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ON THE ECONOMICS OF SUBSCRIPTIONS*

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Firms sell journals both by offering subscriptions, which provide the purchaser with all issues of the journal, and by selling individual copies at a comparatively high price. We show that by selling subscriptions in addition to individual copies a monopolist can price-discriminate, thereby increasing his profits, and that such price discrimination may increase the level of social welfare compared to a situation in which no subscriptions are sold.

1. Introduction

In the world of commerce that economists have been known at times to observe, subscription sales are widely observed but little studied. Several examples of subscriptions come to mind. A consumer can purchase either an individual copy of a newspaper or he can purchase a subscription which provides him with a set of issues at a fixed price. The same holds true for the purchase of many other periodicals. Symphony orchestras and theater groups sell many of their seats on a subscription basis. Disneyland offers its visitors the choice of either buying a ticket book for a certain number of rides, or of purchasing each ride individually. The Book of the Month Club offers yet another version of subscription sales: members of the Club can purchase books at a lower price than that available at book stores, but in return for this discount they are required to purchase a minimum number of books in the course of a year. Notice, however, that under this subscription system, as opposed to the case of newspaper or concert subscriptions, consumers have a choice as to which particular goods they purchase.

This paper examines the economics of subscription sales in a monopolistic

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market. We study a model in which the firm's optimal policy is to sell some of its output by means of individual tickets, and the remainder through subscriptions. Particular attention is paid to the behavior of consumers who can choose between purchasing a subscription or purchasing individual tickets.

Several factors may induce a firm to sell its product by means of subscriptions, rather than only by means of individual tickets. Subscription sales reduce the firm's costs of transacting with its customers; for any given customer, money need be transferred only once (say at the beginning of the concert season) rather than each time the good is consumed (say at each concert). Due to this efficiency, the firm may find it feasible to deal directly with its customers instead of relying on middlemen (compare direct mail subscription solicitations to sales through newsstands).

In selling a subscription the firm offers a fixed price for goods that will be delivered in the future. This means that the firm rather than the consumer faces the risks posed by changes in factor prices, and that, in effect, the firm obtains a loan from the subscriber who remits payment in advance; under conditions of imperfect capital markets such an arrangement can be mutually beneficial.

Sales through subscriptions alone also ensure that consumers will purchase equal quantities of all the varieties of goods offered: a theater, for example, may wish to fill all the seats in the auditorium for all of its productions. It is difficult to obtain this result if the theater cannot sell subscriptions, if it cannot charge different prices for different plays, or if it must set the price of tickets for a particular performance before it knows the expected demand for that performance.

Another advantage to the firm of selling subscriptions is that by so tying the sales of several goods it can provide price discrimination. Price discrimination has been extensively studied in the literature, although not in the context of subscriptions. Burstein (1960) examined the conditions under which it would be profitable for a firm to condition the sale of a monopolized good with the requirement that consumers purchase from it other, non-monopolized, goods. Stigler (1963) and Telser (1979) studied tie-in-sales for the cases of block-booking and complementary goods, respectively. Oi (1971) examined the features of an optimal two-part tariff as a form of price discrimination. Murphy (1977) discussed more general forms of price discriminating tariffs. Leland and Meyer (1978) studied block pricing in which the first unit is sold at a lower price than succeeding units; certain subscriptions may in fact take the form of such block pricing. Leland and Meyer's article is especially important because in it they show that block pricing may be socially preferable to pure monopoly pricing. Mitchell (1978) examined the characteristics of optimal two-part tariffs for the telephone industry. He mentions that telephone pricing may include a form of

subscriptions (e.g., unlimited local calls for a fixed monthly fee), but does not pursue the point.[1]

There is another aspect of subscriptions, related to, but distinct from, the concept of tie-ins. In many circumstances, a consumer may be offered a reduced price for the purchase of a good whose price characteristics he does not know. This same good will later be offered for sale at a greater price, when the consumer does know the characteristics of the good. Consider, for example, a magazine subscription. At the time the consumer is offered a subscription he may not know the contents of the magazines he will receive. Whenever he buys an individual copy of a magazine, however, he can browse through the magazine and discover its contents.

This uncertainty at the time a subscription is purchased may consist not only of ignorance of the characteristics of the good, but also of uncertainty as to the state of the consumer himself. To return to our magazine example, when a consumer purchases a subscription he may not know how much leisure time he will have available for reading, or whether the weather will be suitable for reading rather than for skiing. A consumer, however, can purchase an individual issue when he is not thus ignorant. In other words, when a subscription is offered, the consumer may know only the *expected* value to him of consuming the goods; when faced with the opportunity to purchase the goods individually the consumer can know the exact value to him of the good and can purchase it only when its value is greater than its price.

Our analysis will accordingly focus on the characteristics of equilibrium in a monopolistic market in which, under conditions of imperfect information described above, consumers have the choice of purchasing a subscription or tickets.

In the following section we present a simple example illustrating the advantages of subscription sales. Section 3 analyzes a mathematical model of a monopolistic market in which both subscriptions and tickets are sold. The welfare economics of such a market are discussed in section 4, and concluding observations are offered in section 5.

2. An example

The essential features of subscription sales can be illustrated by means of a simple example. Let a journal be published twice a year, and let there be only two consumers. Denote by r_i^j the value of issue i to consumer j (that is, the maximum amount that consumer j would be willing to pay for issue i).

[1]In spite of the similarity between subscriptions and the forms of non-linear pricing mentioned above, the two concepts are not identical. In subscriptions, the consumer obtains a discount only if he purchases a fixed set of goods; in non-linear pricing, the consumer does not usually face such an all-or-nothing choice with regard to discounts.

The value of r_i^j is a function not only of the contents of the issue of the magazine, but also of some exogenous environmental factors. Thus, for example, the consumer would be willing to pay more for an issue if it appeared during rainy weather which was conducive to reading than if the weather was more suitable for swimming and lying on the beach. Similarly, an issue that discussed plumbing repairs would be especially useful to the reader if he happened to be struggling with a leaky water pipe at the time the issue hit the newsstands.

Thus, it is not unreasonable to treat r_i^j as a random variable. In particular, suppose that for consumer A an issue is equally likely to be worth six dollars or fourteen dollars. The four possible pairs of valuations of the two issues for consumer A are shown in lines 1 through 4 of table 1. We further suppose that for consumer B an issue is equally likely to be worth either two dollars or ten dollars. The four possible valuations of the issues for consumer B are shown in lines 5 through 8 of table 1.

We suppose that the firm knows the expected, but not the actual, value of any issue to a consumer. In contrast, each consumer knows the value of an issue at the time he purchases any one issue. At the time a subscription is offered the consumer knows the expected values of the two forthcoming issues; he may or may not know his *ex post* valuations of the issues he will receive. We shall consider the firm's profit-maximizing pricing strategy under three different conditions: no subscriptions can be offered; consumers are perfectly informed at the time they can purchase a subscription; consumers are imperfectly informed at the time they can purchase a subscription.

Case A. Consider first the firm's profit-maximizing strategy when no subscriptions can be sold. In this case it will charge \$10 per issue. At this price, a consumer will purchase an issue only if its value to him is at least \$10; consumers A and B are each expected to purchase one issue per year, and the firm's total expected revenue is \$20. The expected value of consumer's surplus in this case (the sum of the values of the issues purchased minus their cost) is $(14-10)=4$ for consumer A, and $(10-10)=0$ for consumer B.

Table 1

		Issue 1	Issue 2
Consumer A	(1)	6	14
	(2)	14	6
	(3)	14	14
	(4)	6	6
Consumer B	(5)	2	10
	(6)	10	2
	(7)	10	10
	(8)	2	2

Case B. Suppose next that the firm can sell subscriptions in addition to individual issues, and that a consumer must decide whether to purchase a subscription at a time when he knows only the *expected* values of the issues to him, not their realized values after he receives them. Any one issue, on the other hand, can be purchased when the consumer knows for certain its value to him. Under these conditions the firm maximizes profits by charging $\$16-\varepsilon$ for subscriptions (where ε is very small), and \$10 for each individual issue.

Recall that for consumer A the expected value of an issue is $\frac{1}{2}(14+6)=\$10$, so that if he purchased a subscription at a price of $\$16-\varepsilon$ (which provides him with two issues during the year), his expected consumer's surplus would be $\$20-\$16-\varepsilon=\$4+\varepsilon$. If, on the other hand, consumer A decided not to purchase a subscription, he would purchase an issue whenever it happened that $r_i^A=14$; by following this policy the expected number of issues he would purchase is one, and his expected consumer's surplus would be $\$14-\$10=\$4$. As $4+\varepsilon>4$, consumer A will find it worthwhile to purchase a subscription at the prices specified above.

Consumer B, however, will not find it worthwhile to purchase a subscription (the price of a subscription, \$16, is greater than the expected benefit, \$12, he would obtain from receiving two issues). He will instead purchase an individual issue whenever $r_i^B=10$. His expected expenditure is \$10, and his expected consumer's surplus is \$0.

Thus, we find that if the firm can offer subscriptions as well as individual issues, and if consumers are imperfectly informed about the values of the issues they would receive by purchasing a subscription, the firm maximizes profits by selling a subscription to consumer A and selling individual issues to consumer B, obtaining a total expected revenue of $\$16+\$10=\$26$. This revenue (which equals profits in our case) is clearly greater than the expected revenue of only \$20 the firm obtains when it cannot sell subscriptions. Observe, incidentally, that total consumer's surplus, four dollars, is the same as in Case A. Thus, the sale of subscriptions in addition to individual issues has raised both the level of the firm's profit and the level of social welfare (which we take to equal the sum of consumer's surplus and firm's profit).

Case C. Finally, consider the case in which each consumer (unlike the firm) knows the precise values to him of the issues he would receive if he purchased a subscription. Thus, for example, consumer A may know that if he purchased a subscription he would receive two issues, the first one of which he would value at \$6, and the second one which he would value at \$14 (these are the values of r_1^A and r_2^A given in line 1 of table 1). Similarly, at the time he purchases a subscription, he may realize that the values of r_i^A are those given by line 2, or line 3, or line 4. That is, in distinction to Case B discussed above, each consumer is assumed to possess perfect information at the time he must decide whether or not to purchase a subscription.

We suppose, however, that the firm does not know the actual values of r_i^j, and therefore does not know with certainty whether or not a consumer will purchase a subscription. The firm must therefore choose a set of profit-maximizing prices under conditions in which it knows the expected values of the r_i^j's, but in which consumers are perfectly informed about these values.

Faced with these conditions, the firm can maximize its profits (or revenue) by offering subscriptions at \$16 and individual issues at \$10. At these prices, consumer A would never purchase an individual issue, but would rather purchase a subscription whenever the values of the two issues were those given by any of the first three lines of table 1. The expected revenue obtainable from him is $\frac{1}{4}(16+16+16+0)=\$12$, and his expected consumer's surplus is $\frac{1}{4}(4+4+12+0)=\$5$. Consumer B would purchase a subscription only if the values of the issues were those given by line 7 in table 1; otherwise he would buy an issue when its value is \$10. Consumer B's expected expenditure is $\frac{1}{4}(10+10+16+0)=\$9$, and his expected consumer's surplus is $\frac{1}{4}(0+0+4+0)=\$1$. Thus, the firm's total expected revenue is $\$12+\$9=\$21$, and consumer's surplus equals $\$5+\$1=\$6$. Observe that compared to Case B, in which consumers possessed imperfect information, the firm's profit has declined from \$26 to \$21, and that the level of social welfare (equal to the sum of producer's and consumer's surplus) has declined as well.[2]

In this example, we have shown that a firm can increase its profits by selling subscriptions in addition to individual issues. But more surprising is the result that both the firm's profits and social welfare are greater when consumers are incompletely, rather than completely, informed about the values of issues they may receive.

3. Mathematical model

In this section we develop a model describing the behavior of consumers who are faced with the choice of purchasing a subscription or individual issues. We shall also study characteristics of a firm's profit-maximizing policy when faced with such consumer behavior. For concreteness, we discuss the pricing of a journal that appears m times during the year. A consumer can either purchase a subscription which provides him with all m issues that appear during the year, or he can purchase any one (or more) of the issues at a price of t dollars each. Obviously, not all issues will have the same appeal to any given consumer. If he does not purchase a subscription, the consumer will therefore purchase only those issues whose value to him is greater than

[2]The firm could attain the same revenue as specified above if it sold only subscriptions at a price of \$12. Consumer A would always purchase such a subscription, and consumer B would if his valuations of the issues were those given by lines 5 through 7 of table 1. The firm's expected revenue is thus $\$12+\frac{3}{4}(\$12)=\$21$. This strategy is, however, inferior to the one we discussed of selling both subscriptions and tickets if the cost of producing a copy is even infinitesimally greater than zero.

the price of an issue. We assume that at the time he may purchase a subscription, the consumer knows the expected value of how much each issue will be worth to him, but he does not know precisely how much any particular issue will be worth to him. Thus, the consumer must decide whether or not to purchase a subscription under conditions of uncertainty. In distinction, a consumer knows the value of any particular issue at the time he is given the opportunity of purchasing a single copy of that issue.[3]

Although we adopt the terminology of journal subscriptions, the analysis can be applied more generally. We use the following notation:

$\bar{p}$ = average value to a consumer of an issue of the journal. Each consumer may have a different value of $\bar{p}$. Where it is unambiguous to do so we shall denote $\bar{p}$ by p.

$H(p)$ = cumulative distribution function of $\bar{p}$ in the population.

$h(p)$ = the corresponding probability mass function.

ε = random variable with mean 0. For a consumer characterized by some given value of $\bar{p}$, the distribution of $\bar{p}+\varepsilon$ represents the distribution of his valuations of any issue.[4] [For example, in the numerical example of section 2 we assumed that $\bar{p}=10$ for consumer A, $\bar{p}=6$ for consumer B, and $\Pr(\varepsilon=4)=\Pr(\varepsilon=-4)=\frac{1}{2}$.]

$G(\varepsilon)$ = cumulative distribution function of ε, assumed to be independent of $\bar{p}$ and identical for all consumers.

$g(\varepsilon)$ = the corresponding probability mass function.

m = number of issues of the journal that appear in a year.

$L(s,t)$ = probability that a person will purchase a subscription.

$K(s,t)$ = probability that a person will purchase an issue of the journal.

t = price of one issue.

s = average price of an issue when purchased by means of a subscription. As m issues are sold for each subscription, the price of a subscription is $(s)(m)$. Although $s<t$, we suppose that transaction costs are sufficiently high to preclude the sale of issues obtained by subscription.

Consider a consumer characterized by an arbitrary level of $\bar{p}$. Mathematically, the expected value of consumer's surplus he can obtain by purchasing a subscription is

$$m(\bar{p}-s). \tag{1}$$

If the consumer does not purchase a subscription, he will buy an issue whenever its value to him, $\bar{p}+\varepsilon$, is greater than the price of an issue, t. The

[3]Thus, in this section we generalize the numerical example given as Case B in the previous section.

[4]The model is not appreciably changed if we assume instead that a consumer's valuation of an issue is given by $\bar{p}(1+\varepsilon)$.

expected value of consumer's surplus obtainable from purchasing individual issues is

$$m \int_{t-\bar{p}}^{\infty} (\varepsilon + \bar{p} - t) g(\varepsilon)\, d\varepsilon. \tag{2}$$

Subtracting eq. (2) from eq. (1) and dividing by m we define

$$\Delta \equiv \bar{p} - s - \int_{t-\bar{p}}^{\infty} (\varepsilon + \bar{p} - t) g(\varepsilon)\, d\varepsilon, \tag{3}$$

and find that

$$d\Delta/d\bar{p} = 1 - \int_{t-\bar{p}}^{\infty} g(\varepsilon)\, d\varepsilon > 0. \tag{4}$$

It is thus obvious that there exists a critical value of $\bar{p}$, p^*, such that all consumers for whom $\bar{p} > p^*$ will purchase subscriptions, and all consumers for which $\bar{p} < p^*$ will not purchase subscriptions but will rather purchase individual issues as the occasion arises.[5] This critical value of $\bar{p}$ is defined as that value, p^*, which satisfies

$$p^* - s - \int_{t-p^*}^{\infty} (\varepsilon + p^* - t) g(\varepsilon)\, d\varepsilon = 0. \tag{5}$$

To find the effect of changes in s and t on the demand for subscriptions and tickets we take the derivatives of eq. (5) with respect to s and t,

$$\partial p^*/\partial s - 1 - \int_{t-p^*}^{\infty} (\partial p^*/\partial s) g(\varepsilon)\, d\varepsilon = 0, \tag{6}$$

and therefore

$$\partial p^*/\partial s = 1/G(t - p^*) > 0. \tag{7}$$

Similarly,

$$\partial p^*/\partial t - \int_{t-p^*}^{\infty} [\partial p^*/\partial t - 1] g(\varepsilon)\, d\varepsilon = 0, \tag{8}$$

and therefore

$$\partial p^*/\partial t = 1 - 1/G(t - p^*) < 0. \tag{9}$$

[5]The reader should note that our model is not identical to a deterministic one: if consumers know the realized values of ε when subscriptions are sold, then some consumers with $\bar{p} < p$ would purchase subscriptions. This would occur, for example, if $\bar{p} + \varepsilon > t$ for all m issues, so that the consumer benefits from the lower price a subscription provides on the purchase of all m issues. This result was made clear in the previous section: in Case B, where consumers possessed imperfect information, consumer A (with $\bar{p} = 10$) purchased a subscription, and consumer B (with $\bar{p} = 6$) did not. In the deterministic case, discussed as Case C, consumer B as well as consumer A purchased a subscription in certain circumstances.

As we would expect, an increase in the price of subscriptions reduces the demand for subscriptions, and an increase in the price of tickets has the opposite effect.

To determine the firm's revenue as a function of s and t we must first find the demands of consumers for subscriptions and for individual issues. We have shown above that a consumer whose average valuation of an issue is $\bar{p}$ will purchase a subscription if and only if $\bar{p} > p^*$. The fraction of consumers who purchase subscriptions is thus

$$L(s,t) = \Pr(\bar{p} > p^*) = 1 - H(p^*). \tag{10}$$

A consumer will purchase an issue if and only if he does not purchase a subscription (i.e., $\bar{p} < p^*$) and it is worthwhile for him to buy a ticket (i.e., $\bar{p} + \varepsilon > t$). The probability, therefore, that a person will purchase a given issue is

$$K(s,t) = \Pr(\bar{p} < p^*, \varepsilon > t - \bar{p}) = \int_0^{p^*} [1 - G(t-p)]h(p)\,\mathrm{d}p. \tag{11}$$

The firm's expected revenue, given m issues offered for sale, is $NmsL(s,t) + NmtK(s,t)$, or

$$Nms[1 - H(p^*)] + Nmt\int_0^{p^*} [1 - G(t-p)]h(p)\,\mathrm{d}p, \tag{12}$$

where N is the number of persons in the market. Henceforth, for mathematical simplicity we will set $N = 1$; this in no way changes the results given below. We assume that the marginal cost of producing a copy of the magazine is constant, which is denoted by c.[6]

The firm's objective is to maximize profits, or to maximize

$$\pi = m[1 - H(p^*)](s-c) + m\int_0^{p^*} [1 - G(t-p)]h(p)\,\mathrm{d}p(t-c). \tag{13}$$

Necessary conditions for an optimum are found by taking the partial derivatives of eq. (13) with respect to the variables t and s. Doing so, and making use of eqs. (7) and (9), we find that the optimal values of t and s (t^* and s^*) must satisfy the following equations:

$$G(t^* - p^*)[1 - H(p^*)] - (s^* - c)h(p^*) + (t^* - c)[1 - G(t^* - p^*)]h(p^*) = 0, \tag{14}$$

[6]We assume that the number of customers at the firm is very large, so that the firm can ignore any random variation in demand and simply maximize profits, behaving as if the expected volume of sales equals the actual volume of sales realized.

and

$$-(s^*-c)h(p^*)(\partial p^*/\partial t)+\int_0^{p^*}[1-G(t^*-p^*)]h(p^*)\,dp$$

$$+(t^*-c)[1-G(t^*-p^*)]h(p^*)(\partial p^*/\partial t)$$

$$-(t^*-c)\int_0^{p^*}g(t-p^*)h(p)\,dp=0, \tag{15}$$

where $\partial p^*/\partial t=1-1/G(t-p^*)$, and p^* is defined in eq. (5). Eqs. (14), (15), and (5) give necessary conditions for an optimum, and can be solved for the optimal values of s, t, and p^*.

Several observations are in order about the characteristics of this solution:

(1) The value of m does not appear anywhere in eqs. (14) and (15), so that the characteristics of the optimal solution are independent of the number of issues that appear. This also implies that profits are maximized by selling subscriptions that include *all* the issues which consumers view as being, on average, identical. We do observe, however, that firms offer subscriptions for various periods — 26 weeks, 52 weeks, two years, etc. Such a policy is readily interpretable on our framework as providing yet another layer of price discrimination. Consumers, for example, may be more certain of what benefits they will derive from journal issues appearing during the coming year than of journals that will appear two years in the future. In other words, not only may the consumer place different values on different issues of a journal, but he may also place different values on subscriptions offered in different periods. The firm can then further price-discriminate by selling subscriptions for different lengths of time.

(2) From the optimality conditions (14) and (15) we can obtain the condition

$$-[1-H(p^*)][1-G(t^*-p^*)]=\int_0^{p^*}[1-G(t^*-p^*)]h(p)\,dp$$

$$-(t^*-c)\int_0^{p^*}g(t^*-p)h(p)\,dp. \tag{16}$$

Because the left-hand side of eq. (16) is negative, the right-hand side must be negative as well. This requires that $t>c$; at the optimum solution the firm sets the price of an issue at a level greater than its marginal cost of providing a copy of the journal. Clearly, s must also be greater than c. For if it were not, eliminating the subscription sales would eliminate the loss from such sales and increase demand for individual issues, which we saw are sold at a profit.

(3) It is trivial to see that t must be greater than s. For otherwise no consumer would purchase a subscription, but would rather adopt a 'wait and see' strategy.

(4) As we have seen, the right-hand side of eq. (16) is negative. If we set $c=0$, the right-hand side must still be negative, but now it represents the change in revenue obtainable from an increase in the price of an issue. Thus, as in monopoly without subscription pricing, at the optimum, marginal revenue with respect to price is negative and demand is elastic.

(5) In our discussion of eq. (5) we argued that those persons who highly value the good purchase subscriptions rather than individual issues. But since $t>s$, we find that persons who highly value the good pay a lower average price for the good than do persons who have low valuations for the good. If we assume that the value of $\bar{p}$ is positively correlated with a person's wealth or income, then we conclude that the wealthy pay a lower average price for the good than do the poor. This result may appear to be a surprising feature of price discrimination, but it is similar to conditions that may arise with other forms of price discrimination, such as two-part tariffs or block pricing.

(6) For any given volume of sales the price of an issue, t, is greater if subscriptions as well as individual copies are sold than if the monopolist is constrained to sell only individual copies. To see this, suppose that under a subscription pricing system the volume of sales is K and the price of any one copy is t. Now suppose the firm changes its policy and sells only individual issues at the same initial price of t. Given this price of t and no subscription sales, the volume of sales must be less than K: those consumers with $\bar{p}<p^*$ will continue to purchase the same quantity of the good, but persons with $\bar{p}>p^*$ will switch from purchasing subscriptions which provide them with *all* m issues, to purchasing some issues when it is worthwhile for them to purchase an issue. The quantity demanded by these consumers, and therefore the total demand, will decline. A quantity of sales equal to K can thus only be obtained by a decrease in the price of an issue.

(7) The firm would have no reason to sell both subscriptions and individual issues if all consumers were identical. For if all consumers were identical, that is, if all consumers were characterized by the same value of $\bar{p}$, then either $\bar{p}<p^*$, or $\bar{p}\geqq p^*$. In the former case the firm would sell no subscriptions, and in the latter case it need sell only subscriptions.

(8) An interesting case of subscription sales arises when $m=1$, that is, there exists only one issue per year; for convenience we can call this one issue a book. A subscription then consists of selling the book at a discount price under conditions in which the consumer does not know exactly how much the book will be worth to him. For example, prior to the appearance of the book at bookstores, a publisher can offer the book by mail order at a price of ten dollars, while the price of the book when purchased at the bookstore (where the consumer can examine it and determine its value to him) can be

set at a higher level, say fifteen dollars. In terms of our model the mail-order price is a subscription price (s), and the bookstore price is the price of an individual issue (t). As we have argued, the firm may find it profitable to offer sales under these different terms.

Observe that for such price discrimination to be feasible, at the time the book is offered at a reduced price the consumer must know only his expected, and not his actual, valuation of the book he will receive; the firm has an incentive to generate some uncertainty in the minds of consumers so that it will be able to sell such 'subscriptions'. Furthermore, note that because the consumer can purchase at most one book, conventional forms of price discrimination (such as tie-ins with other books, block pricing, or quantity discounts) are not practicable in this case.

4. Welfare economics of subscriptions

In the previous section we saw that the monopolist sets the price of an issue at a level greater than marginal cost; this implies that in the absence of other distortions in the economy the subscription and ticket pricing system is not Pareto-optimal. There are two aspects of such non-optimality. Firstly, the level of production is too low resulting in consumers not consuming goods whose value to them is greater than the marginal cost of producing the good. Secondly, for any *given* output level, the values of s and t chosen by the firm are not those values which would maximize social welfare. We shall examine these aspects in turn, with particular emphasis on a comparison of monopolistic pricing when subscriptions can and cannot be offered.

Because $t > c$, the output level of the firm is sub-optimal; social welfare could be increased by lowering the price of an issue to a level equal to the marginal cost of producing a good. In comparison to pure monopolistic pricing, however, we have seen that subscription pricing permits the firm to practice a form of price discrimination. It is therefore possible that, under a pricing system in which both subscriptions and individual copies are sold, the firm may sell a larger quantity than it would under a system in which only tickets could be sold. Indeed, in section 2 we presented a numerical example which showed that the sum of consumer and producer's surplus is increased when subscriptions are sold in addition to tickets.

The next issue we address is the socially optimal values of t and s for a *given* level of sales. Suppose the firm is constrained to sell exactly the quantity K. We shall show that in this case the Pareto-optimal solution is to sell *only* individual copies. The proof is very simple.

Suppose the firm sells K copies of any issue of the journal. Under a pricing system in which no subscriptions are sold, the price of a copy is set at a level t, such that K copies are demanded. Which consumers purchase these copies? Obviously, only those consumers who value a copy at t dollars

or more, or in other words, those consumers who most highly value the copies of the journal. A pricing system under which only individual copies are sold thus yields the socially optimal allocation of the goods among consumers, for any fixed level of sales. It follows that any other pricing system, including one in which subscriptions are sold, cannot yield a better allocation, but may of course yield a worse one.

This argument is valid for any value of K, including that value chosen by the profit-maximizing firm that sells both subscriptions and tickets. It follows that the values of s and t chosen by the firm are not Pareto-optimal, even given a sales volume constraint.

We have arrived at the following prescriptions: the allowance of subscription sales may increase social welfare if the level of output can be varied, and will decrease social welfare if the level of output is fixed. Subscriptions may be an efficient form of pricing for such goods as periodicals in which marginal cost is positive and there exists no binding capacity constraint. But the sale of subscriptions in addition to tickets will decrease social welfare in the context of concerts or theater performances in which the marginal cost of a seat is nearly zero and in which there exists a capacity constraint inherent in the size of the auditorium.

5. Conclusion

In our study of subscription pricing we found, not surprisingly in light of the other literature on non-linear pricing, that the use of subscription sales allows the firm to practice a form of price discrimination, and that as a result of such price discrimination the level of social welfare may be greater than that which would obtain if the firm could not so discriminate.

But perhaps of greater importance, we have seen that a firm may find it profitable to withhold information about a product; it can earn greater profits when consumers are imperfectly, rather than perfectly, informed about the goods they will receive. A book club may thus find it profitable to mention only the general nature of the books it will offer for sale, but conceal the exact titles of the books it knows it will publish; or a journal may find it useful not to divulge the topics that will be covered in future planned feature articles. The use of the subscription concept may shed light not only on the behavior of consumers who are faced with uncertainty, but also on the firm's incentive to generate consumer ignorance.

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