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***TRADE OR INVESTMENT ? LOCATION DECISIONS
UNDER REGINAL INTEGRATION***

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TRADE OR INVESTMENT ? LOCATION DECISIONS UNDER REGIONAL INTEGRATION

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This paper studies the production and trade patterns that may arise between two different countries if plant location is introduced as a first step in the producers' decision making. A three-stage game is used: the first deals with location and the next two with capacity and final sales decisions. Demand and cost structures differ by country, and the latter contain specific elements related to the foreign operation. The structure of possible Nash-equilibria is examined and an analysis of the changes in the solution, if the countries engage in an integration process, is made. As in previous models, though global welfare gains may not be very high, single country ones may be considerable, due to changes in the location of the plants. However, even if full integration takes place, global Marshallian welfare may decrease. Conditions which determine a tendency towards multinationalisation are obtained. Assuming a move toward integration, conditions are also provided to characterize when exporting will be preferred to local production. The fact that producers may retain a certain discriminating power, notwithstanding the elimination of barriers to arbitrage, creates a tendency to locate production in the country where prices are higher. This explains why welfare gains may not be obvious. An empirical illustration, with real data from two MERCOSUL countries (Brazil and Argentina) illustrates the possible outcomes.

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1. Introduction

Horstmann and Markusen (1992) and Rowthorn (1992) presented trade models in which a firm's decision to become a multinational enterprise is endogenized. Though the former work in a general equilibrium framework and the latter in partial, the basic mechanics, common to both papers, is the use of a two-stage game in which the first stage accounts for the location decision. A symmetric, two countries setting where Cournot-Nash competition takes place for one traded homogenous good completes the structure. The conclusions point out the discontinuities in welfare that can be obtained if a small change in the parameters - namely the tariff rate - induces a different plant configuration.

In this paper we generalise these models, combining their ideas with the capacity setting framework in Venables (1990a,b). A three-stage game is used: the first reflects the location decision and the next two are as in Venables (1990a). Demand and cost structures differ by country, and the latter contain specific elements related to the foreign operation. Equilibrium is defined in the sense of Nash, and the structure of possible equilibria is examined. An analysis of the changes in the solution, if the countries engage in an integration process like the European Union programme, is made. As in the previous models, though global welfare gains may not be very high, single country ones may be considerable, due to changes in the location decision. Conditions which determine a tendency towards multinationalisation are also obtained. The fact

that, even if tariffs are zeroed trade costs may persist, allows producers to retain a certain discriminating power, notwithstanding the elimination of barriers to consumers arbitrage. There is then a tendency to set production in the country where prices are higher. This explains why welfare gains are not obvious under the model.

An empirical illustration, with real data from a machine-tools sector in two MERCOSUL countries (Brazil and Argentina) illustrates one possible use of the framework. However, the structure is sufficiently rich to enable further developments and can also be used to examine the behaviour of a country *outside* the integration with respect to the newly formed block.

After presenting the model in section 2, the structure of the solutions is investigated in section 3. Section 4 examines the impacts of integration, and section 5 describes the application. Section 6 concludes.

2. The model

We consider two countries, 1 and 2, and two firms whose headquarters are respectively in 1 and 2. Both firms produce the same homogenous good and, in principle, supply both markets.

There is a representative consumer in each country, with a quadratic utility function yielding inverse demand functions of the form:

$$p_i = a_i - b_i (x_i + y_i) \quad ; \quad a_i, b_i > 0 \quad (1)$$

where $i=1,2$ is the country and x_i and y_i are the quantities sold in country i by the firms in country 1 and 2, resp.

The cost structure of each firm is as follows:

- * there are fixed costs G_x and G_y , resp., associated with the operation of each productive plant, and fixed costs F_x and F_y , resp., associated with the global activities of the firm - as R&D, administrative and financial concerns, etc - and independent of the number of operating plants;
- * there are constant marginal costs, which can be decomposed into four parts:
 - one called c_x (or c_y) related to the technical aspects of production,
 - one called s_i , $i=1,2$, which represents taxes and other charges on production levied in country i ,
 - two components, called α_i and β_i , $i=1,2$, which account for extra costs incurred by a plant operating in a country different from the one of its parent firm: α_i is related to technical and cultural aspects of a foreign operation in country i , and β_i is exclusively related to its extra red tape and regulatory costs.

The above structure means that, considering the country 1 firm, if it operates in its own country, the marginal cost will be:

$$k_x = c_x + s_1 \tag{2}$$

whereas if it operates a plant in country 2, it will be:

$$k_x^* = c_x + s_2 + \alpha_2 + \beta_2 \tag{3}$$

This means that foreign operation represents an increase in marginal cost of

$$B_x = (s_2 - s_1) + \alpha + \beta \quad (4)$$

an analogous result holding for the country 2 firm.

Both firms can choose between various alternatives to supply their markets. They can operate only one plant, either in the home or foreign country, and supply the other market via exports, or they can produce in both countries. They can also prefer not to produce. In the case that exports take place, trade costs t are added. These include tariffs and transportation costs, as well as other components analogous to those represented by α above.

By defining for each firm two extra variables, total cost can be represented as a single equation. Taking country 1 firm, for instance, it will be:

$$C(x_1, x_2) = (k_x + A_{1x})x_1 + (k_x + A_{2x})x_2 + n_x G_x + F_x \quad (5)$$

where n_x is the number of plants in operation and A_{1x} and A_{2x} are the extra variables which can be thought of as additional marginal costs, dependent on the strategic choice made. As an illustration, if production is made by a single plant in the home country: $n_x=1$, $A_{1x}=0$ and $A_{2x}=t$. If, however, one plant is in operation in each country : $n_x=2$, $A_{1x}=0$ and $A_{2x}=B_x$.

Each firm wants to maximise its total profits, which, in the case of country 1 firm, can be expressed by:

$$P^*(x_1, x_2) = (p_1 - k_x - A_{1x})x_1 + (p_2 - k_x - A_{2x})x_2 - n_x G_x - F_x \quad (6)$$

The strategic variable is quantity and the firm's decision process is modelled in three stages. First it chooses the number and location of each operating plant. As said before, this case includes the possibility of no-entry. Once this choice is made, total production X and Y is set, under Cournot-Nash. In the third stage, the quantities supplied to each market are determined, in such a way that all production is sold, i.e.:

$$X = x_1 + x_2 \quad \text{and} \quad Y = y_1 + y_2 \quad (7)$$

The combination of the above possibilities for each firm produces a 4×4 payoff matrix with all possible outcomes for the game. As in Horstmann and Markusen (1992), we shall use ordered pairs (a,b) to represent them. The first element will relate to country 1 firm and will be denoted $a=0,1,1^*$ or 2, if it decides not to produce, to produce only in the home country, to produce only in the foreign country or to produce in both countries, resp. The same applies to the second element $b=0,1,1^*$ or 2, related to the country 2 firm. As an example, $(1,1^*)$ means that both firms are operating one plant located in country 1.

3. The solutions

Excluding the $(0,0)$ outcome, the fifteen remaining may be divided into six monopoly situations and nine duopolies. The game is solved backwards and

we consider first the duopoly situations. The first order conditions (f.o.c.) will give for each firm:

$$\begin{aligned} p_1 - b_1 x_1 (1+v) - A_{1x} &= p_2 - b_2 x_2 (1+v) - A_{2x} \\ p_1 - b_1 y_1 (1+v) - A_{1y} &= p_2 - b_2 y_2 (1+v) - A_{2y} \end{aligned} \quad (8)$$

where v is a conjectural variation to be interpreted as in Venables(1990b).

As the profit functions are concave, the equations in (8) are sufficient for a maximum. Actually, together with (1) and (7), they characterize the third-stage equilibrium, whose solution gives the optimal quantities sold in each market and resulting prices, as functions of the total capacities set in the previous stage. With a bit of algebra, they are found to be:

$$\begin{aligned} x_1 &= (1/b_1 + b_2) (Xb_2 + D_x) & x_2 &= (1/b_1 + b_2) (Xb_1 - D_x) \\ y_1 &= (1/b_1 + b_2) (Yb_2 - D_y) & y_2 &= (1/b_1 + b_2) (Yb_1 + D_y) \end{aligned} \quad (9)$$

$$p_1 = a_1 - (b_1/b_1 + b_2) [b_2(X+Y) - (2(a_1-a_2) + (A_{2x}-A_{1x}) - (A_{1y}-A_{2y})) / (3+v)]$$

$$p_2 = a_2 - (b_2/b_1 + b_2) [b_1(X+Y) + (2(a_1-a_2) + (A_{2x}-A_{1x}) - (A_{1y}-A_{2y})) / (3+v)]$$

$$D_x = ((A_{2x}-A_{1x})(2+v) + (A_{1y}-A_{2y}) + (a_1-a_2)(1+v)) / (3+v)(1+v)$$

$$D_y = ((A_{1y}-A_{2y})(2+v) + (A_{2x}-A_{1x}) - (a_1-a_2)(1+v)) / (3+v)(1+v)$$

In the second stage, the f.o.c. are:

$$\begin{aligned} dP^x/dX &= (b_1 + b_2)^{-1} [(p_1 - A_{1x})b_2 + (p_2 - A_{2x})b_1 - Xb_1b_2] - k_x = 0 \\ dP^y/dY &= (b_1 + b_2)^{-1} [(p_1 - A_{1y})b_2 + (p_2 - A_{2y})b_1 - Yb_1b_2] - k_y = 0 \end{aligned} \quad (10)$$

and they implicitly define the firms' reaction curves. The equilibrium values are:

$$\begin{aligned} X &= (1/3b_1b_2) [b_2(a_1 + A_{1y} - 2A_{1x}) + b_1(a_2 + A_{2y} - 2A_{2x}) + (b_1 + b_2)(k_y - 2k_x)] \\ Y &= (1/3b_1b_2) [b_1(a_2 + A_{2x} - 2A_{2y}) + b_2(a_1 + A_{1x} - 2A_{1y}) + (b_1 + b_2)(k_x - 2k_y)] \end{aligned} \quad (11)$$

By giving the appropriate values to A_{1x} , A_{2x} , A_{1y} and A_{2y} , (11) represent all possible solutions to the nine different duopolies.

In the case of the six monopolies the second stage is meaningless, the monopolist going straight to optimize the sales in each market. The f.o.c. simply equate marginal cost to marginal revenue in each market. Supposing the monopolist to belong to country 1, the final quantities and prices will be:

$$\begin{aligned} x_1 &= (1/2b_1) (a_1 - A_{1x} - k_x) \\ x_2 &= (1/2b_2) (a_2 - A_{2x} - k_x) \\ p_1 &= (1/2) (a_1 + A_{1x} + k_x) \\ p_2 &= (1/2) (a_2 + A_{2x} + k_x) \end{aligned} \quad (12)$$

a similar set being true if the monopolist is in country 2.

The solutions found above allow the calculation of each firm's profit in all the fifteen situations. Taking again country 1 firm, its profits are:

* if it is a monopolist

$$P^*(x_1, x_2) = b_1 x_1^2 + b_2 x_2^2 - n_x G_x - F_x \quad (13)$$

* if a duopoly takes place

$$P^*(x_1, x_2) = 1/(b_1 + b_2) [X^2 b_1 b_2 + (1 + v) D_x^2] - n_x G_x - F_x \quad (14)$$

Equilibrium of the game will be taken in the sense of Nash. As an immediate consequence of this, a necessary condition for a monopoly outcome to be an equilibrium is that, at least for one locational choice of one of the firms, the other will have all its duopoly profits negative or zero. This will be due to relatively high values of the G_x and F_x (or the G_y and F_y) costs, and can be thought of as a somewhat extreme situation, with strong differences in technology between both producers.

The following propositions help in the identification of the equilibria:

Proposition 1. Considering country 1 firm, let

$$I(a, a') = (t + B_x)(x_{1(a,0)} + x_{1(a',0)}) \quad , \quad J(a, a') = (t - B_x)(x_{2(a,0)} + x_{2(a',0)}) \quad ,$$

where the symbols $a, a' = 1, 1^*, 2$, and, for instance, $x_{2(a,0)}$ means the quantity sold in market 2 under the solution $(a, 0)$,

THEN

the monopolistic profits are ordered by the following relationships:

$$P^*_{(2,0)} \geq P^*_{(1,0)} \quad \text{iff} \quad J(2,1) \geq 2G_x \quad ,$$

$$P^*_{(2,0)} \geq P^*_{(1^*,0)} \quad \text{iff} \quad I(2,1^*) \geq 2G_x$$

$$\text{and } P_{(1,0)}^x \geq P_{(1^*,0)}^x \text{ iff } I(1,1^*) \geq J(1,1^*)$$

Proof: See the Appendix.

Proposition 2. Considering the country 1 firm, let $b=1,1^*,2$ stand for a given country 2 firm decision, defining

$$I(a,a';b) = (t+B_x)(x_{1(a,b)} + x_{1(a',b)}) \quad , \quad J(a,a';b) = (t-B_x)(x_{2(a,b)} + x_{2(a',b)})$$

where the symbols $a,a'=1,1^*,2$, and, for instance, $x_{1(a,b)}$ means the quantity sold in market 1 under the solution (a,b) ,

THEN

the profits under duopoly are ordered by the following relationships:

$$P_{(2)}^x \geq P_{(1)}^x \text{ iff } 2J(2,1;b) \geq 3G_x \quad ,$$

$$P_{(2)}^x \geq P_{(1^*)}^x \text{ iff } 2I(2,1^*;b) \geq 3G_x$$

$$\text{and } P_{(1)}^x \geq P_{(1^*)}^x \text{ iff } I(1,1^*;b) \geq J(1,1^*;b)$$

Proof. See the Appendix.

The above results are fairly intuitive. Taking for instance the first monopoly inequality, the condition $J(2,1) \geq 2G_x$ can be rewritten as

$$t \cdot x_{2(1,0)} - (B_x \cdot x_{2(1,0)} + G_x) \geq (G_x + B_x \cdot x_{2(2,0)}) - t \cdot x_{2(2,0)} \quad . \quad (15)$$

This means that, whenever the *additional cost* of exporting to country 2

the quantity to be sold under one home plant is superior to the *additional cost* of local production under two plants, the two-plant solution is preferred to the one home plant solution. *Additional costs* being defined as the difference between the variable costs under the solution at stake and under the other, computed *at the sales level of the former*.

Another way of looking at the same condition is rewriting (15) as:

$$t.(1/2)(x_{2(1,0)} + x_{2(2,0)}) \geq G_x + B_x.(1/2)(x_{2(1,0)} + x_{2(2,0)})$$

which can be read as, whenever exporting the average of both solutions is costlier than producing this amount locally, the two-plant solution is preferred to the home plant one.

Propositions 1 and 2 and their equivalents for country 2 allow a constructive characterization of the possible equilibria. We present three derived results which illustrate their use.

Corollary 1. If $t > 0$ and, for both firms, the increase in marginal cost due to foreign operation is higher than the trade costs (i.e., $B_x \geq t$ and $B_y \geq t$)

THEN

provided that for any choice of one firm there is a positive profit choice of the other, the point (1,1) is the equilibrium.

Proof: The proviso excludes the monopoly situations; inspection of the inequalities in Proposition 2 reveals that, as $t - B_x \leq 0$ and $t - B_y \leq 0$ by hypothesis, for each choice of one firm, the one home plant solution is the other's best choice.

Viewed in a dynamic way, Corollary 1 says that if trade liberalisation goes faster than bureaucratic streamlining between the two countries, so that trade costs become smaller than those of foreign operation, there will be no incentive to multinationalise. The next statement deals with a situation in which there are strong fiscal differences between the two countries. In this case, one of the increases in marginal cost defined in (4) may be negative, what may cause production to take place only in the "tax haven" country.

Corollary 2. If for country 1, $B_x < 0$, and trade costs are such that

$$t < \min \{ |B_x|, B_y \} ,$$

THEN

provided that for any choice of one firm there is a positive profit choice of the other, the point $(1^*, 1)$ is the equilibrium.

Proof: The proviso excludes the monopoly situations; inspection of the inequalities in Proposition 2 reveals that, as $t + B_x \leq 0$ and $t - B_y \leq 0$ by hypothesis, the country 1 firm will always choose the 1^* decision while country 2 producer will

opt systematically for one home plant. It follows that the $(1^*, 1)$ solution is the Nash equilibrium.

4. The effects of integration

Integration is usually supposed to lower the degree of market segmentation, providing an increase in welfare. In our case, integration will have an impact on four dimensions:

- i) a reduction in trade costs,
- ii) a reduction in the extra costs related to operating a foreign plant,
- iii) tax equalisation,
- iv) elimination of arbitrage barriers.

The first effect is commonly achieved by zeroing the tariff component in t . As for the second, we shall assume that red tape costs will be minimised and bureaucrats will be less powerful, so that the extra costs will be equal to α_i only. Moreover, due to a greater interpenetration of cultural and business practices, α_1 and α_2 will converge to a single value α . Tax equalisation will imply that $s_1 = s_2$, so that, from (4), after integration,

$$B_x = B_y = \alpha$$

It must be noticed that if $\beta_i \geq |s_1 - s_2|$, $i = 1, 2$, both B_x and B_y decrease, as we shall assume.

The elimination of arbitrage barriers renders producers less powerful in terms of price discrimination. Actually, under iv), the difference between consumer prices in both markets can not surpass the new (reduced) trade costs. If this were the case before integration, the condition has no effect; however, it may be that it is binding. Calling $|p_1 - p_2|_B$ and $|p_1 - p_2|_A$ the price differentials before and after integration, iv) is translated as:

$$|p_1 - p_2|_A \leq \min \{ t, |p_1 - p_2|_B \} \quad (16)$$

where the t in (16) is the trade cost *after* the integration.

We shall think of dimension iv) as a second step in the integration process. First, the reductions due to the three other dimensions will take place, and next, eventually, arbitrage barriers will fall. Taking the conjectural variation v in eqs. (8) as in Venables (1990b), before integration, $v=0$ and both firms have a maximum price-discriminating power. After integration, $0 > v > -1$, i.e., v is adjusted so that inequality (15) is binding. To illustrate this, we evaluate from (9) the price differential under the duopoly situations:

$$|p_1 - p_2| = [(a_1 - a_2)(1 + v) - (A_{2x} - A_{1x}) + (A_{1y} - A_{2y})] \tau / (3 + v) \quad (17)$$

where $\tau = 1$ or -1 , depending whether $p_1 > p_2$ or $p_1 < p_2$. Supposing that before integration the price differential was higher than the new t , combining (17) with (16) allows to determine v :

$$v = [3t - ((a_1 - a_2) - (A_{2x} - A_{1x}) + (A_{1y} - A_{2y}))\tau] / [(a_1 - a_2)\tau - t] \quad (18)$$

Of course, if $|p_1 - p_2|_B$ were less than the new trade costs, v will continue to be zero.

The combined impact of all the four effects can be rather significant. It can be described according to the following situations:

Impact on the duopoly situations

In this case, impacts vary considerably with the initial equilibrium and the possible values of the demand parameters. We shall work out the (1,1) setting, which is the classical case in the literature, and suppose that reductions in B_x and B_y do not influence the location equilibrium (this instance will be treated in separate below).

The changes in t will impact all variables. Regarding total capacity, we have:

$$dX/dt = (b_2 - 2b_1)/3b_1b_2$$

$$dY/dt = (b_1 - 2b_2)/3b_1b_2$$

This implies that only for b_1 and b_2 values in the interior of the cone defined by the lines $2b_1 = b_2$ and $2b_2 = b_1$, both capacities will increase with integration. As for the quantities sold in each market, we have:

$$dx_1/dt = 1/3b_1$$

$$dx_2/dt = -2/3b_2$$

$$dy_1/dt = -2/3b_1$$

$$dy_2/dt = 1/3b_2$$

which means that, for both firms, domestic sales will decrease while exports will increase. Finally, for prices:

$$dp_1/dt = dp_2/dt = 1/3 \quad ;$$

so that prices fall in both markets.

All these results are rather intuitive. Now, the introduction of condition (16) implies, from (17), that:

$$t(3+v) = \tau(a_1-a_2)(1+v)$$

Taking into account the expressions for D_x and D_y in (9), this means that

$$\text{if } p_1 > p_2 \text{ then } D_x > 0 \text{ and } D_y = 0 \quad ;$$

$$\text{if } p_1 < p_2 \text{ then } D_x = 0 \text{ and } D_y < 0 \quad ;$$

so that for the firm in the country with the lower price third stage decisions will depend only on the demand parameters.

The above conclusion can be rephrased to the cases $(1, 1^*)$ and $(1^*, 1)$, if we suppose that both plants - in this perhaps new equilibrium - are located in the country with lower prices.

As regards the welfare changes, under full integration, decreases in t alter the value of v (which gets closer to -1). Considering country 1, calling S^* the consumers surplus (equal to $b_1/2$ times the square of the total quantity supplied to the country), the variation of the two components of Marshallian welfare with t will be:

$$\frac{dS^x}{dt} = (p_1 - a_1) \left[\frac{1}{3b_1} + \frac{a_1 - a_2}{|a_1 - a_2| (b_1 + b_2)} \right] \quad (19)$$

$$\frac{dP^x}{dt} = \frac{1}{b_1 + b_2} \left[\frac{2(b_2 - 2b_1)}{3} X + \left(1 + \frac{a_1 - a_2}{|a_1 - a_2|} \right)^2 \left(\frac{|a_1 - a_2|}{2} - t \right) \right]$$

Notice that, if dimension iv) of the integration had not been used, the derivatives would simplify to:

$$\frac{dS^x}{dt} = \frac{p_1 - a_1}{3b_1} \quad (20)$$

$$\frac{dP^x}{dt} = \frac{2}{b_1 + b_2} \left[\frac{(b_2 - 2b_1)}{3} X + \frac{a_1 - a_2}{3} + t \right]$$

Examination of the two pairs above tells that under integration and segmentation (i.e., no enforcement of dimension iv)), the consumers surplus always increases as $p_1 < a_1$; however, if the elimination of arbitrage barriers takes place, whenever $a_1 < a_2$ and $b_2 < 2b_1$ it will decrease. As for the producers profits, even under segmentation, all the coefficients of both demand functions play a role in the analysis. The final result is stated in

Proposition 3. If the initial equilibrium was (1,1) and supposing that integration does not change it

THEN

- i) under segmented integration, Marshallian welfare increases if $4x_2 > x_1 - y_1$;
- ii) under full integration, Marshallian welfare increases if $X < (x_1 + y_1)/2$.

Proof: See the Appendix.

Impact on the monopoly situations

The first three effects have some clear impacts on equations (12). Quantities sold abroad increase (A_{2x} is lower), with the consequent fall of the price in this market. Total output also increases, as domestic sales remain at least constant, and profits rise. If the single plant is in the foreign country, domestic sales surely increase, while domestic price falls, and profits experience an even higher increase.

However, when the arbitrage condition is imposed, inspection of eq. (12) is no longer useful, as the monopolist's programme is now:

max P^* under the restrictions

$$\text{a) } p_1 - p_2 \leq t \text{ and } \text{b) } p_2 - p_1 \leq t \quad (21)$$

This amounts to add two multipliers to the original Lagrangean, whose f.o.c., by the Kuhn-Tucker theorem, will now apply with complementary slackness. If the restrictions are not binding, both multipliers will be zero and there will not be much change from the pre-integration situation. However, if one restriction is binding an alteration takes place.

Let us suppose that $p_1 - p_2 = t$. Calling l_1 and l_2 the multipliers associated with a) and b), resp., we have that $l_1 \geq 0$ and $l_2 = 0$. Use of the (now) three f.o.c. together with (1) gives the solutions:

$$x_1 = (1/2b_1) (a_1 - A_{1x} - k_x) + l_1/2$$

$$x_2 = (1/2b_2) (a_2 - A_{2x} - k_x) - l_1/2$$

$$p_1 = (1/2) (a_1 + A_{1x} + k_x) - l_1 b_1/2 \quad (22)$$

$$p_2 = (1/2) (a_2 + A_{2x} + k_x) + l_1 b_2/2$$

$$l_1 = (a_1 - a_2 - 2t + A_{1x} - A_{2x})/(b_1 + b_2)$$

Multiplier l_1 can then be interpreted as a parameter which reflects the degree of integration between the two countries. As $l_1=0$ gives the solution before integration, the further it is from zero the greater will be the impact of the integration. Notice however that total production remains the same, indeed the presence of arbitrage affects the allocation of total output, but not necessarily its value. As for prices, they get closer until equality when $t=0$.

The monopolist's profits will be equal to:

$$P^x = b_1 [x_1^2 - (\frac{l_1}{2})^2] + b_2 [x_2^2 - (\frac{l_1}{2})^2] - n_x G_x - F_x \quad (23)$$

Comparison with (13) shows that, as expected, if arbitrage is possible the monopolist's profits decrease. As regards welfare, if the price at the monopolist location is lower than the one in the other country, it varies in opposite directions. Indeed, in the country of production, supply and profits decrease, while in the other supply increases. As in the latter there is no production, welfare increases there and decreases in the former. If however the higher price

is in the home country, it may happen that welfare also improves there. Using (22) and (23), welfare will increase if

$$dS^x = \frac{b_1 l_1}{2} \left[x_1 + \frac{l_1}{4} \right] > -dP^x = \frac{l_1^2}{4} [b_1 + b_2] \quad (24)$$

what amounts to the condition

$$l_1 < \frac{4 b_1 x_1}{b_1 + 2b_2}$$

Impact on the location decision

The location decision (or the first stage of the game) is seriously affected by integration. Taking for instance the case $B_x > t$, which was shown to yield the (1,1) equilibrium, integration effects due to i) to iii) imply that, as seen above, B_x and B_y will tend to a common value, equal to the homogenized marginal costs of technical and cultural aspects of a foreign operation. As, even if tariffs are zeroed, t also contains costs of this nature *plus* transportation costs, it is likely that $B_x, B_y \leq t$. This means that, if the initial equilibrium was (1,1), a move toward multinationalisation will probably take place. Indeed, even the incentive to hold only a foreign plant can be higher, so that $(1^*, 1^*)$ might become more likely. The following proposition sets a basis to analyse the possible changes:

Proposition 4. With the notation of Proposition 2, considering country 1 producer under a duopoly situation

THEN

$$\frac{d(P_{(2)}^* - P_{(1)}^*)}{dt} > 0 \quad , \quad \frac{d(P_{(2)}^* - P_{(1)}^*)}{dB_x} < 0$$

$$\frac{d(P_{(2)}^* - P_{(1)}^*)}{dt} > 0 \quad , \quad \frac{d(P_{(2)}^* - P_{(1)}^*)}{dB_x} > 0$$

Proof: See the Appendix.

The above derivatives show that, in principle, there will be a tendency toward 1* instead of 2, though the same can not be said of 2 with respect to 1. In this case, the derivatives act in the opposite direction, and 2 will be favoured relatively to 1 if $|dt| < |dB_x|$. As it is reasonable to suppose that one is moving from a situation in which $B_x > t$ to another one in which $B_x \leq t$, the tendency will again be toward multinationalisation. It must be emphasized that these are *tendencies* and not at all sufficient conditions. The different sizes of the markets and of the fixed costs may act against these changes.

Introduction of the no barriers to arbitrage condition adds a further degree of complexity, as v changes according to each location pattern. However, an

informal argument points that equilibria $(1,1^*)$ or $(1^*,1)$ become more likely. The reasoning is that if $p_1 > p_2$, 1^* is the least attractive choice for the country 1 producer, as he will not profit from his "residual" price-discriminating power. Moreover, as country 2 is less important, one domestic plant is probably more profitable than two plants. A similar logic shows that if $p_1 < p_2$, 1^* will be the more attractive choice for country 1 producer and, as country 2 producer will be in a symmetric situation, the argument is completed.

5. Empirical application: a machine-tool sector in Argentina and Brasil

The production of digitally controlled lathes presents a highly concentrated pattern in Brasil and Argentina. Though such machines are not perfectly homogenous products, they follow rigorous standards common to all varieties and are not much diversified in the two countries. Moreover, location decisions in the sector are quite independent of external factors, so that partial equilibrium can be a reasonable approximation.

Basic data for the experiment resulted from an average of 1987 and 1988 information. Calling Brasil = 1 and Argentina = 2, Table 1 shows the base "year" data and the calibrated values for the initial equilibrium $(1,1)$, existing at the time. Following the discussion in the previous section, integration effects due to the MERCOSUL are portrayed as:

- i) production taxes are equalled at their lower level, $s_1=s_2=7.27$ thousand US\$;
- ii) trade costs decrease by half, so that the new $t=27.53$ thousand US\$;
- iii) foreign operating costs also decrease
- iv) increase of arbitrage possibilities.

TABLE 1: BASIC AND CALIBRATED DATA USED IN THE EXPERIMENT (calibrated values are followed by an *)

Quantities (in units)

$x_1=320$	$x_2=5$	$X=325$
$y_1=52$	$y_2=30$	$Y=82$

Prices and cost parameters (in 1000 US\$/unit or 1000 US\$)

$p_1=170$	$p_2=142$	$t=55.05^*$	
$s_1=7.27$	$k_x=80.00$	$G_x=826.65$	$F_x=2479.95$
$s_2=9.12^*$	$k_y=100.32^*$	$G_y=655.00$	$F_y=1048.00$

Demand coefficients

$a_1=274.63^*$	$b_1=.28^*$
$a_2=190.63^*$	$b_2=1.39^*$

Table 2 shows the pay-off matrices for the after integration situation including dimension iv). There is much variation in the profits which, in general, are higher for the Brazilian firm; while increasing for the Argentinian one whenever multinationalisation is adopted. The much bigger size of the Brazilian market makes for it being more attractive when integration takes place, what is also confirmed by a general increase in the quantities sold and a fall in the price, under the integrated market. It is then not surprising that the new equilibrium is the (1,2) situation: the Argentinian firm decides to multinationalize. This means that, in spite of the lower trade costs, "business simplification" afforded by integration, together with the size of the new "nearby market", justifies the location decision.

Table 3 compares the values before and after the full integration equili

TABLE 2: PAY-OFF MATRIX AFTER INTEGRATION

Argentina		0	1*	1	2
Brazil	0	0/0	0/23.1	0/19.0	0/23.2
	1	31.6/0	17.5/5.6	20.0/3.3	17.0/5.7
	1*	19.7/0	6.9/10.3	7.7/6.5	6.0/10.2
	2	31.3/0	17.4/5.6	19.8/3.0	16.6/5.5

brium. It is worth remarking that:

- a) both firms gain market share abroad and lose in their respective domestic markets;
- b) the Argentinian firm increases its capacity and profits, while the opposite applies to the Brazilian firm;
- c) though consumers gain in both countries, for Brazil this fact is not enough to compensate for the producers' loss, so that Marshallian welfare decreases in Brazil. However, Marshallian welfare for the two countries together increases, as it equals:

$$W_{A+B} = (17.0 + 25.5) + (5.7 + 1.2) = 42.5 + 6.9 = 49.4 > 46.1$$

6. Conclusions

This paper has studied the production and trade patterns that may arise if the location decision is introduced as a first stage in the game played by producers in two different countries. Analysis of the changes in the equilibrium and welfare if the countries engage in an integration process is also made.

In general, given the multiplicity of situations portrayed by all the model parameters, equilibria and related changes may present a wide variation. However, specific answers to important situations may be provided. In particular, assuming that a move toward integration is present, conditions are provided to characterize when exporting will be preferred to local production.

The fact that, even if tariffs are zeroed, trade costs persist in the form of transportation and red tape (or non-tariff barriers) expenditures makes for the producers to retain a certain discriminating power, notwithstanding the elimination of barriers to consumers arbitrage. As location is also part of their choice, there is a tendency to set production in the country where prices are higher. This explains why welfare gains are not obvious under the model. Indeed, even if full integration takes place, global Marshallian welfare may decrease.

The model structure is sufficiently rich to enable further developments in the lines discussed. It can also be used to examine the behaviour of a country *outside* the integration with respect to the newly formed block. This is an important issue for the emerging free trade areas among developing countries (as the MERCOSUL in South America) where, due to the past trade restrictions, many multinational firms had located a production unit in the area and now, with trade liberalisation and bureaucratic simplification, may consider to return to an exports policy rather than maintain or increase local production.

Appendix : Proof of the Propositions

Proof of Proposition 1: We prove the first inequality, the others being similar. By means of (13), and with use of (12), the difference between the two profits is:

$$\begin{aligned}
P_{(2,0)}^x - P_{(1,0)}^x &= \\
&= b_1(x_{1(2,0)} + x_{1(1,0)})(x_{1(2,0)} - x_{1(1,0)}) + b_2(x_{2(2,0)} + x_{2(1,0)})(x_{2(2,0)} - x_{2(1,0)}) - G_x \\
&= 0 + (x_{2(2,0)} + x_{2(1,0)})(t - B_x)/2 - G_x
\end{aligned}$$

and the result follows immediately.

Notice that the condition can be written entirely in terms of the parameters of the model. Using again (12) it becomes:

$$(1/b_2)(a_2 - k_x - (t + B_x)/2)(t - B_x) \geq 2G_x$$

Proof of Proposition 2: We prove the first inequality. By (14), the difference between the two profits is:

$$\begin{aligned}
P_{(2)}^x - P_{(1)}^x &= \\
&= (1/(b_1 + b_2))[b_1 b_2 (X_{(2)} + X_{(1)})(X_{(2)} - X_{(1)}) + (1 + v)(D_{x(2)} + D_{x(1)})(D_{x(2)} - D_{x(1)})] - G_x
\end{aligned}$$

use of (11) and of the expression for D_x given in (9) produces

$$P_{(2)}^x - P_{(1)}^x = ((t - B_x)/(b_1 + b_2))[2b_1(X_{(2)} + X_{(1)})/3 - (2 + v)(D_{x(2)} + D_{x(1)})/(3 + v)] - G_x$$

setting $v=0$ and using the expression for the final quantities sold in country 2 shown in (9) gives the desired result.

The other inequalities follow analogously.

Proof of Proposition 3:

i) Adding up the two derivatives one has:

$$\begin{aligned}\frac{dS^x}{dt} + \frac{dP^x}{dt} &= \frac{p_1 - a_1}{3b_1} + \frac{2}{b_1 + b_2} \left[\frac{(b_2 - 2b_1)}{3} X + \frac{a_1 - a_2}{3} + t \right] = \\ &= \frac{p_1 - a_1}{3b_1} + \frac{2}{3(b_1 + b_2)} \left[Xb_2 - 2(Xb_1 - t - \frac{a_1 - a_2}{3}) + \frac{a_1 - a_2}{3} + t \right]\end{aligned}$$

Examination of the values of the final quantities in (9), under (1,1), tells that the left member of the above sum is equal to $-(x_1 + y_1)/3$ and the right one $2(x_1 - 2x_2)/3$, so that welfare increases if

$$-(x_1 + y_1) + 2(x_1 - 2x_2) < 0 \quad \text{or} \quad x_1 - y_1 < 4x_2$$

ii) The result is obtained through a similar reasoning.

Proof of Proposition 4: It suffices to evaluate each derivative and show that they bear the required sign. The four derivatives are equal to:

$$\begin{aligned}\frac{d(P_{(2)}^x - P_{(1)}^x)}{dt} &= \frac{4}{9b_2} [a_2 + k_y - 2k_x - 2t] \\ \frac{d(P_{(2)}^x - P_{(1)}^x)}{dB_x} &= -\frac{4}{9b_2} [a_2 + k_y - 2k_x - 2B_x] \\ \frac{d(P_{(2)}^x - P_{(1)}^x)}{dt} &= \frac{4}{9b_1} [a_1 + k_y - 2k_x - B_x] \\ \frac{d(P_{(2)}^x - P_{(1)}^x)}{dB_x} &= \frac{4}{9b_1} [a_1 + k_y - 2k_x - 2B_x - t]\end{aligned}$$

To verify the signs, taking for instance the last derivative, as $x_1 > 0$, taking its expression under 1° given by (9), one has:

$$x_1 = (1/b_1 + b_2) (Xb_2 + D_x) =$$

$$= (1/b_1 + b_2) (Xb_2 + ((B_x - t)^2 + (A_{1y} - A_{2y}) + (a_1 - a_2)) / 3)$$

substitution of the corresponding X value gives the desired result.

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TABLE 3: The integration effects

	Before	After	Variation (%)
X	325	283	-12.9
Y	82	185	125.6
$x_1/(x_1 + y_1)$	.86	.62	-27.9
$y_1/(x_1 + y_1)$	.14	.38	171.4
$x_2/(x_2 + y_2)$	.14	.43	207.1
$y_2/(x_2 + y_2)$	.86	.57	-33.7
P ₁	170.0	154.7	-9.0
P ₂	142.0	132.2	-6.9
P ^x	25.5	17.0	-33.5
S ^x	19.4	25.5	31.4
P ^y	.3	5.7	1761.6
S ^y	.9	1.2	44.3

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