Two-part Pricing with Consumption Externalities: The Ladies' Nite Dilemma

Steven B. Caudill

Auburn University

*This research was partially funded by the Public Utility Research Center at the University of Florida. The author is grateful to Sanford V. Berg, Randall G. Holcombe, Richard P. Saba, and Frank A. Scott for their comments on the paper. The author would also like to express his thanks to several introductory microeconomics classes at Auburn University, and to his sister for helping collect examples of the type of price discrimination discussed in this paper.

This paper presents a model of price discrimination with consumption externalities. There are two customer groups with interdependent demands for some product. A model is developed which illustrates how a profit maximizing monopolist can exploit the interdependencies in demand.

The basic result on two-part price discrimination is given by Oi (1971) who examined pricing policies when access to and actual usage of a service could both be metered. Oi's results suggested that a profit maximizing monopolist should set price equal to marginal cost, and then charge each customer the resulting consumer's surplus as an admission fee. Oi also suggested that the profit maximizing price could be set above or below marginal cost depending on the particular configuration of consumer demands. The now-famous example discussed by Oi was the pricing of entry and rides for Disneyland. Oi assumed that individuals purchased admission to park based only on the benefits obtained from the rides. That is to say that Oi assumed there were no benefits from simply being in the park.

Oi's original result has been extended by several authors including Ng and Weisser (1974), Murphy (1977), Willig (1978), Roberts (1979), and Schmalensee (1981). None of the authors has extended Oi's result to the case where the customer obtains some utility from being inside the park, or connected to the system, as would be the case if either telecommunications pricing or computer system pricing were being discussed. The purpose of this paper is to examine monopolistic pricing if there are benefits from either joining the system, or being inside the park.

An Application to Ladies' Nite

The actual case being examined in this paper is somewhat more complicated than the Disneyland case. The "system" customers seek to join is

a tavern, and entering the tavern is joining the system. There are two customer groups, males and females, seeking entry into the tavern to purchase drinks. Purchasing drinks is not the only reason for desiring admission to the tavern. It will be assumed that male customers derive benefits directly related to the number of females in the tavern. For simplicity, it will initially be assumed that female customers derive no benefits from male attendance. Thus, it becomes possible that male customers may purchase access to the tavern even if they do not desire to drink. In addition, the presence of females can drive up the admission charge for males. This process reflects the consumption externality because the presence of females in the tavern makes the male customers better off.

In this formulation, the larger the number of unescorted females, the greater the benefits enjoyed by the male customers. Thus, a relation of complementarity exists between female admission to the tavern, and male admission to the tavern. Research has been done on some aspects of the pricing phenomenon just described. For instance, Littlechild (1975) and Willig (1979) have examined network access pricing with consumption externalities. In both cases new members of the network confer benefits on customers already connected. This differs somewhat from the situation analyzed herein because here two customer groups are identified. Benefits are conferred upon one group, namely males, by the increased attendance of the other group, namely females. The pricing of complementary goods has been examined by Telser (1979) and Scott and Morrell (1983). However, neither of these papers considers classes of customers and consumption externalities. This paper attempts to shed some light on a widely practiced

form of price discrimination, which features two customer classes and consumption externalities.

The Model

Before examining the profit maximizing calculus some expressions need to be defined.[1] Each customer has a demand for drinks, d, which depends on the price of a drink, p, and income, y, or $d = d(p,y)$. Drinks are assumed to be normal goods implying that $\partial d/\partial y > 0$. Both customer groups, male and female are thus heterogeneous, being differentiated by income.

Male customers purchase admission to the tavern if their consumer's surplus from purchasing drinks at price p plus the value of the benefits they receive from the number of females in the bar exceed the admission fee, f. The admission fee determines some critical level of income for male customers such that males with incomes below this level do not enter the tavern, and males with incomes exceeding this level purchase admission to the tavern, for any given number of females in the tavern.

Female customers purchase admission to the tavern if their consumer's surplus from purchasing drinks at price p exceeds their admission charge. It was previously assumed that females receive no benefits from the presence of male customers in the tavern. This, of course, implies the existence of a critical level of income for female customers. Females with incomes above this critical level purchase access, and those with incomes less than the critical level do not purchase access.

If these critical levels of income for males and females are denoted by y_m^* and y_f^*, respectively, the aggregate demand for drinks by males and females may be expressed as

$$D_m(p_m, y_m) = \int_{y_m^*}^{\infty} d_m(p_m, y')m(y')\, dy' \tag{1}$$

$$D_f(p_f, y_f) = \int_{y_f^*}^{\infty} d_f(p_f, y')m(y')\, dy' \tag{2}$$

where D_m represents the aggregate demand for drinks by male customers. This demand, as given in (1), is the sum of the individual demand curves for all male customers whose income exceeds the critical level y_m^*. The density of male customers at each income level is given by $m(y')$, which is assumed to be uniform and equal for both male and female customers. The aggregate demand for drinks by females is defined similarly in (2).

The number of male customers in the tavern is equal to

$$M_m(y_m^*) = \int_{y_m^*}^{\infty} m(y')dy'. \tag{3}$$

provided the tavern has sufficient capacity. M_f is similarly defined for female customers.

As a first step in the analysis of the price discrimination model for two customer groups, it will prove useful to examine the results when only one customer group is identified. Additionally, the assumption is made that the tavern size is fixed at M^*. In this case the profit function will be

$$\pi = (p-c)D + sM^*. \tag{4}$$

where p is the drink price, and c is the constant marginal cost per drink. The fixed charge, s, is simply the consumer's surplus of the marginal customer,[2] or the last person to enter the tavern, assuming that the capacity constraint is binding.

Differentiating with respect to price yields

$$\frac{\partial \pi}{\partial p} = (p-c) \left.\frac{\partial D}{\partial p}\right|_{M=M^*} + D - dM^*. \tag{5}$$

The first term on the right side of (5) represents the lost profit due to the decreased consumption resulting from an increase in the price of a drink. The tavern is assumed to remain full, so the increase in the price of a drink does not decrease the patronage, but only the consumption. The second term on the right in (5) represents the additional profit resulting from the increased price of each drink sold, and the third term represents the admission fees lost on all customers due to the increased drink price.[3]

Setting (5) equal to zero and solving for p-c yields

$$p-c = \frac{dM^* - D}{\left.\frac{\partial D}{\partial p}\right|_{M=M^*}} > 0. \tag{6}$$

The above may be manipulated[4] to yield,

$$p = \frac{\bar{d}\varepsilon}{\bar{d}\varepsilon - d + \bar{d}} \cdot c, \tag{7}$$

where $\varepsilon = \left.\frac{\partial D}{\partial p}\right|_{M=M^*} \cdot \frac{p}{D}$ and $\bar{d} = D/M^*$, thus ε is the elasticity of the demand for drinks when tavern capacity is fixed at M^*, and $\bar{d}$ is the average number of drinks per customer. Note that as the demand for drinks becomes more inelastic, the profit maximizing price increases. The profit maximizing price also increases when average consumption per customer increases. These relationships will be very useful when the optimal pricing policy in the case of two customer groups is analyzed.

The Case of Two Customer Groups

Now the profit maximizing strategy of a monopolist facing two customer groups will be examined. One group's willingness to pay to enter the tavern depends on the number of members of the other group which are present in the tavern. In terms of the notation used previously, the profit function faced by the monopolist is

$$\pi = (p_m - c)D_m + f_m M_m + (p_f - c)D_f + f_f M_f. \tag{8}$$

where the subscripts m and f have been added to denote male and female. Here f_m is the admission charge for males, and f_f is the admission charge for females. The male admission charge is $f_m \equiv s_m + V(M_f)$, or the charge is equal to s_m, the consumer's surplus resulting from drinking inside the tavern, and $V(M_f)$, the value associated with having M_f females in the tavern.[5] Thus, the male admission charge is a function of the number of females present in the tavern. Similarly, the admission charge for females $f_f \equiv s_f$, is simply equal to the consumer's surplus resulting from purchasing drinks at price p_f. Since the capacity of the tavern is fixed, $M_m + M_f = M$, where M is the capacity of the tavern.

The above profit function may be written more instructively as

$$\pi = (p_m - c)D_m + (s_m + V(M-M_m))M_m + (p_f - c)D_f + s_f(M-M_m). \tag{9}$$

Differentiating the above with respect to M_m, the number of males in the tavern, will give an indication of the number of males and females which should be included in the tavern in order to maximize profits.[6] After this determination, drink prices for each group are set according to equation (7) above. The differentiation yields, as a first approximation.[7]

$$\frac{\partial \pi}{\partial M_m} = (p_m - c)d_m + (s + V) - M_m \frac{\partial V}{\partial M_f} - (p_f - c)d_f - s_f = 0. \tag{10}$$

The first term on the right side of the equals sign in (10) represents the increased profit from selling drinks to an additional male customer, while the second term represents the extra male admission fee collected. The third term reflects the lost admission fees on all male customers because a female customer has been replaced by a male customer which makes the tavern less attractive to male customers. The fourth term repesents the profit from drink sales lost by having one less female customer, and the lost term is the lost female admission fee.

Equation (10) may be written,

$$f_f = f_m + (p_m - c)d_m - (p_f - c)d_f - M_m \frac{\partial V}{\partial M_f}. \tag{11}$$

The first and second terms on the right-hand side of equation (11) are positive, and it seems probable that the second term on the right-hand side of equation (11) is probably larger than the third term. This is reasonable because, as the earlier results show, profit maximizing drink prices are higher the less elastic the demand curve, and the greater the average consumption of the customer group. The second term in equation (11) will exceed the third term if, as casual empiricism suggests, males have more inelastic demands for drinks, and higher average consumption than females. In the absence of any consumption externalities of the kind discussed herein $f_f > 0$. The consequence of these consumption externalities is to make the profit maximizing value of f_f the admission charge for females, less than if the externality were not present. This is probably the case even though f_m has a somewhat different interpretation

than before since in the presence of consumption externalities, the male admission charge includes a premium for the number of females in the tavern. One might now ask if there is any empirical evidence to support the conclusions of the model.

Empirical Evidence

It is certainly difficult, if not impossible, to present evidence to show that a profit maximizing admission charge is less than it would be in the absence of any externalities. Anecdotal evidence exists which seems to support a model of the type developed herein. Such evidence comes from the pricing policies of taverns, two of which will be examined in detail. In each case it will be shown that the effective admission charge for unescorted females is negative. These negative prices are indirect evidence of the existence of the externality, because it is otherwise difficult to account for such low prices. Though the two pricing schemes are different, in both cases it is clear that female admission is being subsidized in order to extract higher admission charges from males. In any event, it is very difficult to otherwise explain why, on a regular basis, taverns pay females to attend!

Perhaps the most interesting example is that of The Frontier Club in Dallas, Texas, which has employed a most unusual pricing scheme. On Tuesday nights after 8:00 p.m. the first 50 unescorted females were admitted to the club free, allowed to drink free beer, and presented with a coupon. If the females remained at the club until 11:00 p.m., the coupon could be redeemed for $5. During this time the admission charge for males was $3, and the males could purchase beer for 25¢ each.

The Frontier Club is an unusual example in that unescorted females could actually earn money by patronizing the club. Transfers to females in terms of drinks and entertainment are much more common.

Transfers in kind are more common because there is a problem with the pricing scheme employed by The Frontier Club. There are enormous costs associated with correctly identifying females as escorted or unescorted. It would appear to be very easy to foil any type of policing scheme by having escorted females pretend to be unescorted. Other taverns have solved this problem.

The Spinnaker II in Panama City, Florida, circumvents the policing problem by only admitting females from 8:00 p.m. to 10:00 p.m. During this time the females are provided with free entertainment and free drinks. At 10:00 p.m. males are admitted after paying an admission fee of $3.

This example seems to fit the model described in this paper. The tavern owner certainly loses money from 8:00 to 10:00 p.m., but hopes to more than recover the losses after 10:00 p.m. on the male admission charges. The presence of unescorted females has once again inflated the male admission charge.

It has been demonstrated that if males are willing to pay more for additional unescorted females in taverns, tavern owners may use this information to provide incentives for females to enter the tavern. As the examples suggest, these incentives may take the form of income, or some payment in kind (such as drinks and entertainment). Occasionally, the inducements take the form of drinks which are priced lower than the regular price. Tavern owners have incentives for wanting unescorted females in the tavern because their presence permits higher male admission fees to be charged.

A further point regarding the presence of unescorted females in taverns should be made. In those extreme cases in which the females may actually profit from being in the tavern, such as in the Frontier Club example, or in those cases in which the unescorted females are provided with free services, such as drinks and entertainment, a fine line has been crossed. In these instances it is clear that the unescorted females have gone from being customers of the tavern to employees of the tavern. After all, they are now being paid to be in the tavern. One might wonder why tavern owners simply do not hire unescorted females to attend the tavern. However, there are many possible reasons why this is not done including the avoidance of the transactions costs of hiring. The pricing schemes provide a variety of "employees" in the tavern each week, which would be expensive to arrange through labor markets. Also, since the females presumably derive some benefits from being inside the tavern, perhaps they are willing to work for lower wages than regular employees who might possibly be covered by minimum wages laws. In any event there are incentives for additional unescorted female attendance in taverns, whether they be customers or employees of the tavern.

Conclusions

Pricing policies by businesses frequently yield insight into how firms use demand configurations and interdependencies to obtain greater profits. By using consumption externalities, the model presented here accounts for low admission charges for females to taverns on Ladies' Nite. The demand for access to the tavern by males depends upon the number of female customers in the tavern. A situation very similar to the Ladies' Nite dilemma occurs in the pricing of telecommunications services. There are two customer groups, business and residential. The demand for access

to the telecommunications network by residential customers depends on the number of business customers and vice versa. The fact that each group benefits when members of the other group join the system complicates the analysis slightly.

The problem examined here is also closely related to endorsements and sponsorships. The usage of a product by a celebrity constitutes an endorsement, and frequently celebrities are paid huge sums of money for these endorsements. The expenditures can be justified because the use of the product by the celebrity will increase the demand for the product for the remainder of the market. For example, when Joe Namath wears panty hose, the demand for panty hose will increase. Endorsements involve subsidizing the consumption of one group, celebrities, to increase the consumption of the non-celebrity group.

Textbook sales are another familiar situation for which the model presented here generally applies. Professors are frequently courted by textbook salesmen hopeful of obtaining an adoption. When a professor adopts a text the demand for the text by his students is instantly increased. Thus, expenditures on courting professors has some justification.

The Ladies' Nite problem is representative of a wide variety of pricing problems which occur when customer demands are interdependent. There is certainly more to be said about pricing when demands are interdependent.

Footnotes

[1]The notation used in the model, and the model itself closely parallel that of Littlechild (1975).

[2]In this analysis it is assumed that the marginal cost of admission to the tavern is zero.

[3]The price increase reduced the consumer's surplus so the admission charge fell.

[4]To obtain (7) from (6) note that division by p yields

$$\frac{p-c}{p} = \frac{dM^*}{p \left.\frac{\partial D}{\partial p}\right|_{M=M^*}} - \frac{D}{p \left.\frac{\partial D}{\partial p}\right|_{M=M^*}}$$

$$= \frac{dM^*}{D\varepsilon} - \frac{1}{\varepsilon} = \frac{d}{\bar{d}\varepsilon} - \frac{1}{\varepsilon} .$$

Thus $p = \dfrac{\bar{d}\varepsilon}{\bar{d}\varepsilon + \bar{d} - d}$

[5]Here it is implicitly assumed that the male utility function is a monotonic transformation of $U = U'(d,z,) + U''(M_f)$, where d represents drinks, M_f represents unescorted females, and z is a composite good.

[6]Once again assuming the tavern capacity constraint is binding.

[7]This is an approximation because the profit maximizing drink prices for both groups must change slightly when the number of male and female customers changes.

Bibliography

1. Auerbach, A. J. and Pellechio, A. J., "The Two-Part Tariff and Voluntary Market Participation." Quarterly Journal of Economics. 92 (November, 1978): 571-87.
2. Littlechild, S. C., "Two Part Tariffs and Consumption Externalities." The Bell Journal of Economics. 6 (Autumn, 1975): 661-70.
3. Murphy, M. M., "Price Discrimination, Market Separation, and the Multi-Part Tariff." Economic Inquiry. 15 (October, 1977): 587-99.
4. Ng, Y. and Weisser, M., "Optimal Pricing with a Budget Constraint--The Case of the Two-part Tariff." Review of Economic Studies. 41 (July, 1974): 337-45.
5. Oi, W. Y., "A Disneyland Dilemma: Two-Part Tariffs for a Mickey Mouse Monopoly." Quarterly Journal of Economics. 85 (February, 1971): 77-96.
6. Roberts, K. W. S., "Welfare Considerations of Nonlinear Pricing." The Economic Journal. 89 (March, 1979): 66-83.
7. Schmalensee, R., "Monopolistic Two-Part Pricing Arrangements." The Bell Journal of Economics. 12 (Autumn, 1981): 445-66.
8. Scott, F. A., and Morrell, S. O., "Multi-part Pricing for a Multi-product Monopolist," unpublished.
9. Telser, L. G., "A Theory of Monopoly of Complementary Goods." Journal of Business. 52, no. 2 (1979): 211-230.
10. Willig, R. D., "Pareto-Superior Nonlinear Outlay Schedules." The Bell Journal of Economics. 9 (Spring, 1978): 56-69.
11. _____, "The Theory of Network Access Pricing," in Issues in Public Utility Regulation, ed. by Harry M. Trebing. MSU Public Utilities Papers 1979.