THE KOREAN ECONOMIC REVIEW
Volume 7, Number 1, Summer 1991.

DISUTILITY AND SELF-SELECTION PROBLEMS

JAE-CHEOL KIM*

Common practice adopted in these traditional models of self-selection is that consumers are characterized by a single parameter generally representing their utility they receive from a good. In this paper, we present a simple model where disutility a consumer necessarily receives when consuming a good is as important a factor as utility in characterizing consumer types. It is shown that some of widely known traditional results about welfare distortion have to be modified.

I. INTRODUCTION

Recently, substantial amount of self-selection literature has emerged in economics and management that explores the issue of welfare distortion made by a monopolistic seller in an asymmetric informational environment.(See, for example, Mussa and Rosen(1978), Cooper(1984), Maskin and Riely(1984 and Matthews and Moore(1987), Srinagesh and Bradburd(1989), Moorthy(1984) and among others.) The standard results within the framework of two consumer types can be possibly summarized as follows: the profit maximizing monopolist will choose its pricing and quality policy in such a way that(i) consumers with lower preference get all their surplus extracted by the monopolist while consumers with higher preference do not and(ii) consumers with lower preference consume a less quality than consumers with higher preference. Furthermore, the former group receive a quality less than the socially optimal one while the latter group receive the socially optimal quality.

Common practice adopted in these traditional models of self-selection is that consumers are characterized by a single parameter generally representing their utility they receive form a good. In this paper, we present a simple model where disutility a consumer necessarily receives when consuming a good is as important a factor as utility in characterizing consumer types. The main purpose of the present paper is to show that some of widely known traditional results about welfare distortion described above have to be modified.[1]

* *Department of Management Science, Korea Advanced Institute of Science and Technology Cheongryang, P.O. Box 150, Seoul Korea*

[1]Chiang and Spatt(1982) consider two attribute consumer type model in their study of a monopolist

II. THE MODEL

For the comparison purpose, we will first describe the standard results in the self-selection literature using a simple example and then show that such results should be modified if a new element-disutility-is added into it.

Consider a cold patient who is thinking of buying a cold medicine. If he takes the medicine, he is cured with probability r and gets utility a>0. If he either does not take the medicine or does take the medicine but is not cured, then he has to go through with the cold and gets utility (or pain) 0. The probability of being cured r can be interpreted as quality of the medicine. His expected utility U is then

$$U = ar - P$$

where P is the price of the medicine.

Suppose that there are two types of cold patients with different values of a, a_1 and a_2 where $a_2>a_1$; type 2 patients are willing to pay more for an increase in quality than type 2 patients. Reservation utility of both types of patients is assumed to be zero. The monopolist can produce the medicine of various qualities at different costs. The usual increasing, convex cost function $C(r)$ is drawn in the figure. Let r_i and P_i be quality and price offered to type $_i$ patients. We first consider the full-information case when the monopolist can perfectly identify each consumer type. Then, the problem of monopolist's profit maximization is

$$\max \pi = P_1 - C(r_1) + P_2 - C(r_2)$$
$$\textit{subject to } U_i \geqslant 0 (i=1,2)(IR)$$

where the individual rationality constraints denoted by IR are introduced because the monopolist has to provide nonnegative utility to patients in order to sell his products. Let (r_i^*, P_i^*) be a quality-price pair the monopolist would offer to type i patients for this profit maximization. We will call the collection of those pairs the full-information solution. It is straightforward to see that the monopolist will extract all surplus from both types of patients. Therefore, given r_i, the optimal $P_i = a_i r_i$. Substituting these prices into the profit function and maximizing it, we obtain the following optimal solutions:

$$P_i^* = a_i r_i^*$$
$$a_i = C'(r_i^*)$$

---

who imperfectly discriminate consumers differing in time valuation and reservation price, to obtain some results that do not go along the standard results. Our model generates more diverse results than those of Chiang and Spatt. For related studies, see Laffont, Maskin and Rochet(1982) and Engers(1987).

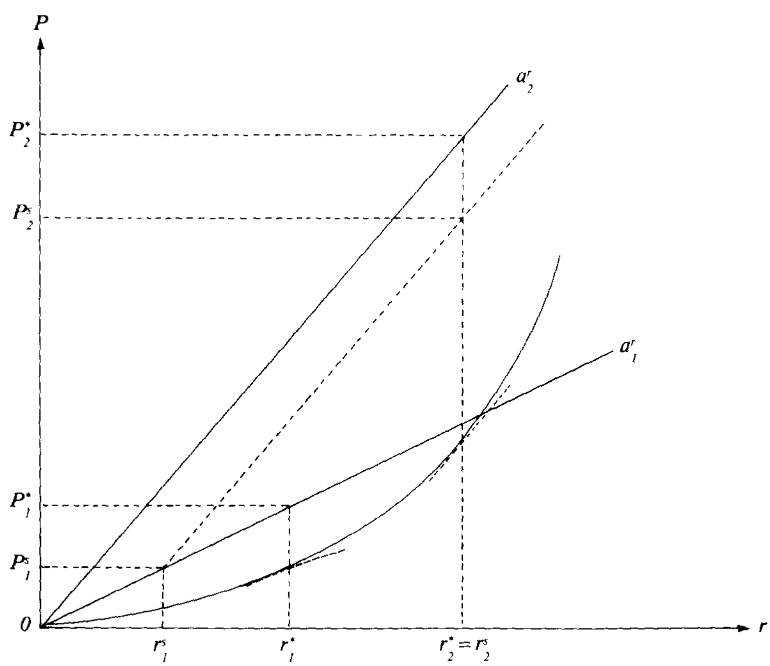
Clearly, $r_1^* < r_2^*$ and $P_1^* < P_2^*$. This result can be seen graphically. For this, define an indifference curve on *r-P* plane on which type *i* patient is indifferent between taking and not taking the medicine (henceforth called the indifference curve for zero surplus) by

$$P = a_i r_i.$$

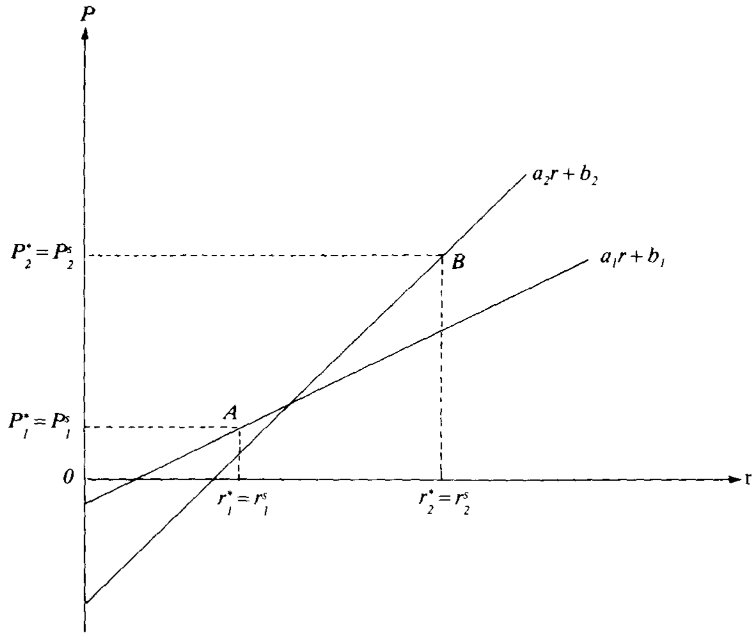
(See Figures 1 and 2). Note that the indifference curves for zero surplus are straight lines starting from the origin with slope a_i. Furthermore, the indiffrence curve of type 2 patients is steeper than and lies above that of type 1 patients as shown in the figures.

If there is informational asymmetry that the monoploist cannot distinguish the types of patients, he has to offer a self-selection menu-the collection of (r_i^s, P_i^s) intended for type *i* patients. The self-selection menu must satisfy not only the individual rationality constraint but also the incentive compatibility(IC) constraints in order for each type of patients not to switch its choice to the one intended for the other type of patients. That is, the monopolist solves the above profit maximization problem with the following IC constraints added.

$$U_i \geqslant a_i r_j - P_j \quad (i = 1,2, i \neq j)$$



[**Figure 1**]



[Figure 2]

where the right-hand side of the above inequality is utility of type i patients obtained when choosing the option intended for type j patients. The self-selection solutions are given by

$$P_1^s = a_1 r_1^s$$
$$P_2^s = a_2 r_2^s - (a_2 - a_1)\, r_1^s$$
$$C'(r_1^s) = a_1 - n_2(a_2 - a_1)/n_1$$
$$C'(r_2^s) = a_2$$

where n_i is the number of type i patients. Proof is standard and can be found in Moorthy(1984), for example. As is well known, (i) type 2 patients are served efficiently in terms of quality while type 1 patients are not because $r_2^s = r_2^*$ and $r_1^s < r_1^*$, (ii) type 2 patients obtain positive surplus while type 1 patients get zero surplus and (iii) type 2 patients are indifferent between the options (r_1^s, P_1^s) and (r_2^s, P_2^s) while type 1 patients strictly prefer (r_1^s, P_1^s). Roughly speaking, type 2 patients choose a higher quality because they have a higher marginal valuation of quality(a higher value of a) than type 1 patients. Also, because type 2 patients have a higher total valuation for any quality, especially for r_1^s, the monopolist provides a higher(positive) surplus in order to dissuade them from choosing an option intended for type 1 patients.

III. DISUTILITY

Now, we will deviate from the conventional self-selection framework by introducing into the picture disutility a patient may suffer when taking the cold medicine-a bitter taste that comes with the medicine. Patience with bitterness will generally vary among patients. Let $b_i<0$ denote the utility (or-b_i is the disutility) type i consumers obtain from being forced to consume the bitterness. Consumers are then represented by a vector (a_i, b_i) where $a_2>a_1$ is still assumed to hold. The expected utility is rewritten as

$$U_i=(a_i+b_i)\ r+b_i(1\text{-}r)\text{-}P.$$

With this modified utility function, we can formally analyze the problem as before. However, for our purpose, it only suffices to proceed grophically. At this moment, it is useful to scrutinize the fact that when the medicine does not carry a bitter taste, the indifference curve for zero surplus starts from the origin, irrespective of patients types. This fact makes a patient with a higher marginal valuation of quality have a higher total valuation for all quality levels, which plays a crucial role in the standard results.[2] This means that patients are willing to pay only the amount equal to the reservation utility for the lowest possible quality. Put differently, patients of any type regard an outcome resulting from the lowest possible quality as equivalent to an outcome from the best alternative. When bitterness matters, this is clearly not true. If a patient took the medicine with $r=0$ (the lowest quality), he would only suffer the bitter taste without being cured, which he could avoid if he did not try it at all. The indifference curve for zero surplus of type i in this case is

$$P=a_ir+b_i$$

The indifference curve is still linear with slope a_i but does not necessarily start from the origin; a type i patient would pay for the medicine $r=0$ the amount equal to his reservation utility minus disutility of bitterness. Since $a_2>a_1$, type 2 patients are always served with a higher quality. If $b_2\geqslant b_1$, because type 2 patients have a higher marginal as well as total valuation of quality, the standard conclusion continue to hold with a slight modification taking into account the disutility associated the bitterness. However, if $b_2<b_1$ or type 2 patients are more impatient with bitterness, the situation is quite different. As an example, consider a case depicted in Figure 2 where the full-information solution is denoted by points A

[2]Srinagesh and Bradburd(1989) in fact consider a mirror-image where situation this relationship is reversed and obtain mirror-image results.

and B(the cost curve is suppressed from the figure for brevity). Note that the indifference curves are crossing each other and at A type 1 patients have a higher total valuation while at B type 2 patients have higher total valuation. Therefore, patients will self-select the full-information solution and both types of patients will obtain zero surplus and efficient qualities. Note that type 2 patients strictly prefer the option intended for them. P_i^s must be appropriately adjusted by the introduction of b_i but not the choice of r_i. For certain combinations of the indifference curves and the cost function for which the self-selection solution occurs to the left of the intersection, completely opposite results to the standard ones obtain; type 1 rather than type 2 patients will earn positive surplus with the efficient quality(cf. Srinagesh and Bradburd(1989)). There arise other possibilities. Suppose that the full-information solution lies beyond the intersection. If r_l^s in the case of no bitterness is greater than r_l at the intersection, the standard results apply. Otherwise, with that r_l^s, the monopolist will not have to provide postive surplus to type 2 patients because they have no incentive to switch toi the option intended for type 1 patients. Since r_l^* is located to the right of the intersection, profits will increase by offering a higher quality than r_l^s to type 1 patients. Therefore, the monopolist will offer type 1 patients r_l at the intersection. In this case, although both types of patients have zero surplus, the situation is different from that in figure 1 because only type 2 patients are served efficiently in terms of quality.

In sum, the introduction of disutilty makes one more careful in deciding on whcih types of patients will be served with the efficient quality and will have positive surplus.

IV. CONCLUDING REMARKS

We have found that the conventional conclusions fail to hold in a situation where utility from the lowest possible quality is different from the reservation utility. As the above cold medicine example indicates, this will be the case when consumption of a good entails some necessary "bitterness", which is sunk and not recoverable when a good fails to work. As another example, consider a researcher who works at a computer for computing a numerical expression. If the computer goes down for a second during work, he may lose the work of several hours assuming that he does not have a proper protection device. In this case, the loss of effort he has made in computing-writing a computer program, typing on a keyboard and so on-is an unrecoverable "badness". There is another form of "badness" in this case, the risk of having no output, which does not occur if the researcher uses a less efficient calculator.

The problem we have discussed seems to be serious, especially when reliability of a service is main concern, for example, as in the discussion of Chao and Wilson(1987) on priority pricing in the provision of electric service, who have not paid attention to the effort and risk element in using electric service. Indeed, as the term "reliability" indicates, what really deserves more attention is *disutility* accruing when service is not properly supplied.

REFERENCES

CHAO, H and WILSON R (1987), "Priority Service: Pricing, Investment, and Market Organization". *American Economic Review*, Vol. 77, pp.899-916.

CHIANG, R and SPATT, C.S (1987), "Imperfect Price Discrimination and Welfare", *Review of Economic Studies*, Vol. 49, pp.155-182.

COOPER, R. (1984), "On Allocative Distortions in Problems of Self-Selection", *Rand Journal of Economics* Vol. 15, pp.568-577.

ENGERS, M. (1987), "Signaling with Many Signals", *Econometrica* Vol. 55, pp.663-674.

LAFFONT, J.-J., MASKIN, E. and ROCHET, J.-C (1982), "Optimal Nonlinear Pricing with Two-dimensional Characteristics," Memeo.

MASKIN, E. and RIELY, J. (1984), "Monopoly Selling Strategies with Incomplete Information", *Rand Journal of economics* Vol. 15, pp.171-196.

MATTHEWS, S. and MOORE, J. (1987), "Monopoly Provision of Quality and Warranties: An Exploration in the Theory of Multidimensional Screening", *Econometrica* Vol. 55, pp.441-467.

MOORTHY, S. (1984), "Self-Selection and Product Line Design", *Marketing Secience* Vol. 3, pp.288-307

MOORTHY, S. (1988), "Product and Price Competition in a Duopoly", *Marketing Science* Vol. 7, pp.141-166.

MUSSA, M. and ROSEN S (1978), "Monopoly and Product quality", *Journal of Economic Theory* Vol. 18, pp.301-317.

SRINAGESH, P. and BRADBURD, R.M. (1989), "Quality distortion by a Discriminating Monopolist", *American Economic Review* Vol. 79, pp.96-105.