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TRADE LIBERALIZATION, PRODUCT QUALITY AND CONSUMERS' WELFARE UNDER MONOPOLISTIC COMPETITION

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Abstract: This paper examines the effects of trade liberalization on the quality of products and on the welfare of consumers in the domestic country under a monopolistic competition in which the quality of products is endogenously determined by firms. If the fixed cost for the firms is positive and increasing with respect to quality (or identically zero), trade liberalization lowers (or does not affect) the quality of products. The falling in the product quality through trade liberalization lowers the welfare of consumers in the domestic country if the utility cost for consumers per distance from their best product location is small relatively to the derivative of the fixed cost function with respect to quality.

1. INTRODUCTION

In imperfectly competitive industries, the quality of products as well as prices and quantities is important for welfare of consumers, and plays a significant role for the structure and performance of markets. In this paper I examine the effects of trade liberalization on the quality of products and on the welfare of consumers in the domestic country under a monopolistic competition in which the quality of products is endogenously determined by firms. There are some studies about the effects of trade liberalization (or economic integration) under imperfect competition. Eldor and Levin (1990) have studied the welfare effects of a partial trade liberalization by a quota in a monopoly, and have shown that the welfare of the domestic country is lowered by a partial trade liberalization due to a loss of monopolistic rent. Fung (1992) has examined the effects of economic integration by tariff reduction on competitiveness of an industry under an international duopoly, and has shown that, if the foreign firm is the high (or low) cost producer, economic ingegration retard (or enhance) competition.

In this paper I consider a model of monopolistic competition on a circle according to Salop (1979) in which domestic and foreign firms produce differentiated products, and I allow that the quality of the products is endogenously determined

by the firms.[1] Trade liberalization in this paper is characterized as the entry of foreign firms into the domestic market of this monopolistically competitive industry.

In Section 2 I present the closed economy model of monopolistic competition with endogenous quality, and consider the conditions for the optimal price and quality choice by firms. In Section 3 I examine the effects of trade liberalization on the prodct quality. I will show that if the fixed cost for the firms, which depends on the quality of the products, is positive and increasing with respect to quality (or identically zero), trade liberalization lowers (or does not affect) the quality of the products. In Section 4 I examine the effects of trade liberalization on the welfare of consumers in the domestic country. I will show that the falling in the product quality through trade liberalization lowers the welfare of consumers in the domestic country if the utility cost for consumers per distance from their best product location is small relatively to the derivative of the fixed cost function with respect to quality. Section 5 concludes this paper.

In this paper I assume that the numbers of firms in both countries are not changed by trade liberalization, and I focus attention to the effects of trade liberalization or opening of markets on the quality of goods and the welfare of consumers. The analysis of the effects of trade liberalization under free entry is a problem for future research.

2. THE CLOSED ECONOMY MODEL

Consider a monopolistically competitive industry in which n firms produce differentiated products whose quality is endogenously determined by the firms. The (products of the) firms and (most preferred products of) a continuum of uniformly distributed consumers locate along a circle of unit circumference. n firms are equally spaced, so each two firms are separated by the distance $1/n$.[2]

Each consumer buys a single, non divisible unit of a differentiated product from one or the other of the firms adjacent to his preferred location. Consumers can observe the quality of products.[3] The surplus for a consumer derived from buying a product that is a distance y from the best location on the circle for the consumer depends on the price and quality of the product and the distance. The relationship is represented as

$$v = h(q) - p - ty$$

where $h(q)$ represents the utility for the consumer derived from consuming a product whose quality is q (>0), and t (>0) denotes the utility cost per unit

[1] Salop's model with exogenous quality has been applied to international economic problem by Dornbusch (1987) to analyze the effects of exchange rate movements on the prices of products.

[2] Reitzes (1992), using a similar model, studies quality choice by firms in an international duopoly.

[3] In this paper I do not consider imperfect observability of quality or imperfect information. Some authors have studied trade and trade policy problems under imperfect observability of quality. See, for example, Donnenfeld (1986) and Falvey (1989).

distance from the best location. I assume

$$h'(q)>0 \qquad \text{and} \qquad h''(q)<0$$

Denote by x_1 the distance between a product of one firm and a consumer for whom the product of this firm and the product of the one of the adjacent firm are indifferent. Then, denoting the price and quality of the product of this firm by p and q, and the price and quality of the adjacent firm by p_1 and q_1, we have the following relationship:

$$h(q)-p-tx_1=h(q_1)-p_1-t\left(\frac{1}{n}-x_1\right)$$

From this we obtain

$$x_1=\frac{1}{2t}[h(q)-h(q_1)-p+p_1]+\frac{1}{2n} \tag{1}$$

x_1 represents the market segment for this firm in one direction. Similarly, let x_2 denote the distance between this firm and a consumer for whom the product of this firm and the product of another adjacent firm are indifferent. Then we obtain

$$x_2=\frac{1}{2t}[h(q)-h(q_2)-p+p_2]+\frac{1}{2n} \tag{2}$$

From (1) and (2) we have

$$\frac{\partial x_1}{\partial p}=\frac{\partial x_2}{\partial p}=-\frac{1}{2t}$$

and

$$\frac{\partial x_1}{\partial q}=\frac{\partial x_2}{\partial q}=\frac{1}{2t}h'(q)$$

I assume that all firms have the same cost function. Then, we can consider that in an equilibrium the quality and prices of all products are equal, and the market segments for all firms in each direction are equal.

The cost function for a firm is described by

$$c(q)(x_1+x_2)+f(q)$$

where x_1+x_2 is the output of a firm which equals its total market segment. $c(q)$ is unit production cost which depends on the quality of the product, and $f(q)$ is fixed cost which is unrelated to production, but depends on the quality of the product.

I assume the following relations:

$$c'(q)>0 \qquad \text{and} \qquad c''(q)\geq 0$$

and

$$f'(q)>0 \quad \text{and} \quad f''(q)\geq 0\,, \quad \text{if } f(q)>0$$

$f(q)$ may be identically zero. The marginal production cost for each firm given the quality of its product is constant, but the cost for quality increment is increasing and convex with respect to the quality. The fixed cost, if it is positive, is increasing and convex with respect to the quality. The profit of a firm is represented by

$$\pi=(x_1+x_2)[p-c(q)]-f(q)$$

Each firm simultaneously chooses the price and quality of its product to maximize its profit given the prices and quality of the products of all other firms.

The first order conditions for the optimal price and quality choice for a firm are

$$\frac{\partial\pi}{\partial p}=(x_1+x_2)-\frac{1}{t}[p-c(q)]=0 \tag{3}$$

and

$$\frac{\partial\pi}{\partial q}=\frac{1}{t}[p-c(q)]h'(q)-(x_1+x_2)c'(q)-f'(q)=0 \tag{4}$$

From (3) we get

$$p-c(q)=t(x_1+x_2)$$

Substituting this into (4), we obtain

$$(x_1+x_2)[h'(q)-c'(q)]-f'(q)=0 \tag{5}$$

The second order conditions are

$$\frac{\partial^2\pi}{\partial p^2}=-\frac{2}{t}<0\,,$$

$$\frac{\partial^2\pi}{\partial q^2}=(x_1+x_2)[h''(q)-c''(q)]-f''(q)-\frac{2}{t}h'(q)c'(q)<0 \tag{6}$$

and

$$\left(\frac{\partial^2\pi}{\partial p^2}\right)\left(\frac{\partial^2\pi}{\partial q^2}\right)-\left(\frac{\partial^2\pi}{\partial pq}\right)^2=-\frac{2}{t}\{(x_1+x_2)[h''(q)-c''(q)] -f''(q)+\frac{1}{2t}[h'(q)-c'(q)]^2\}>0 \tag{7}$$

where

$$\frac{\partial^2\pi}{\partial pq}=\frac{1}{t}[h'(q)+c'(q)]$$

I assume that the second order conditions hold globally over the region of interest.

From (5) we find

$$h'(q)-c'(q)>0\,, \qquad \text{if} \quad f(q)>0 \tag{8}$$

and

$$h'(q)-c'(q)=0\,, \qquad \text{if} \quad f(q)\equiv 0 \tag{9}$$

We have

$$[h'(q)-c'(q)]^2\geq 0$$

So, from (7), we obtain

$$(x_1+x_2)[h''(q)-c''(q)]-f''(q)<0 \tag{10}$$

I assume that there exists an equilibrium in which the price and quality of the products are positive and bounded. Denote the equilibrium price and quality by p and q. Then, in an equilibrium, we have $p_1=p_2=p$ and $q_1=q_2=q$. From (1), (2) and (3), we obtain

$$p=c(q)+\frac{t}{n} \tag{11}$$

and

$$x_1+x_2=\frac{1}{n} \tag{12}$$

In an equilibrium (5) and (10) are reduced to

$$\frac{1}{n}[h'(q)-c'(q)]-f'(q)=0 \tag{13}$$

and

$$\frac{1}{n}[h''(q)-c''(q)]-f''(q)<0 \tag{14}$$

(11), (12), (13) and (14) are the conditions for the equilibrium for the monopolistically competitive industry.

3. TRADE LIBERALIZATION AND PRODUCT QUALITY

In this section I examine the effects of trade liberalization on the product quality. Trade liberalization in our model is characterized by the entry of foreign firms into the monopolistically competitive industry. Consider two countries, the domestic country and the foreign country, and a monopolistically competitive industry in which n domestic firms and n^* foreign firms produce differentiated products whose quality is endogeneously determined. For simplicity I consider

only the domestic market. The structure of the domestic market is as described in the previous section. $N\,(=n+n^*)$ domestic and foreign firms are equally spaced by the distance $1/N$. I assume that all domestic and foreign firms are identical, that is, they have the same cost function. Also I assume that there is no transportation cost, traiff and other trade barriers. Each domestic and foreign firm simultaneously chooses the price and quality of its product to maximize its profit given the price and quality of the products of all other firms. Then, we can obtain the equilibrium conditions in the international monopolistic competition by replacing the number of firms (and products) in the closed economy model in the previous section, n, by N. I examine the effects of trade liberalization on the product quality and on the consumers' welfare by considering the effects of an increase in the number of firms, N, through an increase in the number of the foreign firms, n^*.

The equilibrium conditions for the monopolistically competitive industry, (11), (12), (13) and (14) are rewritten as

$$p=c(q)+\frac{t}{N}, \tag{15}$$

$$x_1+x_2=\frac{1}{N}, \tag{16}$$

$$\frac{1}{N}[h'(q)-c'(q)]-f'(q)=0 \tag{17}$$

and

$$\frac{1}{N}[h''(q)-c''(q)]-f''(q)<0 \tag{18}$$

Denote

$$F(q, N)=\frac{1}{N}[h'(q)-c'(q)]-f'(q)$$

Then, we obtain

$$\frac{\partial F}{\partial q}=\frac{1}{N}[h''(q)-c''(q)]-f''(q) \tag{19}$$

From (18) we find

$$\partial F/\partial q<0$$

This is due to the second order condition for the firms, or in other words, due to that the profit of each firm is concave at the equilibrium quality. Consider the case where $f(q)$ is positive (and increasing and convex with respect to quality). From (17) we have

$$h'(q)-c'(q)=Nf'(q)>0 \tag{20}$$

Then, we get

$$\frac{\partial F}{\partial N}=-\frac{1}{N^2}[h'(q)-c'(q)]<0 \tag{21}$$

This is due to that, as the number of firms increases, the market segments for the firms shrink, and their marginal profit with respect to quality (excluding the fixed cost) decreases. Then, we find that $F(q)$ is decreasing in q and N. If n^*, and so N, increases, q must fall to satisfy $F(q, N)=0$. Hence an increase in N lowers q. From (19) and (21) we obtain

$$\frac{dq}{dN}=-\frac{\partial F/\partial N}{\partial F/\partial q}=\frac{\frac{1}{N^2}[h'(q)-c'(q)]}{\frac{1}{N}[h''(q)-c''(q)]-f''(q)} \tag{22}$$

Next assume $f(q)\equiv 0$. We have

$$h'(q)-c'(q)=0$$

Then we find

$$\frac{\partial F}{\partial N}=0$$

This is due to that, if the fixed cost is zero, the marginal profit with respect to quality (excluding the fixed cost) equals zero at the equilibrium quality. In this case a change in N does not affect q. From these arguments we obtain the following proposition.

PROPOSITION 1. *If the fixed cost for the firms is positive and increasing with respect to quality, trade liberalization lowers the quality of the products. On the other hand, if the fixed cost is identically zero, trade liberalization does not affect the quality of the products.*

4. TRADE LIBERALIZATION AND CONSUMERS' WELFARE

In this section I examine the effects of trade liberalization on the welfare of consumers in the domestic country. The welfare of consumers (or consumers' surplus) in the domestic country is represented by

$$CS=2N\int_0^{1/2N}[h(q)-p-ty]dy=h(q)-p-\frac{t}{4N}$$

Substituting (15) into this, we obtain

$$CS = h(q) - c(q) - \frac{5t}{4N} \tag{23}$$

Differentiating CS with respect to N yields

$$\frac{dCS}{dN} = [h'(q) - c'(q)]\frac{dq}{dN} + \frac{5t}{4N^2}$$

Substituting (20) and (22) into this, we obtain

$$\frac{dCS}{dN} = \frac{[f'(q)]^2}{\frac{1}{N}[h''(q) - c''(q)] - f''(q)} + \frac{5t}{4N^2} \tag{24}$$

The first term represents the reduction in the consumers' welfare due to the falling of the product quality, on the other hand the second term represents the increase in the welfare due to the increase in the number of products. (24) may be negative if t, which is the utility cost per distance from consumers' best product location, is small relatively to $f'(q)$. Thus we obtain

PROPOSITION 2. *If the utility cost per distance from consumers' best product location is small relatively to the derivative of the fixed cost function of the firms with respect to quality, trade liberalization lowers the welfare of consumers in the domestic country.*

An example

Now consider an example. Assume

$$h(q) = q^{\varepsilon}, \quad 0 < \varepsilon < 1,$$
$$c(q) = cq$$

and

$$f(q) = fq$$

where c and f are constants. These are a strictly concave utility function, a linear variable productions cost function, and a linear fixed cost function. Then, we have

$$h'(q) = \varepsilon q^{\varepsilon - 1},$$
$$h''(q) = \varepsilon(\varepsilon - 1)q^{\varepsilon - 2},$$
$$c'(q) = c,$$
$$f'(q) = f,$$
$$c''(q) = 0,$$

and

$$f''(q) = 0$$

From (20) we obtain

$$\varepsilon q^{\varepsilon-1}-c=Nf$$

The equilibrium quality is obtained as

$$q=A^{1/(1-\varepsilon)}$$

where

$$A=\frac{\varepsilon}{c+Nf}$$

Then we have

$$h''(q)=\varepsilon(\varepsilon-1)A^{(\varepsilon-2)/(1-\varepsilon)}$$

Substituting these into (24) and arranging terms, we obtain the condition for $dCS/dN<0$ as follows

$$f^2>\frac{5t}{4N^3}\varepsilon(1-\varepsilon)A^{(\varepsilon-2)/(1-\varepsilon)} \tag{25}$$

This is the condition for the consumers' welfare to fall by trade liberalization. Therefore, if f is sufficiently large, or t is sufficiently small so that (25) is satisfied, trade liberalization lowers the welfare of consumers in the domestic country.

5. CONCLUSION

In this paper I have examined the effects of trade liberalization on the quality of products and on the welfare of consumers in the domestic country under a monopolistic competition in which the quality of the domestic and foreign products is endogenously determined by firms. I have shown that, if the fixed cost for firms is positive and increasing with respect to quality, trade liberalization lowers the quality of products. This is due to that an increase in the number of firms through trade liberalization reduces the market segments for firms, and then their marginal profit (excluding the fixed cost) decreases. Also I have shown that the falling in the product quality through trade liberalization lowers the welfare of consumers in the domestic country if the utility cost per distance from consumers' best product location is small relatively to the derivative of the fixed cost function with respect to quality.

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