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單一空間定價策略之福利比較的再探討

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Welfare Comparisons of Mill and Uniform Pricing: A Revisited

Among many pricing policies in the context of the spatial market, the relative economic advantage of the two simple ones[1], namely *mill* pricing and *uniform* pricing, is the first to receive the attention in the literature. Under mill pricing transportation costs are paid by the consumer, while under uniform pricing, the firm pays for such expense. The first attempt made by Smithies (1941) shows among others that the firm is indifferent between the two pricing policies if demand is linear, whereas profit is greater (smaller) under mill pricing than uniform pricing if demand is concave (convex). (See also Stevens and Rydell, 1966). The analysis of Smithies (1941) is conducted with a set of assumptions, including (S1) the market area, a firm actually serves, is fixed and equal under alternative pricing policies, namely the *fixed market area assumption*; and (S2) the buyers are uniformly dispersed over space.

In an oft-cited revisited paper of spatial price theory, Beckmann (1976) extends the analysis of Smithies (1941) to include other economic benefit comparisons in addition to profits under alternative spatial pricing policies. One additional assumption made by Beckmann (1976) is that (B1) individual demands are of a linear form, but (B2) the shape of spatial buyer distribution is allowed to be a general form instead of uniform. It shows among others that both the firm's profit and the total output sold are invariant to simple pricing policies, but the level of social welfare, as measured by the sum of the profit and consumers' surplus, is higher under mill pricing than uniform pricing.

A recent paper by Cheung and Wang (1996) attempts to reexamines the welfare comparisons of the two simple pricing policies in a more general context. Much is to say, Cheung and Wang (1996) relax the assumption (B1) by a general demand function without any specific form, and thereby, their analysis is conducted with two general functions, one

[1] Simple price policy refers to the case that the firm charges a constant price while another type is spatial price discrimination under which different mill prices are selected over space. It is worthy pointing out that since the appearance of Greenhut and Ohta (1972) and Holahan (1975), effects of movement from spatial price discrimination to mill price has received much attention in the literature (see, for example, Hwang and Mai (1990) and the literature cited therein), but less effort has been devoted to theory of simple monopoly price policies. For example, some attempts have been devoted recently to the economic effect of spatial price discrimination when the firm's location is variable (see Hwang and Mai (1990), Claycombe (1996), and Tan (2001))

is the consumer demand, and the other, the distribution of buyers over space. Five propositions as well as some corollaries are provided, and all of which, similar to Smithies' (1941), are dependent upon the shape of consumer demand.

Maybe the model studied by Cheung and Wang (1996) has too many general function forms. Some of their conclusions are inconsistent with those previously obtained by prior studies. For example, they claim that the level of social welfare under uniform pricing is lower (higher) than those under mill pricing when the individual local demand is convex (concave). A natural deduction from this result is that the resultant social welfare is invariant to simple spatial pricing policies when demand is linear. This is in sharp contrast to Beckmann's finding mentioned above. In this research, we attempt to revisit the welfare comparison of mill pricing as compared with uniform pricing instead in a world with both the consumer demand and the buyer distribution over space are of a general but specific function form. The consumer demand function can be linear, convex, or concave; and the shape of the consumer distribution can be uniform or not. Our purpose is to provide some correct conclusions on welfare comparison of two simple pricing policies

The organization of this paper is as follows: In Section 2, we present our model in which the individual demand function is allowed to be linear, convex or concave, depending on a parameter of the function form. In Section 3, we present the optimal prices and market areas of the two simple price policies, and relate those to the shape of the demand function. Section 4 is devoted to a comparative study of the relative economic benefits of the two simple pricing policies, including monopoly output, profits, the aggregate benefits of consumers, and social welfare. We will examine in detail the robustness of the results obtained by prior studies. Section 5 contains some concluding remarks.

2. BASIC MODEL

Consider a linear spatial market over which consumers are continuously and uniformly distributed. A monopolist sells a homogeneous product subject to a strictly positive and constant freight, say t. The demand is given by

$$(1) \qquad q(x) = f(p) = (a - bp)^{(1/v)}$$

where x denotes the distance from the seller's mill, $q(x)$ = the quantity demanded at the market site x, p = the *delivered* price--the amount a consumer shall pay for a unit of commodity, and a, b as well as v are positive parameters of the demand function. While examining spatial (total) demands under competition, Greenhut, Hwang, and Ohta (1975) have demonstrated that Equation (1) "is, in fact, completely general" for the purpose of spatial price theory (see fn. 10, p. 673 for their argument). Greenhut (1977) has also employed Equation (1) to examine the output effect of spatial price discrimination as compared with mill pricing. Moreover, Equation (1) implies that

$$(2) \qquad f'' = \partial^2 f(p)/\partial p^2 = [b^2(1-v)/v^2](a-bp)^{(1/v-2)}$$

since $f' = \partial f(p)/\partial p = (-b/v)(a-bp)^{[(1-v)/v]}$. Thus, $v<1$, $v=1$, and $v>1$ respectively yields that f'' is greater than, equal to, or less than zero and thereby, demand curves are convex, linear, or concave from above. In short, Equation (1) not only includes the linear demand generally postulated by prior studies as a special case, but allows also the shape being concave, or convex. Finally, throughout this paper, we refer an increase in the value of v to the situation that the demand function becomes less convex, or more concave.

3. Example of our findings

Cheung and Wang (1996) have shown that "if demand is concave, then the optimal output under uniform pricing is greater than the optimal output under mill pricing," provided an additional condition (p. 136). While the above-mentioned result is provided with Smithies' fixed market area assumption, we show in this paper that when demand is concave and the market area are fixed and same under alternative simple pricing policies, the optimal output under uniform pricing is greater than the optimal output under mill pricing. Moreover, we show that the above-mentioned result holds in a world without the fixed market area assumption, namely that the market area is endogenously determined.

Our result can be summarized in the following Figure in which the horizontal axis is the concavity of demand function, the value of v in (1). The difference of monopoly outputs under alternative pricing policies with Smithies' fixed market area assumption is depicted by the solid and red line while that without that assumption, by the dotted and blue line. It follows that as the value of v is greater than one, that is, demand is concave, the optimal output under mill pricing is greater than the optimal output under uniform pricing when the market area are fixed and same under alternative simple pricing policies. In contrast, in a world that the market area is endogenously determined, the optimal output under mill pricing is greater (smaller) than the optimal output under uniform pricing if demand is convex (concave).