E C O N O M I C S   B U L L E T I N

Location of foreign direct investment in a regional integration area

José Pedro Pontes
Technical University of Lisbon

Abstract

In a regional integration area two processes take place simultaneously: the fall of trade costs and the regional convergence of per capita of the countries. The impact of these trends upon the location of the productive activity is examined through a static two person noncooperative game where each player(firm)selects one of three spatial strategies: to locate a single plant in the large country; to locate a single plant in the small country; and to settle a multiplant firm in the two countries. It can be inferred that to locate a plant in the small country is always a dominated strategy. The degree of symmetry in market size in the two countries appears as the major factor of the feasibility of production in the small peripheral economy.On the other hand, the fall of trade costs has a sensible impact upon the location of production only for intermediate levels of regional convergence. The "tariff jumping" argument for FDI has a limited field of application.

The author wishes to thank Armando Pires and João Gata for helpful comments. The usual disclaimer applies. This Research was funded by the Research Unit of Complexity in Economics (UECE)
Citation: Pontes, José Pedro, (2001) "Location of foreign direct investment in a regional integration area." *Economics Bulletin*, Vol. 18, No. 5 pp. 1−9
Submitted: December 11, 2001. **Accepted:** December 17, 2001.
URL: http://www.economicsbulletin.com/2001/volume18/EB−01R10002A.pdf

1 Introduction

The economic integration of two countries entails two different processes: the fall of trade costs (tariff and non tariff barriers, transport and communication costs) and the convergence of per capita income of the countries. The precise form of these processes will not be discussed here.

How do these processes change the location of the productive activity, namely of multinational firms in these countries is the question that is addressed in this paper. Following MARKUSEN and VENABLES (1998) among others, it will be assumed that Foreign Direct Investment (FDI henceforth) is of the horizontal type: each firm faces a trade-off between concentrating production in a single country and exporting to the other country (thus saving a fixed cost and incurring in additional transport cost) or locating a plant in each country supplying the local market (thus incurring in an additional fixed cost but saving transport costs). The incentive for FDI increases with trade costs: FDI is of a "tariff jumping" nature.

A standard result of this literature (in MARKUSEN and VENABLES, 1998, and in EKHOLM and FORSLID, 1997) is that FDI is more likely if the two countries are similar in size: excessive asymmetry leads the firms to prefer to locate single plants in the large market.

The "tariff jumping" FDI that will be analyzed in this paper is a substitute for trade, which is a unrealistic feature. FDI is often a complement of trade (for models that explain this complementariness see MARKUSEN and VENABLES, 1999 and BALDWIN and OTTAVIANO, 1998).

This paper will use the "pure spatial competition" framework (see EATON and LIPSEY, 1975). The firms set parametric mill prices and take interdependent location decisions. The consumers purchase the product to the firm that charges the lower full price, that is to say, to the nearest plant. The interdependency is modelled through a static noncooperative game where each firm has three choices in its strategy set: to locate a plant in the small country; to locate a plant in the large country; and to settle a multiplant firm. Two main conclusions arise. First, the location of a single plant in the small country is always a strictly dominated strategy.[1] Production in the small country can only take place through multinational firms. Second, the impact of the fall of trade costs appears to be most important for intermediate levels of the process of regional convergence.

2 The model

We assume a spatial economy that obeys the following

[1] However, this result follows directly from the assumption that production costs are the same in both countries. It would no longer be valuable if there existed a cost advantage by the small country.

2.1 Assumptions

1. There are two countries, 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]

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

3. Each firm has a strategy set with three location strategies: to locate a single plant in A (strategy "A"); to locate a single plant in B (strategy "B"); to settle a multiplant firm (strategy "A and B").

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

5. Each consumer 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

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

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

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

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

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

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 $d\left(s_f, s_c\right)$ is minimized. If two sellers have the same location, the consumers purchase the product to each one with probability $\frac{1}{2}$.

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

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

addressed to firm 1 as a function of the locations is

$$
\begin{aligned}
D_1(A,A) &= \frac{n_a+n_b}{2} &(4)\\
D_1(B,A) &= n_b\\
D_1(A,B) &= n_a\\
D_1(B,B) &= \frac{n_a+n_b}{2}\\
D_1(A,\text{A and B}) &= \frac{n_a}{2}\\
D_1(B,\text{A and B}) &= \frac{n_b}{2}\\
D_1(\text{A and B},A) &= \frac{n_a}{2}+b\\
D_1(\text{A and B},B) &= n_a+\frac{n_b}{2} &(5)\\
D_1(\text{A and B},\text{A and B}) &= \frac{n_a+n_b}{2}
\end{aligned}
$$

It is clear that demands addressed to the firms are symmetric, so that

$$D_2(s_i,s_j)=D_1(s_j,s_i)$$

Therefore the two person game is symmetric. If we set $\overline{p}=1$ and $c=0$, the payoff matrix of firm 1 becomes

$$
\begin{array}{llccc}
 & & \text{Firm 2} & & \\
 & & A & B & \text{A and B}\\
\text{Firm 1} & A & \frac{n_a+n_b}{2}-G & n_a-G & \frac{n_a}{2}-G\\
 & B & n_b-G & \frac{n_a+n_b}{2}-G & \frac{n_b}{2}-G\\
 & \text{A and B} & \frac{n_a}{2}+n_b-2G & n_a+\frac{n_b}{2}-2G & \frac{n_a+n_b}{2}-2G
\end{array}
\quad (6)
$$

Now we name $N\equiv n_a+n_b$ the total population in the two countries. Let $\rho\equiv\frac{n_b}{N}$, the share of the small country in the total population. It is obvious that $0<\rho<\frac{1}{2}$ and that ρ is a measure of symmetry in the spatial distribution of consumers.

With these changes of notation, matrix 6 can be written

$$
\begin{array}{llccc}
 & & \text{Firm 2} & & \\
 & & A & B & \text{A and B}\\
\text{Firm 1} & A & \frac{N}{2}-G & (1-\rho)N-G & (1-\rho)\frac{N}{2}-G\\
 & B & \rho N-G & \frac{N}{2}-G & \frac{\rho N}{2}-G\\
 & \text{A and B} & \frac{N(1+\rho)}{2}-2G & \frac{N(2-\rho)}{2}-2G & \frac{N}{2}-2G
\end{array}
\quad (7)
$$

It is possible to perform a linear positive transformation on the game depicted in matrix 7, by adding G and then multiplying each payoff by $\frac{1}{N}$ to get the matrix

$$\begin{array}{lcccc} & & \text{Firm 2} & & \\ & & A & B & \text{A and B} \\ \text{Firm 1} & A & \frac{1}{2} & 1-\rho & \frac{1-\rho}{2} \\ & B & \rho & \frac{1}{2} & \frac{\rho}{2} \\ & \text{A and B} & \frac{1+\rho}{2}-\left(\frac{G}{N}\right) & \frac{2-\rho}{2}-\left(\frac{G}{N}\right) & \frac{1}{2}-\left(\frac{G}{N}\right) \end{array} \tag{8}$$

The relations of dominance between strategies in matrix 8 are clear. "B" is strictly dominated by A. "A" dominates strictly "A and B" iff

$$\frac{G}{N} > \frac{\rho}{2} \tag{9}$$

In this case, both firms locate single plants in the large market and supply the small peripheral market.

Otherwise, "A and B" dominates "A". In this case, each firm installs a plant in each market supplying the local demand.

Let us analyze the case where transport costs are high, $\overline{p} + t > v$, so that each plant is constrained to sell in its local market. The demand addressed to firm 1 is

$$\begin{aligned} D_1(A, A) &= \frac{n_a}{2} \\ D_1(B, A) &= n_b \\ D_1(A, B) &= n_a \\ D_1(B, B) &= \frac{n_b}{2} \\ D_1(A, \text{A and B}) &= \frac{n_a}{2} \\ D_1(B, \text{A and B}) &= \frac{n_b}{2} \\ D_1(\text{A and B}, A) &= \frac{n_a}{2} + b \\ D_1(\text{A and B}, B) &= n_a + \frac{n_b}{2} \\ D_1(\text{A and B}, \text{A and B}) &= \frac{n_a + n_b}{2} \end{aligned} \tag{10}$$

Again the demand addressed to firm 2 is symmetric, so that the game itself is a two person symmetric game. Setting $\overline{p} = 1$, $c = 0$, the payoff matrix of firm

1 is

$$\begin{array}{lcccc} & & \text{Firm 2} & & \\ & & A & B & \text{A and B} \\ \text{Firm 1} & A & \dfrac{n_a}{2}-G & n_a-G & \dfrac{n_a}{2}-G \\ & B & n_b-G & \dfrac{n_b}{2}-G & \dfrac{n_b}{2}-G \\ & \text{A and B} & \dfrac{n_a}{2}+n_b-2G & n_a+\dfrac{n_b}{2}-2G & \dfrac{n_a+n_b}{2}-2G \end{array} \tag{11}$$

Assigning to N and ρ the same meaning as before, matrix 11 becomes

$$\begin{array}{lcccc} & & \text{Firm 2} & & \\ & & A & B & \text{A and B} \\ \text{Firm 1} & A & (1-\rho)\frac{N}{2}-G & (1-\rho)N-G & \frac{(1-\rho)N}{2}-G \\ & B & \rho N-G & \frac{\rho N}{2}-G & \frac{\rho N}{2}-G \\ & \text{A and B} & \frac{N}{2}+\frac{\rho N}{2}-2G & N-\frac{\rho N}{2}-2G & \frac{N}{2}-2G \end{array} \tag{12}$$

By performing to matrix 12 the same linear positive transformation that was applied to matrix 7, we obtain the game matrix

$$\begin{array}{lcccc} & & \text{Firm 2} & & \\ & & A & B & \text{A and B} \\ \text{Firm 1} & A & \dfrac{1-\rho}{2} & 1-\rho & \dfrac{1-\rho}{2} \\ & B & \rho & \dfrac{\rho}{2} & \dfrac{\rho}{2} \\ & \text{A and B} & \frac{1}{2}+\dfrac{\rho}{2}-\left(\frac{G}{N}\right) & 1-\dfrac{\rho}{2}-\left(\frac{G}{N}\right) & \frac{1}{2}-\left(\frac{G}{N}\right) \end{array} \tag{13}$$

Considering together matrices 8 and 13, we have a class of games defined by three parameters: the transport cost (t), the degree of symmetry of the distribution of population across the countries (ρ) and the intensity of scale economies (measured by the ratio $\frac{G}{N}$). In order to simplify, a specific value to $\frac{G}{N}$ is assigned. If a too high value is assigned to the ratio of fixed costs to population, the strategy of settling a multiplant firm is a dominated strategy for all values of the other parameters. Therefore, after considering the best reply structure of the game, the value $\frac{1}{6}$ was chosen for $\frac{G}{N}$. With this value, the class of games in matrix 13 becomes

$$\begin{array}{lcccc} & & \text{Firm 2} & & \\ & & A & B & \text{A and B} \\ \text{Firm 1} & A & \frac{1-\rho}{2} & 1-\rho & \frac{1-\rho}{2} \\ & B & \rho & \frac{\rho}{2} & \frac{\rho}{2} \\ & \text{A and B} & \frac{1}{3}+\frac{1}{2}\rho & \frac{5}{6}-\frac{1}{2}\rho & \frac{1}{3} \end{array} \tag{14}$$

In order to assess equilibria, we must consider three different games in the class defined in matrix 14.

If $\rho < \frac{1}{6}$, strategy A is strictly dominant. There a dominant strategy equilibrium with both firms locating single plants in the large country and supplying the small country with exports.

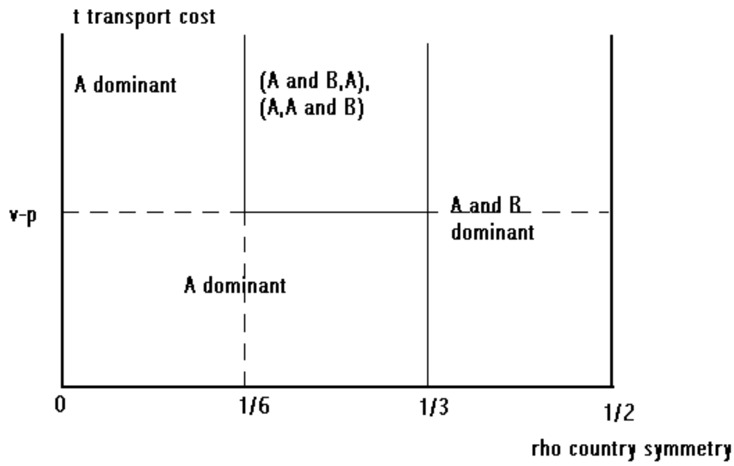

Figure 1: Nash location equilibria in (ρ, t) space.

If $\frac{1}{6} < \rho < \frac{1}{3}$, strategy B is strictly dominated because it is not the best reply to any of the strategies of firm 2. It can be eliminated from the set of strategies of the players. Matrix 14 becomes

$$\begin{array}{cccc} & & \text{Firm 2} & \\ & & A & \text{A and B} \\ \text{Firm 1} & A & \frac{1-\rho}{2} & \frac{1-\rho}{2} \\ & \text{A and B} & \frac{1}{3}+\frac{1}{2}\rho & \frac{1}{3} \end{array} \qquad (15a)$$

It is clear that there are two asymmetric Nash equilibria: (A and B, A) and (A, A and B). One of the firms is multinational and the other has a single plant in the large market.

In the case where $\frac{1}{3} < \rho < \frac{1}{2}$, A and B is a dominant strategy. There is a unique equilibrium in dominant strategies (A and B, A and B), where both firms are multinationals.

We can sum up the results in Figure 1

3 Conclusions

Several conclusions can be drawn from Figure 1. First, in the absence of a cost advantage in the small country, production there is exclusively undertaken by subsidiaries of multinational firms. The key for the small peripheral country to obtain multinational production is the increase of the size of its market (expressed in Figure 1 by an horizontal movement), making it more symmetric with relation to the large market. Therefore, the attraction of FDI is a by-product of real convergence during a process of regional economic integration rather its cause. Finally, the fall of trade costs during commercial integration (expressed in Figure 1 by a downward movement) in has some impact on the attraction of FDI for intermediate stages of the process of regional convergence, but has no sensible effects either in early or late stages of the process of real convergence of the countries involved in economic integration. The "tariff jumping" argument plays therefore a limited role as an explanation of FDI.

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