Entry Deterrence in the Ready-to-Eat Breakfast Cereal Industry

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Entry deterrence in the ready-to-eat breakfast cereal industry

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This paper presents an analysis of the ready-to-eat breakfast cereal industry based on and related to the current antitrust case involving its leading producers. A spatial competition framework is employed, with brands assumed relatively immobile. It is argued that the industry's conduct, in which price competition is avoided and rivalry focuses on new brand introductions, tends to deter entry and protect profits. Entry into a new segment of the market in the 1970s is discussed. Relevant welfare-theoretic issues are analyzed, and it is argued that the remedy proposed by the FTC is likely to improve performance.

1. Introduction and background

■ In April, 1972, the U.S. Federal Trade Commission issued a complaint charging violations of Section 5 of the Federal Trade Commission Act against the four largest U.S. manufacturers of ready-to-eat breakfast cereal (hereinafter simply RTE cereal): Kellogg, General Mills, General Foods, and Quaker Oats.[1] In a section headed "Brand Proliferation, Product Differentiation and Trademark Promotion," the complaint discussed the brand introduction and sales promotion activities of these firms and charged that "these practices of proliferating brands, differentiating similar products and promoting trademarks through intensive advertising result in high barriers to entry into the RTE cereal market."

The trial stemming from this complaint began in April, 1976. Complaint counsel concluded the case-in-chief in January, 1978. In February, 1978, with the support of complaint counsel, Quaker Oats was dismissed from the case.

This essay presents the analysis of entry conditions in the RTE cereal

This paper reports on analysis performed for and supported since 1972 by the Bureau of Economics of the U.S. Federal Trade Commission. Throughout my association with the FTC, I have profited greatly from working closely with Michael Glassman. I am also indebted to many other past and present Commission staff members, including Lawrence Bernard, William Burnett, James Green, Anthony L. Joseph, David Malone, Frederic M. Scherer, and Catherine Winer. I have also received useful comments from Curtis Eaton, Alvin Klevorick, James Meehan, Steve Salop, Robert Willig, and an anonymous referee. In spite of all this help, any shortcomings of the present paper are entirely my responsibility, and this essay does not necessarily reflect the views or assumptions of any other individual or organization.

[1] *FTC* v. *Kellogg et al.*, Docket No. 8883. Nabisco and Ralston-Purina, the fifth and sixth largest firms in the market, were mentioned in the complaint but not listed as respondents.

market upon which the author's testimony as a government witness in that trial was based.[2] It takes as given certain factual points that complaint counsel have sought to establish (on the basis of evidence generally restricted to the precomplaint period). There is little point in debating controversial issues of fact outside the courtroom until the record in this case is complete. Still, an indication of the economics of the government's position in this potentially important antitrust action may be of interest. Further, the analysis that follows develops and applies a number of ideas that have appeared in the theoretical literature, and it may have implications for the study of other industries.

Some key factual points are stated below. Section 2 then presents and discusses three important features of the RTE cereal industry that serve as assumptions in the analysis that follows. In Section 3 these assumptions are applied to static analysis of entry deterrence under the assumption commonly made in theoretical work that established sellers can arrange their affairs once and for all in anticipation of possible entry. Section 4 relaxes this assumption and considers the dynamics of seller conduct and entry deterrence in the RTE cereal industry. Some welfare-theoretic implications of the analysis are discussed in Section 5, and the likely impact of the government's relief proposals is evaluated in their light in Section 6.

The production of RTE cereal has been highly concentrated throughout the postwar period, with the four initial respondents generally making at least 85 percent of sales and the top six firms generally capturing at least 95 percent of the market. Sales of RTE cereal grew rapidly and fairly steadily from 1950 until the mid-1960s. Relatively slow growth was experienced in the latter part of that decade, though rapid growth seems to have returned in the early 1970s. From 1940 until the early 1970s, no new producers of RTE cereal attained nonnegligible market shares. In the early 1970s, however, several large firms entered the industry and began national marketing of so-called natural cereals.

It appears that the leading sellers generally received very high profits from their RTE cereal operations, even after due allowance is made for biases in accounting measures of rates of return. Since observed variability in sales and profits of leading firms does not seem unusually great, and accounting rates of return remained high during the late 1960s, these profits do not seem explicable as compensation for risk bearing.

Given the industry's growth and profitability, the lack of noticeable entry by new firms over a long period implies the existence of some impediment or barrier to entry.[3] Any explanation of the lack of entry of substantial new *firms* must be consistent with the frequent introduction of new *brands* by established sellers. Between 1950 and 1972, the six leading producers introduced over 80 brands into distribution beyond test market. The total number of brands in distribution beyond test market rose from about 25 at the start of 1950 to about 80 at the end of 1972. Further, any explanation of the lack of significant new firm entry during the 1950–1972 period must also be consistent with the subsequent entry of new firms in the natural cereal area in the early 1970s, relatively soon after a slackening in overall demand growth.

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[2] FTC Docket No. 8883, transcript pp. 21671–23935; July 25–August 12, 1978.

[3] More precisely, following Caves and Porter (1977), there exists some barrier to entry or mobility into the group of sellers producing differentiated brands of RTE cereal and marketing them nationally. Small regional producers that advertise little have apparently entered and exited from this industry over the years, but membership in the group of leading sellers was restricted to the six firms named above until the 1970s.

To see the analytical problem more clearly, it will be useful to consider industry attributes generally thought to be relevant to conditions of entry.[4] The best available evidence suggests that the minimum efficient firm size in this market, as of the mid-1960s, involved a 3–5 percent market share. Scale economies of this magnitude would not seem sufficient to explain the prolonged persistence of very high profits, nor is any explanation based on them easily reconciled with the entry of the 1970s.[5] Neither patents nor ownership of raw materials sources is important in this industry. Brand-specific production knowhow is apparently present, since established firms are sometimes unable to duplicate each others' brands. But this has not prevented any of them from producing, promoting, and distributing successful *new* brands. The products in this market are clearly differentiated, and advertising-sales ratios have generally exceeded 10 percent in the postwar period. But it is again hard to reconcile an important barrier based on advertising or differentiation *per se* with the new brand and new firm entry that did occur. (It should also be noted that company name has not always received great stress in the established firms' advertising.)

Finally, the absolute capital costs (including product development and introductory advertising) of efficient entry have been estimated to be in the $80–150 million range in the early 1970s. Neither this cost nor any of the other factors mentioned in the preceding paragraph would seem sufficient to explain the lack of entry into this market during the 1950–1970 period by large, diversified food processing firms, some of which (Pet and Colgate, for instance) entered in the early 1970s. In any case, this conclusion will be assumed to be correct in what follows. (It is, of course, not accepted by the respondent firms in the current FTC proceeding.)

2. Basic assumptions

■ This section describes a conceptual framework suitable for analysis of the RTE cereal market and, it would seem, at least some other markets in which product selection is an important element of conduct. The three component assumptions of that framework are increasing returns at the brand level, localized rivalry among brands, and relative immobility in product space at the brand level. These will be described and discussed in turn.

□ **Increasing returns.** It will be assumed that for individual brands, at least at low levels of output, the unit cost of production and marketing falls with increases in output. Without such a range of increasing returns, each consumer in the country would be able to purchase (or, for that matter, to manufacture) at

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[4] The list of attributes considered follows Bain (1956). One additional possibility should be mentioned at this point. All initial respondents have for some time offered free advice to retailers about the brands of RTE cereal they should stock and about how these brands should be displayed along the "cereal aisle." While one might expect established firms' advice to be slanted against new entrants, and there is anecdotal evidence suggesting that advice has not always been purely scientific, no very precise picture of the effects of these "shelf space plans" is currently available. In any case, while their potential bias might make potential entrants somewhat more reluctant to enter, it is hard to imagine that such plans are powerful deterrence devices.

[5] The entry of the 1970s occurred, as was noted above, in the natural segment of the market. There is some indication that the production process for natural cereals is simpler than for other types, so that minimum efficient firm size in this segment may be below the range indicated. Of course, production economies interact with those in distribution and promotion in determining minimum efficient scale. In any case, no estimate of the magnitude of the net difference (if any) between segments is currently available.

reasonable cost one or more brands of RTE cereal tailored exactly to his or her tastes. In fact, as of the late 1960s, individual brands of RTE cereal tended to be considered viable only if they captured around one percent of the market.

A common simplifying assumption in this context is that the long-run total cost of producing and marketing a typical brand is given by

$$C(q) = F + vq, \tag{1}$$

where F and v are positive constants, and q is the output of the brand. This cost function will be employed for illustrative purposes below; it is merely the *simplest functional form that exhibits increasing returns.*

The appropriate interpretation of "long-run total cost" or of equation (1) in the RTE cereal context requires comment. As the RTE cereal market has operated in recent decades, new brand launchings have required substantial initial outlays for advertising (and, possibly, for research and development as well). It is often asserted that introductory promotional activity can "buy" trials, but that only satisfaction with a product can generate repeat sales. Buyer satisfaction clearly cannot be precisely predicted: if it could be, no new brands would ever fail. It follows that costs of introductory advertising for any single brand are at least to some extent independent of its subsequent sales. Even after a brand has been launched, some advertising spending must have the intended effect of "buying" first purchases. If, for the purposes of long-run analysis, the brand life cycle is collapsed to a single point in time, introductory advertising costs and some fraction of later advertising outlays may be treated to a first approximation as corresponding to some of the fixed cost, F, in equation (1).

It is very important to keep in mind, however, that the level of spending required to launch a new RTE cereal or to produce any given number of initial trials after launch is *not* independent of the level of advertising for other brands nor, in general, of the whole pattern of conduct in the industry. The more intensively brand A is advertised, the harder it must be, *ceteris paribus*, to persuade consumers to try a similar brand B. In terms of our illustrative equation (1), the level of F is determined both by technology *and* by seller conduct in the industry.

□ **Localized rivalry.** Since Hotelling's (1929) classic study, models of spatial competition have frequently been applied to study situations in which, as Lovell (1970, p. 121) puts it, "variations in consumer taste give rise to product differentiation." While consumers do not have perfect information about RTE cereals, imperfect information does not seem to be the major reason why products are not perceived as identical. In fact, individual RTE brands *do* differ physically in perceptible ways, and the spectrum of available brands seems clearly to reflect attempts to appeal to individuals with diverse tastes.

In Hotelling's (1929) model, a large number of small buyers are assumed to be distributed uniformly along a finite line segment. Hotelling suggests that one can imagine distance along that segment as indicating the sweetness of cidar, so that an individual buyer's location corresponds to the exact degree of sweetness he likes best. In the Hotelling model, if all prices are equal, each consumer buys one unit of the brand of cider that is most like his preferred type by patronizing the brand closest to his location on the line. If there are several active sellers on the line, and if individual buyers take into account both prices of and distances to these sellers in determining how much to purchase and which seller to patronize (as most subsequent authors have assumed), then small changes in any brand's

price are only felt by its two closest neighbors on the line.[6] That is, each individual brand of cider competes only with the closest brand on the right (e.g., the sourest of the sweeter brands) and the closest brand on the left (e.g., the sweetest of the sourer brands). In this framework, competitive effects are *localized*. Even though there may be many brands on the market, each brand is effectively an oligopolist, since small price or location changes will have noticeable impacts on only a small number of rival brands. Following Hotelling (1929), a large number of authors have studied spatial models and indicated that they cast light on differentiated markets in general.[7]

An attractive but not yet well-developed alternative to the spatial model is Lancaster's (1966, 1971) "characteristics" approach to demand analysis. That approach assumes that various products or brands are valued by consumers entirely because they provide certain attributes or characteristics, so that demand for products is really derived from the underlying demand for characteristics. Brands differ in the amounts of the various characteristics they supply.

As the analyses of Baumol (1967), Lancaster (1975), and Salop (1976) have shown, the formal correspondence between Lancastrian models with two characteristics and one-dimensional spatial models is almost exact.[8] In particular, the same localization of competitive effects is preserved; small changes in the price or attributes of a single brand generally affect two and only two rival brands.

Archibald and Rosenbluth (1975) have further shown that this sort of localization is preserved in models with three characteristics. But in Lancastrian models with four or more characteristics, the theoretical possibility emerges that the average brand might have a large number of direct competitors; general theoretical conditions that either guarantee or rule out this possibility are apparently not yet known.

It seems likely that RTE cereals provide at least four different attributes relevant to consumers. Existing brands differ in such potentially relevant dimensions as sweetness, protein content, shape, grain base, vitamin content, fiber content, and crunchiness, for instance. The results of Archibald and Rosenbluth (1975) would then seem to imply that the reasonability of the localization assumption in this market is an empirical question. The weight of the evidence seems to me to support it. (This is a judgment with which respondents in the FTC action do not seem to agree.) A good deal of marketing analysis in the industry is done in terms of segments, which are treated as clusters of more directly competitive brands. Further, analysis often proceeds in explicitly spatial terms, with discussions of clusters of brands, open spaces, and of close and distant competitors. Marketing plans for individual brands tend to place greatest stress on the actions of only a few rivals.

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[6] The sourest and sweetest ciders on the market have only one neighbor each. "End effects" of this sort seem unlikely to be of much importance in markets with many brands, and they will generally be ignored in what follows.

[7] See, for instance, Lerner and Singer (1937), Copeland (1940), Smithies (1941), Chamberlin (1951, 1953), Vickrey, (1963, pp. 323–334), Tullock (1965), Samuelson (1967), Telser (1969, 1971), Lovell (1970), Stern (1972), Willig (1973), Peles (1974), Hay (1976), Salop (1976), Eaton and Lipsey (1975, 1976b, 1977), and Prescott and Visscher (1977).

[8] One formal difference is that each buyer in a spatial model is assumed to purchase only one brand, while in a Lancastrian model buyers may rationally elect to consume as many brands as there are relevant characteristics. As long as localization is present, however, this makes no real difference to the aggregate demand conditions facing any individual brand.

In what follows it will be assumed that rivalry among brands is localized, so that actions relating to any single brand generally have important effects on only a small number of other brands. Because models of spatial competition have been intensively studied, it will be convenient to use the spatial framework to indicate the implications of localization. Thus, individual brands can be thought of as having locations in economic or product space that correspond to the collections of attributes that consumers perceive them to possess. Consumers' locations in this same space then correspond to their most preferred (potential) brands. The simplest specific structure of this sort arises when buyers can be though of as uniformly distributed around a circle. In this model, localization is present in an extreme (and thus tractable) form: normally only the two brands between which an entrant locates would be affected by changes in, for instance, its price.[9]

□ **Relative immobility.** If the relevant economic space is in fact geographic space, so that brands differ only in the locations at which they are available, it is clear that changes in location are rarely costless. Similarly, it is not generally costless to change brands' locations in the space of consumer perceptions of attributes provided. The existence of such "repositioning costs" is well recognized in the marketing literature.[10]

I have seen nothing that suggests that RTE cereal producers have the exceptional ability to shift brands' locations in economic space without substantial cost. In fact, established brand names are often dropped entirely when sales fall to low levels, while at the same time new brands are being introduced. If the cost of moving an old brand to an arbitrary location were less than the cost of introducing a new one, this would not be observed. The history of the industry contains a number of instances of successful and unsuccessful attempts to reposition brands; these generally involved substantial costs.

For simplicity, it will generally be assumed in what follows that brands' locations cannot be changed. But it should be clear in context that replacing this with the assumption of substantial (but finite) repositioning costs would not affect the qualitative aspects of the conclusions.[11]

3. Static theory of entry deterrence

■ I first want to argue that the assumptions made above imply the existence of situations in which established brands earn excess profit, but no potential entrant (or established firm) finds it attractive to launch a new brand. Familiar difficulties are encountered in attempts to prove this point mathematically. Under localization, the appearance of a new brand would have noticeable effects on

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[9] If a new entrant were to charge a price so low that demand for one of the two established brands between which it entered were driven to zero, further price cuts would of course affect an additional brand.

[10] See, for instance, Kotler (1976, pp. 168–169). For general discussions of repositioning costs in the context of spatial competition, see Vickrey (1963, pp. 323–334), Hay (1976, p. 252), and Prescott and Visscher (1977).

[11] In the spatial context, the extreme assumption of complete immobility has been explicitly made by Copeland (1940), Tullock (1965), Peles (1974), Eaton and Lipsey (1976b), Hay (1976), Rothschild (1976), Salop (1976), and Prescott and Visscher (1977); it is clearly implicit in the discussions of Baumol (1967) and Archibald and Rosenbluth (1975). Tullock (1965) and Eaton and Lipsey (1977) discuss relaxation of this assumption to permit movement with finite costs.

only a small number of established brands, and it is generally recognized that there exist no simple, generally plausible models of the formation of expectations about rivals' reactions in such oligopoly situations.

On the other hand, numerous analyses that consider particular spatial structures and make more or less plausible assumptions about entrants' expectations have found that entry may not suffice to eliminate excess profit.[12] The main features of these analyses can be illustrated by a simple example that also serves to introduce some useful apparatus.

Consider a situation in which buyers are uniformly distributed around a circle of unit circumference. Let there be N established brands, located distances $(1/N)$ apart around the circle, all charging the same price, p. For simplicity, suppose that all potential entrants face expected demand curves with sharp kinks at this price. That is, they feel that established rivals would not match prices above p, and no such price would be superior to p. On the other hand, they expect prices below p to be rendered unattractive by drastic retaliatory price cuts by established brands. Any new entrant would thus charge p.

As is usual in such models, when all brands charge the same price, each buyer is assumed to patronize the closest brand. Under the assumptions of the preceding paragraph, each brand is closest for buyers located at all distances from it less than or equal to $\frac{1}{2}N$, half the distance to its rivals, on either side. We shall assume that in such symmetric situations, the demand for each brand may be written as

$$q(p,N) = a(p)b(N), \tag{2}$$

where $b(N)$ is decreasing, and $Nb(N)$ is nondecreasing and concave.[13] This latter assumption simply implies that total sales of the product do not fall as the number of brands increases, but the market expanding effect of each additional brand (with all others relocated to preserve symmetry) does not increase with the number of brands on the market.

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[12] Copeland (1940, pp. 8–9) provides an early example. See also Vickrey (1963), Lovell (1970), Peles (1974), Eaton (1976), Eaton and Lipsey (1976a, 1976b, 1977), Hay (1976), Salop (1976), and Prescott and Visscher (1977).

[13] When brands differ only in geographic location, it is natural to write demand at each point in space as a function of delivered price. Integration then yields a total demand function that cannot be written in the form of (2). But unless differentiation is explicitly and entirely geographical, this standard assumption has no compelling justification. The multiplicative separability assumption employed here has the convenient property that in symmetric situations the elasticity of total demand with respect to price (number of brands) is unaffected by the number of brands (price). While the cross effects thus assumed away may be important in some cases, it is not obvious which way they run. It is far from obvious that the assumptions about those effects implicit in the use of the delivered price model are sensible in nongeographical contexts.

Equation (2) can be given a utility-theoretic basis as follows. (I am indebted to Robert Willig for this argument.) Consider a consumer located at some point on the circle. Let the distance around the circle to the ith brand be x_i, let the price of that brand be p_i, let $\tilde{p}$ be the vector of prices of other products (not on the circle), and let I be the consumer's income. Suppose the consumer's indirect utility function can be written as $V[A(\tilde{p},I) + \max\{B(p_i,\tilde{p})C(x_i)\},\tilde{p}]$, where the max is taken over all N brands on the market, A and B are homogeneous of the same degree, A is increasing in I, B is decreasing in p_i, C is decreasing, and V is increasing in its first argument. Only the brand with the largest value of BC is consumed. Roy's Law then implies that if brand i is chosen, the amount purchased is given by a function of the form $q_i = \alpha(p_i,\tilde{p})\beta(\tilde{p},I)C(x_i)$, where α and β are homogeneous of degrees that sum to zero. Integration over x_i and suppression of $\tilde{p}$ and I yield (2) under assumptions of symmetry. (See also Willig (1978).) The specialization $C(x) = (1 - \alpha x)$, $0 \leq \alpha \leq 2$, is useful for illustrative purposes.

Suppose that costs are given by (1), with p greater than v. Then the profits of a typical brand may be written as

$$\pi(p,N) = A(p)b(N) - F, \tag{3}$$

where $A(p) = (p - v)a(p)$. Fix p and let $\bar{N}$ be the solution of $\pi(p,\bar{N}) = 0$. All established brands are then profitable as long as $N < \bar{N}$.

An entrant must locate somewhere between two established brands. In models of this sort an entrant generally does best by locating exactly in the middle of any open interval and catering to those least well served by the existing set of brands. Such an entrant's sales will be made only a distance $1/4N$ to the left and $1/4N$ to the right—halfway to the nearest rival brands. If the rivals are immobile, sales at that level must rationally be expected to persist. The new brand's profits will then be $\pi(p,2N)$, repeating the development leading to (3). It then follows that the entrant's profits will be positive only if N is less than $\bar{N}/2$. Hence, as long as $\bar{N}/2 < N < \bar{N}$, all existing brands earn positive profits, but any entrant would suffer losses.

The detailed features of this example obviously depend on some strong simplifying assumptions, but the general principles it illustrates do not. It has been familiar since at least Bain (1956) that a range of increasing returns can by itself lead to profitable equilibria immune to entry. The assumptions of localized rivalry and relative immobility serve to magnify the effect of this nonconvexity.[14] Under localization, entry imposes a noticeable increase in crowding in the relevant portions of economic space, regardless of conditions elsewhere. Under restricted mobility, an entrant cannot expect existing brands to make room for him by changing their locations, so that the initial crowding he must create must be expected to persist.

I now want to go one step further to suppose that established sellers collude to deter entry at minimum cost to themselves. I shall argue that optimal deterrence under our three basic assumptions is likely to be obtained mainly by increasing the number of brands, rather than by any sort of limit pricing policy. In addition, established firms may find it to their advantage to increase promotional outlays in the face of threatened entry.

Let us begin with a simple illustrative formal model, which is a slight generalization of the circular structure considered above. Let the cost function (1) apply to all established and potential entrant brands. Let the expected or actual average sales per brand when there are N brands optimally positioned in the market, all charging price p, be given by (2). Total profits of the established brands are then given by

$$V(p,N) = N\pi(p,N) = A(p)Nb(N) - NF. \tag{4}$$

Let the values of p and N that maximize this expression be p^m and N^m, respectively.

In the circular model, a price-matching entrant's maximal sales were $q(p,2N)$. We can generalize this by supposing sales of such a brand to be $q(p,\gamma N)$, where γ is some constant greater than one, the exact value of which depends on the precise nature of the economic space and of the distribution of consumers therein. The profits that would be earned by a typical price-matching entrant brand are then

$$\pi(p,\gamma N) = A(p)b(\gamma N) - F. \tag{5}$$

[14] Eaton and Lipsey (1976b) discuss this magnification.

The existing firms optimally deter a price-matching entrant by choosing p and N to maximize $V(p,N)$ subject to the constraint $\pi(p,\gamma N) \leq 0$.[15] Let the corresponding values of p and N be p^d and N^d, respectively. In Appendix 1 we show that $p^d = p^m$ under our assumptions, so that if the constraint is binding, $N^d > N^m$. That is, in this model deterrence is optimally achieved entirely by crowding economic space, by following what might naturally be termed, following the FTC, a brand proliferation strategy.

Before discussing the implications of relaxing the special assumptions of this example, let us expand the model slightly to include advertising. The simplest way to do this in the present context is to consider only introductory advertising and to use F as a proxy for introductory spending per brand. Suppose that established firms can choose F and that level of spending will be matched by any potential entrant. If all brands spend F on advertising, let (2) be replaced by

$$q(p,N,F) = a(p)b(N)d(F), \tag{6}$$

where $d(F)$ is increasing and strictly concave. This equation makes the elasticity of average brand sales with respect to average brand advertising independent of price and the number of brands. Strict concavity implies diminishing returns to advertising. Appendix 2 demonstrates that at a deterrence equilibrium F is such that reductions in advertising would increase the profits of the established brands. The intuition here is that each brand's advertising expands sales in direct proportion to its market area. Since entrants are more crowded after entry than are established firms before entry, entrants would receive less payoff from each dollar of spending than do established brands. If entrants must match spending levels of established brands, it is generally in the latters' collective interest to forego some short-run profits to impose greater costs on potential entrants.

The analysis suggests that under our basic assumptions, the privately optimal entry deterrence strategy involves high prices, brand proliferation, and some degree of overspending on advertising. That analysis rests on restrictive assumptions about behavior, which I now want to argue are not necessary for the conclusion. When potential entrants are sophisticated, the effectiveness of any entry deterrence strategy must depend on the credibility of the postentry threat it is designed to convey. The threats implicit in the strategy described above are at least as credible as any others available.

Suppose, for instance, that established firms attempt to deter entry by some variant of limit pricing, holding prices below the short-run profit maximizing level so that the expected profit of an entrant brand that takes those prices as fixed would be negative.[16] Suppose further that entry nevertheless occurs. Once the entrant is in place, it is relatively immobile. Both its profits and those of its immediate rivals can then generally be raised by increasing price. As only a small group of firms is involved, such mutually beneficial price increases are not implausible. But if potential entrants come to recognize this possibility, limit pricing ceases to be an effective deterrent, since low preentry prices cease to convey a credible threat of low postentry prices.

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[15] Deterrence equilibria of this sort are formally considered by Eaton (1976), Hay (1976), Salop (1976), and Prescott and Visscher (1977).

[16] Arguments resembling that of this paragraph have been made for undifferentiated markets by Scherer (1970, pp. 228–229), in the context of spatial models by Hay (1976) and Eaton and Lipsey (1976b), and with reference to a Lancastrian model by Archibald and Rosenbluth (1975).

A similar argument applies to the use of excess advertising as an entry deterrent. Suppose we conceptually divide brands' advertising into introductory and maintenance spending. A brand's introductory spending is aimed at persuading buyers to try it the first time, while maintenance spending is aimed at those who have tried it in the past. Higher maintenance spending by established brands will raise the level of introductory spending an entrant must do to be noticed. After entry, however, potential entrants might well expect profit-increasing reductions in directly competitive maintenance spending, since, as before, only a small number of brands would be involved. Thus current levels of maintenance spending by established brands might not be persuasive indicators of the level of postlaunch promotion in which an entrant must engage. The deterrent effect of excess advertising is thus weakened, but it is not eliminated, since spending levels of established firms need only be maintained during the period of launch to impose additional introduction costs on an entrant brand.

There exist no similar arguments that weaken the case for brand proliferation's private optimality. An expressed threat to surround an entrant with new brands would be a threat to engage in mutually damaging warfare, and it might thus lack credibility. But if the established firms can crowd economic space with brands *before* the threat of entry appears, as we have been assuming, the entry-deterring threat is that the brands will not be moved if entry occurs. Since repositioning brands is assumed to involve substantial costs, such a threat is quite credible.[17]

It has been implicitly assumed so far that entrants would generally attempt to market brands perceived by consumers as different from those of established firms. In the RTE cereal context one should also consider the possibility of entry by an aggressive private labeler, which would attempt to produce recognizable imitations of some established brands. It would not need to incur the usual heavy introductory advertising costs, and it would price its brands below those they imitated. Since there are increasing returns at small levels of output for individual brands, such entry is most attractive when there are a few large brands that can be imitated; it is then more likely that production efficiency will be attained. But if established firms have proliferated brands, the shares of leading brands will be relatively low. The market share an imitator of such a brand can hope to capture will be correspondingly reduced, and the attractiveness of private labeling thus diminished. It is hard to see how any form of limit pricing would be a powerful deterrent, as the arguments made above apply with a vengeance to a two-seller (the established brand and its imitator) situation. Heavy advertising would be effective only to the extent that it persuaded consumers that no private label product could be comparable to "the real thing" and thus inhibited trial of any private label brand. A brand proliferation strategy thus appears to be a plausible and effective deterrent of private label entry as well as of "branded" entry.

The basic picture that emerges from this section is consistent with the implication of Hay's (1976, p. 253) theoretical analysis that "firms in a differentiated industry do not respond to the threat of new entry by lowering price, but

[17] Established brands that suffered losses because of entry might be withdrawn altogether, of course. But the favored demand positions of established brands ensures that any entrant that imposed losses on an established brand would incur greater losses itself.

rather seek to proliferate products to fill up those parts of quality space where there could be sufficient consumer demand to attract new entry."[18]

4. Application to RTE cereals

■ To apply our general framework to the RTE cereal industry, the assumptions of perfect collusion and a static market must be appropriately relaxed. We now proceed to do this by considering in turn three important questions. First, there is no evidence of explicit agreement among RTE cereal producers to coordinate advertising or brand introduction conduct. Could a pattern of deterrence resembling that described in Section 3 have arisen in the absence of such coordination? Second, demand patterns for RTE cereals have not remained constant, and established firms have introduced numerous new brands in the postwar period. Within our framework, how could the entry of new firms have been deterred, even though established firms found it profitable to launch new brands? Third, is the explanation advanced here for lack of entry during the 1950s and 1960s consistent with the appearance of new firms in the natural cereals segment of the market in the early 1970s?

In the 1950–1972 period leading producers of RTE cereal did not use price with any frequency as an instrument of rivalry. List price cuts and trade deals were rare. Further, the leading firms did very little private label production and on several occasions refused private label business. (In the 1970s nonrespondent Ralston has deviated from this pattern.) Since private label brands compete through price, avoidance of private label production served to protect a profitable price structure. Suppression of nonprice rivalry was apparently less complete. The heavy use of in-the-package premia in the early 1950s ended abruptly in the middle of that decade. The leading firms monitored each others' advertising spending patterns closely, even exchanging detailed information through Nielson until 1972. This monitoring presumably served to mitigate temptations to increase advertising outlays drastically, though by any standard advertising was heavily used throughout the postwar period.[19] No evidence of any attempt to control or restrain new product introductions has been discovered.

Overall, the observed pattern of conduct in the RTE cereal market seems consistent with received doctrine about highly concentrated industries with differentiated products:[20] price competition was suppressed, and rivalry was channelled into advertising and new product introduction. In game-theoretic terms, while pricing conduct may have been approximately cooperative, advertising was probably noncooperative, and new brand introduction activity was almost surely noncooperative.

In a variety of simple spatial models, sequential, noncooperative entry of immobile individual brands gives rise to equilibria closely resembling or identi-

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[18] It is also consistent with Scherer's (1977) description of conduct in the cement and Swedish tobacco industries. In the latter, removal of a government grant of monopoly status led to dramatic increases in the number of cigarette brands and in advertising spending, as the firm sought to replace the entry barrier it had lost.

[19] It is worth noting, however, that one reason why rates of return did not fall in the late 1960s when demand growth ceased is that established sellers made substantial cuts in advertising outlays.

[20] See, for instance, Scherer (1970, p. 336).

cal to the deterrence equilibria of Section 3.[21] In the circular model, the correspondence is exact if the monopoly price is maintained. Each new brand then selfishly maximizes the distance from established rivals (which translates into the level of initial sales) subject to the constraint that no subsequent intermediate entry be profitable. If the final configuration is symmetric, it will have $p = p^m$ and $\pi(p^m,2N) = 0$, and this is precisely the collusive deterrence equilibrium.[22]

The basic principle here is that if each firm selfishly positions its brands in economic space so that new launches by insiders cannot erode its profits, entry by price-matching outsiders is also deterred. If those profits can then be maintained by avoidance of postintroduction rivalry, in particular by avoidance of price competition, a pattern much like the fully collusive deterrence equilibrium of Section 3 emerges. It is thus plausible that such a pattern emerged in the RTE cereal industry as an unforseen, but presumably not unwelcome, consequence of a mode of behavior that arose more or less naturally from the industry's structure.

Moreover, a pattern of rivalry focusing on advertising and new brands and avoiding price competition seems likely to be self-reinforcing once established. The more effectively established brands are differentiated, the less incentive any seller would have to engage in price competition. The less price competition among established sellers, the greater the typical price-cost margin, and the greater the incentive to advertise. To the extent that advertising outlays resemble fixed costs, increased advertising intensity increases the asymmetry between the positions of potential entrants and established sellers.[23] The latters' brands will be kept on the market as long as variable costs are covered, while an entrant will only launch if it can expect to cover total costs. The greater the difference between variable and total cost, then, the less attractive aggressive price-cutting entry appears.

Let us now turn to the second of the questions posed at the start of this section: if the established firms found new introductions to be profitable during the 1950s and 1960s, why did outsiders not? To answer this question, one must consider situations in which the density of demand at various locations in economic space is changing over time, and in which there are costs associated with learning about the demand distribution. In such an environment, opportunities for profitable new brand introductions will be created from time to time. Some of these may be discovered by firms' research efforts. As long as demand is reasonably stable, the number of new opportunities visible to any set of firms in any one year will not be large relative to the total number of brands on the market.[24] A deterrence equilibrium of the sort described in Section 3, once established, will thus continue to protect against entry into most of the relevant

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[21] Hotelling's (1929) famous clustering result depends on complete mobility and strong demand assumptions: see Lerner and Singer (1937) and Smithies (1941). Recent analyses of noncooperative sequential entry include Vickrey (1963, pp. 323–334), Peles (1974), Eaton and Lipsey (1975), Hay (1976), Rothschild (1976), Salop (1976), and Prescott and Visscher (1977).

[22] This discussion assumes that entry is not deterred at the unconstrained monopoly equilibrium. The final configuration will be symmetric if the N' that solves $\pi(p^m,2N') = 0$ is an integer. If not, the collusive deterrence equilibrium will be symmetric with N equal to the smallest integer greater than N'. The sequential entry equilibrium will then have the same N but will not be symmetric; the last brand to enter will have a smaller market area than the others.

[23] The point that follows is due to Eaton and Lipsey (1976b, p. 24).

[24] From 1950 through 1972 the number of introductions of RTE cereal brands into distribution beyond test market by the six leading sellers averaged about 7 percent of the number of brands beyond test distribution at the start of the year.

economic space for some time. Further, there are two basic reasons why the research outlays necessary to locate new RTE cereal opportunities will be more attractive to established firms than to potential entrants.

The first reason is based on differential expectations.[25] For concreteness consider a one-dimensional model and suppose that demand in a segment (of a line or circle) between two established brands is growing in a fairly regular manner and that this situation is known to some established firms and to some potential entrants. In a highly concentrated market, it is natural to assume that the owners of the two brands bordering the segment in question have reached a tacit understanding not to react to new entry with intense price competition nor with ruinous promotional spending. Further, since they face one another as direct competitors at various points in the market, one can also assume that this understanding includes at least some of the other established sellers as well.

It is, however, implausible to assume that a potential entrant would be party to this understanding. Any outsider must thus be less certain than at least some established firms about what reception would greet a new brand it sougnt to establish in the segment. Such uncertainty means that at any point in the segment's growth the expected value of a new brand is less to potential entrants, even if costs are identical, than to established sellers party to the understanding. This difference in value means that some established firm will find it profitable to launch a new brand in the growing segment before any potential entrant sees it as large enough to support its brand. Once the established firm has introduced its brand, both its existing and potential rivals are preempted until considerable further growth occurs. In short, all other things being equal, existing firms that have established a *modus vivendi* with their major rivals possess an asset that makes profitable the introduction of new brands in segments that would not attract outside firms.[26]

A second reason for existing firms to tend to launch the new brands stems from the fact that minimum efficient firm size in the RTE cereal industry is a multiple of minimum efficient brand size. The rough numbers given in Section I suggest that any potential entrant would need to capture at least 3 percent of the market to produce efficiently, while an existing firm might well be happy with a new brand that attained a one-percent share. The existing firms can thus overlook several opportunities for brands that would be profitable for themselves without provoking entry. An entrant, on the other hand, is faced with the task of either developing a single brand that will exceed a 3-percent share—a feat not performed often in this market[27]—or finding three or four "normal-sized" opportunities and successfully taking advantage of all of them before the exist-

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[25] This mechanism was discussed somewhat obliquely in a Lancastrian context by Archibald and Rosenbluth (1975) and presented quite clearly in a spatial model by Eaton and Lipsey (1976b); see also Vickrey (1963, pp. 323–334).

[26] It is not being argued that potential entrants believe with certainty that their entry would provoke a predatory response. As long as an entrant's expectations about rival reactions are less optimistic than those of established firms, the latter will enter first and preempt the relevant segment. And as long as potential entrants agree with Yamey (1972) that predatory reaction to new entry is at least plausible, this difference will exist. This same behavioral disadvantage may face established sellers considering segments bordered by rivals with whom they have not established a mutually agreeable pattern of conduct. The smallest established sellers might from time to time be preempted for this reason.

[27] Of the 80-odd brands introduced into distribution beyond test market in the 1950–1972 period by the six leading sellers, only two ever attained a market share above 3 percent for any full year in this period.

ing firms preempt any.[28] The potential entrant's research task is distinctly harder than those of established sellers.

Since the returns to product development activities are not predictable *ex ante*, it is certainly likely that established firms will from time to time uncover opportunities that would have been attractive to an entrant *ex post*. This may have happened in the RTE cereal market; one can point to small sets of unusually successful new products which might have supported viable entry. This does not mean that potential entrants were irrational. The arguments above indicate that their expected payoff from research was distinctly below that of established firms, even though among the possible outcomes from such research would have been a very successful new product. Thus, a decision not to invest substantial sums in product development was probably perfectly rational.

We can now turn to our third question: is the basic theory presented here consistent with the entry into "natural cereals" that occurred in the early 1970s? The last few paragraphs argued that as long as established firms did not overlook substantial market opportunities visible to others, entry deterrence through brand proliferation could be maintained, even in the face of moderate demand shifts. But the change in demand for natural cereals in the early 1970s was not moderate by historical industry standards. After a rise in consumer interest in "health foods," all natural cereals together had a market share of about 0.5 percent in early 1972. By early 1973 the naturals' share had climbed to about 4 percent, and in mid-1974 natural cereals accounted for about 10 percent of the market. Testimony and documentary evidence suggest that the shifts in consumer taste that led to this sharp increase in demand were not well anticipated by most of the established firms.[29] As a result, a substantial new market segment was up for grabs.

Without natural cereal brands in place, the only possible entry-deterring threats of the established firms would have involved predatory introductions or warfare levels of price or advertising.[30] Such threats, like similar ones analyzed in Section 3, must lack credibility even if they can be communicated. It is thus hardly surprising, given the RTE cereal industry's record of growth and profitability, that Colgate, International Multifoods, Pet, and Pillsbury introduced natural cereals (sold through supermarkets) in 1972 and 1973.

The established firms also introduced natural cereals, and the segment as a whole declined considerably from its mid-1974 peak. Only one of the entrant firms (Pet) still had an RTE cereal brand in national distribution as of late 1977. The industry's history thus hardly suggests that entry is likely to erode profits in the future in the absence of corrective outside intervention.

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[28] Multiple brand entry may be indicated by strategic as well as cost considerations. It is at least plausible that a single brand would be more likely to provoke predatory reactions than would multiple brands, since a firm that introduces several brands signals more convincingly its intention to remain in the industry.

[29] The main exception was Quaker Oats, which was one of the first major firms to produce a natural cereal. Kellogg and General Mills, which entered the segment later, made the unusual decision to have their natural products produced for them by other firms. (See note 5, above.) It is at least plausible that most of the early demand increase for naturals was visible only to those monitoring the "health food" industry. By mid-1973, however, it would appear that most natural sales took place in the "cereal aisle" of supermarkets. As the segment matured, marketing techniques became identical to those used for other RTE cereal brands.

[30] For a similar argument presented in the context of a theoretical analysis of explicitly geographic differentiation see Eaton and Lipsey (1976b, p. 26).

5. Welfare properties of alternative equilibria

■ The analysis to this point indicates that the RTE cereal industry's basic demand and cost conditions have interacted with a pattern of conduct emphasizing brand introduction rivalry to produce a situation in which high profits are not eliminated by rivalry among existing sellers and are not threatened by rivalry from potential entrants. This section applies the tools of welfare economics to see what can be done about this in principle. It will be argued that even though brand introduction and advertising are the most conspicuous aspects of conduct in this market, intervention should focus as directly as possible on pricing and conditions of entry.

Let us temporarily assume that no matter what changes are made in the industry, the pattern of introductory and maintenance advertising spending per brand will remain unaffected. We can then take brands' cost functions as fixed. The basic welfare-theoretic problem in situations of this sort was recognized and discussed long ago by Chamberlin (1933, 1953). On the one hand, the more brands that are offered for sale, the better the market caters to the diversity of consumer tastes. On the other hand, with increasing returns at the brand level, more brands generally imply higher average costs. The problem of optimizing such an industry's conduct from a social point of view is complicated by the fact that price must exceed marginal cost if total cost is to be covered. A number of recent studies have examined this problem under a variety of assumptions, but no simple prescriptions have emerged.[31]

The usual index of social welfare in such studies is the sum of consumers' surplus and producers' excess profits. By employing the illustrative cost function (1) and demand function (2), thus restricting attention to long-run comparisons in which all brands are optimally located,[32] this criterion can be written as[33]

$$W(p,N) = \int_p^\infty Nb(N)a(x)dx + V(p,N). \tag{7}$$

The partial derivatives of this welfare indicator are given by

$$W_p = Nb(N)(p - v)a'(p), \tag{8a}$$

$$W_N = \left[Nb'(N) + b(N) \right] \left[A(p) + \int_p^\infty a(x)dx \right] - F. \tag{8b}$$

As long as $a(p)$ is decreasing, W_p has the sign of $(v - p)$, and marginal cost pricing is globally optimal for any N. With $p = v$, the welfare optimal N, N^w, is obtained by solving $W_N = 0$. The (p,N) point (v,N^w) does not permit fixed costs to be covered, so that it is not a feasible outcome without subsidies for the industry.

A number of other (p,N) pairs can be compared within this framework. We have already defined the monopoly and deterrence points, (p^m,N^m) and (p^m,N^d). Let N_m^0 be the number of brands just sufficient to drive profits to zero

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[31] See, for instance, Stern (1972), Willig (1973), Lancaster (1975), Spence (1976a, 1976b), Salop (1976), and Dixit and Stiglitz (1977).

[32] That is, if N brands are optimally located, costs of mobility imply that adding another brand will not produce a situation with $(N + 1)$ brands optimally located. Given shifts in tastes over time, however, one might expect different patterns of brand introduction rivalry to lead in the long run to situations with different numbers of brands, all at least approximately optimally located.

[33] On this measure of welfare, see Willig (1973, 1978) and Spence (1975, 1976b).

when $p = p^m$, and let N_m^w be the number of brands that maximizes W subject to the constraint that $p = p^m$. If one takes the deterrence equilibrium as a first approximation to the RTE cereal industry's current situation, intervention that focused on brand introduction and ignored pricing would aim for the point (p^m,N_m^w). Finally, let (p_0^w,N_0^w) be the pair that maximizes W subject to the constraint that V be nonnegative. This is also a second-best equilibrium. Appendix 3 proves that the zero-profit constraint is binding and that $v < p_0^w < p^m$.

Appendix 3 also establishes inequalities relating the numbers of brands in the various equilibria. It is shown, for instance, that N_m^w exceeds N^m, so that if $p = p^m$, it is optimal to increase N beyond the profit-maximizing point. The intuition is that each additional brand increases consumers' surplus, and until the last brand subtracts as much from profit as it adds to surplus, it is optimal to add more brands. Similar intuition helps explain why N^w exceeds both N^m and N_0^w. Even in this special model, however, the only inequalities involving N^d appear to be $N^m < N^d < N_m^0$. It thus seems possible for N^d to be less than or greater than N^w, N_m^w, or N_0^w. In short, formal analysis of (7) does not support a charge that the deterrence equilibrium involves too many brands in any well-defined sense.

A number of inequalities relating values of W at various (p,N) points are obvious from the definitions above. In addition, Appendix 3 proves that

$$W(p_0^w,N_0^w) > W(p^m,N_m^0), \tag{9a}$$

$$W(p_0^w,N_0^w) > W(p^m,N^d). \tag{9b}$$

The first of these supports the intuition that if profits are to be driven to zero, it is best to do so with a price below the monopoly level. (Appendix 3 also establishes that N_m^0 exceeds N_0^w.) The second inequality shows that the best zero-profit point is strictly better than the deterrence equlibrium in this model.

Using the analysis of the preceding two sections, suppose we take the deterrence equilibrium as an approximate description of the state of the RTE cereal industry. Then (9b) suggests that if prices could be lowered by the correct amount, and if entry eliminated excess profits, social welfare would increase. This implication follows from other formal models, as does the following difficulty. The pair (p_0^w,N_0^w) was found as the solution to a reasonably complicated constrained optimization problem. Without the kind of complete information that is unlikely ever to be available in practice, one can establish little beyond the fact that p_0^w is less than p^m. It does not seem possible to show that all zero-profit points lead to a higher W than the deterrence point; this can only be established for points "close to" (p_0^w,N_0^w). In short, we cannot prove rigorously that *all* increases in price competition coupled with free entry would serve to increase W; we have only shown that *some* range of increase will do this.

Still, the foregoing analysis does have some useful implications. To the extent that (p^m,N^d) and (p_0^w,N_0^w) correspond to the current and best feasible equilibria in the RTE cereal market, the arguments above imply that the basic problem with seller conduct in that market is *not* that too many brands are introduced. It is rather that too little price competition occurs. As long as excess profits are being earned, this model or any other implies that net gains would result if prices were lower, all else equal. Further, if the deterrence equilibrium is taken as the *status quo* under (1) and (2), we know that a range of outcomes with lower prices and profits would be preferred. Intervention that seeks to enhance price competition and facilitate entry thus seems likely to move in the

right direction. This model supports no such statements about actions focusing directly on brand introductions, since the desired direction of change in N is indeterminate.

Two additional considerations not incorporated in the formal analysis above lend some additional support to this policy prescription. First, the welfare function in (7) gave the same weight to a dollar of consumers' surplus as to a dollar of producers' excess profits. Since RTE cereal is not an obvious luxury, a transfer from profits to surplus may well be progressive. If, for this reason or because excess profits are considered especially malign, greater weight is placed on the first term on the right of (7) than on the second, the attractiveness of all zero-profit points is enhanced. The danger that any particular move to increase price competition and ease entry will be undesirable is thus reduced.

Second, the formal analysis above assumed that brand-specific costs were unalterable. But a large fraction of those costs over the life-cycle are advertising expenditures, and these are conduct-determined to a considerable extent. By lowering margins, increased price competition would reduce the incentive to advertise. As Section 3 argued, this may serve directly to facilitate new entry. Further, if one feels that the industry's intensive use of advertising is not justified as a response to consumer demand for information,[34] or if one objects to the sizeable fraction of that advertising directed at children, one should applaud reductions in advertising spending.

6. The impact of proposed relief

■ The remedy proposed by complaint counsel in the RTE cereal litigation has four substantive components, two of which are of primary importance: divestiture and trademark licensing.[35] The proposed divestiture would create five new firms by requiring the three remaining respondents to spin off certain established brands and trademarks.[36] The licensing provision would require these firms to license their existing trademarks (and to provide the corresponding formulae) on a royalty-free basis to all nonrespondent firms willing to meet quality control standards. In addition, similar licenses would be required to be made available on new brands five years after their introduction. All such licenses would be limited to a maximum duration of twenty years, after which the trademarks would revert to the originating firm. The remainder of this section examines these provisions in light of the foregoing analysis and argues that the proposed relief is quite likely to improve the RTE cereal industry's performance.

Divestiture will have the obvious immediate effect of producing a less concentrated structure, though the four largest firms will still likely account for

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[34] Given the present development of the welfare economics of advertising, this sort of feeling cannot be rigorously supported or opposed.

[35] The other two components are a ban on acquisitions, which serves to make divestiture effective, and a prohibition of the shelf-space plans discussed in note 4, above. The positive case for eliminating such plans is that they may give the largest established firms advantages over actual and potential rivals.

[36] Under spinoff the firms would essentially divide amoeba-like, with existing shareholders receiving equity in all successor entities. Spinoff thus cannot be delayed by failure to find a "qualified" buyer willing to pay a "reasonable" price. Further, the FTC does not have the expertise necessary to optimize the detailed allocation of assets (plant, equipment, trademarks, personnel) among the successor firms, though it can set some standards.

over half the industry's sales. This fall in concentration should directly increase price competition in the industry. Further, major producers' reluctance to engage in private label production likely derives in large part from fear that such activity would be viewed by rivals as a form of aggressive price competition. Deconcentration can be expected to weaken the tacit agreement that supports this mutual restraint. If private labeling is thus increased, greater pressure on prices seems likely. Finally, increased price competition from any source, by reducing margins over production costs, will tend to reduce the incentive to engage in advertising and brand introduction. The analysis above suggests that reductions in these dimensions of rivalry are likely to have the desirable effect of facilitating the entry of new competition.

Still, the proposed divestiture may not by itself constitute an adequate remedy. While deconcentration can be expected to increase the intensity of rivalry, it may not serve to focus rivalry on price to the extent desirable. The industry would still be relatively concentrated, products would still be differentiated, and old patterns of conduct would still be familiar to top personnel. To move the industry toward a low-price, low-profit equilibrium a change in the "rules of the game" will likely be required. The proposed licensing requirement would operate in this direction.

Under that requirement nonrespondent firms will be able to produce products, which we shall call "copies," that can be truthfully promoted as identical to the respondents' established brands. There is no reason to suppose that licensees will have access only to inferior production and marketing technology. They will not need to engage in the usual level of introductory advertising to establish such copies in economic space. If copies are produced by firms with established reputations in prepared foods or marketed by large grocery chains, the issue of differential firm reputation need not arise in buyers' minds. The licensing component of the remedy should thus produce a situation in which at least the largest established RTE cereal brands are offered for sale by more than one firm, and price competition seems virtually certain to erode the margins on those brands. Lower prices for the largest brands seem likely to force reductions in the prices of other (nonlicensed) brands.

Further, trademark licensing will directly expand the options available to potential entrants and thus facilitate entry. Outsiders will be able to gain a toehold in the industry by producing copies of leading brands. Since parity on quality terms can be attained (and, if desired, advertised), this will be more attractive than private labeling is now. Once a firm has attained efficient scale in this fashion, it will be favorably positioned to launch its own brands, should that appear profitable.[37]

Finally, the licensing requirement will directly reduce the incentive to engage in brand introduction rivalry. This should help prevent the reemergence of entry deterrence via brand proliferation.

The design of an appropriate licensing requirement involves a number of considerations.[38] To maintain quality it is important that the licensees' quality control be subject to independent audit. The five-year period of exclusivity was

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[37] Even if respondents deter potential licensees by substantially lowering prices on leading brands, the remedy will still have served to move the industry toward a low-price, low-profit equilibrium.

[38] For a provocative analysis of the relation between patents and trademarks, see Chamberlin (1962, pp. 57–64).

chosen, in light of lifetimes of apparently successful brands and various estimates of payback periods, to retain sizeable rewards for significant innovation. The 20-year license term should provide licensors incentives to maintain the quality of their own products, since the most successful brands (and thus the ones most likely to be licensed) are on the market for at least this long. On the other hand, a relatively long license term is required to make specialized investments attractive to licensees. While the proposed license provisions appear to be reasonable in light of these considerations, it should be clear that they have not been derived as solutions to a precise optimization problem.

Some important interactions between divestiture and trademark licensing should be mentioned. First, by placing the three largest sellers at a disadvantage relative to other existing and potential producers, the licensing provision can be expected to reinforce the deconcentration effects of divestiture. Second, for licensing to have its full effect, there must be a set of firms well situated to take out licenses, and the proposed divestiture would create such a set of firms. Third, the ability to take out licenses on established brands should enhance the viability of the new firms created by divestiture.

The proposed relief seeks to alter conduct and performance by changing the structure of the RTE cereal industry. This would not appear to be a case in which simple prohibitions of particular practices would provide adequate relief. Further, the Commission hardly has the resources or expertise necessary to regulate the day-to-day operations of RTE cereal producers. This section has attempted to show that the proposed relief is likely to facilitate entry and to increase price competition. As Section 5 noted, we cannot prove with mathematical certainty that these changes in conduct will produce welfare gains, but we argued that these changes are the most likely to improve the industry's performance. The relief proposed by the FTC thus seems to provide a sound solution to the problem in normative economics posed by the RTE cereal industry's performance.

Appendix 1

■ The first-order conditions for unconstrained maximization of $V(p,N)$, as given by equation (4), are as follows:

$$A'(p)Nb(N) = 0, \tag{A1a}$$

$$A(p)[b(N) + Nb'(N)] - F = 0. \tag{A1b}$$

Note that we employ the usual assumption that N can be treated as continuous without substantial error. Condition (A1a) clearly implies that $A'(p^m) = 0$. The corresponding first-order conditions for maximization of $V(p,N)$ subject to $\pi(p,\gamma N) \leq 0$, assuming the constraint strictly binding, are as follows:

$$A'(p)[Nb(N) - \lambda b(\gamma N)] = 0 \tag{A2a}$$

$$A(p)[b(N) + Nb'(N) - \lambda\gamma b'(\gamma N)] - F = 0 \tag{A2b}$$

$$A(p)b(\gamma N) - F = 0, \tag{A2c}$$

where λ is a Lagrange multiplier which can be shown to be positive and (A2c) simply restates the constraint.

Two types of solutions to conditions (A2) might seem possible. In brand proliferation solutions, (A2a) is satisfied by $A'(p) = 0$, so that $p = p^m$. Given p, the value of N is obtained from (A2c), and (A2b) merely serves to determine

λ. This solution implies that $N^d > N^m$ if the constraint is binding. In limit pricing solutions, the term in brackets in (A2a) is zero and $A'(p) \neq 0$. This gives one equation in N and λ:

$$Nb(N) - \lambda b(\gamma N) = 0. \tag{A3a}$$

A second such equation is obtained by solving (A2b) and (A2c) for $F/A(p)$ and setting the resultant expressions equal:

$$b(N) + Nb'(N) - \lambda\gamma b'(\gamma N) - b(\gamma N) = 0. \tag{A3b}$$

If these two equations could be solved for N and λ, p would then be determined from (A2c). We now show that limit pricing solutions do not exist, since concavity of $Nb(N)$ implies that (A3a) and (A3b) have no solution.

If a solution to these equations existed, we could substitute for λ in (A3b) from (A3a) to obtain

$$T = b(N)b(\gamma N) + Nb'(N)b(\gamma N) - b(\gamma N)^2 - b(N)\gamma Nb'(\gamma N) = 0. \tag{A4}$$

Concavity of $Nb(N)$ can be readily shown to imply

$$Nb'(N) \geq [\gamma/(\gamma - 1)][b(\gamma N) - b(N)], \tag{A5a}$$

$$\gamma Nb'(\gamma N) \leq [1/(\gamma - 1)][b(\gamma N) - b(N)]. \tag{A5b}$$

Equality holds in both of (A5) if $Nb(N)$ is constant. Substitution of (A5) into the expression for T and some algebra yield

$$T(\gamma - 1) \geq [b(N) - b(\gamma N)]^2 > 0. \tag{A6}$$

Thus T is positive for all N, and no solution to equations (A3) exists. But (A3a) was implied by the assumption $A'(p^d) \neq 0$, so that assumption must be false. If $A'(p^d) = 0$, it follows that $p^d = p^m$. It is then immediate that if entry is not deterred at the unconstrained monopoly equilibrium, N^d must exceed N^m, and the proof is complete.

Appendix 2

■ If equation (2) is replaced by equation (6), conditions (A2) are still necessary for an internal deterrence equilibrium, except that $A'(p)$ in (A2a) and $A(p)$ in (A2b) and (A2c) must be multiplied by $d(F)$. An additional first-order condition must be added to the list:

$$N[A(p)b(N)d'(F) - 1] - \lambda[A(p)b(\gamma N)d'(F) - 1] = 0. \tag{A7}$$

Since λ is positive when the constraint is strictly binding, the two terms in brackets must be of the same sign. Since $b(N) > b(\gamma N)$, they cannot both be zero.

It is easy to show that (A3b) holds at a deterrence equilibrium with demand equation (6). Equation (A3b) can be rearranged as follows:

$$[(\gamma/N) - 1]\gamma b'(\gamma N) = [b(N) - b(\gamma N)]/N + [b'(N) - \gamma b'(\gamma N)]. \tag{A8}$$

Inequalities (A5) can be combined to establish

$$[b'(N) - \gamma b'(\gamma N)] \geq [b(\gamma N) - b(N)]/N. \tag{A9}$$

Substitution of (A9) into (A8) then yields

$$[(\lambda/N) - 1]\gamma b'(\gamma N) \geq 0. \tag{A10}$$

Since $b'(\gamma N) < 0$, it follows that $\lambda \leq N$.

Now suppose that both bracketed terms in (A7) are positive. The result of the preceding paragraph then implies

$$N[A(p)b(N)d'(F) - A(p)b(\gamma N)d'(F)] \leq 0. \tag{A11}$$

But this is impossible, since both quantities in the bracketed expression are positive, and $b(N) > b(\gamma N)$. Thus both bracketed terms in (A7) must be negative. But the first term in (A7) is just the partial derivative of the profits of the established brands with respect to F. Its negativity and the strict concavity of $d(\cdot)$ establish that those profits could be increased by reducing F (and thus obviously making entry attractive), as was to be shown.

Appendix 3

■ The right-hand side of (8b) can be written as $M(N)G(p) - F$. Strict concavity of $Nb(N)$ implies that $M(N)$ is strictly decreasing. $G(p)$ is also decreasing for $p > v$. We can now write the conditions determining N under the various assumptions in the text. From (8),

$$M(N^w) = F/G(v). \tag{A12}$$

From (A1b) and (A2c),

$$M(N^m) = F/A(p^m), \tag{A13}$$

and

$$b(\gamma N^d) = F/A(p^m). \tag{A14}$$

From (8b), $G(p) > A(p)$ at any price at which purchases are made. Assuming that the deterrence constraint is binding, $b(\gamma N^m) > M(N^m)$, and we shall assume that this inequality holds for all N. From the relevant definitions,

$$b(N_m^0) = F/A(p^m). \tag{A15}$$

Note that $b(N) > b(\gamma N)$ for all N. From (8b),

$$M(N_m^w) = F/G(p^m). \tag{A16}$$

Finally, suppose $W(p,N)$ is maximized subject to the constraint that $V(p,N)$ be nonnegative. Since (8a) implies that $W_p < 0$ for $p > v$, and since the constraint cannot be satisfied at $p = v$, the constraint must be binding. The first-order conditions can be written as follows:

$$A(p)b(N) - F = 0, \tag{A17a}$$

$$(p - v)a'(p) + \lambda A'(p) = 0, \tag{A17b}$$

$$M(N) = F[1 + \lambda]/[G(p) + \lambda A(p)], \tag{A17c}$$

where λ is a positive Lagrange multiplier. Condition (A17a) restates the constraint. Condition (A17b) can be seen to imply that the optimal constrained price, p_0^w, satisfies $v < p_0^w < p^m$. Eliminating λ between (A17b) and (A17c),

$$\begin{aligned} M(N_0^w) &= F/\{[G'(p_0^w)I(p_0^w)/a(p_0^w)] + G(p_0^w)\} \\ &= F/\{[A'(p_0^w)I(p_0^w)/a(p_0^w)] + A(p_0^w)\} = F/H(p_0^w), \end{aligned} \tag{A18}$$

where the last equality defines $H(p)$, and $I(p)$ is the integral appearing in (8b). We have immediately that for $p > v$, $H(p) < G(p)$, since $G(p)$ is decreasing in the relevant range. Since G is decreasing, it also follows that $H(p_0^w) < G(v)$.

All but the last of the following inequalities are directly implied by the results of the preceding two paragraphs:

$$N^m < N^d < N^0_m, \tag{A19a}$$

$$N^m < N^w, \quad N^m < N^w_0 \tag{A19b}$$

$$N^w_0 < N^w, \quad N^w_0 < N^0_m. \tag{A19c}$$

To prove that $N^w_0 < N^0_m$, note that both (p^w_0,N^w_0) and (p^m,N^m_0) satisfy (A17a). But $A(p^m) > A(p^w_0)$, since $p^m \neq p^w_0$, and the result follows from $b'(N) < 0$.

To establish (9a), note that both (p^w_0,N^w_0) and (p^m,N^0_m) satisfy the zero-profit constraint. The first point yields a maximum of W subject to that constraint. But the second point satisfies an additional restriction that the first does not: $p \geq p^m$.

The proof of (9b) is as follows. Let $\bar{V} = V(p^m,N^d) > 0$. Suppose W is maximized subject to the constraints $p \geq p^m$ and $V(p,N) \geq \bar{V}$. The solution will be some point (p^m,N') such that $W(p^m,N') \geq W(p^m,N^d)$. Now consider a second optimization problem, formed from this first one by dropping the first constraint entirely and relaxing the second by replacing $\bar{V}$ with zero. As noted above, $W_p(p^m,N) < 0$. Thus the dropped constraint was strictly binding, so its removal must raise the optimal value of the objective function. Replacing $\bar{V}$ with zero expands the feasible set and cannot lower optimal W. But the second problem is precisely the one that led to the point (p^w_0,N^w_0), so that $W(p^w_0,N^w_0) > W(p^m,N') \geq W(p^m,N^d)$, and the proof is complete.

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