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It is well known that high tariffs tend to induce direct foreign investment (DFI) by encouraging the investors to jump the "tariff-wall". We argue that in the presence of a "tough" local competitor DFI may not be possible but suitably designed joint-ventures (JV) between the local and the foreign firm would be feasible. However, very high tariffs would be detrimental to the formation of such joint ventures. Hence we argue that liberal trade policies may attract foreign investments through the formation of joint-ventures.

JEL classification: F1, L2

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1. Introduction

A major incentive for direct foreign investment (DFI) in countries, which restrict trade, is to jump tariff and non-tariff barriers. Local production helps in reducing costs due to protection and therefore "tariff-jumping" stands out to be a strong motivation behind direct foreign investment. Apart from locational advantages arising out of technology, marketing or distributional factors trade policy itself may be a reason why the multinational firms would be lured by protected markets. When market size is large, it makes sense to put additional investment in place so that basic advantages enjoyed by local firms can also be shared by the foreign competitors. In recent years a large number of foreign investors have entered the Indian automobile market which still enjoys a significant degree of protection. Most of such investments are in the form of joint-ventures where well known foreign firms tie up with major Indian companies to grab a share of the large domestic market. Recently India has increased the ceiling on foreign equity holdings and liberalized foreign investment regulations to attract more foreign investment for the success of the ongoing reform program.[1] It is logical to argue that higher is the existing tariff rate, greater must be the incentive to jump tariff. This in turn implies greater possibility of direct foreign investment if high tariffs push profits from

exports to a low level. The purpose of this paper is to show that this is not necessarily true. In fact we argue that very high tariffs may actually discourage direct foreign investments in the presence of a strong local competitor. There might be situations when the only feasible form of investment is through a "joint-venture" between the foreign firm and the local competitor. The success of such a joint-venture, in the presence of a high tariff, is impossible to guarantee.

The literature on direct foreign investment and the political economy of tariff regimes is limited and our paper is distinct from the existing contributions on various counts. First, we analyze "joint-ventures" (JVs) between a local firm and the foreign firm and demonstrate that high level of tariffs do deter JVs under very general conditions. Second, existing contributions focus on "incumbent-entrant" type models and the effects of foreign investment and tariffs on the entry of the local firms. Our primary concern in this paper is with a tough local competitor who may be weakened by the removal of tariff, but is very much there. In the earlier papers, higher anticipated tariffs, may induce local firms to enter and hence may deter direct foreign investment. But if the local firm exists independently of the tariffs, then again a higher tariff increases the incentive for direct foreign investment.[2] We rule out the possibility of "go-alone" foreign investment to focus on joint-ventures. High tariffs, as we shall show, would always deter joint ventures. This result does not depend on parametric configurations. Third, in the standard cases, if tariffs deter direct foreign investment, there is no rationale as to why the firms can not tie-up in a joint venture. Our paper argues and demonstrates that such contracts, even if

[1] See Gupta and Chawla (1995).

[2] If one looks at the Indian joint-ventures, they always indicate tie-ups of a multinational with a local partner who already enjoys a significant position in the market. The Indian big names such as the Tatas, Mahindras and others are examples of this type of ventures.

enforceable, may not work out with high tariffs, but does materialize for certain range of tariffs.

Analytical models dealing with trade policy and joint-ventures, to the best of our knowledge, are rare. This paper is intended to be a contribution in this area. Generally speaking, the issue of direct foreign investment in transition economies is quite appealing. Countries are often forced to reduce trade-barriers gradually while trying hard to woo foreign investors in the meantime. This may naturally lead to a situation where tariffs are still in place but the barriers to direct foreign investment have been lifted. Analysis of investment strategy of the foreign firms in that situation is of interest to us and we believe to a number of people interested in policy issues. This is yet another motivation behind the paper.

The rest of the paper is organized as follows. The next section reviews the relevant literature. Section 3 describes the model and the basic result. Section 4 introduces asymmetries in cost between the foreign firm and the local firm. The final section concludes the paper.

2. Literature

In this section we review some notable contributions on joint ventures with relevance to the literature on direct foreign investment and the political economy of trade barriers. The effect of trade barriers on direct foreign investment has been the subject of much debate. The tariff discrimination hypothesis, dating back to Mundell (1957), holds that to avoid obstacles in trade, resulting from the imposition of a tariff, foreign investment is undertaken in the country to which it is difficult to export because of the tariff obstacle; trade liberalization allows goods to move freely and, hence, is expected to reduce the

amount of international investment. Subsequent contributions (Dinopoulos and Wong (1991) and Grossman and Helpman (1994)) added a new dimension (*quid pro quo* intention) to this traditional "tariff-jumping" explanation by claiming that as the probability of protection rises, foreign firms may engage in more DFI, *ceteris paribus*, in order to establish a presence in the host country as an insurance policy against protectionist barriers. Horstmann and Markusen (1996) modeled foreign investment with local competition but ignored the possibility of joint-ventures. Harris and Schmitt (2001) examined discretionary and strategic DFI incentives in the export sector relative to a non-interventionist policy. Neary (2002) studied the influences of internal trade liberalization by a group of countries on the level and pattern of inward DFI. Chakrabarti (2003) distinguished between the host-country-motive and export-motive of DFI to argue that an increased level of protection in a host location provides an incentive for the multinational to expand its subsidiary in that location as against serving that location through exports while an increased level of protection in a rival location dampens multinational activity in the host country. Damania (2003) explored the success of lobbying in terms of the strategic role of investment opportunities. Herander and Kamp (2003) looked at the relation between tariff rates and DFI when the foreign firm lacks full information on the cost structure of a local incumbent. Liu and Chiou (2003) analyzed the tariff-jumping DFI decision of firms facing uncertainty in the host country's market. Eicher and Woo (2005) investigate political motives to impose endogenous tariffs that influence not only the local incumbent but also the entry mode of the multinational.

The literature on joint-ventures is growing though relatively few have looked at the interaction between trade policy and joint ventures. A couple of early papers by Smith

(1987) and Motta (1992) had set the grounds by nicely summarizing the issue and by providing some rather interesting results. In particular, they had shown that though high tariffs may deter foreign equity participation there exist a large number of possibilities depending on the parameters of their models. Svejnar and Smith (1984) and Gang and Gangopadhyay (1989, 1994) dealt with non-strategic aspects of joint ventures. Marjit (1990) investigated the problem of foreign equity participation in a less developed country where the threat of expropriation or nationalization leads necessarily to withholding of technological knowledge of the foreign firm. Subsequent contributions by Chan and Hoy (1991), Marjit, Broll and Mallick (1995), Al-Sadoon and Das (1996), Broll, Marjit and Ng (1996), and Das (1995) studied similar dimensions of international joint ventures. Purkayastha (1993) showed that an upstream firm in one country may be willing to form a joint venture with a downstream firm in another country if the downstream firm has unique entrepreneurial knowledge of local conditions and the government in the host country can formulate a tariff policy that uses this dependence. Chao and Yu (1996) showed that in a competitive equilibrium a small open economy under tariff protection should allow 100% foreign ownership of subsidiaries coupled with an export-share requirement. Jones (1999) showed how a joint venture is essentially a distortion in a protectionist regime where local capital is costlier than foreign capital. Chao and Yu (2000) demonstrated that when tariffs are in place a policy of foreign equity participation raises welfare in the short run but lowers welfare in the long run and the reverse holds under quotas. Mukherjee and Sengupta (2001) studied the strategy choices of multinational joint ventures and the local firms in the later stages of liberalization. Broll *et al*. (2003) constructed a model of international joint ventures where the foreign

firm decides whether to undertake full ownership foreign direct investment, or to form a public-private joint venture with the host country government of an economy in transition. Das and Katayama (2003) studied the effects of trade protection on equity sharing in international joint ventures. Marjit and Chowdhury (2004) constructed a theory of joint venture buy-outs based on asymmetric access to capital, synergy, and market size. Lin and Saggi (2004) derives optimal ownership structures under different sharing rules in a model of a joint venture between a local and a foreign firm who provide complementary inputs. Marjit *et al*. (2004) show that incomplete information about the host-country policy and foreign technology along with the threat of entry can create an option value for setting a joint venture in the current period when the foreign firm is expected to invent a new technology in the future. Hagedoom *et al*. (2005) studies the degree to which country differences in intellectual property rights protection affect the choice of companies for either an equity joint venture or a contractual partnership. Luo and Park (2004) study the possibility of vertical and horizontal cooperation among the foreign partners, the local partner, and the management in joint ventures. Luo (2005) examines how transactional characteristics and the institutional environment influence contractual governance for international joint ventures.

3. The Basic Model

Our model starts with two firms indicated by 1 and 2: 1 denotes the foreign firm and 2 the local firm. Initially the foreign firm exports the product to the local market which is also served by the local competitor. Firms are engaged in a duopolistic Cournot game. To start with let us assume that firm one faces a per unit tariff t, and the firms have the same

constant marginal costs, *c*. The reduced form profit functions for the *i*-th firm ($i = 1,2$) is given by,

$$\pi_i = \pi_i(c + t, c), \qquad i = 1,2 \tag{1}$$

where equation (1) has the following properties:

$$\frac{\partial \pi_1}{\partial t} < 0, \ \frac{\partial \pi_2}{\partial t} > 0$$

The process of direct foreign investment (DFI) requires a sunk cost of, *I*, to be incurred by the firm one. Local production will imply an increase in π_1 as *t* is effectively reduced to zero. The new π_1 is denoted by $\hat{\pi}_1$ and the initial one is π_{10}. DFI is profitable if the following conditions holds.

$$\left[\hat{\pi}_1 - \pi_{10}\right] > I \tag{2}$$

From condition (2) it is obvious that the higher is *t*, greater is the possibility that DFI will take place. Higher *t* reduces π_0 and increases the profitability of DFI vis-a-vis direct exports. This is the standard tariff-jumping argument. Let us now consider $t = \bar{t}$ such that $\pi_{10}(c + \bar{t}, c) = 0$ i.e. is $\bar{t}$ the prohibitive tariff. We now make the following assumption,

$$\hat{\pi}_1 < I < \left(\pi_m - \hat{\pi}_1\right) \tag{3}$$

where π_m is the monopoly profit in the local market. Equation (3) suggests that regardless to the initial tariff rate, the foreign firm would never go for DFI, since the net duopoly pay-off even with an initial prohibitive tariff is not good enough to cover the sunk cost of investment. However, the monopoly profit could recover the sunk investment cost and the opportunity cost even with zero tariffs. This assumption basically rules out "go-alone" DFI and makes the standard tariff-jumping argument irrelevant. Even when

$(\pi_m - \hat{\pi}_1) > I$, since the firms face the same costs, π_m can not be an equilibrium outcome in the post-DFI game due to the standard "prisoner's dilemma" type problem. Also for all tariffs rates DFI would be impossible and hence tariff-jumping does not give enough incentive for direct foreign investment.

Now, consider an alternative arrangement where the foreign firm and the local firm can enter into a joint-venture contract which is allowed by the local government provided that certain amount of investment, *I*, in this case, is incurred by the organization. For example, to promote the influx of foreign investments, the Indian government has allowed several joint-venture contracts provided that they bring in substantial investment. [See Gupta and Chawla (1995)].

The nature of the joint-venture (JV) contract is described by the following clauses:

(a) Each firm would bear a portion of *I*, and would derive a share of profits.

(b) Neither firm would compete with the JV firm through independent production.

It is obvious that if collusion is enforceable in the court of law, the foreign firm does not have to invest anything. We are assuming that such arrangement is not enforceable. Governments allow jointventures provided that it brings in some new investments. Also we assume that the JV contract is enforceable in the court of law such that both the above clauses are adhered to.

The question then is whether such a JV contract would be agreed upon. Note that a successful JV would bring in foreign investment which was not available through tariff-jumping and DFI.

Let $\lambda \in (0,1)$ be the share of *I* to be borne by the local firm, then for a successful JV contract the following incentive constraints must be satisfied.

$$\lambda(\pi_m - I) \geq \pi_{20}(c+t, c) \tag{4}$$

and,

$$(1-\lambda)(\pi_m - I) \geq \pi_{10}(c+t, c) \tag{5}$$

By rearranging inequalities (4) and (5) we obtain,

$$1 > \lambda \geq \left[\frac{\pi_{20}}{\pi_m - I}\right] \tag{6}$$

$$0 < \lambda \leq \left[1 - \frac{\pi_{10}}{\pi_m - I}\right] \tag{7}$$

Where equations (6) and (7) suggest that the necessary and sufficient condition for such a λ to exist is given by,

$$\left[1 - \frac{\pi_{10}}{\pi_m - I}\right] > \left[\frac{\pi_{20}}{\pi_m - I}\right]$$

which can be written as,

$$\pi_m - (\pi_{10} + \pi_{20}) > I \tag{8}$$

Let us now define,

$$\pi_m - (\pi_{10} + \pi_{20}) \equiv \Omega(t) \tag{9}$$

where π_{10} and π_{20} both depend on *t* whereas π_m is independent of the tariff rate. The next question is how $\Omega(t)$ behaves with respect to changes in the tariff rate. An increase in *t* reduces π_{10} but increases π_{20}. There is no prior presumption as to how the sum of Cournot profits would move along with *t*. To get a closed form solution, let us assume the demand function to be,

$$P = a - (q_1 + q_2) \tag{10}$$

and the cost function,

$$c = cq_i \qquad i = 1,2 \tag{11}$$

So that we have,

$$(\pi_{10} + \pi_{20}) = \frac{[a - 2(c+t) + c]^2}{9} + \frac{[a - 2c + c + t]^2}{9} \tag{12}$$

It is evident from equation (12) that,

$$\left[\frac{\partial(\pi_{10} + \pi_{20})}{\partial t} \right] \begin{matrix} > \\ = \\ < \end{matrix} 0 \quad iff \quad t \begin{matrix} > \\ = \\ < \end{matrix} \left[\frac{a-c}{5} \right] \tag{13}$$

Therefore,

$$\Omega'(t) \begin{matrix} > \\ = \\ < \end{matrix} 0 \quad iff \quad t \begin{matrix} < \\ = \\ > \end{matrix} \left[\frac{a-c}{5} \right] = \tilde{t} \tag{14}$$

$\Omega(t)$ has been depicted in figure (1). Note that for $t = 0$, $\Omega(t)$ represents the difference between the monopoly and symmetric duopoly pay-off. At $\bar{t}$, the local firm is a monopolist and the difference vanishes. The intuition behind the non-monotonic response of $(\pi_{10} + \pi_{20})$ with respect to changes in *t* is as follows.[3]

Changes in *t* affect the effective marginal cost of the foreign firm. At $t = 0$, we have a symmetric duopoly situation. A rise in *t* increases the cost of one of the duopolists and hurts the total industrial profits because, to start with, q_1 is quite significant. An increase in π_2, due to the strategic effects, fails to compensate for the fall in π_1. If it is near $\bar{t}$, π_1 falls and hence q_1 is already quite small. Therefore, further rise in *t* increases π_2 more

[3] The joint Cournot-Nash industry profits usually move non-monotonically with the cost differentials of the participating firms. This has been used in the literature on international technology transfer and horizontal mergers by Long and Vousden (1995).

than a decline in π_1. The proof with a general demand function is provided in the appendix.

For the general demand function of the following form,

$$P = f(q_1 + q_2) \tag{15}$$

with $f' < 0$ and $f'' < 0$, we obtain,

$$\Omega'(t) \begin{matrix} > \\ = \\ < \end{matrix} 0 \quad \textit{iff} \quad \left[\frac{f'q_2 + (q_2 - q_1)(f' + f''q_2)}{3f' + f''(q_1 + q_2)} \right] \begin{matrix} < \\ = \\ > \end{matrix} q_1 \tag{16}$$

It is easy to check that with a linear demand function equation (16) is reduced to equation (14). At $t = 0$, $q_1 = 0$ and it is obvious that $\Omega'(t) > 0$. For $t \geq \bar{t}$, $q_1 = q_2$ and $\Omega'(t) < 0$. At this stage it can be said that for very low tariff rates $\Omega(t)$ rises as t increases and for very high tariff rates it falls with t. While in the linear case we could guarantee unique inflection of the $\Omega(t)$ function, in the general case it may not be true. But as we shall see our proposed result would follow even if we can not characterize the entire $\Omega(t)$ function. We shall first prove our result with single inflection of $\Omega(t)$.

Proposition I: Suppose $(\pi_m - I) < (\pi_{10} + \pi_{20})$ at $t = 0$, then either (a) joint-ventures would not be feasible under very low or very high tariffs, or (b) joint-ventures would not be feasible under any tariff.

Proof: We know that $\Omega(t)$ reaches a maximum at $t = \tilde{t}$. Suppose $\Omega(\tilde{t}) \geq I$. We also know that $\Omega(t) < I$ at $t = 0$. Hence, $\exists \ t_1$ such that $\Omega(t_1) = I$ as $\Omega(t)$ is increasing for $t \in [0, \tilde{t}]$. Hence, $\forall \ t < t_1$, joint-ventures would not be feasible. Similarly one can define

t_2, where $t_2 > \tilde{t}$ such that $\Omega(t_2) = I$ and $\forall \; t > t_2$, $\Omega(t) < I$. This proves (a). Suppose now that $\Omega(\tilde{t}) < I$ then there does not exist any tariff rate for which joint-venture is feasible. This proves (b).

This result is shown in figure 1. For $I = I_1$, the feasibility region is between t_1 and t_2. Whereas for I_2 no such region exists. It is straightforward to argue that a region such as Ot_1 would vanish provided that I is fairly low and less then *OA*. But region such as $t_2\bar{t}$ would always exist, no matter how low I is, provided it is not zero. The condition stipulated in the proposition guarantees that $OA < I_1$. This suggests that for very high tariff rates joint-ventures will not be feasible. This qualifies the standard tariff-jumping argument.

In our set up "go-alone" DFI is not possible, but firms are allowed to form a joint-venture. In case of "go-alone" direct foreign investment, higher tariff provided greater incentive for DFI. But in a joint-venture, the local partner's reservation pay-off depends on the initial tariff rate. If *t* is very high, the local partner is already close to being a monopolist. If one looks at the incentive constraint (b), it is revealed that for a π_{20} close to π_m a feasible λ would not exist. The local firm would demand a lot and the joint-venture will not mature. In a sense pre-existing high tariffs imply a strong bargaining position for the local partner. It is quite possible that lower tariff rates would induce investment through the formation of joint-ventures. This would be true if $I_1 < OA$.

Proposition II: *Even for* $\Omega(t)$ *function with multiple inflections, very high tariffs will discourage joint-ventures.*

Proof: Note that even with multiple inflections a stretch such as $t_2\bar{t}$ (in figure 1) would always exist as $\pi_2(c+\bar{t},c)=\pi_m(c)$. Now for any positive *I*, however small, the following condition must be true:

$$\Omega(\bar{t})=0<I$$

Then one can easily choose $t_2<\bar{t}$ such that $\Omega(t_2)=I$. Hence, so long as *I* is positive a prohibitive tariff will always deter joint-ventures. Another way of proving it for the general case is to manipulate equation (6). Note that the minimum λ needed to induce the local firm is given by,

$$\lambda_{\min}=\left[\frac{\pi_{20}(t)}{\pi_m-I}\right] \tag{17}$$

Let $\pi_{20}(\hat{t})=(\pi_m-I)$, this is always possible as $\pi'_{20}(\hat{t})>0$, $\pi_{20}(\hat{t}=0)=\hat{\pi}_1<(\pi_m-I)$ and $\pi_{20}(t=\bar{t})=\pi_m>(\pi_m-I)$. Hence, $\forall\ t\in(\hat{t},\bar{t})$, $\lambda_{\min}>1$. This makes joint-ventures infeasible.

4. Asymmetric Costs

In this section we introduce asymmetric costs between firms 1 and 2. Since our goal is to develop an analytical structure to highlight situations where the local market is protected, it will not be unreasonable to assume that $c_2>c=c_1$. There is now an interesting caveat to the existing problem. One has to know how $[\pi_{10}(c_2+t,c)+\pi_{20}(c_2+t,c)]$ behaves for a given *t* as one changes c_1. This would determine the position of the new $\Omega(t)$ function relative to the old one.

Following the example developed in the earlier section one can write,

$$\frac{\partial[\pi_{10}+\pi_{20}]}{\partial t_1} \begin{matrix} > \\ = \\ < \end{matrix} 0 \quad \textit{iff} \quad c_2 \begin{matrix} > \\ = \\ < \end{matrix} \left[\frac{a+4(c+t)}{5} \right] \tag{18}$$

This leads us to the following proposition.

Proposition III: *If* $c_2 < \left[\frac{a+4(c+t)}{5} \right]$, *then the range of tariffs that implements joint-ventures expands under asymmetric costs relative to the symmetric situation.*

Proof: Following figure 2, the new $\Omega(t)$ function lies above the old one whereas $\tilde{t}$ is raised and also $\bar{t}$ has to be increased now as $c_2 > c$. This increases the feasible range of tariffs.

The fact that c_2 needs to be small or reasonably close to c for $[\pi_{10}(c_2+t,c)+\pi_{20}(c_2+t,c)]$ to be a decreasing function of c_2, can be proved under general demand conditions. The proof and the intuition is very similar to the tariff case. If c_2 is pretty close to *c*, a rise in c_2 hurts π_{20} more than it helps π_{10}. Hence, total profit goes down and $c_2 < \left[\frac{a+4c}{5} \right]$ implies that the new $\Omega(t)$ function would be uniformly higher. But still very high tariffs would discourage joint-ventures.

If $c_2 \in \left(\frac{a+4c}{5}, \frac{a+4(c+\bar{t})}{5} \right)$, then there will be a stretch of the new $\Omega(t)$ function which may lie below the old one for some tariff levels. Note that $(c+\bar{t}) = \left(\frac{a+c_2}{2} \right)$ and given this, one can show that c_2 can not exceed $\left(\frac{a+4(c+\bar{t})}{5} \right) = \left(\frac{3a+2c_2}{5} \right)$ and,

$$\left(c_2 - \frac{3a + 2c_2}{5}\right) = \left(\frac{3(c_2 - a)}{5}\right) < 0 \qquad (19)$$

Therefore, there will always be a stretch of the new $\Omega(t)$ function that lies above the original $\Omega(t)$ function with $c_2 = c$. If c_2 is very high, the exporting firm already enjoys a good share of profits and therefore may not be induced to write a joint-venture contract. This is likely to happen when tariffs are low, thus shrinking the feasibility region by $t_1 t_1''$ in figure 2.

Investment costs in a joint-venture have been assumed to be the same as in direct foreign investment. However, it may seem appropriate to change it since the joint-venture can use local production facilities of the local firm. But there are reasons why it may not be possible. The foreign technology, even if yielding the same *c*, may entail automated plants and then one needs new investments. There may be sunk organizational costs of joint-ventures. If *c* and c_2 are different, the adoption cost due to technological difference may be more compelling.

To summarize, in this section we have shown how the technological difference between the local firm and the foreign firm enhances or curtails the scope for joint-ventures. However, our earlier result that relatively high tariff rates tend to jeopardize the possibility of a joint-venture, continues to hold. If firms are different but close enough, the prospect of a joint-venture increases. If the local firm is significantly backward, it does not work and the feasibility is somewhat recovered through higher tariffs. Again for very high tariffs such a possibility disappears.

5. Concluding Remarks

I this paper we propose a possible relationship between high tariff rates and joint-ventures when "go-alone" direct foreign investment is impossible due to the existence of a strong local firm. High tariffs imply a large reservation pay-off to the local firms which therefore claims significant share in a joint-venture deal. We have shown that very high tariffs will fail to generate a joint-venture contract thus reducing the possibility of direct foreign investment. There does exist certain tariff rates for which direct foreign investment may not be forthcoming although joint-ventures would take place. It is our hope that the model presented in this paper will encourage researchers to look at the empirical relationship between tariffs and foreign equity participation particularly for countries with significant experience with protected industrialization such as India. As the governments launch liberalization policies and tariffs start coming down and contrary to the tariff-jumping argument, this may help foreign investment through the formation of joint-ventures. On the other hand, China, one of the world's largest destination of DFI, maintains an average (trade-weighted) tariff rate of more than 26%. Shortly after liberalizing its foreign investment regime in 1995 allowing 100% foreign ownership Nigeria began to modify its tariff lines (most recently in 2001) resulting in an upward revision by 25% on as many as 70 tariff lines. As such countries such as India, China, and Nigeria offer natural experiments for the testable hypothesis that emerge from our model: Are joint ventures more dominant in less protected industries after controlling for foreign capital inflows and firm heterogeneity?

Our analysis can be extended to an oligopolistic setting with many foreign firms when a few of them are allowed to come in and form joint-ventures. Another interesting

extension would be to consider the differentiated product case when domestic and foreign brands differ in terms of their quality. In this paper we have not discussed the optimal tariff policy of the government to induce foreign investment. However, note that once the foreign firm jumps the tariff, further lowering of the tariff does not alter the consumer surplus, however the government can increase the bargaining position of the local firm by keeping a high initial tariff. If one follows our figure 1, it is obvious that t_2 is the optimal tariff rate because for $t > t_2$ investment does not take place and for $t < t_2$ consumer surplus does not change but by increasing tariff up to t_2 the government can maximize home firm's profit in the joint-venture.

Appendix

Characterization of the $\Omega(t)$ function with symmetric costs is given by

$$\Omega(t) = \pi_m - [\pi_1(t) + \pi_2(t)]$$

where

$$\pi_1 = [q_1 f(q_1 + q_2) - (c + t)q_1] \tag{1A}$$

and

$$\pi_2 = [q_2 f(q_1 + q_2) - cq_2] \tag{2A}$$

From the usual first order conditions we get

$$[q_1 f' + f - (c + t)] = 0 \tag{3A}$$

and

$$[q_1 f' + f - c] = 0 \tag{4A}$$

Therefore,

$$\left[(2f' + q_1 f'')\left(\frac{dq_1}{dt}\right) + (f' + q_1 f'')\left(\frac{dq_2}{dt}\right)\right] = 1$$

and

$$\left[(f' + q_2 f'')\left(\frac{dq_1}{dt}\right) + (2f' + q_2 f'')\left(\frac{dq_2}{dt}\right)\right] = 0$$

Hence,

$$\left(\frac{dq_1}{dt}\right) = \frac{(2f' + q_2 f'')}{\Delta}, \quad \left(\frac{dq_2}{dt}\right) = -\frac{(f' + q_1 f'')}{\Delta}$$

where

$$\Delta = \left[(2f' + q_2 f'')(2f' + q_1 f'') - (f' + q_1 f'')(f' + q_2 f'')\right] > 0$$

since $f' < 0$ and $f'' < 0$.

Now we have

$$\begin{aligned}\Omega'(t) &= -\left(\frac{\partial \pi_1}{\partial t}+\frac{\partial \pi_2}{\partial t}\right)\\ &= -\left[q_1 f'\left(\frac{\partial q_2}{\partial t}\right)+q_2 f'\left(\frac{\partial q_1}{\partial t}\right)-q_1\right]\end{aligned}$$

so that

$$\Omega'(t) \begin{matrix}>\\=\\<\end{matrix} 0 \quad \textit{iff} \quad \left[\; q_1 f'\left(\frac{\partial q_2}{\partial t}\right)+q_2 f'\left(\frac{\partial q_1}{\partial t}\right)-q_1 \;\right] \begin{matrix}<\\=\\>\end{matrix} 0$$

or,

$$\left[\; \frac{-q_1 f'(f'+q_1 f'')}{\Delta}+\frac{-q_2 f'(f'+q_2 f'')}{\Delta}-q_1 \;\right] \begin{matrix}<\\=\\>\end{matrix} 0$$

Substituting for Δ and simplifying we obtain

$$\Omega'(t) \begin{matrix}>\\=\\<\end{matrix} 0 \quad \textit{iff} \quad \left[\; \frac{f'q_2+(q_2-q_1)(f'+f''q_2)}{3f'+f''(q_1+q_2)} \;\right] \begin{matrix}<\\=\\>\end{matrix} q_1 \qquad \text{(5A)}$$

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Figure 1

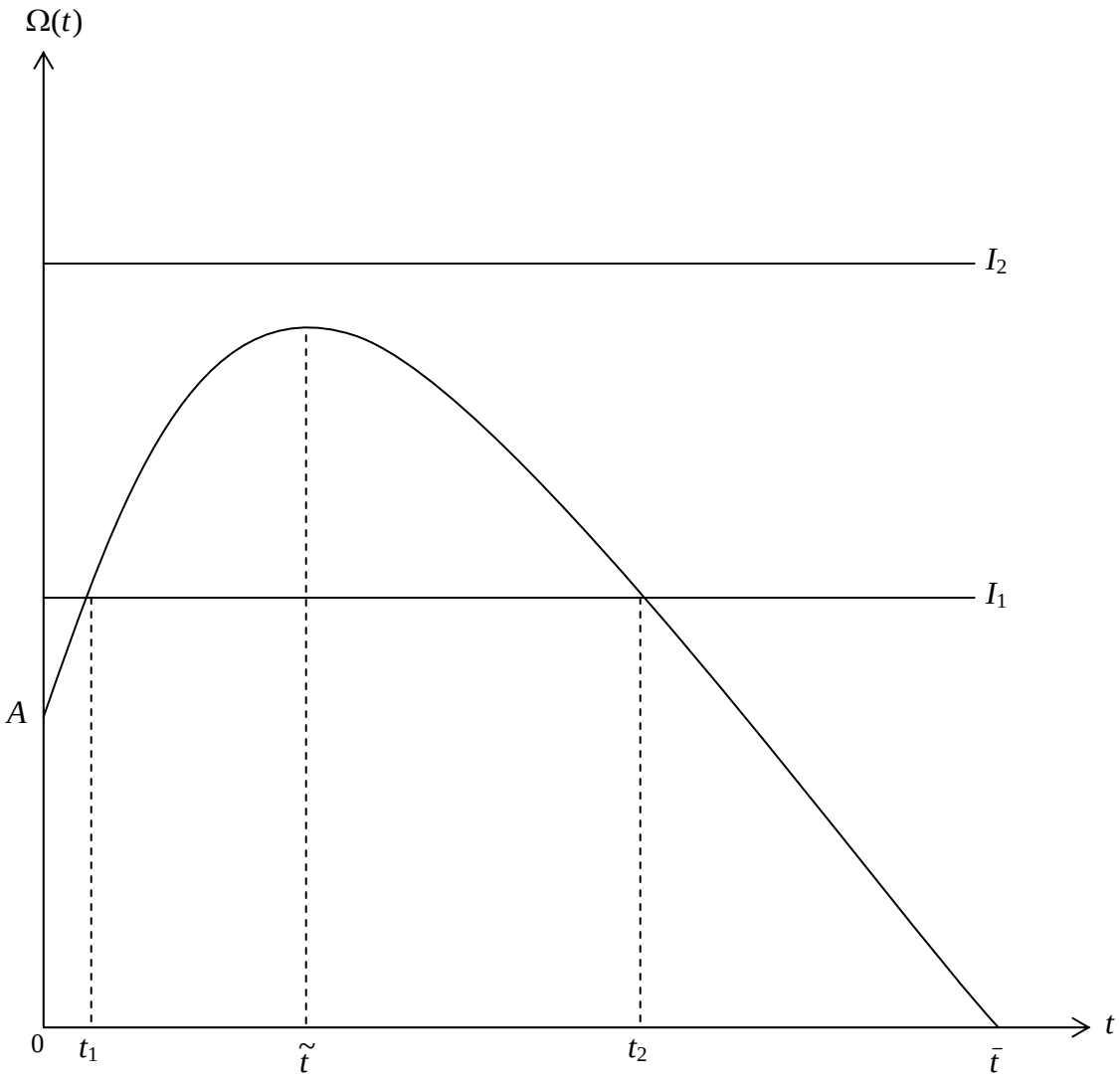

Figure 2