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Sugeta, Hajime
Japan Society for the Promotion of Science : Research Fellow

https://doi.org/10.15017/4369973

出版情報：經濟學研究. 65 (1/2), pp.81-91, 1998-08-31. 九州大学経済学会
バージョン：
権利関係：

A Model of 'International Sales'

Hajime Sugeta

Abstract

This paper presents an explanation about why foreign dumping occurs in a model of monopolistic competition with imperfect information. The domestic and foreign monopolistically competitive firms compete in the domestic market and adopt mixed pricing strategies. The foreign dumping is defined as the pricing below the minimum average cost in the domestic market. The presence of the consumers that search for the lowest price only of the domestic firms causes the foreign dumping. The paper predicts the probability of the foreign dumping in terms of the number of consumers ignorant of the existence of s foreign store. Of course, if such type of consumers were absent, the foreign dumping would never occur.

1. Introduction

In the complicated real world, the price of good tends to be dispersed. Especially, in international markets, it is evident for price dispersion to be observed. The dumping practice by foreign firms can be characterized by such kind of price dispersion. Sometimes the foreign firms charge the price less than their own average costs. Such predatory dumping is called the "inter-temporal" dumping, where in the future, the firms raise their prices to normal level.

As pointed out by many economists, the "law of the single price" is no law at all. That law seems to be just an assumption for economic analysis to be made tractable. Since the seminal paper by George Stigler (1961), The Economics of Information, a number of economic theorists have set up the models to explain the above first observation as the result of equilibrium price dispersion. Therefore this paper tries to figure out that equilibrium price dispersion would result in the foreign dumping.

The paper by Salop and Stiglitz (1977), the "bargains and ripoffs", set up the model called "spatial" price dispersion; that is, some stores sell at the competitive price (minimum average cost) and other stores sell at a higher price and this type of price dispersion persistently continues. If consumers can learn from experience, this persistence of price dispersion seems rather implausible.

The more plausible model of price dispersion is proposed by Varian (1980), called "temporal" price dispersion. Each store randomizes its pricing strategy over time and, therefore, consumers cannot learn by experience about stores that consistently have low prices. Varian proves the existence of a mixed-strategy equilibrium in which all prices are charged with positive probability from the lowest (minimum average cost) to the highest (reservation price).

This paper extends the Varian's Model of Sales to the international framework and shows the possibility of the foreign dumping where the foreign firm may charge the price less than its minimum average cost. On the other hand, domestic firms, whose minimum average cost is lower than that of the foreign firm, would never charge the price at their minimum average cost and always charge the price above the foreign minimum average cost. This situation might be characterized by the limit-pricing strategy in the entry-deterrence model.

In the model to be described below, informed consumers in Varian's Model of Sales will be divided into two groups, internationally informed and domes-tically informed. The domestically informed consumers search for the lowest price among the domestic firms. Therefore the domestic firms are more advantageous than the foreign firm in the domestic market. Hence the foreign firm's sales behavior becomes more aggressive in the domestic market to capture the internationally informed consumers. Such kind of predatory behavior gives rise to the foreign dumping.

Since traditional dumping theory consists of an analysis of price discrimination between national markets by monopolist, this paper will be the first attempt to view dumping as a temporal price dispersion derived from informational product differentiation..

2. The Model

The n domestic firms and one foreign firm have a store in the domestic market and are selling a homogeneous product in that market. Each store is operating under and identical, strictly decreasing average cost curves denoted by $AC(q)$ where $AC'<0$. All domestic consumers have the same reservation price r. Each consumer is supposed to desire to purchase, at most, one unit of the homogeneous good. Consumers are classified into three types, domestically informed, internationally informed, and totally uninformed. Uninformed consumers visit a store at random without discriminating domestic and foreign stores and, if the price of the good charged by that store is less than r, the consumer purchase it. Internationally informed consumers go to the store charging the lowest price among the n domestic stores and one foreign store. Domestically informed consumers, on the other hand, go to the domestic store with the lowest price among the n domestic stores even though the foreign store were charging the lowest price internationally. Let I be the number of domestically informed consumers, I^* the number of internationally informed consumers where $I < I^*$ is assumed, and M the number of uninformed consumers. The number of uninformed consumers per store is therefore $U \equiv M/(n+1)$.

Each domestic store adopts the symmetric pricing strategy, that is, advertises a price p chosen at random from a density function $f(p)$. The foreign store, on the other hand, has a different density function from the domestic stores', denoted by $f^*(p)$, since the demands are asymmetric between domestic and foreign firms and this asymmetry might affect the foreign store's strategy.

The sales by some domestic firm is "internationally" successful if the advertised price turns out to be the lowest of the $(n+1)$ prices being offered: the demestic store attracts $I+I^*+U$ consumers. The sale by the domestic firm is "domestically" successful if the advertised price does not reach the internationally lowest price but if its price is the lowest of the n domestic Prices: the domestic store can get I+U consumers. Otherwise this domestic store gets only its share U of uninformed consumers.

On the other hand, the foreign store can get, at most, I^*+U consumers even though this store succeeds in an international sale. In this sense, the foreign store cannnot get an equal footing with the domestic firms under this information structure of demand side. If the foreign store fails in an international sale, then it get the same share U of uninformed consumers.

Finally, we assume the domestic market structure is monopolistically competitive. Therefore the free-entry will drive (expected) profits to zero. In the next section, we will investigate the monopolistically competitive equilibrium in pricing strategies.

3. The Analysis

Notice, first, the following lemma:

Lemma 1 The minimum average cost of the domestic firms are smaller than that of the foreign firm.

Proof: It is obvious from the assumption $AC'<0$ that the minimum average cost of the domestic firms, $p_L \equiv AC(I+I^*+U) < AC(I^*+U) \equiv p_L^*$, which is equal to the minimum average cost of the foreign firm.■

Figure 1 illustrates this situation. As in Varian's (1980) model, there are no point masses in

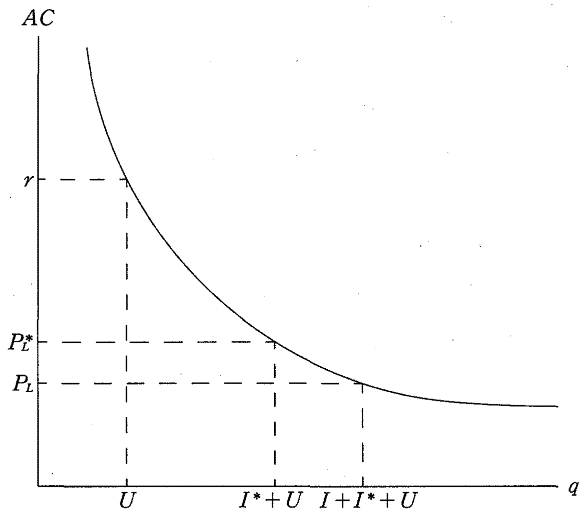

Figure 1 The minimum average costs

the equilibrium pricing strategies. So the cumulative distribution functions $F(p)$ and $F^*(p)$ for the density functions $f(p)$ and $f^*(p)$, respectively, are continuous on their supports $[\underline{p}, \overline{p}]$ and $[\underline{p}^*, \overline{p}^*]$; thus $f(p) = F'(p)$ and $f^*(p) = F^{*1}(p)$ alomst everywhere.

When a representative domestic store charges a prise p, $F(p)$ represents probability that the other domestic store charges a prise less than p. Thus the representative domestic store will succeed in international sales with probability $(1-F(p))^{n-1}\cdot(1-F^*(p))$, or it will fail in international sales but charge the lowest price among the domestic stores with probability $(1-F(p))^{n-1}\cdot F^*(p)$, or it will completely fail in sales with probability $1-(1-F(p))^{n-1}$. Therefore the expected profit of the representative domestic store is given by

$$\int_{\underline{p}}^{\overline{p}} \{\pi_s(p)\cdot(1-F(p))^{n-1}\cdot(1-F^*(p)) \\ +\pi_m(p)\cdot(1-F(p))^{n-1}\cdot F^*(p)+\pi_f(p)\cdot[1-(1-F(p))^{n-1})]\}f(p)dp, \tag{1}$$

where the profit of each state is given by, respectively,

$$\pi_s(p) \equiv (p-AC(I+I^*+U))(I+I^*+U);$$
$$\pi_m(p) \equiv (p-AC(I+U))(I+U);$$
$$\pi_f(p) \equiv (p-AC(U))U.$$

Similarly, the foreign store will succeed in international sales only if all the n domestic stores charges the prices greater than the price p charged by the foreign store. The probability of such an event will be given by $(1-F(p))^n$. Therefore the expected profit of the foreign store is given by

$$\int_{\underline{p}}^{\overline{p}} \{\pi_s^*(p)\cdot(1-F(p))^n+\pi_f^*(p)\cdot[1-(1-F(p))^n]\}f^*(p)dp, \tag{2}$$

where the profit of each state is given by, respectively,

$$\pi_s^*(p) \equiv (p-AC(I^*+U))(I^*+U);$$
$$\pi_f^*(p) \equiv (p-AC(U))U = \pi_f(p).$$

The maximization problem of the domestic store is to choose the density function $f(p)$ and that of the foreign store is to choose the density function $f^*(p)$ in a Nash fashion so as to maximize expected profits subject to the constraints:

$$f(p)\geq 0 \text{ and } \int_{\underline{p}}^{\overline{p}} f(p)dp = 1 \text{ for the domestic stores;}$$

$$f^*(p)\geq 0 \text{ and } \int_{\underline{p}^*}^{\overline{p}*} f^*(p)dp = 1 \text{ for the foreign store.}$$

The first-order condition for the representative domestic store is therefore given by

$$\begin{aligned}\pi_s(p)\cdot(1-F(p))^{n-1}\cdot(1-F^*(p))+\pi_m(p)\cdot(1-F(p))^{n-1}\cdot F^*(p)\\ +\pi_f(p)\cdot[1-(1-F(p))^{n-1})] = 0 \quad \text{if } f(p)>0.\end{aligned} \tag{3}$$

On the other hand, the first-order condition for the foreign store is also given by

$$\pi_s^*(p)\cdot(1-F(p))^n+\pi_f^*\cdot(p)\cdot[1-(1-F(p))^n] = 0 \quad \text{if } f^*(p)>0, \tag{4}$$

which gives rise to the cumulative distribution function of the representative domestic store:

$$1-F(p) = \left(\frac{\pi_f^*(p)}{\pi_f^*(p)-\pi_s^*(p)}\right)^{1/n} \tag{5}$$

Substituting this expression in the FOC for the domestic store yields

$$\begin{aligned}F^*(p) &= \left(\frac{\pi_f(p)}{\pi_s(p)-\pi_m(p)}\right)\cdot(1-F(p))^{1-n}+\frac{\pi_s(p)-\pi_f(p)}{\pi_s(p)-\pi_m(p)}\\ &= \left(\frac{\pi_f(p)}{\pi_s(p)-\pi_m(p)}\right)\cdot\left(\frac{\pi_f^*(p)}{\pi_f^*(p)-\pi_s^*(p)}\right)^{(1-n)/n}+\frac{\pi_s(p)-\pi_f(p)}{\pi_s(p)-\pi_m(p)}\\ &= \left(\frac{\pi_f^*(p)-\pi_s^*(p)}{\pi_s(p)-\pi_m(p)}\right)\cdot\left(\frac{\pi_f^*(p)}{\pi_f^*(p)-\pi_s^*(p)}\right)^{1/n}+\frac{\pi_s(p)-\pi_f(p)}{\pi_s(p)-\pi_m(p)}\end{aligned} \tag{6}$$

These FOCs are consistent with the zero profits due to free entry. We have derived the equilibrium distribution functions and these should be increasing in p.

Lemma 2 $\pi_f^*(p)/(\pi_f^*(p)-\pi_s^*(p))$ is strictly decreasing in p.

Proof: Differentiating the expression, we have to show that

$$(\pi_f^*(p)-\pi_s^*(p))U-\pi_f^*(p)(-I^*)<0.$$

This inequality is implied by means of the definitions of π_f^* and π_s^* and the assumption of $AC'<0$, that is, $AC(U+I^*)<AC(U)$.■

It follows from the above lemma that the equilibrium distribution function $F(p)$ is strictly increasing in p. It is technically difficult to prove that $F^*(p)$ is strictly increasing in p. So the analysis below is obeying the Varian's procedure.

Varian gives the following example. Suppose the store's cost function has fixed cost k and zero marginal cost. Then

$$\pi_s(p) = p(I+I^*+U)-k\,;$$
$$\pi_m(p) = p(I+U)-k\,; \qquad \pi_s^*(p) = p(I^*+U)-k\,;$$
$$\pi_f(p) = pU-k = \pi_f^*(p)$$

Hence we obtain the following Nash equilibrium cumulative distribution functions:

$$F(p) = 1-\left(\frac{k-pU}{pI^*}\right)^{1/n}; \tag{7}$$

$$F^*(p) = 1-\left(\frac{k-pU}{pI^*}\right)^{1/n}+\frac{I}{I^*} \tag{8}$$

Finally, we impose the boundary vanditions:

$$F(\underline{p}) = 0 \Longrightarrow \underline{p} = \frac{k}{U+I^*}\,;$$

$$F(\overline{p}) = 1 \Longrightarrow \overline{p} = \frac{k}{U}\,;$$

$$F^*(\underline{p}^*) = 0 \Longrightarrow \underline{p}^* = \frac{k}{U+(1+I/I^*)^n I^*}\,;$$

$$F^*(\overline{p}^*) = 1 \Longrightarrow \overline{p}^* = \frac{k}{U+(I/I^*)^n I^*}.$$

The results derived in the above analysis will be summarized by the following series of propositions.

Proposition 1 $\underline{p} = p_L^* > p_L$, that is, the lower bound of the support of F coincides with the minimum average cost of the foreign firm and the domestic firms never charges their prices at the minimum average cost which is the most efficient.

This result tells us that the domestic stores adopt the limit-pricing strategy because they have a cost-advantage in the sense that their minimum cost is lower than that of the foreign store.

Proposition 2 $\underline{p}^* < p_L^*$, that is, there exists a positive probability that the foreign store practices a dumping. Moreover, the probability of the dumping is given by

$$F^*(p_L^*) = \frac{I}{I^*} < 1.$$

If $I = 0$, that is, if there were not any consumers that seatch for the lowest price only of the domestic stores, then the probability of foreign dumping would be zero. Such kind of imperfect information causes the foreign dumping. Intuitively, the foreign store takes into sccount that the domestic stores know that the minimum average cost of the foreign store cannot be reduced below the lovel of p^*_L and they will never charge their price below that level. Therefore the foreign store's pricing strategy results in the predatory manner to attract the I^* consumers.

Proposition 3 As the number of the domestic firms, n, increases infinitely, $[\underline{p}^*, \overline{p}^*] \to [0, \overline{p}]$.

Proof: Since $I/I^* < 1, (I/I^*)^n \to 0$ and $(1+I/I^*)^n \to \infty$ and $n \to \infty$. Thus $\underline{p}^* \searrow 0$ and $\overline{p}^* \nearrow \overline{p}$ are obtained.■

The above result tells us the following intuition: the domestic market becomes more competitive, the more aggressively the foreign store will charge the price.

We now have the endogenous variables n, p_L, and p^*_L. First, we consider the case in which a store charges the reservation price, r. Then the store only gets the uninformed consumers, and so its profits must satisfy $\pi_f(r) = \pi^*_f(r) = 0$, which implies, together with $U = M/(n+1)$, that

$$\frac{rM}{n+1} - k = 0 \tag{9}$$

or

$$n = \frac{rM}{k} - 1. \tag{9'}$$

Thus

$$U = \frac{M}{n+1} = \frac{k}{r}. \tag{10}$$

Since $AC(q) = k/q$, we have

$$p_L = \frac{k}{I+I^*+k/r}; \quad p^*_L = \frac{k}{I^*+k/r}; \tag{11}$$

and

$$r = \frac{k}{U} = \overline{p} > \overline{p}^* = \frac{k}{U+(I/I^*)^n I^*} \tag{12}$$

Proposition 4 The domestic stores charge at most the reservation price while the foreign store can not charge as high prices as the domestic stores can.

The Nash equilibrium distribution functions are determined by

$$F(p) = 1 - \left[\left(\frac{k}{I^*}\right) \cdot \left(\frac{1}{p} - \frac{1}{r}\right)\right]^{1/n}; \tag{13}$$

$$F^*(p) = 1 - \left[\left(\frac{k}{I^*}\right) \cdot \left(\frac{1}{p} - \frac{1}{r}\right)\right]^{1/n} + \frac{I}{I^*} \tag{14}$$

The Nash equilibrium density functions are found by differentiating the above distribution functions:

$$f(p) = f^*(p) = F'(p) = F^{*\prime}(p)$$
$$= \frac{(k/I^*)^{1/n}}{n} \frac{(1/p-1/r)^{1/n-1}}{p^2} \tag{15}$$

Define

$$m \equiv 1-\frac{1}{n} = \frac{n-1}{n} = \frac{rM-2k}{rM-k}. \tag{16}$$

Then $f(p) = f^*(p)$ can be written as

$$f(p) = f^*(p) = \frac{k(k/I^*)^{1-m}}{(rM-k)} \frac{1}{p^{2-m}(1-p/r)^m}. \tag{17}$$

If n is sufficiently large, m will be approximately 1, so $f(p) = f^*(p)$ will be proportional to

$$\frac{1}{p(1-p/r)}.$$

This density function has an U-shape described in figure 2, that is, it is more likely that each store charges high and low prices than it does intermediate prices. This is quite intuitive: a store wants to charges high prices to exploit the uninformed and low prices to attract the informed. The support of the foreign firm lies below that of the domestic stores because the foreign firm has a disadvantage that it can not attract the domestically informed and because the competition for the internationally informed becomes keen. Hence the foreign firm is compelled to practice the foreign dumping.

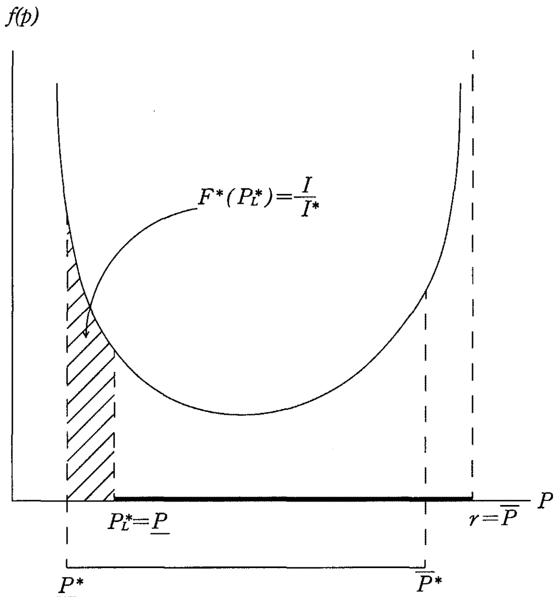

Figure 2 The approximated Nash eguilibrium density function

4. Policy Implications

In the above analysis, the assumptin that the number of foreign firm is just one while that of domestic firms are n seems to be unrealistic. However the following re-interpretation would make the model realistic. For example, consumers in the United State seem not to differentiate the products from the domestic, Japan, Germany, France, Italy, England, etc. But they would differentiate the product from the developing counties with the product from the above developed country. Such kind of product differentiation is defined as national product differentiation stemming from the informational product differentiation, that is, the consumers have been imperfectly informed about the quality of products. The inperfectly informed consumers tend to treat the products from the developing countries as the lower qualities even thought those products have the same quality as the ones from the developed countries.

Thus we re-interpret the model as the one that there exist k domestic firms, $n-k$ exporting firms from the developed countries, and one exporting firm from the developing country, like Japan, in the late 1950's. The exporting firm from the developing country tries to capture the totally informed consumers by charging the lower price than the other n firms. Therefore the dumping practice can be justified as the exporting strategy to acquire the some amount of market share.

From the viewpoint of domestic government, the presence of the partially informed consumers in the domestic causes the large number of domestic firms and exporting firms from the developed countries to charge the higher prices than their minimum average costs, p_L, which leads to the inefficiency in the domestic market. Therefor the polisy reducing the above national product differentiation should be highly promoted. For example, the deregulation of advertising the foreign product in the newspaper would make the partially informed consumers totally informed. Hence such kind of policy reduces the value of I and the probubility of dumping, I/I, approaches zero.

Moreover, policies that eliminata the domestically informed consumers, I, will improve the efficiency in the domestic market because the decrease of I to zero implies the positive probability that the domestic firms charge the prices in the range of $[p_L, p_L^*]$.

5. Concluding Remarks

The analysis above provides the reasonable exposition of the foreign dumping by the modified model of sales by Varian (1980). The crucial point is that there exist the partially informed consumers that have only the domestic price information while the totally informed consumers have the international price information since reducing the number, I, of partially informed consumers to zero gives rise to Varian's original model. This kind of informational asymmetry distorts the foreign and domestic firms' pricing strategies. That is, the domestic firms never charge their competitive price (i. e. minimum average cost) and the foreign firm charges the price less than its minimum average cost (i. e. the foreign dumping).

The analysis in the paper does depend heavily on the assumption that there exists only one foreign firm in the domestic market. This assumption seems to be unrealistic while there exist n domestic firms in the market. Therefore one way to extend the analysis is to allow n^* foreign firms in the domestic market. However this extension involves the technical difficulties with the analysis. To be more specific, the FOCs (or zero-profit condisions) become

$$\pi_s(p)\cdot(1-F(p))^{n-1}\cdot(1-F^*(p))^{n^*}+\pi_m(p)\cdot(1-F(p))^{n-1}\cdot F^*(p)$$

$$\cdot(1-F^*(p))^{n^*-1}+\pi_f(p)\cdot\left[1-(1-F(p)^{n-1})\cdot(1-F^*(p))^{n^*-1}\right]=0$$

$$\pi_s^*(p)\cdot(1-F(p))^{n}\cdot(1-F^*(p))^{n^*-1}+\pi_f^*(p)\cdot\left[1-(1-F(p))^{n}\cdot(1-F^*(p))^{n^*-1}\right]=0$$

These two simultaneous equations in F and F^* and hard to handle. So restricting the analysis to the triopoly case ($n=2$, $n^*=1$) and focusing on the more strategic aspect are the other better way of extension. In that case, it will be possible to discuss the strategic trade policy.

The model presented in the text takes the internationally and domestically informed and uninformed consumers as exogenously given. Therefore endogenizing the decision to get the

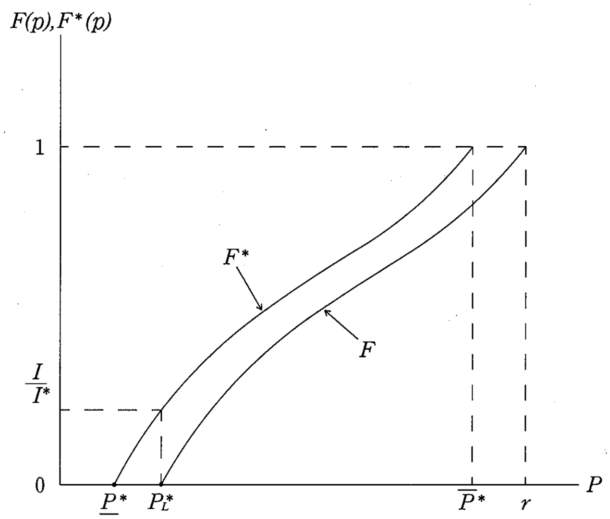

Figure 3 The Nash egulilibrium cumulative distribution functions

domestic price information and the international price information by introducing search process by the consumers is another way of extension. These extensions will be given to the future reseach.

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[Research Fellow of the Japan Society for the Promotion of Science]