Optimal Tariff Policy

and

Endogenous Market Structure *

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Abstract. Strategic trade policy affects foreign-based firm's internationalization mode. In this paper, we endogenize market structure and tariff policy by considering a sequential game in which (i) a policy-maker maximizes national welfare, (ii) a foreign-based firm decides whether to supply the host-country market by exports or by activating a local plant, (iii) a local firm decides whether entering or not the domestic market, (iv) both firms choose output. We show that optimal tariff policy does not allow for the existence of multinational enterprises at equilibrium (when transportation costs are neglected). The link between national welfare and fixed costs is fairly complex and counterintuitive results arise.

JEL Classification Numbers: F23, F13.

(*) We are indebted to Hideki Yamawaki for the encouragement to work on this problem. We would also like to thank Lawrence Leger, Massimo Motta and all the other participants to EEA Summer School (Firenze, September 7th-16th, 1992) for helpful comments and suggestions on a previous version of this paper. The usual disclaimer applies.

(#) CORE, Université Catholique de Louvain, Louvain-la-Neuve. Financial support by «Consiglio Nazionale delle Ricerche» is gratefully acknowledged.

(##) Département des Sciences Economiques, Université Catholique de Louvain, Louvain-la-Neuve. Financial support by «Ente Luigi Einaudi» is gratefully acknowledged.

1. Introduction

The analisys of trade and trade policy has been considerably furthered by considering some important aspects such as imperfect competition and increasing returns to scale. Market imperfections justify the definition of the firm as an active agent and hence the attention devoted to the strategic interaction among firms. Some recent contributions show that the market structure is endogenously determined as a result of such a strategic interaction among firms. The models presented by Smith (1987), Horstmann - Markusen (1987) and Motta (1991) are some examples of such a market-structure endogenization considering segmented markets and at most one (potential) horizontal multinational enterprise (MNE)[1].

In Smith (1987), the choice of the mode of internationalisation is studied with reference to different trade policies, considering a sequential game between one MNE and one local potential entrant (HCF, standing for host country firm) and all the different possible cases of first mover advantage. The traditional argument for "tariff-jumping" (i.e. tariff-induced investments in a host country by a foreign-based firm improve national welfare) is reproduced in this context, but cases of (i) tariff-induced "disinvestments"[2] and (ii) tariff-jumping used to deter entry by a local firm, are found out as well.

Horstmann and Markusen (1987) focus on the strategic timing of investment in a growing market by a MNE facing competition from a continuum of local potential entrants. The main result is that of determining the conditions for market preemption by MNE.

Motta (1991) deals with the case of a simultaneous game between one MNE and one HCF, finding a close association between the equilibria arising in this case and those obtainable

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(1) The multinational enterprise, strictly speaking, is «an enterprise that controls and manages production establishments - plants - located in at least two countries» [Caves (1982)]. It is evident from this definition the narrow link between existence of multinational enterprises (in such a strict sense) and foreign direct investment flows.
However in this paper, unless differently specified, we will use the concept of multinational enterprise in a more extensive sense, including also "potential" ones, i.e. those foreign-based firms which have no locally-based production activity yet, but which are nevertheless allowed to invest in the host country.

(2) As Motta (1991) observes, this «label can be misleading, since we are comparing two market structures -with and without tariffs- and we are not considering the imposition of a tariff after a decision on the internationalisation mode has already been made».

considering a sequential game (and all possible cases of first-mover advantage). The main results of Smith (1987) and Horstmann - Markusen (1987) are reproduced in this framework (namely the possibility of tariff-induced "disinvestment" and of market-preemption by MNE). In addition, some further results are obtained on the welfare impact of a tariff, with reference to the special case of sequential moves (in which no multiple equilibria arise). However, the author does «not carry out a full analysis of all the possible changes [in the trade policy] and their relative welfare impact» [Motta (1991)], but he limits himself to the study of some specific cases.

Horstmann and Markusen (1992) extend the analysis to deal with the case of at most two (potential) horizontal MNE; the impact of firms' decisions on optimal trade policy is then studied, emphasizing that small changes in trade policy can generate large changes in prices, outputs, profits and, as a consequence, in welfare. Endogenous market structure changes are the main reason for such discontinuities. The authors emphasize that «the negative point for public policy is that the ability of firms to change plant configurations seriously limits the applicability of "optimal" tax results» (p.129).

In our paper, we endogenize both market structure (in the spirit of Horstmann - Markusen (1992)) and the decision of the policy-maker by considering a (sequential) game in which (i) a host-country government (HCG) decides the amount of the per-unit import tariff, then (ii) a MNE based in a foreign country decides whether to supply the host-country market by exports or by activating a local plant, then (iii) a HCF decides whether to enter or not the local market and finally (iv) both firms choose output with Cournot conjectures. Welfare is then computed for all possible pairs of firm-specific and plant-specific fixed costs. By a comparative static analysis we show that, once the tariff is optimally chosen, welfare crucially depends from the level of such fixed costs. The strategic interaction among firms and host-country policy-maker makes the relation between welfare and fixed costs quite complex, and gives rise to some quite counterintuitive cases; for instance, we show that an increase in MNE's strategic advantage (of which the firm-specific cost is a measure) may induce a decrease in MNE's profit and an increase

in national welfare.

Let us emphasize that, on the one hand, «while the traditional theories of foreign direct investments assume that a firm acts as a "passive" agent when deciding about its mode of internationalisation (it just goes abroad to exploit some advantages it possesses, and it does not take into consideration rival firms' behaviour), the game theoretic approach can account for the strategic and oligopolistic reasons behind foreign investments» [Motta (1991)]. On the other hand, even in such an oligopolistic framework which considers the strategic interaction among firms (MNE and HCF), once we take into account the strategic behaviour of another player such as a policy-maker (HCG), we go back to more traditional outcomes: foreign investments (and the corresponding decision to become a multinational in a strict sense) follow from either a suboptimal tariff policy or other traditional causes such as the existence of transportation costs.

2. The model

A partial equilibrium model is studied in which a homogeneous commodity is produced by quantity-setting firms.

As in previous models [Smith (1987) and Motta (1991)] two firms are considered, a foreign-based firm (a MNE in strict sense or a "potential" MNE) and a HCF. The former is assumed to be a "horizontal" MNE (i.e. whose branch plants produce identical products in several countries) and to be already established in its home country, while the latter is assumed not to be established yet.

The production technology is characterized by strictly positive firm-specific costs F (i.e. joint inputs across plants) and plant-specific costs G. This distinction is important to capture the difference between plant and firm (a group of plants under joint control), which is crucial to any discussion on MNE activity. By assumption, MNE has already sunk both firm-specific costs and plant-specific costs relative to the plant in its home country. A constant marginal cost c is

considered, which is normalized to zero without loss of generality. Transportation costs are supposed to be negligible. The justification for such a strong assumption is that we would like to find out reasons for the existence of multinational enterprises other than the very intuitive argument based on huge transportation costs. Finally, HCG is able to impose a per-unit tariff t on imports, which is fixed before any decision is taken by the other players.

The total cost functions are therefore (let us identify MNE by subscript 1 and HCF by subscript 2)

$$C_1^{\mathrm{EXP}} = t \cdot q_1 \tag{1a}$$

$$C_1^{FDI} = G \tag{1b}$$

respectively in the case of MNE choosing to serve the host country market by exports (EXP) or by branch-plant production (FDI, standing for foreign direct investment). On the other hand, HCF faces the following cost function:

$$C_2 = F + G. \tag{2}$$

Markets are segmented, so that entry decisions depend only on host-country demand. The following inverse demand function is considered:

$$p = 1 - q \tag{3}$$

where $q \equiv q_1 + q_2$.

The objective function of the HCG is represented by the total surplus of the host country, given by the sum of consumer surplus, domestic producer surplus and tariff receipts:

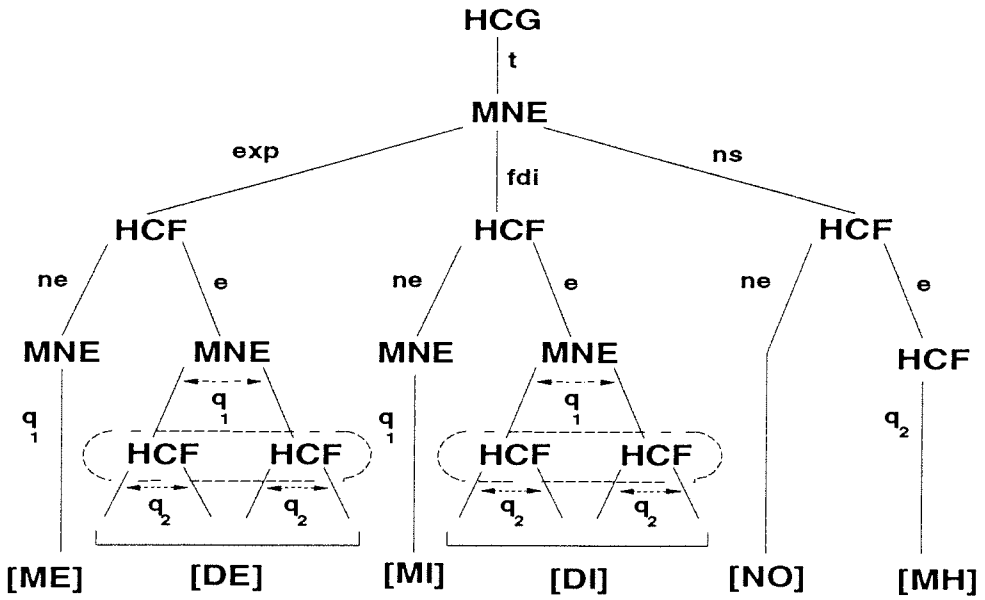

Fig. 1 - Game tree

case	equilibrium output (q_1^*, q_2^*)	corresponding payoff (Π_1^*, Π_2^*)
MNE monopoly with exports (**ME**)	$\left(\frac{1-t}{2}, 0\right)$	$\left(\frac{(1-t)^2}{4}, 0\right)$
duopoly with exports (**DE**)	$\left(\frac{1-2t}{3}, \frac{1+t}{3}\right)$	$\left(\frac{(1-2t)^2}{9}, \frac{(1+t)^2}{9} - F - G\right)$
MNE monopoly with investments (**MI**)	$\left(\frac{1}{2}, 0\right)$	$\left(\frac{1}{4} - G, 0\right)$
duopoly with investments (**DI**)	$\left(\frac{1}{3}, \frac{1}{3}\right)$	$\left(\frac{1}{9} - G, \frac{1}{9} - F - G\right)$
no firm supplying the market (**NO**)	$(0, 0)$	$(0, 0)$
HCF monopoly (**MH**)	$\left(0, \frac{1}{2}\right)$	$\left(0, \frac{1}{4} - F - G\right)$

Table 1 - Payoffs for the game in figure 1.

$$W = \max\{0, pq_2 - F - G\} + \int_0^{q^*} (1-q)\,dq - p \cdot q^* + t \cdot q_1 \tag{4}$$

where the first term is the profit of the domestic firm (which is obviously equal to zero when HCF does not enter) and q^* identifies the equilibrium level of the total output.

It is worthwhile to emphasize that here we use a very simplified characterization of policy-maker's objective function and instruments. In the real world, firms' interests have often a more important weight in policy-maker's objective function than parcelled consumer gains, and trade policy instruments other than tariffs exist.

A four-stage game is considered. At the first ("policy") stage, HCG decides the amount of the per-unit import tariff, by maximizing its objective function *W*. At the second ("pre-entry") stage, MNE decides whether to supply the host-country market (either by EXP or by FDI) or not (NS, for "not supply")[3]. The third ("entry") stage is characterized by the HCF's decision whether to enter (E) or not (NE) the local market.[4] At the final ("quantity-setting") stage, decisions on output are taken, supposing that firms behave *à la* Cournot.

3. Equilibrium outcomes

The equilibrium is defined following the criterion of subgame perfectness in pure strategies. The solution to the above game is therefore obtained by backward induction.

(3) Indeed, the choice by MNE not to supply the host-country market is not excluded (while Smith (1987) explicitly assumes it away), but we will show that it can never arise at equilibrium when we consider HCG optimal tariff policy.

(4) HCF's strategy space is limited by assuming that if it enters the local market, it will neither export nor invest back to MNE's home market. In other words, HCF cannot become a MNE.

3.1 Quantity-setting stage

Assuming that when both firms decide to supply the market they behave *à la Cournot*, it is straightforward to compute the quantities produced at equilibrium and the corresponding profits, which are summarized in table 1.

3.2 Entry stage

At the entry stage, HCF chooses to enter only if it obtains a strictly positive profit at equilibrium[5]. The entry decision depends upon the level of fixed costs (F, G) and tariff, and upon MNE's decision. The conditions for profitable entry by HCF are listed in table 2.

provided that MNE chooses ...	the HCF strategy is ...	
export (EXP)	entry if	$F+G<(1+t)^2/9$
	no entry if	$F+G\geq(1+t)^2/9$
invest (FDI)	entry if	$F+G<1/9$
	no entry if	$F+G\geq 1/9$
not supply (NS)	entry if	$F+G<1/4$
	no entry if	$F+G\geq 1/4$

Table 2 - HCF strategic choice at the entry stage.

3.3 Pre-entry stage

At the pre-entry stage, MNE perfectly knows HCF's optimal choice at the following stage (in other words, it knows whether it will be duopolist or monopolist for each option it has) and it will simply make its choice in order to maximize profits. Remark that this decision crucially depends on the tariff level, which is fixed by HCG at the "policy" stage of the game. MNE's strategic choices are summarized in table 3.

(5) It is implicitly assumed that if a firm earns zero net profit after entry, it would prefer not to enter.

provided that ...	the MNE strategy is ...	
$G < \frac{1}{9} - F$	export if	$t \le (1/2)\cdot(1-\sqrt{1-9G})$
	invest if	$t > (1/2)\cdot(1-\sqrt{1-9G})$
	no supply	never
$\frac{1}{9} - F \le G < \frac{1}{4}$	export if	$t \le 1-\sqrt{1-4G}$
	invest if	$t > 1-\sqrt{1-4G}$
	no supply	never
$G \ge \frac{1}{4}$	export if	$t < 1$
	invest	never
	no supply if	$t \ge 1$

Table 3 - MNE strategic choice at the pre-entry stage.

3.4 Policy stage

At the first stage of the game HCG, having perfect knowledge of the other players' optimizing choices, determines the amount of the import tariff by maximizing the total domestic surplus defined in (4).

Let us denote $\hat{t}$ the tariff that HCG would choose without considering the possibility of a change in market structure (i.e. of the switch from EXP to FDI by the MNE). Such a tariff is computed by maximizing W with respect to t in the two cases for which t influences W (i.e. MNE monopoly with exports and duopoly with exports). In both cases

$$\hat{t} \equiv \operatorname{argmax}_t(W) = 1/3. \tag{5}$$

It is worth emphasizing that such a tariff is not always optimal when we take into consideration the endogenous market structure changes, in the sense that an excessive tariff could induce MNE

to switch from exports to local production (i.e. to "jump the tariff"); for such excessive levels, the tariff would be no longer relevant either for national welfare or for its influence on MNE decision. Welfare levels computed with respect to firms' equilibrium strategies, and optimal tariffs (t^*) are listed in table 4.

provided that ...	if MNE chooses ...	then $W(t)$= ...	and t^* = ...
$G < \frac{1}{9} - F$	export	$-\frac{1}{2}t^2 + \frac{1}{3}t + \frac{1}{3} - F - G$	$\min\left\{t, \frac{1-\sqrt{1-9G}}{2}\right\}$
	invest	$\frac{1}{3} - G$	
$\frac{1}{9} - F \le G < \frac{1}{4}$	export	$-\frac{3}{8}t^2 + \frac{1}{4}t + \frac{1}{8}$	$\min\{t, 3\cdot\sqrt{F+G} - 1, 1 - \sqrt{1-4G}\}$
	invest	$\frac{1}{8}$	
$G \ge \frac{1}{4}$	export	$-\frac{3}{8}t^2 + \frac{1}{4}t + \frac{1}{8}$	t
	no supply	0	

Table 4 - HCG strategic choice at the policy stage.

Once we have found t^*, it is possible to determine the equilibrium structure of the market and to compute welfare (this time for $t=t^*$) and MNE's profits as function of F and G alone. The optimal policy from a social viewpoint is that of extracting a part of MNE's profit by the tariff. This result can be attained by imposing a tariff lower than the one which would induce the MNE to switch from EXP to FDI; otherwise stated, HCG can use the tariff to extract at most the difference between MNE's profit under EXP and FDI. In fact, an increase in the tariff which induces MNE to switch from EXP to FDI, makes the total tariff receipts fall to zero and the national welfare decrease.

It is therefore possible to fully characterize the space (F,G) as in figure 2 below. Moreover, table 5 shows, with reference to each region of figure 2 (formally defined in column 2), the HCG's choices about tariff and the corresponding levels of welfare and MNE's profit.

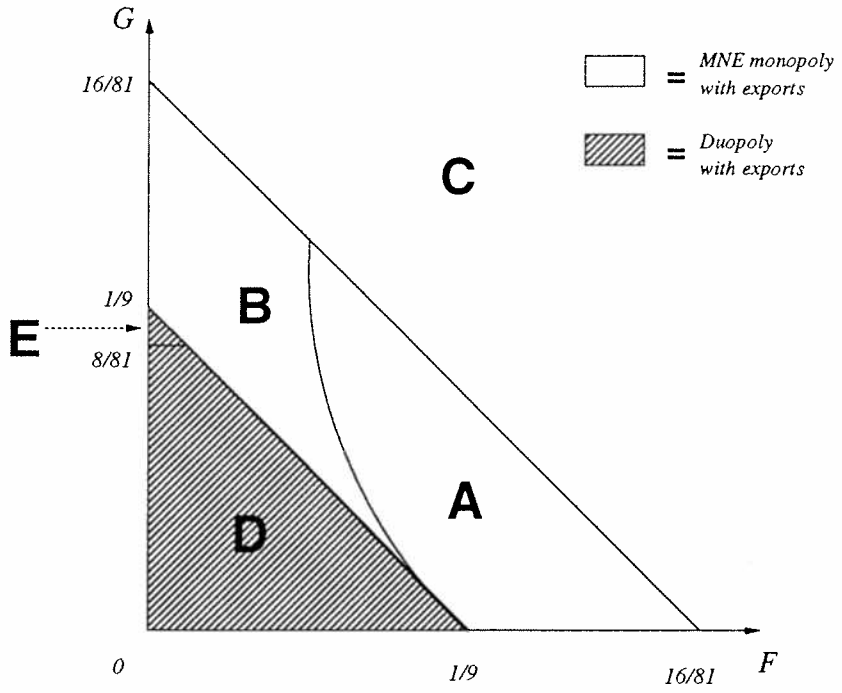

Fig. 2 - Characterization of the space (*F*,*G*)

	definition of the region	optimal tariff (t^*)	welfare ($W(t^*)$)	MNE's profit ($\Pi(t^*)$)
A	$\frac{1}{9} \le F+G < \frac{16}{81}$ and $G \ge \alpha$ [6]	$1-\sqrt{1-4G}$	$\frac{\sqrt{1-4G}}{2}+\frac{3}{2}G-\frac{3}{8}$	$\frac{1}{4}-G$
B	$\frac{1}{9} \le F+G < \frac{16}{81}$ and $G < \alpha$	$3\cdot\sqrt{F+G}-1$	$3\cdot\sqrt{F+G}-\frac{27}{8}(F+G)-\frac{1}{2}$	$1-\frac{9}{4}(F+G)-3\cdot\sqrt{F+G}$
C	$F+G \ge \frac{16}{81}$	$\frac{1}{3}$	$\frac{1}{6}$	$\frac{1}{9}$
D	$F+G < \frac{1}{9}$ and $G < \frac{8}{81}$	$\frac{1-\sqrt{1-9G}}{2}$	$\frac{\sqrt{1-9G}}{12}+\frac{1}{8}G-F+\frac{1}{4}$	$\frac{1}{9}-G$
E	$F+G < \frac{1}{9}$ and $G \ge \frac{8}{81}$	$\frac{1}{3}$	$\frac{7}{18}-F-G$	$\frac{1}{81}$

Table 5 - Tariff, welfare and MNE's profit at equilibrium.

(6) Where $\alpha \equiv (1/338)\cdot[66-234F-\sqrt{(234F-66)^2-676(9-90F-81F^2)}]$

In region D, the fixed costs F and G are sufficiently low not to discourage HCF entry. The HCG cannot levy $\hat{t}$, because in that case it would induce tariff-jumping by MNE. On the other hand, higher costs to activate branch-plant production (i.e. higher levels of G) will decrease MNE willingness to jump the tariff, and correspondingly allow HCG to impose a higher tariff without inducing tariff-jumping. However, in this region HCF enters the market, and therefore such an increase in G is not welfare-improving because the higher tariff receipts do not outweigh the decrease in HCF's profit due to higher entry costs.

Using the same arguments with reference to region E, we can observe that there exists a sufficiently high level of G (i.e. G=8/81) allowing HCG to levy the tariff $\hat{t}$, and that the welfare in this region is never higher than in region D.

In region B, the sum of firm-specific and plant-specific fixed costs is too high for the HCF to enter, given the optimal tariff. For higher tariff levels, the MNE would yet find it more profitable to export than to invest, if the market structure were not altered. But this is not the case since, for such tariffs, HCF would enter the market, provided that MNE keeps on exporting. Hence, HCG tariff policy has not to take into consideration the "traditional" tariff-jumping, but MNE's entry-deterring strategy[7].

It is therefore not surprising that in this region t^* depends positively from F. In other words, an increase in the fixed cost asymmetry (measured by F) increases the tariff that HCG is able to impose without inducing "entry-deterring" tariff-jumping by MNE, and consequently increases tariff receipts and national welfare[8]. This counterintuitive result simply follows from the fact that an increase in F restricts the set of cases in which HCF's entry is profitable for a tariff level that, if monopolist, the MNE would not have jumped. An increase in F would therefore widen the set of cases in which MNE does not need to use tariff-jumping to deter entry. In such

(7) Smith (1987) shows that tariff-jumping aimed to deter entry of a local firm is not necessarily suboptimal, from a social viewpoint. Motta (1991) argues that the possibility that this kind of tariff-jumping could arise depends on the consideration of sunk costs and first-mover advantages.

(8) It is easy to show that the first partial derivatives with respect to F of welfare and profit function are, respectively, positive and negative for all pairs (F,G) in region B of figure 2: $\frac{\partial}{\partial F} W = \frac{3}{2\sqrt{F+G}} - \frac{27}{8}$ is positive for $\forall\, G < 16/81 - F$ while $\frac{\partial}{\partial F} \Pi_1 = -\frac{9}{4} - \frac{3}{2\sqrt{F+G}}$ is always negative.

an apparently more favourable situation, characterized by a higher fixed cost asymmetry, the MNE will therefore "tolerate" a higher tariff (and a lower profit) than in a situation characterized by a lower asymmetry in its favour.

Another aspect in the characterization of region B is that welfare increases when G increases, because (i) the relationship between G and t^* is positive and (ii) t^* is such that no local firm finds it profitable to enter the market and no welfare loss can consequently arise in form of lower local producer profit.

In region A, firm-specific costs are sufficiently high to induce HCF not to enter anyway. The limit to optimal tariff policy is represented, again, by the possibility that MNE decides to switch from EXP to FDI (in which case, as we know, tariff receipts would fall to zero, generating a harsh welfare decrease). Nevertheless, in this case the switch in MNE's choice is not aimed to deter entry (as in previous case), but simply to jump the tariff in the more traditional sense. Moreover, there exist positive relationships between t^* and G (the same argument as for region D holds here), and between W and G (the same argument as for region B holds here)[9].

In region C, finally, the optimal tariff policy is not limited by the possibility of tariff-jumping; the choice by HCG can be easily determined since $\hat{t}$ can be attained, and it is intuitive that it will depend neither on F nor on G. On the other hand, MNE's decision is easily determined as well, since the level of G is so high that MNE will never be willing to activate a branch plant in the host country.

It is possible to rank the regions in figure 2 with respect to the corresponding welfare outcomes, in the following decreasing order: D, E, C, A, B. Some remarks are useful. Firstly, welfare is lower in E than in D because the higher tariff receipts do not outweigh the decrease in HCF's profit due to higher entry costs. Secondly, local producer's profits falling to zero is

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(9) Notice that $\frac{\partial W}{\partial G} \geq 0$ for $\forall\, G \leq 5/36$, which is always the case in region A.

the main reason for lower welfare in C than in E. Thirdly, the main difference between region C and region A (or B) is that in the former the tariff $\hat{t}$ is attained without inducing market structure changes, while in the latter it is not.

Let us emphasize that equilibrium market structures emerging from the above analysis (and represented in figure 2) exclude the existence of multinational enterprises, defined as foreign based firms activating branch plants in a host country[10]. Otherwise stated, we have shown that multinational enterprises (and FDI) could be explained as the result of suboptimal tariff policies. This result crucially depends on the assumption of zero transportation costs; on the other hand, such an assumption is mainly aimed to put on evidence the link between (optimal) tariff policy and existence of multinational enterprises (existence of FDI flows), isolating it from more intuitive and traditional justifications such as the existence of transportation costs.

4. Conclusion

In the above analysis we consider a optimal (i.e. welfare-maximizing) tariff policy to observe, as in Horstmann - Markusen (1992), that HCG's choice concerning the tariff to charge on imports may be limited by the possibility that the MNE chooses to service the host country market by operating a local branch-plant rather than by exporting ("tariff-jumping").

The market structures emerging at equilibrium exclude the existence of multinational enterprises, strictly defined as foreign-based firms activating branch plants in a host country. Multinational enterprises (and FDI) could be therefore thought as generated by suboptimal tariff policies. Transportation costs are assumed away in our analisys, just to isolate from such a traditional argument the study of the link between optimal tariff policy and existence of multinational enterprises (existence of FDI flows).

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(10) Notice that this is a more restrictive (but more realistic) definition than the one adopted up to now, which considered as MNE even a "potential" one.

We also show that, once the tariff is fixed at the optimal level, national welfare depends on firm-specific and plant-specific fixed costs. The strategic interaction between firms (MNE and HCF) and national policy-maker (HCG) makes such a relationship fairly complex and gives rise to some counterintuitive cases. For instance, we show that there exists a whole set of cases in which the increase in MNE's strategic advantage (of which the firm-specific cost F is a measure) induces a decrease in MNE's profit and an increase in national welfare.

Despite the fact that we consider a very simplified framework, in which the tariff is the only policy instrument and the policy-maker's objective function is very simplified, some light is shed on the role of the strategic interaction between firms and policy-maker in explaining how some unfamiliar or even counterintuitive results could arise.

Two points should be carefully considered: (i) the assumption of "strategic substitutability" (in the sense of Bulow et al. (1985)) between EXP and FDI, implicit in the specification of the demand function (which yields a concave revenue function), and (ii) the assumption of Cournot behaviour at the last stage of the game. In fact, as it is frequently shown in the literature, problems could arise with reference to the robustness of the results to changes in the specification of the demand function, as well as to changes in the kind of competition between firms at the quantity-setting stage of the game.

Some extensions can be prospected. The first is to consider some kind of asymmetry in variable costs, such as the possibility to anticipate some of them in form of an investment in capacity. The second could be to consider the issue related to licensing, either in terms of a third possibility for the MNE to supply the host country market, alternative to EXP and FDI, or in terms of an additional source of revenue for the MNE in the case of duopoly.