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Pricing the razor: A note on two-part tariffs☆

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ABSTRACT

The “razor-and-blades” pricing strategy involves setting a low price for a durable basic product (razors) and a high price for a complementary consumable (blades). In a timeless model, Oi (1971) showed that if consumers' demand curves differ and do not cross and unit costs are constant, a monopolist should always price blades above cost. This note studies the optimal razor price. With a uniform distribution of parallel linear demand curves it is never optimal to sell the razor below cost, while with two types of consumers and non-crossing linear demands it is optimal to do so for some parameter values.

1. Introduction

The so-called “razor-and-blades” pricing strategy involves a firm with market power setting a low price for a basic, durable product, like a razor, and to earn all or most of its profits from sales of a complementary consumable, like blades, that is used to produce something the buyer values, like shaves. In a timeless setting this strategy is, in effect, a two-part tariff for shaves. One sometimes hears this strategy summarized as, “Give away the razor and make money on the blades.” This note is concerned with whether within the classic timeless framework it is in fact ever optimal for a monopolist to sell the razor at a loss and, if so, when it is optimal to do so.

In some cases the link between the basic product and the consumable is technological, but in others it results from a tying contract. In a pioneering analysis of such contracts, Bowman (1957) discussed an 1895 antitrust case involving the seller of a patented machine for attaching buttons to high button shoes that required users of that machine to purchase the unpatented staples the machine employed from it at a high price relative to available alternatives.[1] Bowman argued that this requirement served as “a counting device” that enabled the seller to earn more from users who valued the machine more, that is, to implement a monopolistic two-part tariff. Bowman did not address the pricing of the machine.

The first formal analysis of monopolistic two-part tariffs was given in Oi's (1971) classic Disneyland Dilemma paper. The basic product was admission to the park and the complementary product was tickets for rides. Considering a finite set of possible buyers with different demand curves, Oi showed that it was always optimal for Disneyland to set the price of ride tickets above the corresponding marginal cost if those demand curves did not cross. He also showed that it was generally optimal for Disneyland to charge a positive price for admission, for which he assumed a zero unit cost.

In the same timeless framework, Schmalensee (1981) considered a monopolist with positive and constant unit costs for both basic and consumable products that faced a continuum of consumers. He retained Oi's assumption that one unit of the consumable product was required to produce one unit of the product ultimately demanded, an assumption retained here for notational simplicity. Following Oi, he showed that if demand curves do not cross, an assumption retained throughout this note, it is always optimal to set the price of the consumable product above cost.[2]

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[1] Bowman (1957, pp. 23–4). The case was *Heaton-Peninsular Button-Fastener Co. v. Eureka Specialty Co.*, 65 Fed 619 (C.C.W.D. Mich. 1895).

[2] Schmalensee's “direct case” involves a slightly weaker assumption than non-crossing demand curves, but the latter assumption is made here for simplicity.

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Schmalensee (1981, Proposition 8) also showed that if R is the price of the basic product, called the razor in all that follows, F is its constant unit cost, and Q is total sales of the consumable product, called blades in all that follows, then at a profit-maximizing point, $(R - F)$ has the sign of

$$m = (\overline{q} - \hat{q})\frac{\partial Q}{\partial R} - \sigma, \tag{1}$$

where σ is a negative substitution term, $\overline{q}$ is the average demand for blades of those who purchase razors, and $\hat{q}$ is the demand of the marginal buyer of razors, where clearly $\hat{q} < \overline{q}$. Since increases in R reduce the demand for blades, the sign of m is ambiguous when demand curves do not cross. Schmalensee went on to argue that the greater the diversity in potential buyers' demands, the larger would likely be the difference in parentheses in Eq. (1), and thus the likelier it would be that the optimal R would be below F.

But since all the terms in Eq. (1) are evaluated at the profit-maximizing point, without solving the profit-maximization problem one cannot generally know their magnitudes. Thus Eq. (1) does not enable one to determine the sign of m from knowledge of costs and demands. Most importantly, as the analysis below demonstrates, the diversity of demands among those who choose to buy the basic product is endogenous; even if there is great diversity in the population of potential buyers, it may be profit-maximizing to serve only a small fraction of them.

Section 2 presents a model with constant unit costs of both razors and blades and a continuum of buyers, uniformly distributed with parallel linear demand curves, in which it is *never* optimal to price razors below cost no matter how diverse potential buyers' demand curves are. This result rests on very strong assumptions, however, that it has not proven possible to relax in a continuum setup without great loss of tractability.

Accordingly, Section 3 considers a model with variable numbers of two types of potential buyers and constant unit costs of both products. Individual demand curves are assumed linear and non-crossing, though not generally parallel. In a number of special cases of this model it is again never optimal to price razors below cost. But we also show that in a relatively small portion of the parameter space it *is* optimal to sell razors for less than their cost of production.

While this analysis makes it clear that one cannot absolutely rule out a monopolist finding it optimal to sell the basic product below cost in the standard timeless multi-consumer model, it at least suggests that such a policy is unlikely to be optimal. Section 4 provides a few concluding observations.

2. A continuum model

Consider a firm with market power that can be treated as a monopolist and that has constant per-unit cost F for razors and v for blades. Consumers have parallel linear demand curves for shaves, the service provided jointly by these products, with one blade providing one shave. The assumption of linearity allows us to set $v = 0$ without loss of generality.[3] By choice of units, the slopes of the individual demand curves and the total mass of consumers can be set equal to unity, so that the demand curve for shaves of a consumer of type t who owns a razor becomes

$$q_t = t - P, \tag{2}$$

where P is the price of blades. Let R be the price of razors, as above, and θ be the index of the lowest type that buys a razor. Then R must equal the consumer's surplus of a consumer of type θ:

$$R = \frac{1}{2}(\theta - P)^2, \quad or \quad \theta = \sqrt{2R} + P. \tag{3}$$

Finally, we assume that t is uniformly distributed between 0 and T, so that higher values of T correspond to more dispersion in the population of potential buyers. For there to be any possibility of positive profit, F must be less than the surplus of the highest type when $P = 0$, i.e., $F < T^2/2$. If N is the total number of razors sold and Q is the total number of blades sold, the monopoly's profit function is

$$\begin{aligned}\Pi &= (R - F)N + PQ \\ &= (R - F)\frac{T - \theta}{T} + \frac{P}{T}\left[\frac{T^2}{2} - \frac{\theta^2}{2} - P(T - \theta)\right],\end{aligned} \tag{4}$$

where θ is given by (3).

Differentiation of (4) yields the two first-order conditions:

$$2T\frac{\partial \Pi}{\partial P} = 3P^2 - 4PT - 4R + 2F + T^2 = 0, \quad \text{and} \tag{5a}$$

$$T\frac{\partial \Pi}{\partial R} = -\sqrt{\frac{R}{2}} + \frac{F}{\sqrt{2R}} + T - \sqrt{2R} - 2P = 0. \tag{5b}$$

It is useful to re-write Eqs. (5a) and (5b) in terms of the following variables:

$$X = {}^{P}\!/_{T}, \quad Z = {}^{\sqrt{2R}}\!\big/T, \quad \text{and} \quad W = {}^{\sqrt{2F}}\!\big/T. \tag{6}$$

Substituting (6) into (5a) and (5b) and combining similar terms, Eq. (5a) and (5b) become

$$\frac{2}{T}\frac{\partial \Pi}{\partial P} = 3X^2 - 4X - 2Z^2 + W^2 + 1 = 0, \quad \text{and} \tag{7a}$$

$$2\frac{\partial \Pi}{\partial R} = \frac{1}{Z}\left[-3Z^2 + W^2 + 2Z - 4ZX\right] = 0. \tag{7b}$$

Note that $F \in [0, T^2/2)$ is equivalent to $W \in [0, 1)$. When $W = F = 0$, (7b) is linear in X and Z. Substituting for Z in (7a) and, using asterisks to denote optima, solving the resulting quadratic yields $X^* = 1/5$, and (7b) then yields $Z^* = 2/5$. In this case the monopolist could profitably sell to all buyers if it could discriminate perfectly. Because it cannot do so, it optimally excludes some low-type buyers. The fraction of potential buyers who do not buy a razor at the optimum in this case is equal to θ/T, and Eqs. (3) and (6) imply

$$\theta/T = X + Z, \tag{8}$$

From the values of X^* and Z^* above, it follows that 3/5 of buyers are excluded in this case.[4]

At the other extreme, as $W \rightarrow 1$, the set of potentially profitable buyers shrinks to the highest type. In the limit, with no buyer heterogeneity, the best the monopolist can do is to set $X^* = P^* = 0$ and just break even by setting $Z^* = W = 1$, giving away blades and capturing all available surplus via the razor price. We now show that $Z^* > W$ for all $W \in [0, 1)$, which establishes

[3] That is, in the notation introduced below, if $v > 0$, one can define $P' = P - v$, $t' = t - v$, $T' = T - v$, and $\theta' = \theta - v$. Substituting for P, t, T, and θ in the profit function and recognizing that the support of t' is $[-v, T']$, one obtains a profit function of the form of (4), in which v does not appear. This argument also justifies setting $v = 0$ in the model of Section 3.

[4] Interestingly, if R is constrained to be zero, setting $Z = W = 0$ in (7a) and solving yields $X^* = 1/3$. Constraining the razor price to be zero makes a higher blade price optimal, but a larger fraction of buyers is served. This constraint reduces profits only slightly, from $2T^2/25$ to $2T^2/27$.