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The Tariff-Jumping Argument and Location Theory

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Abstract

When examining the tariff-jumping effect, the literature emphasizes the cost-induced effect, which states that a foreign firm has an incentive to jump over the tariff wall in order to locate in a foreign territory, and thereby escape tariffs. The authors set up a location model to show what they refer to as the location-induced effect on tariff-jumping. This location-induced effect, together with the traditional cost-induced effect, makes tariff-jumping more (less) likely to take place when the production function in question exhibits decreasing (increasing) returns to scale.

1. Introduction

Over the last three decades, the significance of multinational firms in all phases of international exchange has grown tremendously. Along with the growth of multinational firms, new issues concerning individual national economies as well as the world economy have sprung up. Among other things, multinational firms' choice of either foreign direct investment (FDI) or exports has become a key issue in theory as well as in practice.[1] Several studies (Horst, 1971, 1972; Caves, 1971, 1982; Dunning, 1981) have shown how the linkages in costs between countries provide a basis for using the familiar analytical tools of international trade theory in studies of multinational firm decision-making. In particular, traditional tariff-jumping FDI theory argues that tariffs increase the cost of exports, and thus encourage foreign investment in the tariff-levying country.[2] More recent studies have made explicit use of game theory to model international investment in an oligopolistic setting and to highlight the strategic role of FDI (Smith, 1987; Brander and Spencer, 1987; Horstmann and Markusen, 1991; Motta, 1992; Levy and Nolan, 1992; Flam, 1994). In any event, this line of thinking provides the cost-induced motivation for FDI.

Generally speaking, the "FDI vs. export" choice involves a firm's location choice. What is surprising is that the traditional literature on FDI implicitly treats foreign investment as a change in production location. This simply indicates that location theory plays at best a marginal role in the decision-making process of multinational firms as well as in the development of international trade theory.[3] Because international trade takes place, by definition, between spatially separated markets, a number of papers on international trade-policy issues based on spatial models have been published. For example, by employing the standard model of spatial competition *à la* Hotelling (1929), Benson and Hartigan (1983, 1987) examine whether the Metzler Paradox can occur under tariffs when firms are employing f.o.b. or discriminatory

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pricing; Benson and Hartigan (1984a) investigates the relative impacts of tariffs and quotas and finds that the Metzler Paradox can also occur under import quotas in an f.o.b. duopoly model; and Greenhut et al. (1987) and Benson and Hartigan (1984b) explain why intraindustry trade might be expected to exist.

The present paper develops as simple a formal location model as possible to provide what we refer to as the "location-induced effect" on tariff-jumping FDI and to distinguish this effect from the cost-induced effect as postulated in traditional trade theory. It is shown that the location-induced effect, together with the cost-induced effect, makes tariff-jumping less (more) likely to take place when the production function in question exhibits increasing (decreasing) returns to scale.

2. The Model

The analysis in this paper is confined to a partial-equilibrium setting and a line space. We assume there is a monopolist in the home country. For simplicity, we further assume that this firm produces output Q using a single transportable input M (raw materials). The relation between Q and M is given by

$$Q = f(M), \tag{1}$$

where the production function is assumed to be homogeneous degree of n; i.e., $Mf_M \equiv nQ$. The locational space perceived by the firm is depicted in Figure 1, where the domestic/foreign border is denoted by point B. The firm buys the input at point I (the input source) in the home country and sells its output at point J (output market) in the foreign country. The firm will choose a point along the straight line IJ at which to locate its plant, in either the home or the foreign country. The length of the line IJ is s, while x is the firm's distance from point I where $x \in [0, s]$.[4]

The monopolist chooses location and output level simultaneously in order to maximize profit. If it chooses to locate its plant in the home territory and exports its output to the foreign country, then its profit from exports (defined by Π) can be specified as follows:

$$\Pi = [p(Q) - u(x) - t]f(M) - [m + v(x)]M, \tag{2}$$

where $P(Q)$ is the inverse demand function with $P_Q < 0$; t is the specific tariff levied by the foreign country; m is the unit price of the input at I; $u(x)$ is the cost of transporting a unit of Q from the plant site to the final output market; and $v(x)$ is the cost of transporting a unit of M from I to the plant site. It is clear that output transport costs decrease and input transport costs increase with distance from the input site; i.e., $u_x < 0$ and $v_x > 0$. According to the tariff-jumping argument, the monopolist would choose to invest in the foreign country (i.e., FDI takes place) if the profit from exports Π as defined in (2) is less than the profit from FDI (defined by Π^I) which is specified as follows:[5]

$$\Pi^I = [P(Q) - u(x)]f(M) - [m + v(x)]M - F, \tag{3}$$

where F is the fixed cost of investing abroad. In other words, FDI occurs if $\Pi < \Pi^I$. Obviously, given the two transport cost functions and the production function, the FDI decision depends mainly on the magnitudes of t and F. Specifically, given x, the higher the tariff rate and/or the lower the fixed cost, the more likely will the monopolist be to choose FDI. This is the so-called "cost-induced effect" on FDI, which is well-known in FDI literature. In this paper, we endogenize the location variable and demonstrate that the monopolist's location decision per se can produce a "location-induced effect,"

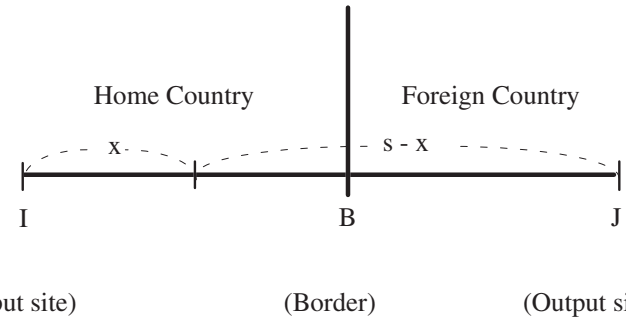

Figure 1. A Location Line

which may have something to add to analysis of FDI and tariffs. *In what follows, we shall concentrate only on the location-induced effect on FDI, intentionally leaving aside the well-known cost-induced effect on FDI.* It is shown that the location-induced effect on FDI is crucially dependent on the degree of returns to scale, which is in turn related to the form of the production function in question. In accomplishing this end, we consider the following two cases: (i) the interior solution, and (ii) the corner solution.

The Interior Solution

For the time being, let us assume that the monopolist currently locates its plant in the home territory and has a profit function as specified in (2). The output and location equilibrium of the monopolist is derivable by differentiating (2) with respect to M and x, respectively:

$$\Pi_M = [P(Q) + P_Q Q - u(x) - t] f_M - [m + v(x)] = 0, \tag{4}$$

$$\Pi_x = -u_x Q - v_x M = 0, \tag{5}$$

where subscripts to functions denote partial derivatives. The second-order conditions require that

$$\Pi_{MM} = [P + P_Q Q - u(x) - t] f_{MM} + (P_{QQ} Q + 2P_Q) f_M^2 < 0, \tag{6a}$$

$$\Pi_{xx} = -u_{xx} Q - v_{xx} M < 0,^{6} \tag{6b}$$

$$D = \Pi_{MM} \Pi_{xx} - \Pi_{Mx}^2 > 0, \tag{6c}$$

where $\Pi_{Mx} = -u_x f_M - v_x = v_x(n - 1)$ by (5).

Next, the comparative static effects of import tariffs on M and x, respectively, can be evaluated as follows:

$$\frac{dM}{dt} = \frac{\Pi_{xx} f_M}{D} < 0, \tag{7}$$

$$\frac{dx}{dt} = \frac{-v_x(n-1) f_M}{D} \gtreqless 0 \quad \text{if } n \gtreqless 1. \tag{8}$$

Let us first consider (7). It follows that an increase in tariffs results in a reduction in the monopolist's foreign sales. From (8), we see that the plant location of the monopolist is invariant with respect to a change in tariffs if the production function is

constant returns to scale (i.e., $n = 1$). Nevertheless, the monopolist will move its plant towards the domestic input source if the function is increasing returns to scale (i.e., $n > 1$), but will move its plant towards the foreign output market if the function is decreasing returns to scale (i.e., $n < 1$). The latter may be defined as location-induced FDI.

The economic intuition for this result may be given as follows. As mentioned above, the monopolist lowers its output as tariffs increase. When the production function exhibits decreasing (increasing) returns to scale, the reduction in output means that the input/output ratio falls (rises). Hence, the burden of transporting the input decreases (increases) in relation to the burden of transporting the output, and thus the pulling power of the input source decreases (increases) in relation to the pulling power of the output, thereby moving the monopolist's plant location towards (away from) the foreign output market. Nevertheless, when the production function exhibits constant returns to scale, the pulling power of the input is balanced with that of the output, so that the location is invariant with respect to an increase in tariffs. To develop as simple a formal location model as possible, we purposely confine our analysis to a monopoly case. Nevertheless, the results derived in this paper can still be readily applied to more general market structures such as the n-firm oligopoly model. Therefore, we can summarize the above discussion as follows.

Proposition 1. *The location-induced effect of higher tariffs leads to* (*mitigates against*) *FDI if the production function exhibits decreasing* (*increasing*) *returns to scale. The effect is neutral with respect to FDI if the production function is constant returns to scale.*

For purposes of exposition, we shall undertake a diagrammatic analysis to illustrate Proposition 1. The slopes of the loci $\Pi_M = 0$ and $\Pi_x = 0$, as respectively specified in (4) and (5), can be derived as follows:

$$\left.\frac{dx}{dM}\right|_{\Pi_M=0} = -\frac{\Pi_{MM}}{\Pi_{Mx}}\begin{cases}\gtrless 0 \text{ for } n \gtrless 1,\\ = \infty \text{ for } n = 1;\end{cases} \tag{9a}$$

$$\left.\frac{dx}{dM}\right|_{\Pi_x=0} = -\frac{\Pi_{xM}}{\Pi_{xx}}\begin{cases}\gtrless 0 \text{ for } n \gtrless 1,\\ = 0 \text{ for } n = 1;\end{cases} \tag{9b}$$

The difference between the two slopes is given by

$$\Delta = \left.\frac{dx}{dM}\right|_{\Pi_x=0} - \left.\frac{dx}{dM}\right|_{\Pi_M=0} = \frac{D}{\Pi_{xx}\Pi_{xM}}\begin{cases}\gtrless 0 \quad \text{for } n \gtrless 1,\\ = -\infty \text{ for } n = 1.\end{cases} \tag{10}$$

Now let us focus solely on the case of the decreasing-returns-to-scale production function. It follows from (9) and (10) that if $n < 1$, then both of the loci $\Pi_x = 0$ and $\Pi_M = 0$ are downward-sloping and the slope of $\Pi_x = 0$ is flatter than that of $\Pi_M = 0$, as depicted in Figure 2. Assume that the initial equilibrium is at point E where the domestic monopolist locates its plant in the domestic territory x^0. A rise in tariffs does not affect the position of the locus $\Pi_x = 0$, but will shift inward the locus of $\Pi_M = 0$ to $\Pi_M^t = 0$, moving the equilibrium from E to E^t. Under such a circumstance, even if we ignore the cost-induced effect on FDI, a high enough tariff level will induce the monopolist to cross the border x^B and to locate its plant in the foreign territory x^t. In other words, a higher tariff may lead the profit-maximizing monopolist, other things being equal, to locate its plant in the foreign territory in the case of decreasing returns to scale. Hence, the location-induced effect of higher tariffs may lead to FDI.

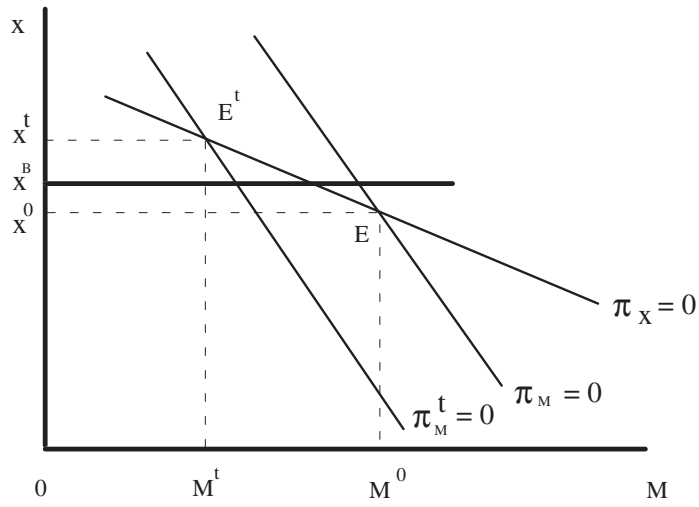

Figure 2. A Decreasing-Returns-to-Scale Production Function ($n < 1$)

By employing the same diagrammatic technique, we can also analyze the cases of increasing returns to scale and constant returns to scale. It can be shown that the new locations after tariffs, x^t, are smaller than x^B under increasing and constant returns to scale. The location-induced effect may mitigate against FDI in the case of increasing returns to scale, while it is neutral with respect to FDI in the case of constant returns to scale. To highlight the role of the locational tariff-jumping effect more fully, let us next consider corner solutions.

Corner Solutions

In contrast, we now assume that transport rates are constant such that $u(x) = h(s - x)$ and $v(x) = rx$, where h and r are the constant transport rates of shipping one unit of output and input per unit of distance, respectively. Under these conditions, one of the second-order conditions specified in (6b) is not satisfied; i.e., $\Pi_{xx} = -u_{xx}Q - v_{xx}M = 0$. Consequently, the optimal location is determined by

$$\Pi_x = hQ - rM \gtreqless 0. \tag{11}$$

To put it another way, the optimal location will be at the foreign output market J if $hQ > rM$, but at the input source I if $hQ < rM$. Since there is no interior solution, the comparative static analysis is no more proper. Nevertheless, the intuition derived in the previous case still holds true here.

It may be of interest to provide examples to illustrate this point. Let us first consider the case of decreasing returns to scale with $Q = f(M) = \sqrt{M}$. As shown in Figure 3, the negatively sloped TT curve in the upper quadrant indicates that higher tariffs are associated with a lower input usage, a result which corresponds to (7); $Q = \sqrt{M}$ in the lower quadrant is the production function. The other straight line passing through the origin in the lower quadrant is derived by setting $hQ = rM$, dividing the lower quadrant into two parts with $hQ > rM$ for the upper part and $hQ < rM$ for the lower part. Under free trade (i.e., $t = 0$), the production equilibrium is at E_0, with the optimal input usage at

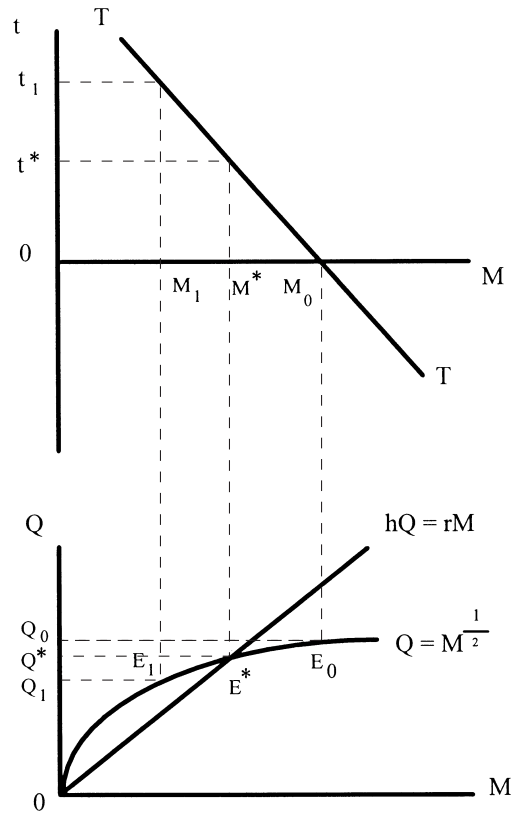

Figure 3. A Decreasing-Returns-to-Scale Production Function with $Q = \sqrt{M}$

OM_0 and the optimal output level at OQ_0. As shown in the figure, E_0 is below the $hQ = rM$ schedule, indicating that $hQ < rM$, and that therefore the optimal location is at $x = 0$ or at I, the home input source in Figure 1. If the foreign government raises import tariffs to a level exceeding t^*, say t_1, then the production equilibrium moves to E_1, which is above the $hQ = rM$ schedule, indicating that $hQ > rM$. According to (11), the optimal location is at $x = s$ or at J, the foreign output market. Hence, for any tariff exceeding t^*, the monopolist will move its plant to the foreign country, and then tariff-jumping FDI occurs.

Similarly, we can also consider the case of increasing returns to scale with $Q = f(M) = M^2$. In this case, the production function is convex rather than concave as shown in Figure 3, and the free-trade production equilibrium will be below the $hQ = rM$ schedule, indicating that the optimal location is at $x = 0$ (the home input source). It is clear that raising tariffs would never change the monopolist's location. In fact, the foreign government would have to subsidize imports in order to make the monopolist switch its location from $x = 0$ to $x = s$. Hence, a subsidy jumping takes place if the subsidy rate is sufficiently large to a certain extent.

Finally, in the case of constant returns to scale with $Q = f(M) = M$, the production function is a straight line. As a result, neither import tariffs nor subsidies would change the monopolist's location.

Note that we have so far concentrated only on the location-induced effect of FDI, ignoring completely the well-known cost-induced effect of FDI. Under the latter effect,

higher tariffs give investing firms an incentive to jump the tariff wall and to locate their plants in foreign territories. In general, the two effects should coexist, making tariff-jumping FDI less (more) likely to take place when the production function in question exhibits increasing (decreasing) returns to scale.

3. Concluding Remarks

This paper proposes an additional explanation for a firm's decision to operate a multinational branch plant. Beyond the tradeoff in the standard model between additional set-up costs and tariff avoidance in a foreign branch plant, this paper proposes a further tradeoff between the costs of transporting inputs versus the costs of transporting output. More specifically, it develops a very simple and illustrative model to provide another line of argument concerning tariff-jumping FDI based on interaction between economies of scale and transportation costs. In particular, it is shown that once the location decision is taken into consideration, the question of whether a higher tariff, in the absence of the familiar cost-induced effect, will induce FDI or not depends critically upon the characteristics of the production function concerned. More specifically, in the absence of the cost-induced effect, the location-induced effect of higher tariffs may lead to (mitigate against) FDI if the production function is decreasing (increasing) returns to scale. It warrants mention here that the present paper focuses only on the location-induced effect, ignoring completely the well-known cost-induced effect on FDI. In general, the two effects should coexist.

We conclude by pointing out a few possible directions in which this model can be generalized. First, our model could be extended to highlight the strategic role of FDI. Second, it would be interesting to extend the analysis to allow for input tariffs and to consider whether the results can be related to past literature on effective protection. Third, another factor of production could be introduced—think of it as labor or even as capital—which is imported from a foreign country and/or is available in the domestic country. Finally, the model can be easily applied to the opposite case in which the domestic country has an output market and imports raw materials from the foreign country. In this case, location-induced FDI will occur if the foreign government imposes an export tax on its raw material exports (as in the case of plywood in Indonesia) when the production function exhibits increasing returns to scale. It is hoped that this paper will go some way toward stimulating these lines of research.

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Notes

1. This area of research is nicely surveyed in Dunning (1981) and Caves (1982).
2. Caves (1982) provides an excellent survey on evidence for tariff jumping as a determinant of FDI.
3. Krugman (1993) argues that there is no longer any reason for trade theorists to regard location theory as an alien field.
4. The particular references here are Weber (1929), Moses (1958), Sakashita (1967), Mathur (1979), and Mai (1981).
5. If the monopolist chooses FDI, it has to import raw material from the home country. It is assumed that the host country imposes no tariffs on the imported raw material. In fact, imposing a tariff on the imported raw material would complicate the analysis; however, it does not affect the intuition derived in the paper.
6. It is worth noting that $\Pi_{xx} < 0$ if $u_{xx} > 0$ and $v_{xx} > 0$. These conditions, which are necessary for the existence of an interior solution for location, can be satisfied if we assume that transport rates are decreasing and sufficiently convex with respect to distance. The case of corner solutions is discussed later in the paper.