DEFENSIVE MARKETING STRATEGIES: AN EQUILIBRIUM ANALYSIS BASED ON DECOUPLED RESPONSE FUNCTION MODELS*

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The entry of a new product (attacker) into a competitive market is likely to provoke responses from some or all of the existing products (defenders). This paper investigates the development of optimal defensive strategies based on an understanding of the possible reactions of all the defenders to an optimal attack. Following Lane (1980) we assume that \( N \) products each enter sequentially with perfect foresight on subsequent entry. Then, based on new technology, an unanticipated attacker enters. The \( N \) defenders respond in price but not position according to Lane’s model. Once this equilibrium is obtained, advertising and distribution response functions scale sales.

We show that under these decoupled response function models of advertising and distribution, uniformly-distributed tastes, and nonincreasing market size, the optimal defense for all existing brands is to decrease their respective prices, advertising, and distribution. Those qualitative results are consistent with recommendations by Hauser and Shugan (1983) who used related, but different, consumer response models and a different equilibrium assumption.

(MARKETING; COMPETITION; NEW PRODUCTS; PRICING)

1. Introduction

Most new products are introduced into markets with existing competitive products. The entry of a new product (attacker) into such an environment is likely to provoke responses from some or all of the existing products (termed defenders). This paper investigates the development of optimal defensive strategies based on an understanding of the possible reactions of the defenders.

In so doing, we demonstrate clearly the impact of using decoupled response function models for advertising and distribution on the derivation of optimal defense strategies. Specifically, we show that optimal defense dictates lowering price in markets with uniformly distributed consumer tastes. We also show that the directions of change in advertising and distribution expenditures are contingent on market parameters. This result is shown to hold for all concave advertising and distribution response functions, and for any such \( N \)-product market which is in equilibrium when attack occurs. These results are similar to the directional results obtained by Hauser and Shugan (1983) for uniformly distributed tastes. Our results establish that prices will fall upon entry in an extension of Lane’s (1980) environment.

§2 discusses the existing literature briefly. Then, in §3, we discuss the consumer and managerial models that are used in our analysis. This is followed by a discussion of the competitive interaction between the \( N \)-products in the initial market and of all products after attack. In §4, we present our general analytical results. Following the general analytical results, some comparative statics relating market structure, performance, and strategy are stated. We conclude this paper with a summary of our results and a brief discussion of directions for future research.

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2. Past Literature in Brief

Past work that we build on has largely appeared in two streams: (i) economics, and (ii) analytical marketing.

To quote Lane (1980, p. 237), "Economists have developed very detailed models to describe the behavior of markets that are characterized by homogeneous products, perfect information, and identical, noncolluding consumers and firms." Lane’s paper relaxes the assumption of homogeneous products and develops a positive description of the choice of product position and price by firms. Excellent reviews of the product differentiation literature are provided by Lancaster (1980), Scherer (1980), Schmalansee (1981, 1982), and Stigler (1964). 1

Considerable work in the analytical marketing literature has been done on developing new product entry strategies. This literature provides guidelines for the selection of couponing, initial advertising design, dealing and sampling. This literature also develops algorithms for determining the optimal position (brand features) of the new brand without explicitly considering defensive reactions on the part of existing brands. Complete reviews are available in Shocker and Srinivasan (1979), Urban and Hauser (1980), Wind (1982), Pessemier (1982), Sudharshan, May, and Shocker (1987).

This body of knowledge does not, in any integrated fashion, prescribe how an entrant firm should optimally position its new brand, choose advertising expenditures, channel expenditures and price—given competitive reactions by defending firms in defense of their existing brands. Very little work modeling such defensive reactions exists in the literature. Notable exceptions to this paucity are the work in marketing of Hauser and Shugan (1983) 2 and in economics of Lane (1980).

We shall compare and contrast these two works in detail in the subsequent sections in terms of model assumptions and analytical results.

3. Model Overview

1. Consumers: They are assumed to be utility maximizers. Utility is a function of brand characteristics, price and remaining income available for other purchases.

2. Managers: We assume that they are profit maximizers and rational competitors. Upon knowledge of the number of products entering the market, they can compute optimal strategies to be competitive. The attacker managers will use optimal market entry strategies of position, price, advertising and distribution (i.e., 4 P’s). On the other hand, defender managers will defend their brands optimally only through price, advertising and distribution, and not brand repositioning. This seems to be a reasonable assumption for short-term defensive reactions in the frequently purchased goods industry, but long-run response would require repositioning.

3. Market structure: Our analysis assumes a market in which brands already exist and are in one type of equilibrium. (No manager has any incentive to modify any of his marketing mix strategy variables unilaterally.) The optimal new product entry strategy we derive is for a brand entering such a market. This strategy is based on the adjustment of existing brands to this entrant. The entire market, including the new brand, achieves a new equilibrium. 3 A natural question here is why does attack occur in a market in equilibrium? A possible scenario is that a new firm discovers a technology with lower fixed costs and hence decides to enter the market. Another possible scenario is that the

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1 Other important articles in this area are those by Hotelling (1929) and Prescott and Visscher (1977).
2 Referred to henceforth as H&S.
3 It is noted that for some mathematical models an equilibrium might not exist. For the particular model we have chosen, Lane (1980) proves the existence of an equilibrium. His proof holds for both before attack and after attack market structures.
demand in a market increases after the initial structure is obtained, thus making attack attractive. It is also possible that the market demand estimate, based on which the initial market structure is obtained, was inaccurate. This inaccuracy may also make attack attractive. That such situations are managerially relevant is evidenced by the numerous practical applications of the Defender model (Hauser and Gaskin 1984, and Hauser 1986).

3.1. Consumer Model

We will deal with a market for a single product class, with two attributes on which products can be differentiated. The consumer model that we shall use for price and position response is that used by Lane (1980).

Consumer tastes are assumed to be continuously and uniformly distributed over an interval [0, 1] and a randomly chosen consumer is represented by the parameter \( \alpha \in [0, 1] \). Each customer is assumed to buy one unit of any brand \( q(\alpha) = 1 \) for all \( \alpha \in [0, 1] \). Assuming the distribution of consumers is a continuous function \( f(\alpha) \), \( M \) the total demand from this market is \( \int_0^1 q(\alpha)f(\alpha)d\alpha = M \) units, where \( M \) is set exogenously. (A possible measurement procedure for \( f(\alpha) \) is described in Srinivasan 1975.)

Consumers are assumed to be maximizers of a Cobb-Douglas utility function given by:

\[
U_d(w_i, z_i, p_i) = w_i^\alpha z_i^{1-\alpha}(Y - p_i)
\]

where \((w_i, z_i)\) are the attribute values for a particular brand, \( p_i \) is its price and \( Y \) is the total dollar amount available to the consumer by way of income. We assume that all consumers have the same income \( Y \). Then, the consumer type \( \alpha \) weights the attribute values \((w_i, z_i)\) correspondingly with exponential weights of \((\alpha, 1 - \alpha)\). The term \((Y - p_i)\) in the utility function signifies the remaining amount of income available to the consumer to spend in other markets. This explicit incorporation of consumer income allows a comparison of the market structure-strategy-performance linkages in markets with varying consumer incomes. However, it does have its downside. Because price is generally a small percent of income, Lane’s model tends to have a very low price elasticity making it suspect for empirical work.

3.1.1. Comparison to Defender Consumer Model. Both Lane’s model and the Defender model are based on the idea of choice with each consumer maximizing his utility function. Both the models begin by dealing with a two-dimensional brand characteristics space. Lane’s model reduces the two-dimensional space to one dimension by imposing an efficient frontier (or technology constraint) for the brand characteristic dimensions and by restricting brands to positive values of \( w_i \) and \( z_i \). The Defender model does not make this reduction, but in an equilibrium analysis, Hauser (1987), assumes a technology constraint of a quarter-circle. Thus, Hauser’s positioning becomes a one-dimensional decision—the relative values of the two attributes.

The main difference between the models is the way they handle price. Lane has price enter in the utility function, hence firms choose positions in a space scaled by \((Y - p)\). Defender assumes maximization subject to a budget constraint causing price to enter in a “per dollar” manner—that is, firms choose positions in a “per dollar” space. Empirically, Lane’s model implies very low price elasticities while the Defender price-module implies elasticities that are too high. Hauser and Wernerfelt (1987) show that response analysis mitigates the extreme price elasticities and brings them within empirically observed ranges.

In Lane’s model, brands are forced to be efficient by using the concept of “viability” as defined by some technical conditions (see our Lemma 1). In Defender, the concept of “efficient brands” is defined to address domination of a brand on a per dollar measure-
ment of the characteristic dimensions. Consumer choice of an inefficient brand can occur only if the dominating brand is not in the evoked set of that consumer.

In both models, each consumer chooses only between the two brands that are near the indifference curve in the price modified space. Thus, from an information point of view, consumers are required to be knowledgeable only about their immediately adjacent brands.

Regarding the functional forms of the utility functions, Lane uses the Cobb-Douglas form which is partly transformable to H&S's linear functional form. (If Lane's utility is with respect to physical features and a logarithmic transformation maps features into perceptions, then Lane's utility is linear in perceptions. Of course, the price response will remain different.) Consumer density is assumed to be uniform in Lane's model and in most theoretical analyses with Defender. A major difference between the models is the treatment of consumer income. Lane's model explicitly considers consumer income in the utility function but assumes it to be the same for all consumers. Also, the analytical form of introduction of consumer income and price exhibit questionable facets in the price elasticity of utilities. The Defender model involves consumer income explicitly in a budget constraint which is needed for the dollar-metric scaling used. Adding reservation prices to Defender (Hauser 1987) makes market demand a function of consumers' income.

Summing up, the two models are similar on many important facets and yet differ in some significant ways.

3.2. Managerial Model

We assume that brand managers are profit maximizers and have control over the decisions on brand positioning, in terms of levels for the two attributes of their product, and other marketing decisions in terms of price, advertising expenditures and distribution expenditures. Each brand i faces the same technology constraint which is described by \( w_i + z_i = 1 \). The net effect is to reduce the product attribute dimension to one, characterized by the ratio \( f_i = w_i/z_i \) in Lane (1980).

The profit function facing a brand manager who is in charge of brand i incorporates the effects of pricing and product positioning as in Lane (1980) and in addition includes the effects of advertising and distribution expenditures. This function is given by:

\[
\pi(p_i, k_{ai}, k_{di}) = (p_i - c)Q_i A(k_{ai})D(k_{di}) - F - k_{ai} - k_{di}
\]

where \((p_i, k_{ai}, k_{di})\) are the brand's price, advertising and distribution expenditures, respectively; \(c\) is the marginal cost of production and \(F\) is the fixed cost of production. Both parameters \(c\) and \(F\) are assumed to be the same for all initial brands. \(Q_i\) is the unadjusted (i.e., before the effects of advertising and distribution are incorporated) demand for brand i and is given by equation (2) of Lane 1980, p. 244):

\[
Q_i = \int_{\alpha_{i-1}}^{\alpha_i} q(\alpha)f(\alpha)d\alpha = M(\alpha_i - \alpha_{i-1}) = M\beta_i,
\]

where \(\alpha_{i-1}\) is the unique customer indifferent to brands \(i - 1\) and \(i\), \(\alpha_i\) is the unique consumer indifferent to brands \(i\) and \(i + 1\), and \(\beta_i\) is the unadjusted market share for brand \(i\). It must be noted that \(\beta_i\) is dependent on competition only in price and position of all the brands. \(Q_i\), the unadjusted demand for brand \(i\), is its demand if all consumers were aware of all the brands and if all the brands were available to all consumers. The actual market demand for brand \(i\) and the corresponding market share are termed adjusted market demand and adjusted market share, respectively. The adjustment referred to is for the extent of awareness and distribution achieved based on the actual
levels of advertising and distribution expenditures, respectively. The adjusted market share (or true market share) for brand \( i \), \( \beta_i \), is given by:

\[
\beta_i = \frac{\beta_i A(k_{ai}) D(k_{di})}{\sum_{j=1}^{N} \beta_j A(k_{aj}) D(k_{dj})}.
\]

The adjusted share of brand \( i \) therefore considers the advertising and distribution expenditures of all brands, not just that of brand \( i \). The adjustment is carried out based on response function models.

The functions \( A(k_{ai}) \) and \( D(k_{di}) \) are decoupled response functions relating sales to the advertising and distribution expenditures respectively. The manner of incorporation of \( A(k_{ai}) \) and \( D(k_{di}) \) in the profit function captures multiplicative interactions among marketing expenditures of a brand but not other more complex interactions. Notice that this form also decouples the effects of distribution and advertising expenditures from those of pricing and product positioning and that advertising and distribution by one firm does not affect sales of another firm. Our results, Theorem 1, are dependent on this decoupling. This model form of decoupling price from advertising and distribution effects is a simplification of models suggested by Little (1979) and Hauser and Shugan (1983). We believe it serves as a valid beginning. (This modeling form also follows the rich tradition in marketing of Urban 1974, Blattberg and Golany 1978, Kotler 1980, Hauser and Urban 1982, Stern and El-Ansary 1982, Hauser and Gaskin 1984.) Like H&S, it is assumed that both functions \( A \) and \( D \) are concave or are operating on the concave portion of S-shaped response curves. Specifically, the functional form chosen for the response functions used in our example is the ADBUDG (Little 1979) type function, i.e.,

\[
A(k_{ai}) = a_{1i} + (a_{0i} - a_{1i}) \frac{k_{ai}^{a_{2i}}}{k_{ai}^{a_{2i}} + a_{3i}^{a_{2i}}},
\]

\[
D(k_{di}) = b_{1i} + (b_{0i} - b_{1i}) \frac{k_{di}^{b_{2i}}}{k_{di}^{b_{2i}} + b_{3i}^{b_{2i}}},
\]

with parameters \( a_{0i}, a_{1i}, a_{2i}, a_{3i}, b_{0i}, b_{1i}, b_{2i} \) and \( b_{3i} \) for every brand \( i \) and chosen such that these functions are concave.

Although the assumption of concavity is not a serious restriction, the assumption that the sales, for any brand, is affected by changes in the expenditures on advertising and distribution through only the multiplicative response functions is stringent. As we shall see later in the analysis, this has serious repercussions as far as defending strategy is concerned if a brand is attacked by a new entry.

3.3. Competitive Interaction Model

It is assumed that brands enter the market sequentially—one at a time. Each brand prior to entry knows the positions of the existing brands. For the initial market equilibrium as in Lane (1980), we assume that, given knowledge of the number of brands that might enter a market, every potential entrant has perfect foresight and can determine the optimal responses of all subsequent entrants to its own pricing and position decisions.

Hauser and Shugan (1983) have investigated how defenders should react when a new product enters their domain. They assume that the optimal positions, prices, advertising and distribution expenditures of existing brands are fixed. They analyze the optimal response by a defender when a new product enters at a known product position. They derive the optimal directional defensive reactions in terms of price, positioning, product improvement, advertising, and distribution expenditures of the existing brands that are directly attacked by the new entrant. They assume the attacker enters with perfect
foresight as to defensive response and that, knowing this, the defender responds. The two-brand equilibrium thus has more of a von Stackelberg rather than a Nash flavor. However, they posit, “the directional results of our theorems for a two-product equilibrium will not change for a multiproduct equilibrium” (pp. 321–322). Hauser (1987) later showed the pricing results hold if all brands respond until a Nash equilibrium is reached.

Lane (1980) proves the existence of a perfect-foresighted equilibrium and derives numerically full equilibrium pricing and positioning strategies for both the cases of endogenously and exogenously fixed number of brands in the market place. Lane also assumes foresight in all interactions and this precludes any attack-defense analysis in a market. He does not consider the major marketing strategy variables of advertising and distribution explicitly in his analysis.

This paper differs from H&S (and is inspired by their challenge to researchers to extend their results into full N-product market equilibrium) in that the optimal defensive reaction results derived here are based on reactions by all existing brands in the market.

We modify Lane (1980), by developing the optimal defensive pricing strategies of all the existing brands to attack by a new product.

The computation of the equilibrium market structure involves the separation between positioning strategies and the other marketing strategies (this is because repositioning is not an allowed defensive move). The optimal price strategies for all brands follow the concept of Nash equilibrium, i.e., given the other brands' Nash strategies, no brand manager has any incentive to unilaterally deviate from his Nash strategies.4 Because the advertising and distribution decisions for any firm do not depend upon the advertising and distribution decisions of other firms, they are automatically Nash equilibria.

4. Analysis

As Lane (1980) points out, the equilibrium outcomes (the list of optimal strategies, one for each firm, given that other firms follow their optimal strategy) are analytically derivable and can be computed numerically. We next present our analysis of the optimal defensive strategies of N products in equilibrium upon attack.

4.1. N-Product General Results

Before stating our main result in Theorem 1, we state the three following lemmas which are necessary for the proof to Theorem 1. The formal proofs to the lemmas and theorems are available upon request from the authors.

**Lemma 1.** All existing products adjacent to the attacker will lose some finite portion of their before entry unadjusted market demand to a viable attacker.

Note that this loss in share by the defenders upon viable attack is in terms of unadjusted demand and does not consider the effects of advertising and distribution.

**Lemma 2.** Let \( p^*_i \), \( i = 1, 2, \ldots, N \) be the optimal Nash price equilibrium prices of \( N \) brands. Let \( \beta^*_i \), \( i = 1, 2, \ldots, N \) be their corresponding unadjusted market shares. Let another brand enter this market. In the ensuing equilibrium let \( \hat{p}_i \), \( i = 1, 2, \ldots, N \) be the

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4 The interested reader is referred to Lane (1980) for proofs of existence of a unique Nash equilibrium in prices. Existence of such equilibrium in advertising and distribution follows a similar line of proof.

5 Product positions are defined on two technologically related attributes \( (w_j + z_j = 1) \). The net effect is to reduce the product attribute dimension to one. Therefore, any product can have utmost two immediately neighboring products. Any new entrant can have either one or two immediate neighbors which are defined as the adjacent products to the attacker.
optimal Nash equilibrium prices, and \( \hat{\beta}_i \), \( i = 1, 2, \ldots, N \) be the corresponding unadjusted market shares for the incumbent brands. For any existing brand \( j \), \( \hat{p}_j \geq p_j^* \) implies that \( \hat{\beta}_j \geq \beta_j^* \).

**Lemma 3.** Holding all other prices fixed, the unadjusted market share of any existing product decreases (increases) with the decrease (increase) in the price of any of its immediate neighbors and decreases (increases) with an increase (decrease) in its own price, i.e.,

\[
\frac{\partial \hat{\beta}_j}{\partial \hat{p}_{j-1}} > 0, \quad j = 2, \ldots, N, \\
\frac{\partial \hat{\beta}_j}{\partial \hat{p}_{j+1}} > 0, \quad j = 1, \ldots, N - 1, \\
\frac{\partial \hat{\beta}_j}{\partial \hat{p}_j} < 0, \quad j = 1, \ldots, N.
\]

**Theorem 1.** The optimal defensive pricing, for any product in a \( N \)-product market in equilibrium and in which consumer tastes are uniformly distributed, is the reduction of price.

**Theorem 2.** For any existing product \( j \) under conditions of Theorem 1, its optimal advertising and/or distribution expenditures must decrease if the market size, \( M \), does not increase. Otherwise, its advertising and/or distribution expenditures must increase.

The intuition behind this theorem is simple. Because the response functions are decoupled and concave, advertising and distribution will decrease if the revenue, \((p_j - c)\beta_j M\), decreases. Theorem 1 and Lemma 1 cause both \((p_j - c)\) and \( \beta_j \) to decrease hence revenue decreases. This argument and the formal proof follow that of Hauser and Shugan (1980, Theorem 7). Our contribution is to extend the results to the case where all defenders respond to the attacker and one another until an equilibrium is reached.

Other formulations of response functions would not vitiate Theorem 1. But Theorem 2 would have to incorporate additional conditions depending on the specific nature of the response functions. For example if \( A(k_{al}) = k_{al}/\sum_i k_{ai} \) (us/everyone), then the optimal advertising and distribution expenditures upon attack will have to be found by solving \( 2(N + 1) \) equations in \( 2(N + 1) \) unknowns for all \( N + 1 \) products as compared to 2 equations in 2 unknowns for each of the \( N + 1 \) products in response function models.

### 4.2. Example Comparison with Lane

Theorem 1 states a general result on the optimal defensive price reaction of all the existing brands in a market (with uniformly distributed consumer tastes, and multiplicative response functions) upon attack. The existing brands are in an equilibrium in positions and prices prior to entry. Because advertising and distribution are decoupled, this equilibrium is exactly as derived in Lane (1980). Lane's analysis was done under the assumption of perfect foresight for all brands. We consider the case when unforeseen entry (brand \( N + 1 \)) occurs in a market (of \( N \) brands) which was initially structured based on perfect foresight. The following example provides a comparison between our analysis and Lane's on the pricing and positioning strategies of the optimal \( N + 1 \)th brand as well as on the optimal pricing strategies of the first \( N \) brands.

In the example below, we consider an initial market of two products in equilibrium in positions and prices. To make the comparison with Lane's results we start out with a two-product market structured exactly as per his work except that we assume fixed cost \( F = 10 \) rather than 0. These are given in the second and third columns of Table 1 and are taken from Lane (1980, p. 252, \( N = 2 \)).
TABLE 1

<table>
<thead>
<tr>
<th>Brand</th>
<th>Position (wi, zi)</th>
<th>Price (pi)</th>
<th>Advertising expenditures (kad)</th>
<th>Distribution expenditures (kdα)</th>
<th>Unadjusted market share βi</th>
<th>Adjusted market share</th>
<th>Profits πi</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(0.5, 0.5)</td>
<td>6.56</td>
<td>26.77</td>
<td>19.70</td>
<td>0.6362</td>
<td>0.6444</td>
<td>343.78</td>
</tr>
<tr>
<td>2</td>
<td>(0.073, 0.927)</td>
<td>5.32</td>
<td>14.60</td>
<td>10.61</td>
<td>0.3638</td>
<td>0.3556</td>
<td>147.30</td>
</tr>
<tr>
<td></td>
<td>(0.927, 0.073)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(With Y = 10, M = 100, and F = 10)

Note that this example (and Lane) assumes income, Y1 to be 10 while equilibrium prices are in the range of 5–6. Thus, for the example to apply either (1) the products must be large durables like automobiles, boats, or houses or (2) income must be budgeted separately for each product category.

[We have also assumed a0 = 2, a1 = 1, a2 = 0.5, a3 = 0.5, b0 = 1.5, b1 = 1, b2 = 0.5, b3 = 0.5 as parameters for the respective ADBUDG type response functions for all firms.]

The unadjusted and adjusted market shares and profits are obtained using the equations shown in our discussion of the managerial model.

Using a line search procedure, we located the optimal attack position and price equilibrium considering defensive reactions in price by both the existing products. The resulting positions, price, advertising and distribution expenditures, unadjusted and adjusted market shares and the respective profits are shown in Table 2.

It is interesting to note that even brand 2 which is not directly attacked suffers considerable loss in share and profits due to attack. To answer the question of whether the optimal strategies associated with the three products, under knowledge by the initial brands that a third brand will enter, will differ from that in Table 2 we need to compare Table 2 with the results obtained by Lane (1980, Table 1, N = 3).

Comparing the positions we see that they are different for all except the first products. The position of the first brand is (0.5, 0.5) in both markets. The second brand in Lane’s analysis is positioned at (0.159, 0.841) which is different from the second brand’s position in Table 2. Lane’s third brand is positioned at (0.825, 0.175) which is different from that of Attacker (0.4205, 0.5795). The main reason for this difference is that the defending products in Table 2 are not allowed to be repositioned and had not anticipated attack.

Comparing market shares, Attacker has a much higher unadjusted market share (Lane does not consider advertising and distribution expenditures and therefore only the unadjusted shares can be compared) than Brand 3 (0.4205 vs. 0.2843). This is because Brands 1 and 2 are not allowed to reposition under attack besides not having foreseen attack. Most of the difference between Attacker’s share and that of Lane’s Brand 3 comes at the expense of Brand 2 which has an unadjusted share decrease of 11.52% (from 27.14% to 15.62%) as compared to a decrease of 2.1% for Brand 1 (from

TABLE 2

<table>
<thead>
<tr>
<th>Brand</th>
<th>Position (wi, zi)</th>
<th>Price (pi)</th>
<th>Advertising expenditures (kad)</th>
<th>Distribution expenditures (kdα)</th>
<th>Unadjusted market share βi</th>
<th>Adjusted market share</th>
<th>Profits πi</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(0.5, 0.5)</td>
<td>1.96</td>
<td>5.08</td>
<td>3.57</td>
<td>0.4233</td>
<td>0.4220</td>
<td>79.78</td>
</tr>
<tr>
<td>2</td>
<td>(0.927, 0.073)</td>
<td>3.55</td>
<td>4.97</td>
<td>3.49</td>
<td>0.1562</td>
<td>0.1554</td>
<td>77.27</td>
</tr>
<tr>
<td>3</td>
<td>(0.4205, 0.5795)</td>
<td>2.06</td>
<td>5.47</td>
<td>3.86</td>
<td>0.4205</td>
<td>0.4226</td>
<td>94.40</td>
</tr>
</tbody>
</table>
44.43% to 42.33%). Ranking of the products based on unadjusted market shares remains unchanged.

Comparing prices, we see that all prices are lower in the attack-defense analysis as compared to Lane's perfect foresight analysis: Brand 1: $3.37 vs. $1.97, Brand 2: $3.80 vs. $3.56, Brand 3: $3.75 vs. $2.07. So, perfect foresight apparently leads to higher prices for all brands. The rankings of the brands with respect to price also remains the same.

Given the downward shift in prices, it is not surprising to see that the profits in the perfect foresight analysis are higher than the unadjusted profits in the attack-defense analysis (in the latter case, the unadjusted profits are computed without considering the effects of advertising and distribution thus making the two sets of profits comparable). The profits are: Brand 1, $95.17 vs. $30.98, Brand 2, $66.06 vs. $29.41, and Brand 3, $73.26 vs. $39.97 in perfect foresight analysis (after imposing similar fixed costs) and attack-defense analysis, respectively. It may be noted that under the attack-defense analysis Brand 3 (or Attacker) has the highest unadjusted (and adjusted) profits of all brands in the market. This is because it has more strategies open to it than the defending results. In Lane's analysis, on the other hand, product 1 has the first mover advantage of perfect foresight and hence the highest profits.

4.3. Comparative Statics in M and Y

Comparative static analyses, assuming a given number of profitable existing brands in a market, under different M and Y were performed. This revealed that the optimal prices, optimal positioning and unadjusted post-entry market shares of all the existing brands and of the attacking brand remain unchanged with changing M.\(^6\) However, higher values of M are associated with higher values for adjusted post entry demands, profits and optimal advertising and distribution expenditures for all brands. With changes in Y, again, the optimal positions and unadjusted post-entry shares remained unchanged. Optimal post-entry prices, post-entry adjusted demands, profits and post-entry advertising and distribution expenditures for all the brands, on the other hand, were higher in markets with higher Y. (Formal proofs may be obtained from the authors.)

5. Summary and Discussion

In this paper we have examined the economic model proposed by Lane (1980) by looking at attack-defense situations rather than complete foresight, and the marketing analysis suggested by Hauser and Shugan (1983) by considering the equilibrium that results from the defending reactions of all incumbent products upon optimal attack. We show that if any market, consisting of products in equilibrium and with consumer tastes distributed uniformly, is optimally attacked, then the optimal defensive reactions for all existing brands would be the reduction of their respective prices. Under such optimal defensive reactions in pricing (regardless of defensive reactions in advertising and distribution expenditures), the optimal attacker’s position is different from that of all the existing brands. Further, as a consequence of response function modeling, the optimal attacking advertising and distribution expenditures are independent of the advertising and distribution expenditures of the defending brands. The optimal advertising and distribution expenditures of the attacker will be dependent only on its own response functions given its position and price.

\(^6\) The attack-defense strategies do not depend on the change in M from pre-attack levels to post-attack levels since the price, advertising and distribution levels are computed following Nash equilibrium and the defending brands cannot re-position. This implies that there is no “memory” of the pre-attack demand level and, hence, only the value of post-attack demand matters.
When the price reactions are optimal, the optimal defensive and advertising expenditures are dependent on the size of the market after attack, relative to that before attack. If this size \((M)\) remains constant or decreases, then at least one of advertising or distribution expenditures must be decreased for optimality. Even if \(M\) increases upon attack (say due to the attacker pointing out more and different usage situations for this product category) and if this increase does not compensate for the loss in profits due to the lower optimal defensive prices, and lower unadjusted market share, then again at least one of advertising and distribution expenditures must be decreased for optimality for all defending brands. On the other hand, if \(M\) increases to such an extent that the defender’s profits increase upon attack, then, for optimality, at least one of advertising or distribution expenditures must be increased for all defending brands.

A natural extension of our analysis would be to investigate markets with piecewise uniformly distributed consumer tastes. This form is important not only because it is a possible one, but also because it is an approximation of continuous functions in a compact space (Bartle 1976, Theorem 24.4). It has been used as an approximation by H&S amongst others in their estimation of consumer taste functions. Furthermore, it works well empirically (Hauser and Gaskin 1984). While Lemmas 1 and 3 easily extend to this case, Lemma 2 does not appear to be so easily extended. The impediment to the extension is the fact that \(\partial^2 f_{1}/\partial p_{1}\) is an explicit function of the taste distribution levels corresponding to the post-entry indifferent consumers \(\alpha_{j-1}\) and \(\alpha_{j}\). These are in turn dependent on the position of the optimal attacker. The optimal attack position cannot be expressed in closed form (it is found as a solution to \(N + 1\) non-linear equations in \(N + 1\) unknowns). This implies that the post-entry positions of \(\alpha_{j-1}\) and \(\alpha_{j}\) (and the corresponding \(f(\alpha_{j-1})\) and \(f(\alpha_{j})\)) cannot be predicted. In the special case when the indifferent consumers continue to be in the same piece of the distribution in the post-entry equilibrium as in the pre-entry one, Lemma 2 holds. Extension to the general case of markets with arbitrary continuous functions (e.g., Normal, Gamma, etc.), while desirable, are impeded by the same difficulty as in the piecewise uniform distribution case.

The challenge now is to analyze optimal attack-defense strategies in product markets characterized by one or more of the following features: multi-attribute concave utility functions, nonhomogeneous \(Y\), \(F\) and \(C\), mechanisms other than response function modeling of advertising and distribution, and other equilibrium concepts.

Finally, the biggest challenge is empirical work to identify which equilibrium concepts and which consumer models are appropriate under which conditions.\(^7\)

\(^7\)The critical comments of Subrata Sen have strengthened the paper.

References


SCHMALENSEE, R., "Economies of Scale and Barriers to Entry," *J. Political Economy*, 89 (December 1981), 1228–1238.


