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NETWORK EXTERNALITIES, LEXICOGRAPHIC DEMAND SHIFTS, AND MARGINAL COST DUMPING

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Abstract: In many cases, dumping involves a massive demand shift from domestic products to competing foreign products that are newly introduced to the domestic market. This study presents a new way of modelling such a demand shift relating to network externalities and demonstrates that the monopolistic supplier of a new product may sell at a price below the marginal cost. This result provides a new explanation for what may be called marginal cost dumping.

Key words: Network Externalities, Demand Shifts, Dumping.
JEL numbers: D42, F12.

1. INTRODUCTION

In 1972, Professor Michihiro Ohyama published his classical paper in this journal, which has served as a foundation for the theories of trade policy and regional agreements. Since then, he has been interested in GATT/WTO issues. As he points out in his stimulating work (Ohyama, 2002), the GATT/WTO regime has contributed significantly to the liberalization of world trade in the post-WWII era. Through the eight rounds of negotiations, tariffs have been reduced dramatically in developed countries. Because, however, the GATT/WTO has at the same time permitted safeguards and anti-dumping

Acknowledgements. This paper is dedicated to Professor Michihiro Ohyama, who recently retired from Keio University. We are highly grateful to Michihiro, who has held a guiding torch for Japanese trade and macro economists and, in particular, for us, who have alway tried to follow in his footsteps. We are also indebted to an anonymous referee for useful comments and to Professors Ronald Jones, Toru Kikuchi, and Takeyoshi Ohgai for helpful conversations and suggestions. This study is in part supported by grants from the Ministry of Education, Science, Sports, and Culture (C2-15530126), and The 21 century COE program, "Development of a Theory of Market Quality and an Empirical Analysis Using Panel Data" at Keio University.

measures against rapid increases in the volume of imports, as the use of tariffs becomes more difficult, safeguards and anti-dumping measures have come to be employed more and more frequently. As this fact shows, massive demand shifts from a domestic product to a newly imported product have become an important issue in the recent international trade relationship.

In many cases, dumping involves a massive discrete demand shift from a domestic product to a product of a developing country that is newly introduced to the domestic market. Domestic producers often perceive such a massive demand shift as a result of dumping, by which competitors from developing countries rapidly penetrate into the domestic market; we call such a phenomenon a *new-product dumping*. In such a dumping, it appears that the volume of import remains small until it reaches a certain threshold value. Once it reaches the threshold value, the volume of import increases very rapidly.

This study demonstrates that a dumping in such a case can be explained by means of the existence of network externalities. For this purpose, we assume that a network externality emerges when the number of users of a new product exceeds a critical mass. Given such network externalities, we demonstrate that the market demand shifts discontinuously from the existing product to the newly introduced product.

Our main result is that, facing this discontinuous demand curve, the monopolistic seller of the new product may create a shortage and sell at a price below the marginal cost. This result provides a new explanation for what may be called *marginal cost dumping*, i.e., the phenomenon that a foreign producer sells its product in the domestic market at a price below its marginal cost.[1] In the existing literature, it has been demonstrated that an exporting firm may engage in marginal cost dumping in a particular phase of its business in order to acquire gains in other phases.[2] This study, in contrast, demonstrates that a firm, facing a lexicographic choice behavior of consumers, may employ marginal cost dumping as a direct means of profit maximization in one particular phase of its business.

This study is not the first to examine a massive discrete demand shift that may occur at the time at which a new product is introduced into a market. Yano (2001) builds a model of a discrete demand shift with a representative agent. In that model, he assumes that the demand shift takes place in a lexicographic fashion. Between the existing product and the new product, at the first step, the agent compares the consumer surpluses from

[1] In addition to marginal cost dumping, at least two other types of dumping have been examined. The first is *price discrimination dumping*, i.e., foreign producers' selling their products at a price lower in the domestic market than in the foreign market (see, for example, Viner, 1923). The second is *average cost dumping*, i.e., their selling their products at a price below their average cost (see, for example, Ethier, 1982, and Clarida, 1993).

[2] Davies and McGuinness (1982) focus on uncertainty in export prices, sales maximizing firms and entry deterrance as a cause of marginal cost dumping. Gruenspecht (1988) points out that the exporters may cut prices in expectation of obtaining market experiences. Yano (1989) demonstrates that if expectations are created such that a future imposition of voluntary export restraint is likely, it drives the exporters to increase the amount of export before the restraint is actually imposed. Anderson (1992) shows this can lead to marginal cost dumping.

those products. If the surpluses are different, he chooses the product that gives the larger surplus. If the surpluses are equal, the consumer chooses the new product over the old product. This study provides an underlying mechanism for Yano's lexicographic demand shift by means of network externalities.

Our treatment of network externalities follows Katz and Shapiro (1985), who explain that network externalities are those which depend on the number of consumers who can purchase. In their model, however, they treat network externalities as positive consumption externalities, which do not have a clear distinction from herd effects, studied by Becker (1991). Focusing on the case in which a firm creates a shortage, Yano and Dei (2006) demonstrate that network externalities and herd effects have different effects on a firm's pricing strategy.[3]

In what follows, in Section 2, we explain stylized facts concerning real-world dumping cases. In Section 3, we build a model of a demand shift in which those stylized facts may be explained by the presence of network externalities and demonstrate the possibility of marginal cost dumping. In Section 4, we relate marginal cost dumping to price discrimination dumping (the phenomenon that a foreign producer sells at a lower price in a country to which it exports than in its own country).

2. STYLIZED FACTS OF A NEW-PRODUCT DUMPING

This study is built on several stylized facts concerning real-world dumping cases in which a foreign product is newly introduced to the home market. At the outset, we examine those stylized facts in detail.

2.1. Network externalities

First of all, many real world cases of anti-dumping and/or safeguard actions occur in association with a developing country's newly penetrating into a developed country's market. Those cases are often associated with network externalities and a massive demand shift from a home product to a newly introduced foreign product. In the latter half of the last century, for example, Japan was accused of dumping many products, such as TVs and other electronic products, in the U.S. market; recently, China has been accused of damaging the Japanese agricultural industry by rapidly expanding the volume of agricultural exports to Japan.

In such circumstances, it is natural that consumers in a developed country have psychological aversion against a new product from a developing country; consumers could be concerned with the quality of a newly imported product or its safety. It is also natural that the more widely consumers adopt such a product, the less the psychological aversion tends to become for that product. This implies the presence of network externalities, by which a broader use of a product enhances consumers' willingness to pay for that product.

[3] The literature on network externalities and herd effects has been expanding rapidly in such fields as finance and international trade. For a nice recent survey on the finance literature, see Bikhchandani and Sharma (2001). For the trade literature, see Harris (1995), who initiates a study of telecommunication and other network externalities. For more recent studies along that line, see Kikuchi (2002).

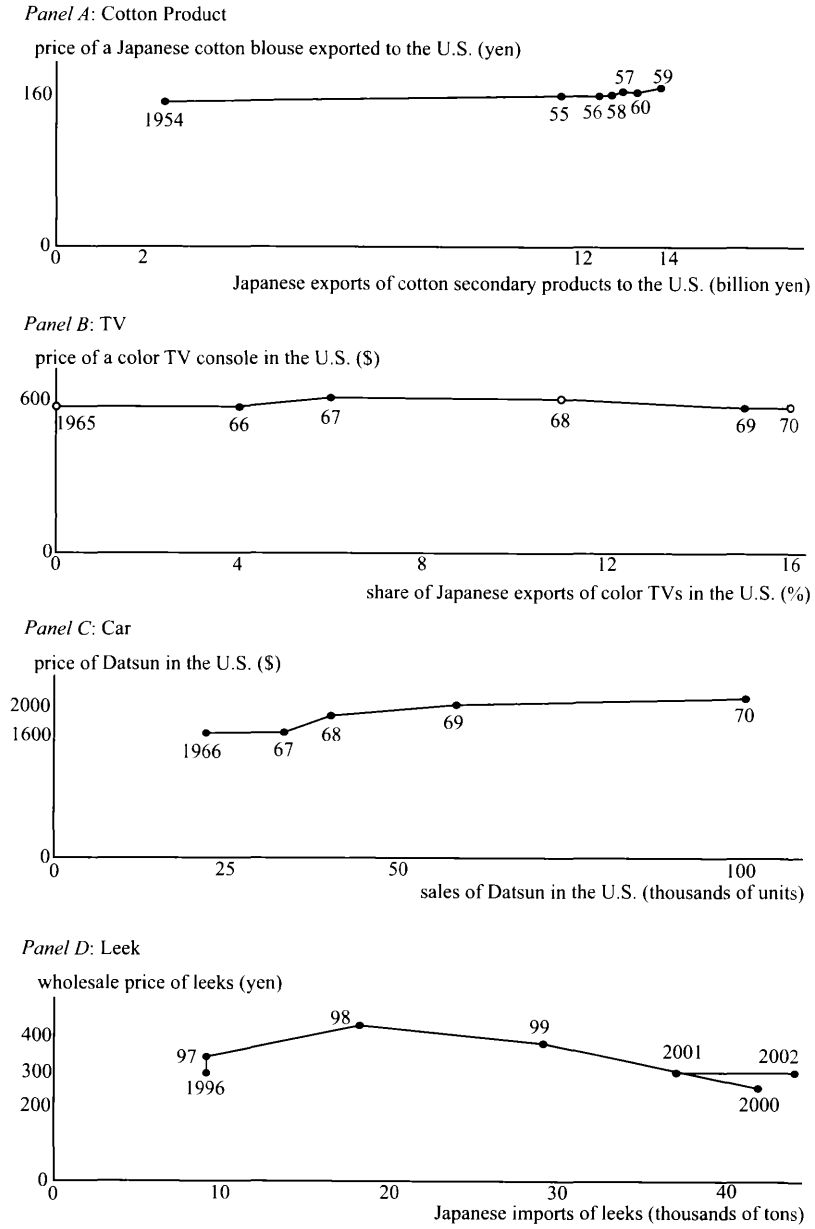

Figure 1.

The data on the Japanese exports of cotton products to the U.S. market in the 1950s suggests the presence of such network externalities. See Panel *A* of Figure 1, in which

the quantity of Japanese cotton secondary products exported to the U.S. and the price of a cotton blouse are measured along the horizontal and vertical axes, respectively.[4] As this panel shows, the Japanese cotton exports increased discontinuously in 1955 while the price remained relatively stable. From the theoretical viewpoint, such a discontinuous increase can be explained either by the presence of a supply shortage before 1955 or by a sudden shift of the demand curve to the right. Because the increase in 1955 is usually attributed to a demand decrease in the Asian and European markets, it is unlikely that there was a shortage for Japanese cotton products prior to 1955. If so, a strong presumption exists that supports that the increase in the U.S. demand for Japanese cotton products in 1955 is attributable to network externalities.

In many cases, business models are designed so as to ease the psychological aversion of a developed country's consumers against a developing country's product. In the early days of Japanese exportation of electronic products to the U.S. market, OEM was the most common method by which large U.S. discount stores purchased Japanese products of private labels.[5] In the case of Chinese exportation of agricultural products to Japan, Japanese trading companies actually go to China and teach Chinese farmers to grow produce that has qualities and safety specifications more easily acceptable for Japanese consumers.[6] These business models can be interpreted as devices for creating larger network externalities by easing an importing country's consumers' psychological aversion.

2.2. *Three phases of a new-product dumping*

Second, the process of a dumping in the real world that takes place at the time at which a new product is introduced into a home market can be divided into three different phases. The first phase takes place before the importation is started. In this phase, foreign producers learn technologies required to produce a product suitable and/or acceptable for the importing country's market. That was the case in many incidents of Japanese dumping to the U.S. market that took place over the third quarter of the last century; examples are cotton products (in the early 1950s), black and white TVs (in the late 1950s and the early 1960s), color TVs (1960s), cars (1970s), and so on. It is also the case in the recent incidents of Chinese dumping to the Japanese market. This suggests that before a dumping, the cost of producing a product that fits to the specifications desired in the importing country's market was prohibitively high. Dumping starts when foreign producers sufficiently master technologies to produce such a product.

The second phase takes place at the very beginning of a dumping. In this phase, the amount of import increases very rapidly. During the second half of the 1960s, for example, a large number of U.S. consumers shifted from a black-and-white TV

[4] The price and export data in Panel *A* are taken from Figures 10 and 4 in Yamada (1997), respectively.

[5] Japanese manufacturers produced private label color TVs. Sears taught Toshiba how to style its sets to attract the U.S. consumer and introduced a 16-inch color set made by Toshiba in 1964 and took on Hayakawa (Sharp) as a second source in 1965. Montgomery Ward took on Hayakawa (Sharp) while J.C. Penney took on Matsushita in 1966. See Porter (1983, pp. 467–471).

[6] See Kajimoto (2001).

to a color TV. This fact is indicated by the facts (1) that the percentage of the U.S. households that owned at least one black-and-white TV decreased from 89.6 in 1963 to 64.6 in 1969 and (2) that the percentage of the households that owned at least one color TV increased from 1.7 percent in 1963 to 30.4 percent in 1969 while that which owned more than one color TV was only 0.02 in 1963 and 1.5 in 1969 (see Porter, 1983, p. 480). These facts show the demand switch that took place in U.S. consumers. During the same period, (3) the share of Japanese color TVs in the U.S. market increased drastically; it was 0% in 1965, 4% in 1966, 11% in 1968 and 15% in 1969 (see Schwartzman, 1993, p. 111). This together with the increase in Japanese black-and-white TV exports prompted the U.S. government's ruling of dumping (see Ohgai, 1998). Similar rapid increases in the amount of imports is shown in other cases, as is shown in Figure 1.[7]

In the third phase, after an initial period of a rapid increase in imports, the amount of import increases only gradually. During this period of a gradual increase, the price of imports tends to stay fairly stable. In order to show this fact, Panel *A* of Figure 1 illustrates the way in which the price and quantity changed for a span of time after the import is initially introduced. As this panel shows, the price tends not to change significantly while the amount of import tends to increase steadily.

2.3. Stylized facts in pricing

In some real-world cases of dumping, it cannot be said that the prices of imported products were set abnormally low relative to that of import-competing products. In order to explain this fact, let us examine the price distribution of a product before and after the starting of the importation of the product from abroad. In Table 1, we summarize the prices of color TVs in the U.S. market that are listed in the 1966–1971 issues of *Consumer Reports*. Over that period, the share of Japanese color TVs in the U.S. increased from 0% in 1965 to 16% in 1970 (see Schwartzman, 1993, p. 111). In 1971, the U.S. government determined that the exportation of Japanese TVs was a violation of the anti-dumping act.

In those days, according to Ohgai (1999, 2003), Japanese TV manufacturers did not produce color CRTs with larger than 18-inch screens. Moreover, Ohgai presumed that the second group of manufacturers and retail chains in Table 1 purchased TVs of 18-inch table model from Japanese manufacturers on an OEM basis and resold them under their own brand names. With respect to the types of products listed in Table 1, the first group of manufacturers sold only products made in the U.S. The third group of Japanese manufacturers did sell their products under their own brand names. These facts imply that, of the price data in Table 1, only the 1968 and 1970 data reflect the prices of comparable TVs of U.S. and Japanese make. The data in the years other than 1968 and

[7] The price and share data in Panel *B* are taken from various issues of *Consumer Reports* and Table 6.5 in Schwartzman (1993), respectively. Because price data are available only for 1966, 1967, and 1969, each of the prices in 1965, 1968 and 1970 is the average of the neighboring values; this appears justifiable because, as Table 1 below shows, the prices of a particular type of TVs are fairly stable over the period. The price and sales data in Panel *C* are taken from various Buying Guide Issues of *Consumer Reports* and Tables 5.1 and 5.3 in Rae (1982), respectively. The price and import data in Panel *D* are taken from http://www.toukei.maff.go.jp/dijest/yasai/negi/negi.html. The data source for Panel *A* is given in footnote 4.

1970 are of U.S. products (with larger than 18-inch screens), which we include in order to provide a point of reference.

Although the data in Table 1 is not sufficient for making any statistically conclusive observations, it reveals several interesting features. First, it demonstrates that even for a rather narrowly defined type of TVs, the variation of prices is not ignorable; in 1967, for example, the average price of large-screen console TVs was about $612 with the standard deviation around $41. This price variation may be interpreted as a reflection of the taste of U.S. consumers who, even for one particular type of TVs, preferred to choose from a variety of products with different grades.

Next, the variation of prices for a type of products for which both Japanese and U.S. manufacturers competed is similar to that for a type of products which only U.S. manufacturers sold. That is to say, the coefficients of variation (ratio between standard deviation and mean) are 0.068 for the 1968 data and 0.060 for the 1970 data, both of which capture the prices of products manufactured by both U.S. and Japanese manufacturers, whereas the coefficients are between 0.065 and 0.111 for the other years' data, which reflects the prices of products manufactured only by U.S. manufacturers.

These facts suggest that U.S. consumers demanded that, for each type of TVs, a variety in quality be offered in terms of the coefficient of variation in the range over

Table 1. U.S. List Prices of Color TV Sets

		1965	1966	1967	1968	1969	1970
		21-inch Metal Cabinet	Large-screen Console	Large-screen Console	18-inch Table Model	Large-screen Console	18-inch Table Model
1st Group							
	Admiral	349.95	579.95	635	369.95	549.95	370
	Emerson	379.95	595			579.95	370
	General Electric	369.95	649.95	549.95	399.95	479.95	360
	Motorola		529.95	629.95		599.95	440
	Philco	369.95	699.95	579.95	380 #	529.95	390
	RCA	349.95	620 #	699.95	370 #	650 #	400 #
	Sylvania	349.5	519.95	579.95	359.95	599.95	370
	Westinghouse	359.95	549.95	649.95	429.95		
	Zenith	349.95	549.95	589.95	380 #	629.95	397
	average price of Group 1				384.26		387.13
2nd Group							
	Magnavox		650	625	398.5	598	
	Olympic				350 #	529.95	
	Packard Bell			629.95	369.95		410
	Sears	299.95 +	480 @	599.95 +	369.95 +	579.95 +	370 +
	Wards		539.95 +	579.95 +	329.95 +	579.95 +	360 +
	average price of Group 2 without Sears and Wards				372.82		410
3rd Group							
	Hitachi						380
	Panasonic						400
	Toshiba						410
	average price of Group 3						396.67
average price		353.23	580.38	612.46	375.68	575.63	387.64
standard deviation		22.92	64.33	40.54	25.62	46.91	23.16
coefficient of variation		0.065	0.111	0.066	0.068	0.081	0.060
Issue of *Consumer Reports*		Jan. 1966	Jan. 1967	Jan. 1968	Jan. 1969	Jan. 1970	Jan. 1971

Symbols #, + and @ mean approx., plus shipping, and in stores, respectively.

Source: List prices are taken from various issues of *Consumer Reports*.

0.06 to 0.11 and that, in the case of 18-inch screen TVs, the variety in quality that the imports from Japan provided was within the normal range that reflected U.S. consumers tastes. In that sense, therefore, it may be safe to state that Japanese TVs were not sold at abnormally low prices.

At the same time, the 1968 data suggests that Japanese TVs were sold at prices cheaper than U.S. products of comparable quality.[8] That is, the average price ($373) of products of three manufacturers in the second group, which had OEM contracts with Japanese manufacturers, is about 10 dollars cheaper than that manufactured by the first group firms. Prices of two retail chains in the second group are excluded because their prices are plus shipping.

Limited as it is, the price data summarized in Table 1 suggests that in the 1960s, during which the volume of Japanese color TV exports rapidly grew, Japanese color TVs were not priced at an abnormally low level. Rather, they took up a lower quality end of the variety of products that was normally offered to U.S. consumers with or without the direct competition between domestic and foreign products. There was a relatively narrow range of the prices of American and Japanese products in which a large number of consumers switch their demand from American products to Japanese products, which were newly introduced to the U.S. market; if, as Table 1 suggests, the American 18-inch screen TVs were sold at the average price of $384 in 1968, and if the comparable-size imports from Japan were sold at the average price of $373, one must conclude that the average cut-off price at which the demand shift occurred was within the narrow range between $384 and $373.

3. MARGINAL COST DUMPING

In this section, we will develop a model that can capture the stylized facts discussed in the previous section. The analysis below demonstrates that the three phases of a new-product dumping, discussed as stylized fact 2.2 in the previous section, can be explained by the introduction of a network externality (stylized fact 2.1) into the model of a demand shift capturing the pricing discussed as stylized fact 2.3. This reveals the possibility of a marginal cost dumping.

Think of two related products F and H. Product F is produced in the foreign country while product H is produced in the home country. Product F is introduced newly to the home country whereas product H is traded in the existing market for H. For the moment, assume that both F and H are sold only in the home country. In order to describe a switch in demand from product H to product F, assume that the consumers

[8] The 1970 data shows that Japanese TVs were of higher end quality among those on the market. It is more likely that the 1970 data is of the period in which the U.S. consumers' demand shift to Japanese products was more or less completed rather than of the initial period in which the U.S. consumers were actively shifting their demand to Japanese products. This may be supported by the fact that while the majority of color TVs imported by the U.S. were sold by the private label distributors such as Sears, JC Penny and Wards during the 1960s, in 1970 the private label distributors' share became less than 50% for the first time. See Wooster (1986) for a more detailed statistics.

do not use the two products at the same time. (In this setting, a demand shift from H to F can be thought of as those from black-and-white TVs to color TVs and from U.S. TVs to Japanese TVs.)

In Yano and Dei (2006), we introduce a division of consumption externalities into two types. One type is what we call a herd effect, which is defined as a consumption externality that depends on the quantity that the consumers desire to purchase. We call the other type a network externality, which is defined as a consumption externality that depends on either the quantity that the consumers can actually purchase or the number of the consumers who can actually purchase.[9]

In this study, we are concerned with a network externality that depends on the fraction of consumers who use a newly introduced product, i.e., product F in the present setting. That is, we assume that if the percentage of consumers who actually use a new product is below an exogenously fixed critical value, say $100\bar{\beta}\%$, that product is (or, at least, perceived as being) of no use. In order to incorporate this aspect in our model, assume that there is a continuum of identical consumers the total mass of which is equal to 1. Let w_F be an individual consumer's willingness to pay for product F, which depends not only on the amount of consumption, x_F, but also on the percentage of consumers who purchase F, denoted by β. It is assumed that

$$w_F = \begin{cases} w_F(x_F) & \text{if } \beta \geq \bar{\beta} \\ 0 & \text{if } \beta < \bar{\beta}. \end{cases}$$

Let $w_H(x_H)$ be an individual consumer's willingness to pay for x_H units of product H. Assume that H (the existing product) is traded at a price $\bar{p}_H$ in a perfectly competitive market, which is held constant. An individual consumer shifts his demand from the old product, H, to the new product, F, if he can obtain a consumer surplus from F at least as large as that which he currently obtains from H, $\bar{s}_H = w_H(\bar{x}_H) - \bar{p}_H\bar{x}_H$ where $w'_H(\bar{x}_H) = \bar{p}_H$. In other words, if p_F is the price of the new product, an individual consumer switches his demand from H to F if

$$w_F(x_F(p_F)) - p_F x_F(p_F) \geq w_H(\bar{x}_H) - \bar{p}_H\bar{x}_H$$

where $x_F = x_F(p_F)$ is the standard demand function determined by solving $w'_F(x_F) = p_F$.

Diagrammatically, the demand shift of an individual consumer can be described as follows. Initially, a consumer purchases the existing product, H, from the home producers. When the new product, F, is introduced to the market, he compares the consumer surplus that he can obtain by purchasing the old product, H, with that which he can obtain by purchasing the new product, F. If the surplus from the new product, F, is larger, the consumer chooses to purchase the new product, F. If it is smaller, he stays with the old product, H. Assume, moreover, that if they are equal, he prefers the newly introduced product, F, to the existing product, H.

[9] In this study, we do not explicitly distinguish network externalities from network effects; as Liebowitz and Margolis (1994) point out, such a distinction may be desirable for certain topics.

In Figure 2, we illustrate the way in which the demand shifts from H to F. Curve x_H illustrates the marginal willingness to pay for product H, $w'_H(x_H)$, whereas curve x_F depicts the graph of $w'_F(x_F)$, from which the marginal willingness to pay for F is derived. Let point P_H indicate the price of product H, $\bar{p}_H$. Point P_F indicates the price of F at which, given $\beta \geq \bar{\beta}$, the consumer can obtain the same amount of consumer surplus by purchasing product F as by purchasing product H at price P_H. Denote this price as $\bar{p}_F$.

Under this setting, as the price of the new product, F, falls from $p_F > \bar{p}_F$, the demand shifts suddenly from the old product, H, to the new product, given that the percentage of consumers who purchase the new product, 100β, exceeds $100\bar{\beta}$. For the sake of explanation, let the price of F is equal to $\bar{p}_F$. At this price, the demand for F is equal to $x_F(\bar{p}_F)$ if $\beta \geq \bar{\beta}$ and to zero if $\beta < \bar{\beta}$. If the price is below $\bar{p}_F$, the demand is on curve x_F. If it is above $\bar{p}_F$, the demand is zero. In the case in which the market demand for F, the new product, is $x_F(p_F)$, the demand for H, the old product, is zero. If the demand for the new product is zero, the demand for the old product is $x_H(\bar{p}_H)$. Thus, at the point at which the price of F falls to $\bar{p}_F$, the demand for F is suddenly created as much as $x_F(\bar{p}_F)$.

The above model of a demand shift extends to the many-consumer case the model of Yano (2001), which is based on the case of a representative agent. Yano's model can be described in the present setting by assuming $\bar{\beta} = 1$, i.e., that the network externalities are created only if all consumers purchase the new product rather than the old. In this case, the market demand curve for the new product is on the vertical axis for the range of $p_F > \bar{p}_F$ and on the part of curve $x_F(p_F)$ below and at point D for the range of $p_F \leq \bar{p}_F$. At the time at which p_F falls to $\bar{p}_F$, the demand suddenly shifts away from the old product, H, to the new product, F.

In this process, the representative consumer purchases the product from which he can obtain a larger consumer surplus if p_F is different from $\bar{p}_F$. If, instead, the consumer can obtain the same amount of a consumer surplus from H and F, he purchases the new

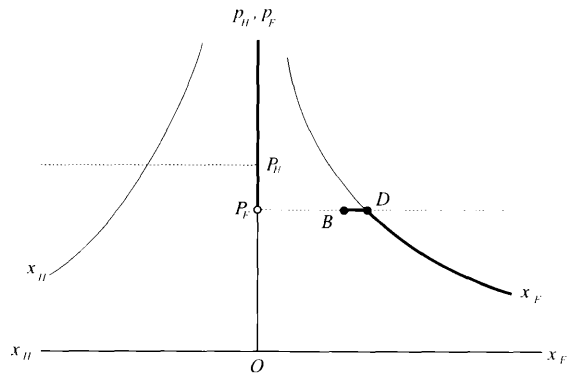

Figure 2.

product. For this reason, Yano (2001) calls this demand shift a lexicographic demand shift.

Return to the present case with a continuum of consumers. In the extreme case studied by Yano ($\bar{\beta} = 1$), the market demand curve for the new product makes a discrete jump from the vertical axis to point D on curve x_F. In the other extreme case ($\bar{\beta} = 0$), in contrast, the market demand curve for the new product has a horizontal part at $\bar{p}_F$, connecting the vertical axis to curve x_F; if the supply of the product is set between points P_F and D, say at S, $100[P_F S]/[P_F D]\%$ of the consumers purchase F, where $[XY]$ denotes the length of segment XY.

In order to illustrate the market demand curve for the general case of $0 < \bar{\beta} < 1$, let B be the point at which the length of segment $P_F B$ is equal to $100\bar{\beta}\%$ of the length of segment $P_F D$. If $0 < \bar{\beta} < 1$, the market demand consists of the vertical axis above $\bar{p}_F$, horizontal segment BD, the part of curve x_F below point D. This is because of the assumption that no demand exists for F if the percentage of consumers who purchase F is below $100\bar{\beta}\%$. If $100\bar{\beta}\%$ of the consumers each purchase $x_F(\bar{p}_F)$, every consumer desires to purchase $x_F(\bar{p}_F)$. Thus, so long as B is supplied at $\bar{p}_F$, the total demand of the consumers become $x_F(\bar{p}_F)$. Of all the consumers, only $100\bar{\beta}\%$ can actually purchase F. The rest purchases product H. Thus, in this case, the demand curve for F consists of the part of the vertical axis above P_F, horizontal segment BD, and the part of the demand curve below point D.

This process generalizes Yano's lexicographic demand shift to the case of $\bar{\beta} < 1$. So long as $\bar{\beta} > 0$ (i.e., so long as network externalities are present), the demand shift takes a lexicographic form, in which more than (or exactly) $100\bar{\beta}\%$ of the consumers purchase the new product at the price $\bar{p}_F$. If the price is different from $\bar{p}_F$, they purchase the product from which they can have a larger consumer surplus. Following Yano (2001), this study views this demand shift as reflecting a lexicographic social ordering, which implies that if $p_F \neq \bar{p}_F$, the consumers choose the product from which they can obtain a larger consumer surplus and that if $p_F = \bar{p}_F$ and $\beta < \bar{\beta}$, they prefer the old product, H, and that if $p_F = \bar{p}_F$ and $\beta \geq \bar{\beta}$, they prefer the new product, F.

We are now ready for analyzing the pricing of the foreign firm, which monopolistically supplies the new product to the home country's market . Given a lexicographic social ordering with respect to the choice between the old product and the new product, the firm faces the three-part demand curve, consisting of the part of the vertical axis above P_F, the horizontal segment between B and D, and the part of the demand curve x_F below D. This demand curve is reproduced in Figure 3.

The main result of this study is that, given the lexicographic shift in market demand, the foreign firm may sell its product, F, below its marginal cost. Assume that the marginal cost curve of product F is U-shaped, as is shown in Figure 3 by curve MC_F. Let $c(y_F)$ be the total cost function where y_F is the amount that the foreign firm sells in the home country.

In order to obtain the foreign firm's optimal pricing, it is useful to derive the marginal revenue curve from the three-part demand curve in Figure 3. Since the demand curve is horizontal between points B and D, the marginal revenue is constant at $\bar{p}_F$ and

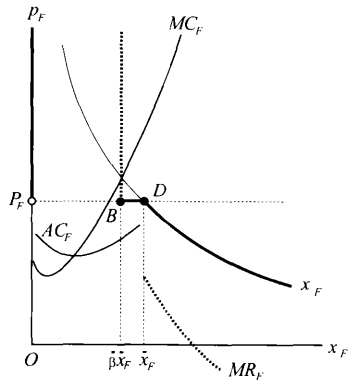

Figure 3.

coincides with segment BD between $\bar{\beta}\bar{x}_F$ and $\bar{x}_F = x_F(\bar{p}_F)$. If y_F exceeds $\bar{x}_F$, the marginal revenue becomes downward sloping and lies strictly below the demand curve x_F. The marginal revenue curve in this region is illustrated by curve MR_F. Since there is no demand for $y_F < \bar{\beta}\bar{x}_F$, it may be assumed that the marginal revenue curve is a vertical line on and above point B at $y_F = \bar{\beta}\bar{x}_F$.

The profit maximizing pricing is determined by the relationship between the marginal revenue curve and the marginal cost curve. Suppose that, as is shown in Figure 3, the marginal cost curve cuts the vertical part of the marginal revenue curve. In this case, so long as the profit condition is satisfied, it is optimal for the firm to sell $\bar{\beta}\bar{x}_F$ at price $\bar{p}_F$, which is below the marginal cost. The profit condition is satisfied if the average cost curve, AC_F, lies below or at point B, i.e., $\bar{p}_F\bar{\beta}\bar{x}_F \geq c(\bar{\beta}\bar{x}_F)$. Figure 3 illustrates this case. If the average cost curve lies above point B, it is optimal for the foreign firm not to sell in the home country.

The above result demonstrates the possibility that the monopolistic supplier of a new product may set its price below the marginal cost. In the case in which the supplier is a foreign company, this demonstrates the possibility of marginal cost dumping. In many real-world dumping cases, as is discussed in Section 2, a massive demand shift from an old product to a new product is followed by a subsequent increase in the demand for the new product. At the time at which the new product is introduced newly, its price can be significantly lower than the price of the old product. However, during the subsequent period of a demand increase, the price of the new product tends to be kept constant.

The above model explains such a phenomenon as a result of a gradual cost reduction that takes place in the production of the new product. For the sake of explanation, return to Figure 3. Think of a downward shift in the foreign firm's marginal cost curve. Suppose that the initial marginal cost curve is so high that the exporting the product to the home country is not profitable for the foreign firm. As the marginal cost curve shifts downward to the point at which the associated average cost curve goes through point B, the foreign firm starts selling in the home country. At that point, a massive demand

shift takes place from the home product to the foreign product. The product is sold at price $\bar{p}_F$. As the marginal cost curve shifts downwards, the price and the amount of exports stay unchanged at $\bar{p}_F$ and $\bar{\beta}\bar{x}_F$, respectively, until the marginal cost curve goes through point B. If the marginal cost curve shifts downwards further, the optimal point for the foreign firm shifts horizontally from point B to point D. During this process, the amount of exports increases from $\bar{\beta}\bar{x}_F$ to $\bar{x}_F$ while its price is kept constant at $\bar{p}_F$. This phase tends to last long. In other words, the price does not go below $\bar{p}_F$ unless the marginal cost curve shifts downwards sufficiently so that it intersects the downward sloping part of the marginal revenue curve. As this analysis shows, the present model captures the stylized fact associated with dumpings involving the introduction of a new product.

The main result of this study may be summarized as follows:

PROPOSITION 1. *In the presence of network externalities, the market demand for a new product makes a discrete shift from zero to a positive value (a lexicographic demand shift). In that case, the monopolistic producer of a new product (a foreign producer) may sell its product at a price below the marginal cost in the home country (marginal cost dumping).*

The above analysis shows that it can be optimal for a firm to create a shortage. That is, at $\bar{p}_F$, the demand for F is $\bar{x}_F$ whereas the supply is $\bar{\beta}\bar{x}_F$. This implies that a shortage is created as much as $(1 - \bar{\beta})\bar{x}_F$. This phenomenon, which Yano and Dei (2006) call an optimal shortage creation, is not a specific phenomenon in the case of network externalities. As Becker (1991) and Yano and Dei (2006) demonstrate, it can occur in the case of herd effects, which is defined as consumption externalities that depend on the amount that the buyers desire to purchase. Because, in the present setting, $\bar{\beta}$ captures the importance of a network size in creating positive consumption externalities, the state in which no network externalities are present can be captured by $\bar{\beta} = 0$. Even in that case, under the above setting, the consumers shift their demand from H to F at price $\bar{p}_F$. If the marginal cost curve intersects segment $P_F D$ in its middle, it is optimal for the firm to sell at the intersection. Even in this case, therefore a shortage is created.

4. PRICE DISCRIMINATION DUMPING AND MARGINAL COST DUMPING

The result in the previous section demonstrates that a firm may sell its product below the marginal cost. It does not, however, capture the price discrimination aspect of dumping, in which the foreign exporters sell their products at a higher price in their own country than in the country to which they export. In this section, we introduce the foreign country's market for product F and demonstrate the possibility that marginal cost dumping and price discrimination dumping can occur at the same time.

For the sake of simplicity, assume that the home product (H) is not sold in the foreign country. In Figure 4, the foreign country's demand curve for product F is depicted by the dotted curve x_F^* in Panel A. The rest of the structure of the model is the same as that in the previous section.

In Panel B, the home country's (aggregate) demand curve for product F that the foreign firm faces is depicted by the dotted three-part demand curve. In order to determine the optimal strategy of the firm, curve MR_F^* in Panel A depicts the marginal revenue in the foreign country's market. Curve MR_F in Panel B depicts the marginal revenue in the home country's market. In Panel C, curve MR depicts the aggregate marginal revenue curve, which can be derived by adding up curves MR_F and MR_F^* in the horizontal direction.

In Figure 4, as shown below, the foreign firm's optimal strategy is determined at the intersection (point E) between the aggregate marginal revenue curve, MR, and the marginal cost curve, MC_F. That is, it is optimal for the firm to sell $\bar{\beta}\bar{x}_F$ units of output at price P_F in the home country's market and $\bar{x}_F^*$ units at price P_F^* in the foreign country's market. Since the marginal cost at $\bar{\beta}\bar{x}_F + \bar{x}_F^*$ is above P_F, marginal cost dumping takes place. Since the price in the firm's own country, P_F^*, is higher than that in the country to which it exports (the home country), price discrimination dumping takes place as well.

In order to prove that point E actually captures the optimal strategy, as in the case of the previous section, the profit condition must be checked. In the case of this section, the profit condition implies that the producer surplus that the foreign firm obtains by selling in both countries is larger than that which it obtains by selling only in its own country (the foreign country). This is because, unlike in the case of the previous section, the firm can obtain a positive profit (by selling in the foreign country) if it chooses not to sell in the home country.

In order to check the profit condition, curve MR_F^* in Panel A is copied to Panel C. If the foreign firm chooses to sell only in the foreign country, it is optimal to sell z^* units at the intersection between curve MC_F and curve MR_F^* in Panel C. In that case, the firm's producer surplus is captured by the gray area (the area surrounded by curve MR_F^*, curve

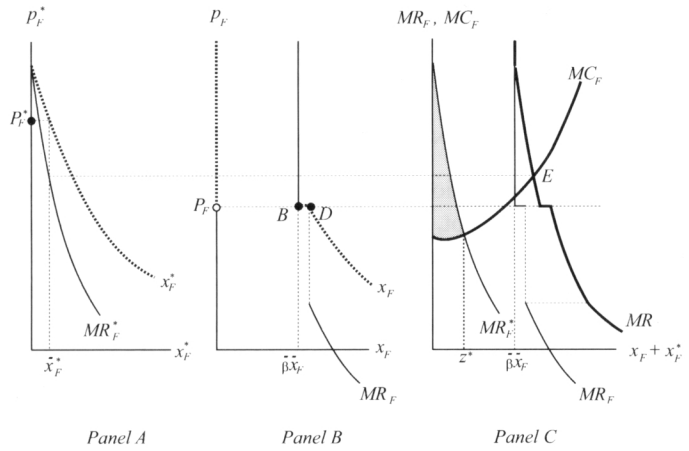

Figure 4.

MC_F, and the vertical axis). If, in contrast, the firm sells in both countries, the surplus is equal to the sum of (1) the area surrounded by the price line through P_F, curve MC_F, and the vertical axis and (2) the area surrounded by the vertical line through point $\bar{\beta}\bar{x}_F$, curve MC_F, and curve MR minus (3) the area surrounded by the price line through P_F, curve MC_F and the vertical line through point $\bar{\beta}\bar{x}_F$. In Figure 4, this is larger than the gray area. Thus, the firm's optimal is to sell $\bar{x}_F^*$ units at price P_F^* in the foreign country and to sell $\bar{\beta}\bar{x}_F$ units at price P_F, which is below both P_F^* and the marginal cost at $\bar{\beta}\bar{x}_F + \bar{x}_F^*$; i.e., marginal cost dumping and price discrimination dumping occur at the same time.

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