Product Differentiation Advantages of Pioneering Brands

By RICHARD SCHMALENSEE*

This essay presents and explores a relatively simple market model in which rational buyer behavior in the face of imperfect information about product quality can give long-lived advantages to pioneering brands. The analysis has some implications for the variation in the strength of such advantages across markets with different basic conditions. Two sorts of evidence provide the motivation for this research.

First, Joe Bain's seminal empirical study of conditions of entry led him to conclude that "the advantage to established sellers accruing from buyer preferences for their products as opposed to potential entrant products is on average larger and more frequent in occurrence at large values than any other barrier to entry" (p. 216). Treating advertising as a proxy for product differentiation, a large literature has attempted to test this assertion by relating advertising to profitability in cross section.[1] It is interesting to note, however, that Bain concluded that advertising was *not* the main force at work:

> All of these things might seem to suggest the existence of fundamental technical considerations, institutional developments, and more or less fundamental consumer traits which make possible or even very probable the development of strong and stable product-preference patterns. They may also suggest that advertising *per se* is not necessarily the main or even the most important key to the product differentiation problem. ... [p. 143]

Bain did not explicitly describe any mechanism by which product differentiation advantages might be created, but a number of his remarks pointed toward buyer uncertainty about product quality as centrally involved.[2]

Second, conventional wisdom in marketing and scattered recent empirical research support the notion that there are important advantages to being the first entrant in some sorts of markets. Marketers usually predict little success for "me too" brands, those claiming to be identical to established brands but selling at a lower price.[3] The success of generic and private-label brands of some consumer products makes it clear that the strength of any handicap under which such brands operate must vary considerably across markets of different sorts. Ronald Bond and David Lean (1977, 1979) find that important and long-lived advantages are enjoyed by pioneering brands of prescription drugs, advantages that can be overcome by later entrants only if they offer distinct therapeutic benefits, not just lower prices. Ira Whittin's study of cigarette market segments points in this same direction, as do the cross-section analysis of marketing costs by Robert Buzzell and Paul Farris, and the study of order-of-entry effects reported by Glen Urban and his associates.

The next section describes the assumptions and notation employed and outlines the analysis of Sections II–V. Buyer learning about quality takes place over time, so that buyers and sellers generally face dynamic decision problems when quality information

*Professor of applied economics, Sloan School of Management, Massachusetts Institute of Technology. I am grateful to the U.S. Federal Trade Commission for its support of this research. I am also grateful for helpful comments to Steven Salop, a referee, the managing editor, and seminar audiences at MIT, Chicago, Harvard, Princeton, Rochester, the Department of Justice, the Federal Trade Commission, and the Santa Barbara and San Diego campuses of the University of California. Naturally, only I can be held accountable for this essay's shortcomings and the opinions it expresses.

[1] William S. Comanor and Thomas A. Wilson and Harold Demsetz provide interesting overviews of this literature; see also my forthcoming essay, especially Section 3.

[2] See pp. 116, 140, and 142, as well as other discussions in ch. 4.

[3] For typical statements, see Kenneth Runyon, p. 214, or J. O. Peckham.

is incomplete. In order to render those problems more or less tractable, a number of rather drastic simplifying assumptions are made. Like most exercises in economic theory, this analysis should thus be thought of as a parable illustrating a general principle, not as a literal description of any particular piece of reality.[4] The findings and some of their implications for research and for public policy are summarized in Section VI.

I. Assumptions and Notation

Consider a narrowly defined product class, like freeze-dried instant coffee or stainless steel razor blades, such that individual consumers can be sensibly modeled as using at most one brand in the class at any instant. It is assumed for simplicity that brands in this class either "work" or "don't work"; they either perform as a brand in this class should, or they fail to perform acceptably. This makes it possible to describe uncertainty about the quality of a new brand by a single parameter, the subjective probability that it won't work. It is assumed that these products are what Phillip Nelson (1970) christened "experience goods," so that the only way a consumer can resolve uncertainty about quality is to purchase a brand and try it. One trial is both necessary and sufficient to determine whether or not any single brand works.

Consumers differ in their valuation of products in this class. Let the function $Q(v)$, $0 \leq v \leq V$, give the number of consumers willing to pay at least v for a brand in this class that is certain to work. Each consumer values a unit that doesn't work at $-\phi v$, with ϕ a nonnegative constant. (One might have $\phi > 0$ for a bleach that could ruin clothes, for instance.) Consumers are perfectly informed except about product quality, so that neither informative nor persuasive advertising occurs.

The time between purchases is assumed constant and equal to one period, so that trial of a new brand consumes the entire normal interpurchase time. This assumption can be altered without changing the basic results, as long as the cost of learning about a new brand's quality is not made negligible relative to current and expected future unit price. Let the one-period discount rate, assumed the same for all consumers, be r. All else equal, more frequent purchase implies a smaller value of r. Consumers are assumed to be risk neutral, to have infinite horizons, and to behave rationally in a sense to be made precise shortly.

The analysis below considers a two-stage scenario. In the first stage, a pioneering brand enters the market and attains steady-state equilibrium. I have in mind here the first appearance of a distinctly new product, like stainless steel razor blades. It is assumed that the first brand actually works for all buyers. If buyers knew enough about the costs of producing working and nonworking brands, and if they were very sophisticated, they might attempt to infer the pioneering brand's quality from its price or simply from its existence. It avoids serious game-theoretic problems and does little violence to reality, especially in the case of new products, to assume that buyers do not have enough information to behave in this fashion.[5] Instead, it is simply assumed that prior to the introduction of the first brand, all consumers have subjective probability π that it will not work, and all act to maximize the discounted value of expected utility. Trial of a new brand of unknown quality yields both an immediate utility payoff and information, the value of which depends on future prices of the brand. Section II analyzes the first

[4]A number of related works deserve mention here. Christian von Weizsäcker, ch. 5, considers a basically competitive model of this sort of situation. The Bond and Lean (1979) model of first-entrant advantages relies heavily on assumptions about buyers' response to advertising. Cecelia Conrad presents a dynamic model resembling mine in some aspects, but she neglects the first brand's problems of getting buyers to learn about it. The development here traces its ancestry to the simple model in the Appendix of my 1979 article. Carl Shapiro's recent work has a number of formal similarities to mine.

[5]My 1978 article defends neglect of such signalling considerations in this general context. This assumption and the assumption that information sources such as word-of-mouth do not exist seem most plausible when quality is subjective, so that consumers can disagree about whether a brand actually works. In the interests of simplicity, I have not attempted to incorporate this sort of preference heterogeneity explicitly.

brand's pricing problem under the extreme assumption that buyers have static expectations about prices. Section IV examines the implications of the polar opposite extreme assumption of perfect foresight. Neither assumption is especially attractive, but together they should at least bound actual buyer expectations.

In the second stage of the scenario considered here, a second, objectively identical brand appears on the market. Innovation is ruled out in order to focus on the effects of order of entry and on related barriers to imitation. The second brand is also assumed to have exactly the same cost structure as the first. Two additional simplifying assumptions are made. First, it is initially assumed that the second brand is subjectively identical to the first at the introductory stage, so that the same value of π applies. It is straightforward to relax this assumption, and this is done in Section V. Second, it is assumed that the first brand does not change prices in response to entry and that the second brand knows this in advance. This is a much more passive response to new competition than is usually considered plausible.[6] In an undifferentiated world, this behavior would permit the second brand to undercut the first by an arbitrarily small amount, steal all the first brand's customers, and duplicate its profit performance. Regardless of cost conditions, it would thus make it impossible for the first brand to earn positive profits without attracting new entry. Despite this assumption, it is shown below that the addition of uncertainty about quality can make a profitable pioneering brand immune to subsequent entry. This assumption permits us to avoid (at least in this essay) modeling the complicated dynamic game between the first and second brands that would be played after the latter's entry.[7]

Section III analyzes the second brand's pricing problem for the case of static expectations and demonstrates that brand's order-of-entry disadvantage. Section IV shows that our basic conclusions are equally valid in the polar opposite extreme case of perfect buyer foresight. The consequences of relaxing the assumptions that buyers assign the same initial probability of inadequacy to both first and second brands, that they know for certain the value to them of a working brand, and that purchase is necessary to get information about quality are explored in Section V.

In my forthcoming essay, this basic setup is analyzed under the assumption that buyers correctly expect sellers never to change price. This very *ad hoc* pricing restriction drastically simplifies the model and turns out not to alter the basic nature of its conclusions. Since both brands actually work, each sells forever to those consumers who try it when it is introduced and to no others. Both brands then have well-defined demand curves, with the second brand's curve depending on the first brand's price. It is shown that the second brand's demand curve has the first brand's price as its intercept. It coincides with the first brand's demand curve only for prices distinctly below the first brand's price. This means that with economies of scale, the (common) long-run average cost schedule can lie everywhere above the second brand's demand schedule even though the first brand is earning positive profits. The analysis below obtains essentially the same results without restricting price changes. Since the second brand's demand curve turns out not to be easily defined in general, however, there does not seem to be a simple graphical description of the second brand's disadvantage.

II. Pricing the Pioneering Brand

In this section and the next, buyers have *static expectations*; they expect the most recently observed price to hold forever, even if price has changed in the past. Suppose that in order to try a new brand, a consumer ceases for the trial period to use a substitute that yields a nonnegative surplus, s. Assuming away income effects and indivisibilities, one can take $s = 0$ for the first brand.

If a consumer would be willing to pay v for a working brand in this class, immediate

[6] See, for instance, Avinash Dixit and the references he cites.

[7] Conrad's paper illustrates the seriousness of these complications. It may be necessary to make basic changes in the model presented here in order to obtain a tractable post-entry game.

trial of a new brand selling at price p is rational if and only if the following inequality is satisfied:[8]

$$(1)\quad \pi[(-\phi v - p)+(s/r)]+(1-\pi)\times[(v-p)(1+r)/r]\geq s(1+r)/r.$$

The first bracketed term on the left gives discounted surplus if the new brand is tried, doesn't work, and the consumer switches back to the substitute. The second term on the left capitalizes the stream of surplus associated with buying a brand that works at price p forever, and the term on the right gives the capitalized benefit of continuing to purchase the substitute.

Inequality (1) can be rewritten simply as

$$(2)\qquad p\leq v(1-\tau)-s,$$

where the important quantity τ is defined by

$$(3)\qquad \tau=\pi r(1+\phi)/(1+r-\pi).$$

If $\tau=0$, condition (2) indicates that the new brand will be purchased if and only if its net surplus, $v-p$, exceeds s. Larger values of τ always discourage trial of a new brand. As one would expect, τ is increasing in both π and ϕ, as these contribute to the expected cost of trial. Larger values of r, which correspond to lower purchase frequency, also increase τ. The lower is purchase frequency, the more important is any single purchase relative to the entire future stream of purchases. This makes the risk associated with trying a new brand loom larger relative to the alternative of sticking forever with the substitute. If $\tau\geq 1$, condition (2) shows that trial is so subjectively risky that it never occurs at positive p. To rule this out, let us assume $0<\tau<1$ in all that follows.

If the first brand on the market charges price p, and all buyers with $v>p$ are sure that it works, its sales equal $Q(p)$. Let $\Pi(p)$ be the per period profit function corresponding to this demand curve. When the first brand initially appears on the market, nobody is sure that it works, and condition (2), with $s=0$, implies that a price p will produce sales of $Q[p/(1-\tau)]$. Let the profit function corresponding to this less-attractive introductory-period demand curve be $\Pi^0(p)$, and assume both profit functions are globally strictly concave.

In period 1, let $\underline{P}=V(1-\tau)$, and in later periods let $\underline{P}$ equal the lowest price previously charged. The demand curve for the pioneering brand then has the general shape of the solid kinked curve in Figure 1. If $p<\underline{P}$, some new buyers are reached, and profits equal $\Pi^0(p)$. If $p\geq \underline{P}/(1-\tau)$, the only buyers are those who have purchased the brand at least once before, and profits are given by $\Pi(p)$. If $\underline{P}\leq p<\underline{P}/(1-\tau)$, current profits could obviously be increased, and no new customers are being informed, so that prices in this range can never be optimal.

If the pioneering brand adopts a *monopoly Q-constant* strategy, it maximizes profit subject to the constraint that it sell to the same buyers in all periods. This constraint implies that it charges a first-period price p^0 and a price p in all later periods such that $p^0=p(1-\tau)$. (See Figure 1.) The optimal values of p and p^0 can then be obtained by maximizing $\{\Pi^0[p(1-\tau)]+(1/r)\Pi[p]\}$. This sort of low/high pricing sequence corresponds roughly to what is called "penetration pricing" in the marketing and managerial economics literature.[9] One can show that if marginal production cost is positive, a monopoly Q-constant policy yields an output level below that which would be chosen by an ordinary monopolist with profit function $\Pi(p)$ because of the extra marginal cost that the pioneering firm must incur in order to persuade buyers (by means of a low price) to try its *ex ante* risky product.

In Appendix A, it is shown that the monopoly Q-constant strategy just described is the best dynamic pricing policy for the first brand, as long as no thought is given to possible subsequent entry. In order to highlight those aspects of later entrants' prob-

[8] One can derive condition (1) with $s=0$ more rigorously by letting buyer utility be the sum of utility from this product class (either zero, v, or $-\phi v$) and income left over to spend on other goods. It is then straightforward to show that trial of the pioneering brand is optimal if and only if (1) holds with $s=0$.

[9] See Joel Dean for a brief discussion and a comparison with the alternative high/low strategy usually called "cream-skimming" and more commonly associated with durable goods.

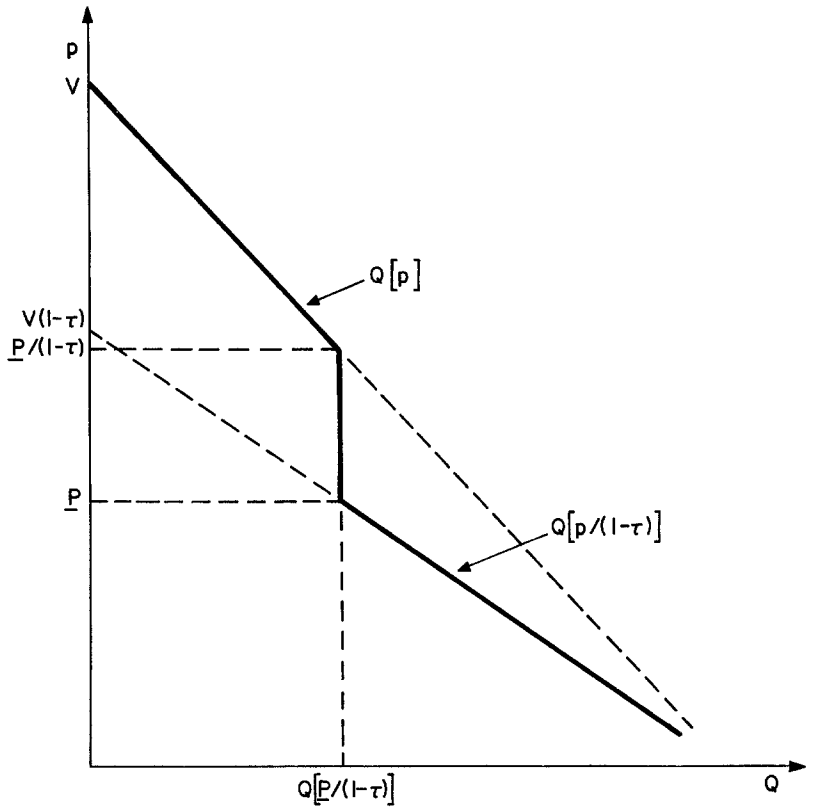

FIGURE 1. SINGLE PERIOD DEMAND FOR THE PIONEERING BRAND

lems that arise naturally, I assume away any such thoughts on the part of the first brand. Allowing the pioneering brand to price strategically could only strengthen the results obtained below at a high cost in added complexity. On the other hand, little is gained by confining the first brand to the monopoly Q-constant strategy defined above. It is thus assumed below only that the first entrant follows *some* Q-constant policy, charging price $P_1(1-\tau)$ in the first period and P_1 in all periods thereafter, and selling $Q(P_1)$ in all periods. Under any such policy, the levelized per period equivalent to the first brand's average revenue stream is simply

$$(4)\qquad \bar{P}_1 = \left[\frac{r}{1+r}\right]\left[P_1(1-\tau)+P_1/r\right] = P_1\left[1-\frac{r\tau}{1+r}\right].$$

III. Demand Conditions Facing a Later Entrant

Because the first brand has followed a Q-constant policy, the second brand faces two and only two distinct types of consumers. If the first brand's price is P_1, those consumers with $v \leq P_1$ have never tried the first brand. If the second brand then charges introductory price p, the condition for trial is again given by (2) with $s=0$, as for the first brand:

$$(5a)\qquad v \leq P_1 \text{ and } p \leq v(1-\tau).$$

Consumers with high v's are a second type of buyer, as they have already tried brand one and found it to work. Because purchase of brand one yields a surplus of $(v-P_1)$, the

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