written with only the payoffs of firm 1.

$$\begin{array}{ccccc} & & & 2 & \\ & & A & & B \\ 1 & A & \dfrac{n_a + n_b}{2} & & n_a \\ & A & n_b & & \dfrac{n_a + n_b}{2} \end{array} \tag{8}$$

With symmetric 2×2 games, we will perform the best reply structure preserving simplification that is proposed by WEIBULL (1997, chapter 1) and that consists of subtracting a_{21} to the first column of the matrix and a_{12} to the second column.[5]. We get the following matrix

$$\begin{array}{ccccc} & & & 2 & \\ & & A & & B \\ 1 & A & \dfrac{n_a - n_b}{2} & & 0 \\ & B & 0 & & \dfrac{n_b - n_a}{2} \end{array} \tag{9}$$

We call the main diagonal elements in matrix 9 a_1 and a_2. It is clear that $a_1 > 0$ and $a_2 < 0$, so that A is a dominant location strategy for both players.

The second class of games is the one where

$$\overline{p} + t > v \tag{10}$$

The transport cost is relatively high so that a firm located in a country can not sell to a consumer in the other country. The demand addressed to firm

[5]Of course, the original matrix will be retained whenever the payoff dominance across Nash equilibria is investigated.

1 as a function of the locations of the firms is

$$\begin{aligned} D_1(A,A) &= \frac{n_a}{2} \\ D_1(B,A) &= n_b \\ D_1(A,B) &= n_a \\ D_1(B,B) &= \frac{n_b}{2} \end{aligned} \tag{11}$$

The demands addressed to firm 2 are just symmetric, according to 6. The positive linear transformation of payoffs that was mentioned in 7 enables us to present the game in terms of demands, as was made in matrix 8. The game is symmetric , so that only the payoffs of firm 1 are mentioned.

$$\begin{array}{ccccc} & & 2 & \\ & & A & B \\ 1 & A & \frac{n_a}{2} & n_a \\ & B & n_b & \frac{n_b}{2} \end{array} \tag{12}$$

If we perform the above mentioned best reply structure preserving simplification, we get the matrix

$$\begin{array}{cccc} & & 2 & \\ & & A & B \\ 1 & A & \frac{n_a}{2}-n_b & 0 \\ & B & 0 & \frac{n_b}{2}-n_a \end{array} \tag{13}$$

It is clear that both a_1 and a_2 are negative, so that there are two symmetric Nash equilibria (A,B) and (B,A).

The outcome of the spatial game without intermediate goods can be summarized by saying that, if the transport costs are high, the productive activity will occur most likely in the two countries (although on account of a lack of coordination it can concentrate in just one of them). When the transport costs become low, on account of the progress of transportation or of some kind of commercial integration, to locate in the larger country is a dominant strategy for both firms.

3 A location game with horizontal multinational firms:an economic integration viewpoint.

We will assume now that each firm has the option to become a horizontal multinational by having two plants located in different countries. Formally, assumption 3 becomes

3-A: Each firm has the choice to become a horizontal multinational by running two plants in different locations. Formally, the strategy set of each player is now $\{A, B, A \text{ and } B\}$,where A and B labels the strategy of creating a plant in each market.

The case where transport costs are relatively low, so that $\overline{p} + t \leq v$, and a plant located in a market can sell in the other market, is dealt first. The demand addressed to firm 1 as a function of the locations, when one of the location strategies is A and B, is

$$\begin{aligned} D_1\left(A, A \text{ and } B\right) &= \frac{n_a}{2} \\ D_1\left(B, A \text{ and } B\right) &= \frac{n_b}{2} \\ D_1\left(A \text{ and } B, A\right) &= \frac{n_a}{2} + n_b \\ D_1\left(A \text{ and } B, B\right) &= n_a + \frac{n_b}{2} \\ D_1\left(A \text{ and } B, A \text{ and } B\right) &= \frac{n_a + n_b}{2} \end{aligned} \tag{14}$$

As in Section 2, demands addressed to firms are symmetric, so that

$$D_2\left(s_i, s_j\right) = D_1\left(s_j, s_i\right) \tag{15}$$

Therefore, the game is symmetric. The matrix of payoffs of firm 1 is

$$\begin{array}{cccccc} & & & 2 & & \\ & & A & B & A \text{ and } B \\ 1 & A & \left(\overline{p} - c\right) \frac{n_a + n_b}{2} - G & \left(\overline{p} - c\right) n_a - G & \left(\overline{p} - c\right) \frac{n_a}{2} - G \\ & B & \left(\overline{p} - c\right) n_b - G & \left(\overline{p} - c\right) \frac{n_a + n_b}{2} - G & \left(\overline{p} - c\right) \frac{n_b}{2} - G \\ & A \text{ and } B & \left(\overline{p} - c\right) \left(\frac{n_a}{2} + n_b\right) - 2G & \left(\overline{p} - c\right) \left(n_a + \frac{n_b}{2}\right) - 2G & \left(\overline{p} - c\right) \frac{n_a + n_b}{2} - 2G \end{array}$$

By adding G to each payoff and after setting $\overline{p} = 1$ and $c = 0$, we obtain the simplified matrix

$$\begin{array}{ccccc} & & & 2 & \\ & & A & B & A \text{ and } B \\ 1 & A & \frac{n_a+n_b}{2} & n_a & \frac{n_a}{2} \\ & B & n_b & \frac{n_a+n_b}{2} & \frac{n_b}{2} \\ & A \text{ and } B & \frac{n_a}{2}+n_b-G & n_a+\frac{n_b}{2}-G & \frac{n_a+n_b}{2}-G \end{array} \tag{16}$$

It is clear that, for all values of the parameters, strategy A strictly dominates strategy B. Therefore, there are two possibilities. If $G > \frac{n_b}{2}$, that is to say, if the additional fixed cost of settling a new plant in the small market is not matched by the increase of sales there, strategy A strictly dominates A and B too. A is a strictly dominant strategy for both firms. There is a dominant strategy equilibrium with both firms having a single plant in the larger market. If $G \leq \frac{n_b}{2}$, strategy A does not dominate A and B. If strategy B is withdrawn from matrix 16, we get the symmetric 2×2 game

$$\begin{array}{cccc} & & 2 & \\ & & A & A \text{ and } B \\ 1 & A & \frac{n_a+n_b}{2} & \frac{n_a}{2} \\ & A \text{ and } B & \frac{n_a}{2}+n_b-G & \frac{n_a+n_b}{2}-G \end{array} \tag{17}$$

If the best reply structure preserving simplification that was used in Section 2 is applied, the following matrix is obtained

$$\begin{array}{cccc} & & 2 & \\ & & A & A \text{ and } B \\ 1 & A & G & 0 \\ & A \text{ and } B & 0 & \frac{n_b}{2}-G \end{array} \tag{18}$$

Direct inspection shows that both a_1 and a_2 are positive, so that this is coordination game with two asymmetric equilibria (A, A) and $(A \text{ and } B, A \text{ and } B)$. If the small market has a sufficient size with relation to the additional fixed cost of establishing there, the settling of a second plant can occur although it is does not happen with certainty.[6]

[6]In the game expressed by the matrix 17, (A, A) dominates in payoffs $(A \text{ and } B, A \text{ and } B)$. However, this fact will be considered has not meaningful, as no consideration will be made of selection among multiple equilibrium points (for that purpose, see among others, HARSANYI and SELTEN, 1988).

We treat now a second class games, where transport costs are relatively high so that $\overline{p}+t > v$. In this situation, a plant located in a country can not supply the consumers in the other market. The demands addressed to firm 1, when a two plant location strategy is used by at least one of the firms, are

$$\begin{aligned}
D_1(A, A \text{ and } B) &= \frac{n_a}{2}\\
D_1(B, A \text{ and } B) &= \frac{n_b}{2}\\
D_1(A \text{ and } B, A \text{ and } B) &= \frac{n_a+n_b}{2}\\
D_1(A \text{ and } B, A) &= \frac{n_a}{2}+n_b\\
D_1(A \text{ and } B, B) &= n_a+\frac{n_b}{2}
\end{aligned}$$

As the game is symmetric, the matrix of payoffs of firm 1 is

$$\begin{array}{cccc}
 & & 2 & \\
 & A & B & A \text{ and } B\\
1 \quad A & (\overline{p}-c)\frac{n_a}{2}-G & (\overline{p}-c)\,n_a-G & (\overline{p}-c)\frac{n_a}{2}-G\\
B & (\overline{p}-c)\,n_b-G & (\overline{p}-c)\frac{n_b}{2}-G & (\overline{p}-c)\frac{n_b}{2}-G\\
A \text{ and } B & (\overline{p}-c)\left(\frac{n_a}{2}+n_b\right)-2G & (\overline{p}-c)\left(n_a+\frac{n_b}{2}\right)-2G & (\overline{p}-c)\frac{n_a+n_b}{2}-2G
\end{array}$$

Adding G to each payoff and setting $\overline{p}=1, c=0$, the simplified matrix is obtained.

$$\begin{array}{cccc}
 & & 2 & \\
 & A & B & A \text{ and } B\\
1 \quad A & \frac{n_a}{2} & n_a & \frac{n_a}{2}\\
B & n_b & \frac{n_b}{2} & \frac{n_b}{2}\\
A \text{ and } B & \frac{n_a}{2}+n_b-G & n_a+\frac{n_b}{2}-G & \frac{n_a+n_b}{2}-G
\end{array} \tag{19}$$

Clearly, in this case, strategy A does not dominate strategy B. However, strategy A and B can be dominated by A if and only if

$$(n_b < G)\; and \left(\frac{n_b}{2} < G\right) \Leftrightarrow n_b < G \tag{20}$$

It is better for the firm to locate a single plant in the large market than to settle two plants if the demand in the second market is small with relation to the additional fixed cost.

Strategy A and B can also be dominated by strategy B if and only if

$$\left(\frac{n_a}{2} < G\right) and\, (n_a < G) \Leftrightarrow n_a < G \tag{21}$$

Therefore, A and B is a dominated strategy if and only if

$$(n_b < G)\, or\, (n_a < G) \Leftrightarrow n_b < G \tag{22}$$

If condition 22 holds, the dominated strategy can be eliminated and the game can studied as a symmetric 2×2 game with matrix (only firm 1 payoffs are registered).

$$\begin{array}{cccc} & & 2 & \\ & & A & B \\ 1 & A & \frac{n_a}{2} & n_a \\ & B & n_b & \frac{n_b}{2} \end{array} \tag{23}$$

which has two symmetric Nash equilibria (A, B) and (B, A).

If the strategy A and B is not dominated, that is to say, if $n_b > G$, it is necessary to examine the 3×3 symmetric game 19. In order to obtain a class of games in just a parameter G, we set

$$\begin{aligned} n_a &= \frac{4}{3} \\ n_b &= 1 \end{aligned} \tag{24}$$

to obtain the following matrix (the payoffs of the players are included)

$$\begin{array}{ccccc} & & 2 & & \\ & & A & B & A \text{ and } B \\ 1 & A & \frac{2}{3}, \frac{2}{3} & \frac{4}{3}, 1 & \frac{2}{3}, \frac{5}{3} - G \\ & B & 1, \frac{4}{3} & \frac{1}{2}, \frac{1}{2} & \frac{1}{2}, \frac{11}{6} - G \\ & A \text{ and } B & \frac{5}{3} - G, \frac{2}{3} & \frac{11}{6} - G, \frac{1}{2} & \frac{7}{6} - G, \frac{7}{6} - G \end{array} \tag{25}$$

It is possible to assess the set of Nash equilibria for different values of G by studying the structure of best replies (see GIBBONS, 1992). This structure is the following:

The best reply to A is B, if $G \geq \frac{2}{3}$, and is A and B otherwise.

The best reply to B is A, if $G \geq \frac{1}{2}$, and is A and B otherwise.

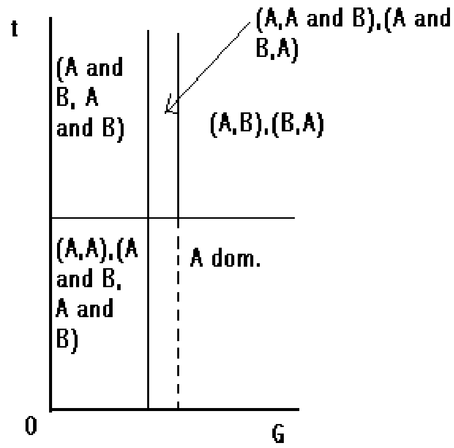

Figure 1: Location Nash equilibria in space (G, t).

The best reply to A and B is A, if $G \geq \frac{1}{2}$ and is A and B otherwise.

Therefore, the set of Nash equilibria in the game described by 25 is the following:

1. If $0 < G \leq \frac{1}{2}$, there is an unique Nash equilibrium $(A \text{ and } B, A \text{ and } B)$.
2. If $\frac{1}{2} < G \leq \frac{2}{3}$, there are two symmetric equilibria $(A, A \text{ and } B), (A \text{ and } B, A)$.
3. If $G > \frac{2}{3}$, there are two symmetric equilibria (A, B) , (B, A).

Summing up the cases where transport costs are low ($\overline{p} + t \leq v$) and high $(\overline{p} + t > v)$, and setting $v = 2$, it is possible to represent the set of Nash equilibria in the parameter space (G, t).

The structure of Nash equilibria has several distinctive features. Multinational production occurs for high transport costs and low plant fixed costs, thus reproducing the results of "tariff-jumping models" of Foreign Direct Investment (see MARKUSEN and VENABLES, 1998, and EKHOLM and FORSLID, 1997). Comparing the structure of equilibrium of this Section with the one in Section 2, it can be remarked that production by multinational firms can take place in the small country, in the context of a coordination game, even in the case where transport costs are low. The introduction of the possibility of multinational firms restricts the region of the parameter space where all production is concentrated in the large country. This is also a result from the literature.

All the equilibria are homogeneous, having only single or two plant firms, with an exception. For high transport costs and intermediate values of the plant fixed cost, single plant firms located in the large country and multinational firms coexist in equilibrium. Coexistence can also occur for low values of transport and fixed cost as an outcome of lack of coordination. The possibility of coexistence of single and multi-plant firm is a realistic feature of the game.

Last, the game yields the model with single plant firms of Section 2 as a special case, when the plant fixed cost is high, thus making unfeasible the setting of a second plant.

Assume that the plant fixed cost is fixed at a low level, so that the creation of multiplant firms is easy. If the trade cost is high, all the firms will be multinational. If a process of commercial integration takes, the firms should coordinate either to remain multinational or to concentrate production in the large country. The small country has still a chance to keep production for a high level of commercial integration.

This chance disappears for high plant fixed costs. The model becomes similar to the one with single plant firms. Production in the small country exists for high trade costs and is eliminated by the process of commercial integration.

4 A location game with horizontal multinational firm: the economic growth viewpoint

In Section 3, we studied the structure of Nash equilibria in the (G, t) parameter space, in order to assess the impact of a process of economic integration (a decline of the transport cost) upon the spatial distribution of production and decision to become multinational choices of firms. In this Section, keeping the transport cost constant at a low level (so that $\overline{p} + t \leq v$), [7] we examine the impact of economic growth on the structure of Nash location equilibria of firms.[8]

[7] We assume that the process of economic integration has already taken place.

[8] The idea of treating separately economic integration and economic growth was suggested by GAO TING (1999).

Economic growth is measured by the increase of population in the two country system, keeping constant the share of each country.[9] The following notation is introduced. Let N be the total population and ρ, the share of population in the small country (therefore, the degree of symmetry of the two countries), with $0 < \rho < \frac{1}{2}$. Then, we have

$$\begin{aligned} N &= n_a + n_b \\ n_b &= \rho N \\ n_a &= (1-\rho) N \end{aligned} \tag{26}$$

Then, the payoff matrix of firm 1 in the symmetric game becomes (from matrix 16)

$$\begin{array}{cccccc} & & & 2 & & \\ & & A & B & A \text{ and } B \\ 1 & A & \frac{N}{2} & (1-\rho) N & \frac{(1-\rho)N}{2} \\ & B & \rho N & \frac{N}{2} & \frac{\rho N}{2} \\ & A \text{ and } B & \frac{N}{2} - G & N\left(1-\frac{\rho}{2}\right) - G & \frac{N}{2} - G \end{array} \tag{27}$$

With the values of the population in the two countries that were specified in 24, ρ becomes $\frac{3}{7}$. Substituting this value in matrix 27, we obtain the class of symmetric games in two parameters, N and G.

$$\begin{array}{cccccc} & & & 2 & & \\ & & A & B & A \text{ and } B \\ 1 & A & \frac{N}{2} & \frac{4}{7}N & \frac{2}{7}N \\ & B & \frac{3}{7}N & \frac{N}{2} & \frac{3}{14}N \\ & A \text{ and } B & \frac{N}{2} - G & \frac{11}{14}N - G & \frac{N}{2} - G \end{array} \tag{28}$$

It is clear that strategy A always dominates strictly strategy B. Furthermore, strategy A will dominate strategy A and B if and only if $N < \frac{14}{3}G$. In this case, there will be a dominant strategy equilibrium with both firms establishing a single plant in the larger market.

[9] More accurately, economic growth should be measured by the increase of per capita income. However, as in our model, each consumer buys buys at most one unit of product, the increase of the market is given by the growth of the number of consumers.

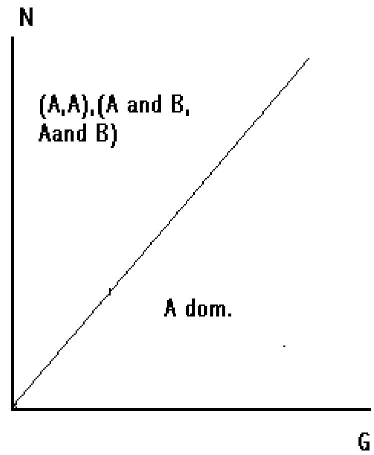

Figure 2: Nash location equilibria in (G, N) space

If $N > \frac{14}{3}G$,through elimination of the strictly dominated strategy B, the game can be studied by a 2×2 matrix.

$$\begin{array}{cccc} & & & 2 \\ & & A & A \text{ and } B \\ 1 & A & \frac{N}{2} & \frac{2}{7}N \\ & A \text{ and } B & \frac{N}{2} - G & \frac{N}{2} - G \end{array} \tag{29}$$

If the best reply structure simplification used before is applied, we obtain the matrix

$$\begin{array}{cccc} & & & 2 \\ & & A & A \text{ and } B \\ 1 & A & G & 0 \\ & A \text{ and } B & 0 & \frac{3}{14}N - G \end{array} \tag{30}$$

It is clear that while $a_1 > 0$, $a_2 > 0$ if and only if $N > \frac{14}{3}G$. If this condition is met, there will be two symmetric equilibria (A, A) and $(A \text{ and } B, A \text{ and } B)$.

Figure 2 depicts the location equilibria in (G, N) parameter space. When the economy is underdeveloped, all the productive activity is concentrated in the large market. The firms with single plants that are located in the core export the output to the small peripheral country. As the size of the market increases with economic growth, it becomes feasible for each firm to have a second plant which is placed in the small market. The productive activity is spread in the course of economic growth through multinational firm formation.

5 Conclusion

The paper reproduces the conclusion that foreign direct investment occurs for high values of the trade costs and for low values of the plant fixed cost. If the settling of a multinational is easy (for a low value of the plant fixed cost), there will be production in the small country even if transport costs are low.

This case is achieved more easily if there is an increase of the market size on account of economic growth and the plant fixed cost is kept constant. Multinational firms become economically feasible and they achieve a decentralization of production towards the small market.

In general, in equilibrium firms will be homogeneous, either national or multinational, except for high values of the trade costs and intermediate values of the plant fixed cost. If plant fixed costs are high, multinational firms are not feasible and the model behaves as the model with single plant firms.

A possible extension of the model would be the inclusion of the exchange of intermediate goods among subsidiaries of multinational firms and with national firms. This would have the advantage of making trade and investment complements rather than substitutes although it could bring a higher degree of multiplicity of Nash equilibria. MARKUSEN and VENABLES (1999) and PONTES (2000) give explicit contributions in this direction of research.

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