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A Spatial View On International Dumping

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I. Introduction

The problem of international dumping is usually described as follows (Haberler [1933], Corden [1974]): Two separate spatial markets (domestic/foreign) exist on which different price elasticities of demand enable the supplier to set different prices. In comparison to fob pricing, the supplier's profit is increased by price discrimination. If the firm's location is domestic and the foreign sales price is lower than the domestic sales price, this type of price discrimination is usually called "dumping"; in the case of reverse price conditions, it is called "reverse dumping" (Viner [1923]). The basic assumptions of the traditional dumping model are as follows: (1) In domestic and foreign markets, consumers show different preferences which are expressed by different price elasticities of demand. (2) Both markets are represented by spaceless point markets which are sufficiently isolated one from the other by means of the economic distance between them. Consequently, the only significance of space is to separate the spaceless point markets. Therefore, it does not actually represent an economic problem.

The purpose of this paper is to present a re-formulation of the dumping problem with the intention to reach a more realistic model of the phenomenon which would lead to new results and which is in accordance with the often requested connection of the international trade theory with the theory of spatial economy (Lösch [1939]). Proceeding on the assumptions that (1) domestic and foreign demand are spread continuously over space and that (2) the transport costs between the domestic firm's location and the domestic and foreign locations of demand are taken into account, a modified theory of spatial price discrimination (Hoover [1937], Greenhut/Ohta [1975], Schöler [1983], Greenhut/Ohta/Sailors [1985]) can be applied as an approach to solve the dumping problem. This approach distinguishes

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between domestic and foreign markets—as usually practised in international trade theory—by assuming different demand structures and/or transport cost structures.

The discussion of the revised approach is to be performed in three steps. Firstly, we shall discuss the assumptions as well as the basic model (section II). Secondly, by means of these initial considerations we then ask if, under certain informational assumptions, a total international price discrimination is possible and what are its preconditions (section III). Finally, we shall discuss the consequences for the supplier (section IV).

II. Assumptions and Basic Model of International Dumping

To simplify our considerations, it would be appropriate to first formulate some assumptions:

A 1: The individual demand for the internationally traded good is identical for all domestic consumers on the one hand and all foreign consumers on the other hand and is supposed to be a linear function of the cif price $p(r)$ and $p^*(r)$ respectively:

$$q(r) = a - bp(r) \qquad \text{resp. } q^*(r) = a^* - b^*p^*(r), \text{ with } a, a^* > 0, \quad b, b^* > 0, \tag{1}$$

where the variables and coefficients of the foreign markets are marked with (*) and r represents the distance between the locations of production and consumption.

A 2: A linear cost function of the supplier is

$$K = k(Q + Q^*) + K_f, \tag{2}$$

in which K_f stands for the fixed cost, Q for the domestic market demand, Q^* for the foreign market demand, and k for the marginal costs.

A 3: The space is represented by a one-dimensional market area in which the distances r are considered from the firm's location ($r = 0$). The border between the countries is marked with $r = R_I$ and the endogenous maximum size of the market area is $r = R$. Let the uniform domestic and foreign population density per area unit be B.[1]

A 4: For simplification we assume the supplier to be a monopolist on domestic and foreign markets.

A 5: The cif price on each of the domestic and foreign markets is calculated from the mill price m and the transport costs $F\ (= fr)$ resp. $F^*\ (= f^*r)$:

$$\begin{aligned} p(r) &= m + fr, && \forall\, r \ni 0 \leq r < R_I, \\ p^*(r) &= m^* + f^*r, && \forall\, r \ni R_I < r \leq R, \qquad f^* \gtreqless f. \end{aligned} \tag{3}$$

[1] It is obvious that the problem of dumping, or more generally, the phenomenon of international trade, does not exist for $R \leq R_I$.

A 6: While the monopolistic firm aims at maximizing its profit, the consumer whishes to maximize his individual consumer's surplus. Consequently, the consumers endeavor to buy the good offered at the lowest cif price.

A 7: The monopolist has all relevant information (I_u) on domestic and foreign preferences and transport costs: $I_u = \{a, a^*, b, b^*, f, f^*\}$. The consumers at the location r know the cif price at their households' location only: $I_{r'} = \{p(r')\}$ or, alternatively, they know all domestic and foreign cif prices:

$$I_{r'} = \{p(r) \forall r \ni 0 \leq r \leq R\}.$$

In consideration of the assumptions made, the aggregated domestic and foreign market demand, which is identical with the firm's demand in the case of a monopoly, is:

$$Q + Q^* = B\left[\int_0^{R_I}(a - bp(r))dr + \int_{R_I}^{R}(a^* - b^*p^*(r))dr\right] \tag{4}$$

Now we have to calculate the profit-maximizing cif prices $p(r)$ under price discrimination for all distances from the firm's location $0 \leq r \leq R$. The results will be given for the domestic case, but by analogy, considering a^*, b^* and f^* this is equally valid for the cif prices in the foreign market. The profit of a monopolistic firm obviously reaches its maximum if, at given fixed costs, the gross profit $E(m, r) = B(m - k)q(r)$ is maximized at any location within the market area:

$$\frac{\partial E(m, r)}{\partial m} = 0 = a - 2bm + k - bfr, \quad \frac{\partial^2 E(m, r)}{\partial m^2} = - 2b < 0, \tag{5}$$

$$\forall r \ni 0 \leq r \leq R_I.$$

From this result we can derive the profit-maximizing mill prices, cif prices, and the demand at the distance r:

$$m(r) = \frac{1}{2}\left(\frac{a}{b} + k - fr\right) \qquad \forall r < \frac{a}{bf} + \frac{k}{f} \tag{6}$$

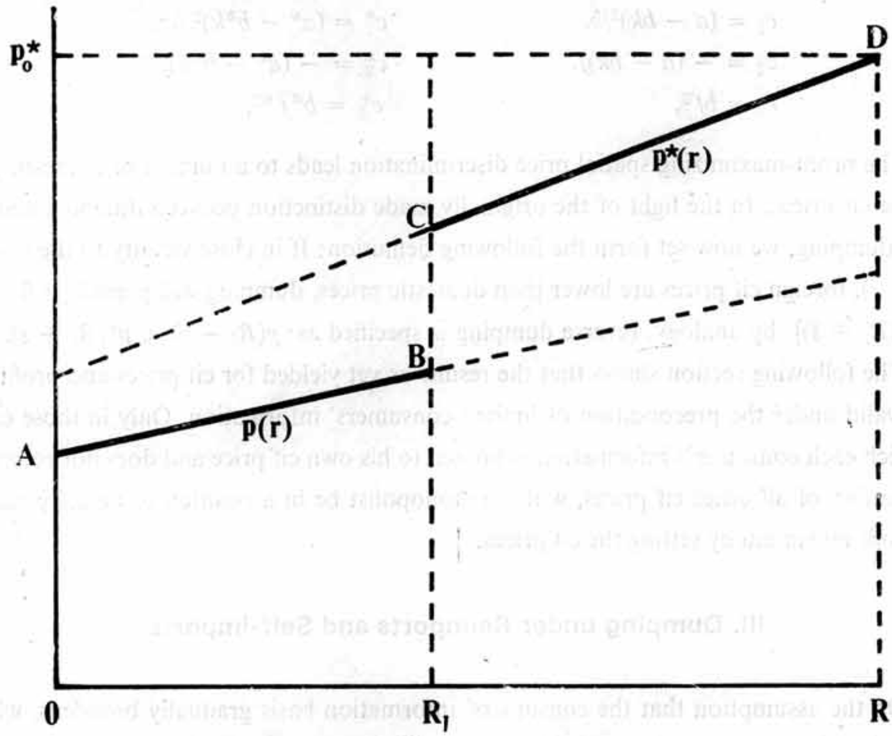
$$p(r) = \frac{1}{2}\left(\frac{a}{b} + k + fr\right) \qquad p(r) \leq \frac{a}{b} = p_0, \tag{7}$$

$$q(r) = \frac{1}{2}(a - bk - bfr)\, B. \tag{8}$$

Figure 1 shows the cif price schedules for domestic and foreign markets. For the graphic illustration we made some necessary ($p_0^* > p_0, f^* > f$) or simplifying ($k = 0$) assumptions. The cif price schedule ABCD has a discontinuity at the border R_I and takes a linear course with a slope of $f/2$ in the domestic market area and $f^*/2$ abroad.

Therefore, at any domestic household's location, the gross profit is

Figure *1*: Cif price schedules ($k = 0, p_0^* > p_0, f^* > f$)



$$E(r) = Bq(r)[m(r) - k] = \frac{B}{4b}(a - bk - bfr)^2, \quad 0 \leq r < R_I \tag{9}$$

and at any foreign household's location

$$E^*(r) = Bq^*(r)[m^*(r) - k] = \frac{B}{4b^*}(a^* - b^*k - b^*f^*r)^2, \quad R_I < r \leq R. \tag{10}$$

Given the assumption of limited consumers' information, the price-discriminating monopolist realizes a profit from domestic and foreign sales of:

$$\begin{aligned} \pi &= \int_0^{R_I} E(r)dr + \int_{R_I}^{R} E^*(r)dr - K_f \\ &= \frac{B}{4}\left[\int_0^{R_I} \frac{1}{b}(a - bk - bfr)^2\, dr + \int_{R_I}^{R} \frac{1}{b^*}(a^* - b^*k - b^*f^*r)^2\, dr\right] - K_f \end{aligned} \tag{11}$$

or

$$\begin{aligned} \pi = B\Big[&\frac{1}{4}(c_1 - c_1^*)R_I + \frac{1}{4}(c_2 - c_2^*)R_I^2 + \frac{1}{12}(c_3 - c_3^*)R_I^3 + \frac{1}{4}c_1^*R \\ &+ \frac{1}{4}c_*R^2 + \frac{1}{12}c_3^*R^3\Big] - K_f \end{aligned}$$

with

$$c_1 = (a - bk)^2/b, \qquad c_1^* = (a^* - b^*k)^2/b^*,$$
$$c_2 = -(a - bk)f, \qquad c_2^* = -(a^* - b^*k)f^*,$$
$$c_3 = bf^2, \qquad c_3^* = b^*f^{*2}.$$

The profit-maximizing spatial price discrimination leads to a number of domestic and foreign cif prices. In the light of the originally made distinction between dumping and reverse dumping, we now set forth the following definition: If in close vicinity to the border ($R_I \pm \varepsilon$), foreign cif prices are lower than domestic prices, dumping will prevail [$p(R_I - \varepsilon) > p^*(R_I + \varepsilon)$]; by analogy, reverse dumping is specified as: $p(R_I - \varepsilon) < p^*(R_I + \varepsilon)$.

The following section shows that the results as yet yielded for cif prices and profit are only valid under the precondition of limited consumers' information. Only in those cases in which each consumer's information is limited to his own cif price and does not comprise the number of all other cif prices, will the monopolist be in a position to actually realize his profit maximum by setting the cif prices.

III. Dumping under Reimports and Self-Imports

On the assumption that the consumers' information basis gradually broadens, which means that the consumers increasingly gain market transparency and that finally the quantity of information per buyer may be characterized by $I_{r'} = \{p(r) \; \forall \; r \ni 0 \leq r \leq R\}$, will domestic reimports and foreign self-imports take place in the absence of trade barriers with lower prices than the prices of the monopolist in a well-defined market area. Our term "domestic reimports" is defined as those purchases made abroad by domestic buyers at the location $R_I + \varepsilon$ at the cif prices prevailing there. In analogy, we define "foreign self-imports" as those purchases by foreign consumers in the domestic market at the location $R_I - \varepsilon$ at the cif prices requested there by the monopolist. The consumers carrying out these two types of imports yield new cif prices which are further charged with the transport costs between the area $R_I \pm \varepsilon$ near the border and the consumers' locations. For simplification, we assume competitive domestic and foreign markets for transport services and identical transport costs for the monopolist and the consumers.

Now all those consumers practice self-imports or reimports whose "private" cif prices are lower than the cif prices requested by the monopolist under price discrimination. The areas for self-imports and reimports are limited by the border R_I on the one hand, and by the equality of the "monopolistic" and the "private" cif price $p(r)'$ on the other hand [reimports: R_{r_e} for $p(r) = p(r)'$; self-imports: R_{s_e} for $p^*(r) = p^*(r)'$]. The domestic reimports are being bought in the area $R_I + \varepsilon$ and transported to the area $R_{re}R_I$ at domestic transport costs. Thus, the "private" cif prices

$$p(r)' = \frac{1}{2}\left(\frac{a^*}{b^*} + k + f^*R_I\right) + f(R_I - r), \ \varepsilon \approx 0, \qquad (12)$$
$$\forall r \ni R_{re} \le r < R_I$$

are lower than the cif prices $p(r)$ requested by the monopolist. In analogy to this, the foreign self-imports are bought in the area $R_I - \varepsilon$ and exported to the area R_IR_{se} at foreign transport costs. In this case, the lower private cif prices yield

$$p^*(r)' = \frac{1}{2}\left(\frac{a}{b} + k + fR_I\right) + f^*(r - R_I), \ \ \varepsilon \approx 0, \qquad (13)$$
$$\forall r \ni R_I < r \le R_{se}.$$

The equations (12) and (13), as well as the monopolistic cif prices of the supplier, determine the border for reimports by

$$R_{re} = \frac{1}{3}\left(\frac{f^*}{f} + 2\right)R_I + \frac{1}{3f}(p_0^* - p_0) \qquad (14)$$

and the border for self-imports by

$$R_{se} = \left(2 - \frac{f}{f^*}\right)R_I + \frac{1}{f^*}(p_0^* - p_0). \qquad (15)$$

We can easily see that at identical differences in maximum prices $(p_0^* - p_0)$ and identical freight costs $(f = f^*)$, the size of the reimport area is one third of the self-import area. Reimports lead to a smaller difference from the monopolistic profit maximum than foreign self-imports.

To clarify the problem of self-imports and reimports, we take four examples from a variety of possible combinations of different domestic and foreign structures of demand and transport costs:

First case: $p_0^* > p_0$ and $f^* = f \Rightarrow$ foreign self-imports,
Second case: $p_0^* < p_0$ and $f^* = f \Rightarrow$ domestic reimports,
Third case: $p_0^* = p_0$ and $f^* > f \Rightarrow$ foreign self-imports,
Fourth case: $p_0^* = p_0$ and $f^* < f \Rightarrow$ domestic reimports.

The illustration of these four cases will be restricted to the area-specific cif price schedules, the cases 1 and 2 are compiled in Figure 2 and the cases 3 and 4 in Figure 3 respectively.

First case:

$$p(r) = \frac{1}{2}(p_0 + k + fr), \qquad \forall r \ni 0 \le r < R_I,$$

$$p^*(r)' = \frac{1}{2}(p_0 + k - fR_I) + fr, \quad \forall r \ni R_I < r \leq R_{se},$$

$$p^*(r) = \frac{1}{2}(p_0^* + k + fr), \quad \forall r \ni R_{se} < r \leq R.$$

Second case:

$$p(r) = \frac{1}{2}(p_0 + k + fr), \quad \forall r \ni 0 \leq r < R_{re},$$

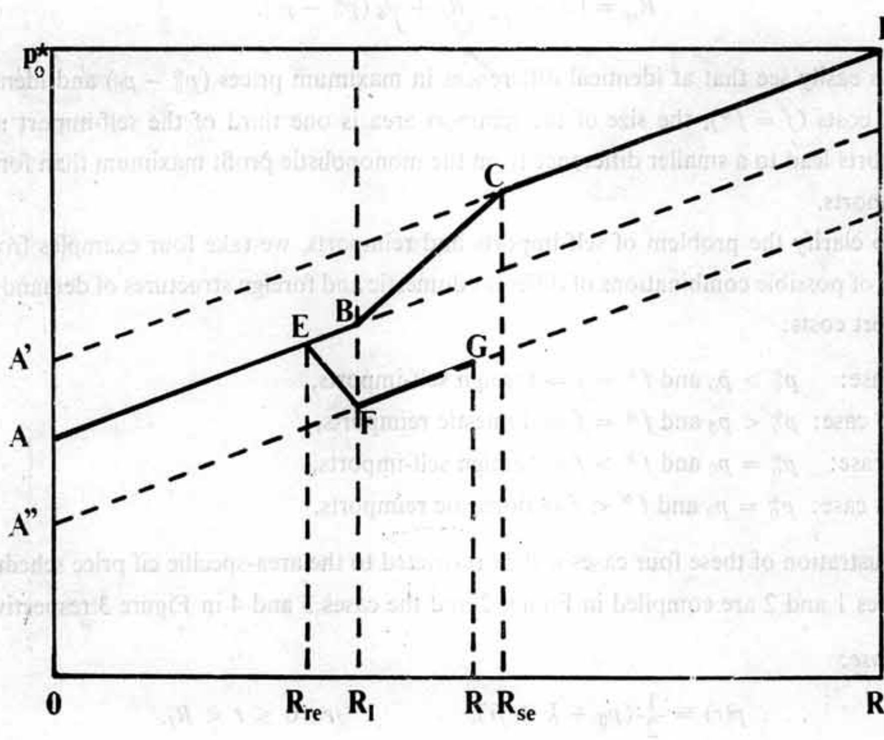
$$p(r)' = \frac{1}{2}(p_0^* + k + 3fR_I) - fr, \; \forall r \ni R_{re} \leq r < R_I$$

$$p^*(r) = \frac{1}{2}(p_0^* + k + fr), \quad \forall r \ni R_I < r \leq R.$$

In the first case, the cif price schedule is represented by ABCD, and in the second case by AEFG. It should be noted that the distance $\overline{OD}$ is precisely $2 \times \overline{OA'}$ or $\overline{OC}$ is $2 \times \overline{OA''}$ respectively.

Figure 2: Reimports and self-imports under

$p_0^* \lesseqgtr p_0,\ f^* = f,\ k = 0$



Third case:

$$p(r) = \frac{1}{2}(p_0 + k + fr), \qquad \forall r \ni 0 \leq r < R_I,$$

$$p^*(r)' = \frac{1}{2}(p_0 + k + fR_I) + f^*(r - R_I), \forall r \ni R_I < r \leq R_{se},$$

$$p^*(r) = \frac{1}{2}(p^0 + k + f^*r), \qquad \forall r \ni R_{se} < r \leq R.$$

Fourth case:

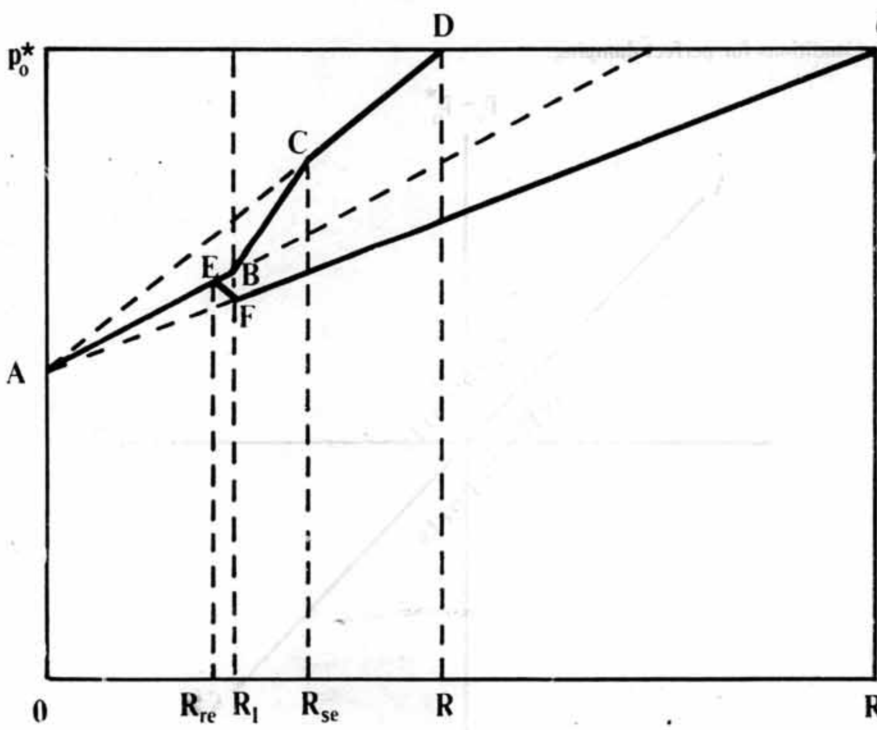
$$p(r) = \frac{1}{2}(p_0 + k + fr), \qquad \forall r \ni 0 \leq r < R_{re},$$

$$p(r)' = \frac{1}{2}(p_0 + k + f^*R_I) + f(R_I - r), \forall r \ni R_{re} \leq r < R_I,$$

$$p^*(r) = \frac{1}{2}(p_0 + k + f^*r), \qquad \forall r \ni R_I < r \leq R.$$

Figure 3: Reimports and self-imports under

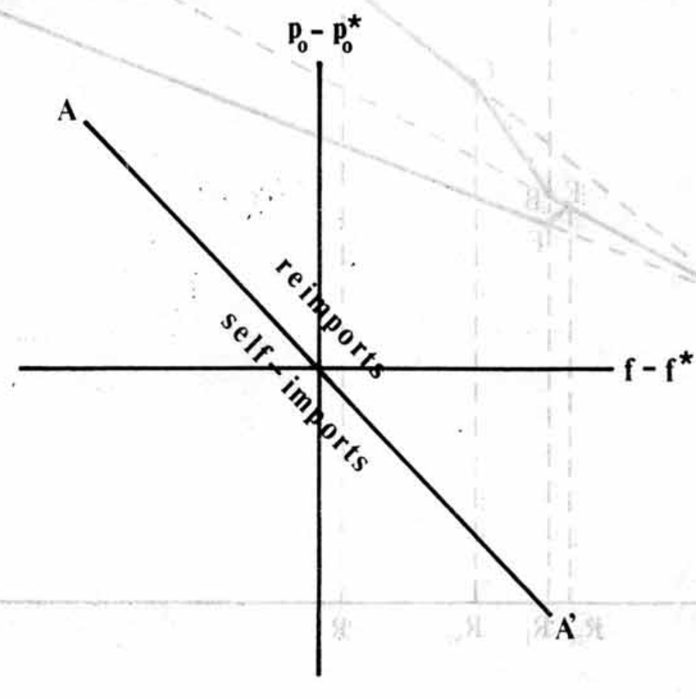
$p_0^* = p_0,\ f^* \lesseqgtr f,\ k = 0$



In Figure 3, case 3 is illustrated by the cif price schedule ABCD and case 4 by AEFG respectively. The distance $\overline{OG}$ is precisely twice as long as the distance $\overline{OA}$.

Both figures visualize that the discontinuity of the cif price schedules represents the precondition for the buyers' reimport or self-import activities caused by the profit-maximizing price discrimination of the monopolist, as well as by the different demand and/or cost structures at home and abroad. In other words: If there is no discontinuity at the boundary R_I in the monopolistic cif price schedule, there will be no reimports or self-imports on either side of the boundary. This condition prevails when $p_0 - p_0^* = R_I(f^* - f)$ is valid, while $p_0^* = p_0$ and $f^* = f$ represent a special case. In the general version, this condition implies contrary effects of differences in transport costs and maximum prices. These differences must be of exactly the size at which the cif price schedules have a sharp bend at the boundary, but not a discontinuity. In the special case of identical demand and transport cost structures, the assumed distinctive criteria for domestic and foreign markets are not applicable, and the problem is reduced to a common model of spatial price discrimination in which the cif price schedule is continual and linear. If the condition for complete dumping $p_0 - p_0^* = R_I(f^* - f)$ is put into equations (14) and (15), we finally yield: $R_{re} = R_{se} = R_I$, i.e. the areas for reimports and self-imports are eliminated. Figure 4 clarifies that only a few

Figure 4: Conditions for perfect dumping



data constellations permit perfect dumping in the sense of total domestic and foreign spatial price discrimination. This means all those combinations of differences from $p_0 - p_0^*$ and $f - f^*$ which are located at zero or exactly on the line AA', represent the possibility of perfect dumping, which is determined by the distance between the firm's location and the boundary.

Now we are able to formulate the monopolist's profit under perfect pricing information of the consumers. We must differentiate between reimports and self-imports:

Profit in the case of domestic reimports:

$$\begin{aligned} \Pi_{re} = B\Big\{ & \int_0^{R_{re}} \frac{1}{2b}(a - bk - bfr)^2 dr \\ & + \int_{R_{re}}^{R_I} (m_{re} - k)(a - bp^*(r)')dr \\ & + \int_{R_I}^{R} \frac{1}{2b^*}(a^* - b^*k - b^*f^*r)^2 dr \Big\} - K_f, \end{aligned} \tag{16}$$

with:

$$m_{re} = \frac{1}{2}(p_0^* + k - f^*R_I),$$

$$p^*(r)' = \frac{1}{2}(p_0 + k - f^*R_I) + f(R_I - r),$$

$$p_0 - p_0^* \neq R_I(f^* - f).$$

Profit in the case of foreign self-imports:

$$\begin{aligned} \Pi_{se} = B\Big\{ & \int_0^{R_I} \frac{1}{2b}(a - bk - bfr)^2 dr \\ & + \int_{R_I}^{R_{se}} (m_{se} - k)(a^* - b^*p(r)')dr \\ & + \int_{R_{se}}^{R} \frac{1}{2b^*}(a^* - b^*k - b^*f^*r)^2 dr \Big\} - K_f, \end{aligned} \tag{17}$$

with:

$$m_{se} = \frac{1}{2}(p_0 + k - fR_I),$$

$$p(r)' = \frac{1}{2}(p_0 + k + fR_I) + f^*(r - R_I),$$

$$p_0 - p_0^* \neq R_I(f^* - f).$$

In comparison to the profit function (11) under limited consumers' information, it is revealed that in (16) as well as in (17) the second integration term respectively differs from the condition for a profit maximizing spatial pricing ($\partial E/\partial m = 0$) and, therefore, the profit situations show the ranking $\Pi > \Pi_{se}$ and $\Pi > \Pi_{re}$.

IV. Conclusions and Summary

It appears to be appropriate to recall the optimum condition for dumping and reverse dumping respectively in the traditional approach and in the revised approach. We assume that consumers are completely informed about all market prices. Price discrimination can only then be reached perfectly when either the condition

$$p\left(1-\frac{1}{\eta}\right)=p^*\left(1-\frac{1}{\eta^*}\right)-fR, \qquad \text{(traditional approach)} \qquad (18)$$

R = distance between the markets, η = price elasticity of demand,

or the conditions

$$\partial E(m, r)/\partial m = 0, \forall\, r \ni 0 \leq r \leq R, \qquad \text{(revised approach)} \qquad (19)$$

$$P_0 - P_0^* = R_I(f^* - f) \qquad (20)$$

are fulfilled. While in equation (18) the market prices p and p^* represent the policy parameters of the monopolist, the condition (19) requires the determination of all mill prices and cif prices which depend on the distance. In equation (20) the transport costs (f, f^*), as well as the maximum prices (p_0, p_0^*) are exogenous variables for the monopolist, thus only R_I — the distance between the supplier's location and the boundary — remains as a policy variable. Of course, it is not necessary to relocate in odrer to vary R_I in such a way that equation (20) does not represent an unequation, but that it is fulfilled as a condition. It is sufficient to establish a basing point system in which the basing point must precisely be R_I^b distance units away from the boundary. If (20) is an unequation, e.g. $p_0 - p_0^* < R_I(f^* - f)$, for the condition $p_0 - p_0^* = R_I^b(f^* - f)$, we then have a distance R_I^b between the basing point and the boundary which is lower than R_I et vice versa. In contrast to the traditional model, the determination of the market prices represents a necessary, but not a sufficient condition for the supplier's profit maximum; in the revised approach we must also determine the basing point.

To summarize, it may be noted that the consideration of the variable "space" in the dumping problem leads to a more realistic formulation of the problem because we renounce the fiction of national spaceless markets. This modification shows us two major results: (1) Under the assumption of consumers' perfect pricing information, foreign self-imports or domestic reimports may occur in certain areas on both sides of the boundary and thus may lead to differences from the profit maximum of the monopolistic supplier. (2) This

— from the supplier's point of view — undesirable result may be corrected by establishing a basing point system. In the revised dumping model, the determination of the basing point is an additional policy variable.

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