**Generic Commodity Promotion and Product Differentiation***

by

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## 1. Introduction

One justification for generic commodity programs is that agricultural products are, essentially, homogeneous, and free-rider problems create little incentive for private promotion. Generic promotion thus helps all growers when it causes demand to shift out. However, during the Supreme Court case of Wileman *et al*. (1997), attorneys for the grower/handlers argued that their clients' products were differentiated and that, although total demand increased with generic advertising, some growers were affected differently than others. Specifically, it was argued that generic promotion reduced the differentiation among products. The idea that branded advertising may increase product differentiation seems plausible. After all, advertisements for a specific brand are used to influence consumers' preferences for different brands (e.g., "Sun Maid raisins are better than other raisins"). What is interesting, however, is whether generic advertising used to raise demand for *all* brands may be sending a signal to consumers that *any* of the brands are worthy (e.g., "buy any California raisins since all California raisins are good").

At stake are millions of dollars in assessment fees that go to pay for the generic advertising programs. For California marketing orders alone, assessments for promotion grew from $51 million in 1985 to $84 million in 1992 (Lee *et al*., 1996). Although many studies have examined the effectiveness of generic programs to increase demand, relatively few have looked at the effects of both branded and generic advertising on commodity demand. Kaiser and Liu (1998) and Alston *et al*. (1998) included both branded and generic advertising variables to determine the effects on aggregate demands for dairy products and prunes, respectively. However, while both studies show that branded and generic promotion increase overall demand, neither looked at whether branded and generic promotion affected individual firms in different ways.

A key claim of opponents of generic promotion programs is that these programs are inimical to their own programs aimed at creating product differentiation. Although such arguments were made in the Wileman *et al*. case, the effects of generic and branded advertising on product differentiation have been ignored in the economic models that have estimated grower returns. In this study, I shall attempt to model the effect of generic advertising in a vertically differentiated, spatial-competition game. The goal will be to examine the veracity of growers' claims under alternative sets of market conditions.

Drawing on recent literature from industrial organization, I shall examine product differentiation and commodity promotion in the context of a multi-stage game where advertising influences a product's perceived quality.[1] The full game will incorporate growers' preferences for a marketing order given the degree of differentiation in their product, processors' decisions as to product quality and whether or not to self-promote, and consumers' preferences given retail prices, the intrinsic quality of the processed good and the quantity of branded and generic promotion. The retail-level stage is modeled as a Bertrand game where competition is in prices. If products are differentiated, there will be market power in this context.

**2. The Model**

Although altered slightly, the model chosen for this paper is based on a model developed by Mussa and Rosen (1978), and shall be referred to below as the Mussa and Rosen model. However, this model differs from Mussa and Rosen-type models and other advertising models using spatial analyses because it allows total demand to increase. In this model, there is a continuum of consumers whose types are identified by $\theta$, the marginal willingness to pay for quality, which is uniformly distributed over $[0, l]$. In this section, I let $l = 1$, but this simplification is relaxed in the empirical section. There are two integrated grower/handlers, firm 1 and firm 2, who compete in the retail sector in a Bertrand fashion. The two firms' products are differentiated such that if both products were offered at the same price, consumers would prefer to buy from firm 1. In this static

[1] For this brief paper, the review of the literature on advertising as a signal of quality has been removed. The reader may contact the author for this section.

game, the firms may not alter the intrinsic quality (e.g., the sugar content, color, texture) of their goods, but they can augment consumers' perceptions of their good's quality through branded advertising campaigns, generic promotion, or both. As in Bonanno (1986), the idea here is that consumers prefer to buy advertised products to unadvertised products (if prices are the same). Each good's perceived quality level is denoted $k_i = k_i(\kappa_{0i}, B_i, G)$, $i$=1, 2. For simplicity, a good's perceived quality is not a function of a competing good's advertising. Perceived quality is divided into two components: i) intrinsic quality, $\kappa_{0i}$, which could be thought of as some (constant) physical characteristic such as the good's sugar content, and ii) quality that is influenced by advertising. In this static model, the intrinsic quality for good 1 is greater than that for good 2, perhaps because of some previous competition in research and development or because firm 1 is established in a better growing region. $B_i$ is firm $i$'s branded promotion and $G$ denotes the level of generic advertising spent in the industry – of which each producer pays a proportion. Perceived quality is increasing in each of its arguments. In the analysis that follows, I shall avoid notational clutter by denoting the perceived quality variables simply by $k_1$ and $k_2$, but the reader should keep in mind that they are functions.

A consumer of type $\theta$ chooses some composite good or bundle of goods outside of the industry and one of the two goods mentioned above in order to maximize $U_i(x, k_i; \theta) = \delta x + \theta k_i$ subject to $P_i(k_i) + x \leq y$. The first choice variable, $x$, is the composite good and prices and income have been normalized by its price. Only one unit of good $i$ is purchased. When consumers purchase good $i$, they are choosing the good's perceived quality, $k_i$, with the price of the good being a function of this quality: $P_i = P_i(k_i)$. $y$ is the consumer's income, and it is assumed for simplicity that all consumers have the same level of income.

Specifying the Lagrangian function for the utility maximization problem as $L = \delta x + \theta k_i - \lambda[P_i + x - y]$, and solving the first-order conditions for this maximization problem gives the indirect utility of a consumer of type $\theta$ buying variant $i$:

(1) $$V_i(P_i, k_i, y, \theta,) = \lambda[y - P_i] + \theta k_i \ , \quad i = 1, 2.$$

By the first-order conditions, $\delta$ is equal to $\lambda$, and setting $\delta = \lambda = 1$ simplifies equation (1):

(1') $$V_i(P_i, k_i, y, \theta,) = y - P_i + \theta k_i$$

In the empirical section, this simplification will not be used. The reader may verify that since $\delta$ is a constant, setting it to unity does not change what follows.

In the industry in question, firm $i = 1, 2$ faces demand $Q_i = Q_i(P_i, P_j, k_i, k_j)$. Each firm has unit costs of production, $c_1 = c_2 = 0$, which do not include the costs of the advertising. $\alpha$ is the cost of advertising, whether that advertising is generic or branded. If a firm chooses to advertise, it pays $\alpha B_i$. If generic advertising exists, each firm pays a proportionate share of the cost, $\phi_i \alpha G$, where $\phi_1 + \phi_2 = 1$. Firm profits are given by,

(2) $$\Pi_i(P_i, P_j, k_i, k_j) \quad = \quad P_i \cdot Q_i(P_i, P_j, k_i, k_j) - \alpha \cdot (B_i + \phi_i \cdot G)$$

where $k_i = k_i(\kappa_{0i}, B_i, G)$; $i, j = 1, 2$ and $i \neq j$.

I consider two scenarios showing how generic advertising may affect product differentiation. The first scenario is the one that is used to justify generic promotion programs, that is, that generic advertising is a "rising tide" increasing demand for both goods in the same proportion. As will be shown below, under scenario 1, generic advertising increases demand by increasing the consumers' perceptions of product quality at the same rate in consumers' utility functions. That is, $\frac{\partial k_1}{\partial G} = \frac{\partial k_2}{\partial G} > 0$. Under scenario 2, I allow the rate of quality increase for good 2 to be more than that for good 1: $\frac{\partial k_2}{\partial G} > \frac{\partial k_1}{\partial G} > 0$.

Because consumer preferences are uniformly distributed from lowest to highest between zero and one, and each consumer buys at most one of the goods, demand for each good is simply the density of consumer preferences in one of the segments along the unit interval multiplied by the total number of consumers in the industry, $N$. Specifically, the demands for goods 1 and 2 are $Q_1(P_1,P_2, k_1, k_2) = (1 - \theta_{12})N$ and $Q_2(P_1, ,P_2, k_1, k_2) = (\theta_{12} - \theta_{02})N$, respectively.

$N \equiv N(G)$ is a function of generic advertising and is increasing at a constant or decreasing rate. To simplify the model, $N$ is not a function of branded advertising. In this way, generic advertising acts to bring in new consumers, but branded advertising just affects market share. The preference level of the consumer indifferent between purchasing good 1 and good 2, $\theta_{12}$, is found by setting $V_1(P_1, k_1, y,\theta) = V_2(P_2, k_2, y,\theta)$ and solving for $\theta$: $\theta_{12} = \frac{P_1 - P_2}{k_1 - k_2}$. To find the preference level of the consumer who is indifferent between buying nothing and buying good 2, $\theta_{02}$, I set the indirect utility function when no good is purchased equal to the indirect utility function when good 2 is purchased and solve for $\theta$. Therefore, solving $y = V_2(P_2, k_2, y, \theta)$ for $\theta$ gives $\theta_{02} = \frac{P_2}{k_2}$. Multiplying the preference shares for each of the goods by the total number of consumers in the market, $N$, gives the demand for each good.

Firm behavior is represented as a three-stage game as follows. In the first stage of the game, generic advertising, $G$, is set by the marketing board. In the second stage, each firm simultaneously decides how much branded advertising to spend. Then, in the final stage, the firms compete through price competition by simultaneously choosing their prices.

Solution to the three-stage game requires first solving the final stage of the game: the competition in prices. Differentiating equation (2) with respect to each firm's own price and setting the first-order conditions equal to zero and simultaneously solving these expressions for prices as a function of qualities obtains the Nash equilibrium prices: $P_1^* = \dfrac{2k_1 \cdot (k_1 - k_2)}{4k_1 - k_2}$ and

$P_2^* = \dfrac{k_2 \cdot (k_1 - k_2)}{4k_1 - k_2}$. Notice that perfect competition in the processing sector arises when consumers no longer distinguish any difference between goods 1 and 2.

Inserting the equilibrium prices into equation (2) gives the final-stage equilibrium profits:

(3) $$\Pi_1^* = \frac{4k_1^2 \cdot (k_1 - k_2)}{(4k_1 - k_2)^2} \cdot N - \alpha \cdot (B_1 + \phi \cdot G) \text{ and}$$

(4) $$\Pi_2^* = \frac{k_1 \cdot k_2 \cdot (k_1 - k_2)}{(4k_1 - k_2)^2} \cdot N - \alpha \cdot (B_2 + (1-\phi) \cdot G).$$

Under scenario 1, the two qualities are directly affected by generic advertising at the same rate. It will be shown below that as *G* increases, the equilibrium levels of branded advertising do not decline. Thus, at the very least, the two equilibrium quality levels are increasing at the same rate under scenario 1. Whether revenue is increasing or decreasing in generic advertising under scenario 2 depends on whether the increase in profits from *N*'s growth offsets the any decrease in profits from a decline in differentiation.

The next step is to solve the branded advertising subgame for the equilibrium levels of branded advertising. For simplicity, I assume that there is a minimum quality level that removes firm 2's incentive to brand advertise. The reason can be seen in equation (4). If the commodities have some minimum grade or standard affecting their intrinsic qualities, then firm 2 will have no incentive to advertise if this minimum standard of quality occurs somewhere in the quality range that makes demand for both goods positive. Given such a minimum quality level results in a Nash equilibrium whereby firm 1 advertises and firm 2 does not (contact the author for proof). Finding the optimal level of branded advertising for firm 1, then, results from optimizing firm 1's second-stage profit function, alone. Before proceeding, though, I shall derive the comparative static for the effect of generic advertising on branded advertising.

Proceeding with the comparative static derivation, I shall write equation (3) as

$$\text{(5)} \qquad \Pi_1^* = \quad f\Big(k_1(B_1,G),k_2(G)\Big)\cdot N(G) \;-\; \alpha\cdot\Big(B_1+\phi\cdot G\Big).$$

Differentiating equation (5) with respect to $B_1$ gives the first-order condition for profit-maximization[2]. It can be shown that an optimum does exist for and I denote the optimal value of branded advertising as $B_1^* \equiv B_1^*(G)$, creating the first-order identity:

$$\text{(6)} \qquad \frac{\partial f(k_1(B_1^*,G),k_2(G))}{\partial k_1}\frac{\partial k_1(B_1^*,G)}{\partial B_1}\cdot N(G) \quad \equiv \quad \alpha$$

Differentiating this identity with respect to $G$, using the previous assumption that the function $k_1$ is additively separable in advertising, suppressing arguments, and re-arranging terms gives the comparative static expression for the effect on firm 1's branded advertising with respect to generic advertising:

[2] I make one assumption about firm 1's quality function. Since either branded advertising or generic advertising or both influence perceived quality, the absence of one should not affect the other. Thus, I assume that firm 1's quality is additively separable in $B_1$ and $G$.

$$(7) \qquad \frac{\partial B_1^*}{\partial G} = \frac{-\frac{\partial k_1}{\partial G}\left[N \cdot \Phi + \frac{\partial f}{\partial k_1}\frac{\partial N}{\partial G}\right]}{N \cdot \left[\frac{\partial^2 f}{\partial k_1^2}\left(\frac{\partial k_1}{\partial B_1}\right)^2 + \frac{\partial f}{\partial k_1}\left(\frac{\partial^2 k_1}{\partial B_1^2}\right)\right]} > 0,$$

where $\Phi \equiv \frac{\partial^2 f}{\partial k_1^2}\frac{\partial k_1}{\partial G} + \frac{\partial^2 f}{\partial k_1 \partial k_2}\frac{\partial k_2}{\partial G} = \frac{8k_2(5k_1 + k_2)\left(k_1\frac{\partial k_2}{\partial G} - k_2\frac{\partial k_1}{\partial G}\right)}{(4k_1 - k_2)^4}$. Note that $\Phi \geq 0$

since $k_1 \geq k_2 > 0$, and $\frac{\partial k_1}{\partial G} \leq \frac{\partial k_2}{\partial G}$ depending on the scenario of interest. Noting that the denominator in equation (7) is negative, the comparative static is strictly positive: an increase in generic advertising results in an increase in firm 1's branded advertising campaign. Interestingly, this positive relationship occurs regardless of which scenario holds.

Under scenario 1, this comparative static suggests that firm 1 capitalizes on the generic advertising. Intuitively, generic advertising is increasing the size of the market by increasing $N$ and by lowering the indifference parameter, $\theta_{02}$. Since firm 1 pays only a proportionate share of the cost of this market increase, the cost of influencing a new consumer through the use of a branded advertisement has declined. Because, under scenario 1, an increase in firm 1's branded advertising helps both firms, generic advertising has the unusual result of *increasing* product differentiation through its effect on firm 1's branded campaign.

Further, $\Phi$ is larger under scenario 2 than under scenario 1. Therefore, if generic advertising does increase good 2's perceived quality more than good 1's (i.e., if as $G$ increases, the two goods lose their differentiation), firm 1 will respond by increasing expenditures on its own branded advertising–even more so than under the first scenario. Firm 1 still capitalizes on the overall increase in both goods' perceived qualities from generic advertising, but, under scenario 2, firm 1 must do even more branded advertising to keep product differentiation from declining. Here, generic advertising does hamper firm 1's attempt to keep its differentiation. In the simulations that follow, I will provide an example showing that the benefit to firm 1 from an increase in perceived quality can be outweighed by the loss in product differentiation.

Solving for the optimal level of branded advertising for firm 1 requires specifying functional forms for the perceived quality variables and $N$. For this stage, I chose the following simple functional forms: $k_i = \kappa_{0i} + \kappa_{bi} B_i + \kappa_{gi} G$ ( $i$ = 1, 2 and $B_2 = 0$) and $N = \rho_0 + \rho_g G$

Some remarks should be made concerning the quality specification. $k_i$ is what I have been referring to as the perceived quality of the good. For simplicity, I assume that all consumers perceive the quality in the same way. The first term in $k_i$ represents the intrinsic quality of the goods such that $\kappa_{01}$ is greater than $\kappa_{02}$. If the coefficients on the advertising variables are zero, then consumers do not believe that advertising adds anything to the quality of the goods and perceived quality is equal to intrinsic quality. Under scenario 1, if generic advertising causes the perceived quality of both goods to increase at the same rate, then $\kappa_{g1}$ is equal to $\kappa_{g2}$; whereas, $\kappa_{g1}$ is less than $\kappa_{g2}$ if generic promotion increases the perceived quality of good 2 more than good 1 (scenario 2).

Substituting $k_i$ and $N$ into equation (3), and solving the first-order condition for $B_1$ gives the equilibrium, branded-advertising level for firm 1 as a function of generic advertising and the other exogenous parameters in the model. Unfortunately, because of the nonlinearities in equation (3), analytical solutions proved intractable for even the simplest specifications. Because of this, the optimal level of branded advertising was solved for numerically.

It can be shown that provided $\alpha$ is greater than $\frac{N(G)}{4}\frac{\partial k_1}{\partial B_1}$, an optimum exists. For the numerical derivation, the intrinsic qualities of the goods were chosen so that in the absence of advertising, good 1 would be preferred to good 2: $\kappa_{01}$ = 1000, $\kappa_{02}$ = 900. The other terms were chosen as follows: $\kappa_{b1}$ = 10, $\rho_0$ = 100 (i.e., in the absence of advertising, there are 100 consumers), $\rho_g$ =1, and $\phi$ = 1/2. To make certain that a maximum would be found, I solved the limit formula $\frac{N(G)}{4}\frac{\partial k_1}{\partial B_1}$ for $G$ equal to ten. Using the above parameter values, the result is 275, so $\alpha$ was set above this number at 285. Again, this ensures that if a solution is found, it will be the solution that satisfies firm 1's first-order condition for optimal branded advertising. The above values remain the same in both cases.

The coefficient values that change in the two scenarios are $\kappa_{g1}$ and $\kappa_{g2}$. Under scenario 1, $\kappa_{g1}$ and $\kappa_{g2}$ both equal ten. Under scenario 2, $\kappa_{g1}$ is unchanged, and $\kappa_{g2}$ rises to forty. The numerical solutions to firm 1's branded advertising choice for each scenario are quite lengthy and may be obtained from the author. Substituting these branded-advertising solutions into the profit equations (3) and (4) gives the second-stage profit functions in terms of $G$ and the exogenous parameters.

In the simulations that follow, generic advertising will vary from zero to nine in order to ensure that $B_1^*$ is optimal. Again, the numbers chosen for the simulations mean very little in themselves and were chosen simply to demonstrate what might happen if, under scenario 1, generic advertising increased the quality of the two goods at the same rate, and, under scenario 2, if these rates differed. Nevertheless, the values are robust in the sense that they are derived from theoretically viable first-order conditions.

Figure 1 shows the results as expected from the discussion of the comparative static of equation (7). Under both scenarios, the optimal amount of branded advertising chosen by firm 1 increases as the level of generic advertising increases. Further, firm 1's level of branded advertising is higher under scenario 2. (The reader may verify that as $G$ increases, so do $k_1$ and $k_2$ under both scenarios.) Figure 2 shows that under scenario 1, profits for both firms increase as generic advertising increases. This is as expected. Under scenario 2, however, less generic advertising is preferred to more by firm 1, while the converse holds for firm 2. As figure 2 shows, an allocation of nine units of generic advertising (the maximum in this example) by the marketing board is preferred by the low-quality firm, whereas, the high-quality firm would prefer no generic advertising. Although these simulations represent just one possible outcome, they show that it is possible for generic advertising to be detrimental to high-quality firms while being profitable to firms producing lower qualities.

## 3. Conclusion

This paper has shown that product heterogeneity is an important, but previously neglected, component of commodity promotion research. Incorporating product differentiation into a model of generic commodity promotion shows that claims that generic promotion can help some growers while hurting others are theoretically justified if the benefit to high-quality growers from increased demand is outweighed by losses from lower differentiation. This result has been overlooked in other studies of commodity promotion showing positive benefits to all growers.

I have also performed an empirical test of this product-differentiation model using retail data on U.S. dried prune consumption and advertising (Crespi, 1999). The results indicate that, at least in the case of dried prunes, the generic promotion campaign of the California Prune Board does not lower the differentiation of competing brands, that is, the Prune Board's advertising campaign fits under scenario 1. Further research into other commodities – especially those represented in the Wileman case – is encouraged.

**Figure 1:** *Firm 1's Optimal Branded Advertising under Both Scenarios and Different Levels of Generic Advertising*

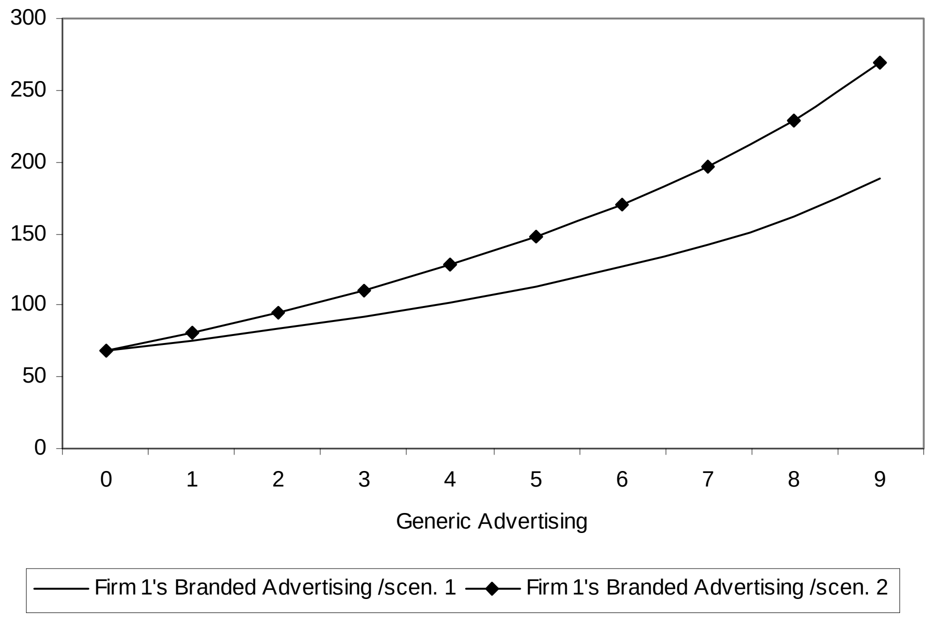
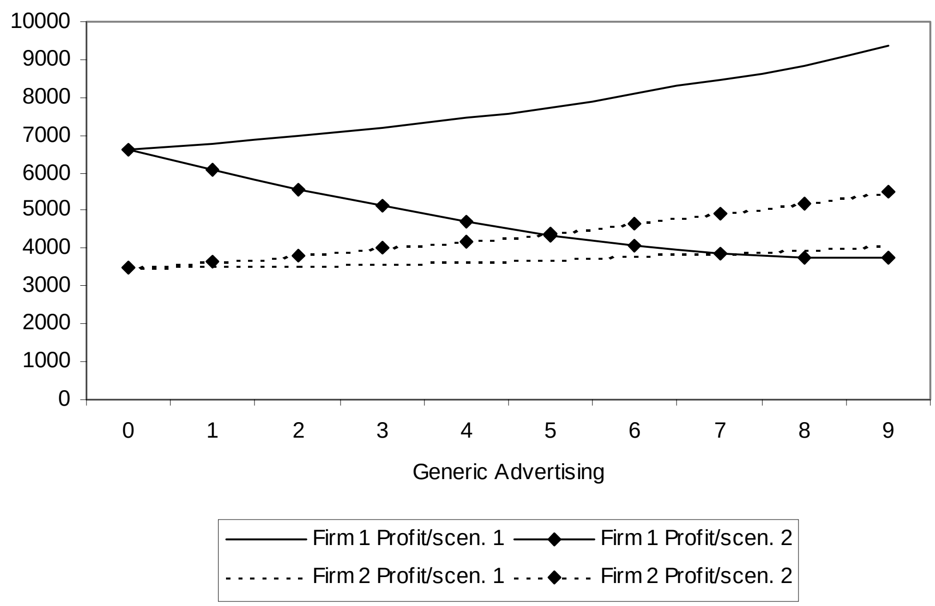



**Figure 2:** *Equilibrium Profits under Both Scenarios and Different Levels of Generic Advertising*



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