Journal of Cooperatives

Do Agricultural Marketing Cooperatives Advertise Less Intensively Than Investor-Owned Food-Processing Firms?

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A common belief is that agricultural marketing cooperatives advertise less than their investor-owned counterparts, holding other factors constant. This paper presents both a conceptual and an empirical analysis that questions this conventional wisdom. Our conceptual model analyzes a cooperative's optimal advertising-to-sales (A/S) ratio under three alternative objective functions. In each instance, the optimal A/S ratio is characterized by the well-known Dorfman-Steiner condition that also characterizes optimal advertising for an investor-owned firm. The empirical analysis examines forty-nine processed food markets, each containing at least one cooperative. The results do not support the conventional wisdom that cooperatives advertise less, *ceteris paribus*. The appearance that cooperatives advertise less is due to their predominance in industries with low margins and little product differentiation, factors that are associated with low advertising intensity regardless of a firm's organizational form.

U.S. food processors are among the largest users of media advertising in the world. Firms like Coca Cola and Philip Morris have spent billions on media advertising to create brands that are known worldwide. For many processed food markets, advertising is the primary strategy for leading firms to create and maintain product differentiation. Agricultural cooperatives are active in many processed foods industries, but the question remains whether these firms use advertising as extensively as do their investor-owned counterparts when marketing branded, processed food products.

For example, does Sun-Maid, the leading marketer of raisins and an agricultural cooperative, advertise as much as would an investor-owned firm under the same market conditions (i.e., same market share, product differentiation, product characteristics, and so on)? This question led us to compare the advertising activities of agricultural marketing cooperatives and investor-owned firms in the food processing sector and to attempt to

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The authors are grateful to the University of California Center for Cooperatives for financial support and to the Center's director, Mahlon Lang, for his unstinting support and encouragement. This work was also supported, in part, by the Cooperative State Research Extension, Education Service, U.S. Department of Agriculture, Massachusetts Agricultural Experiment Station, under Project No. 625, and the Food Marketing Policy Center at the University of Connecticut-Storrs.

ascertain whether an agricultural marketing cooperative advertises less intensively than an investor-owned firm (IOF) when all else is held equal.

Our analysis proceeded in two phases. First, a conceptual model of an agricultural marketing cooperative was developed, and the cooperative's optimal advertising intensity was derived for alternative objective functions commonly ascribed to cooperatives. This conceptual analysis revealed that, in most cases, the rule for optimal advertising intensity for a cooperative is the famous Dorfman-Steiner condition (Dorfman and Steiner 1954), which characterizes optimal advertising intensity for a profit-maximizing IOF.

Second, an empirical analysis examined forty-nine narrowly defined processed food markets where at least one cooperative was present. This restriction enabled a direct comparison of the advertising efforts of the two types of firms and avoided the bias that would otherwise occur because cooperatives do not operate in all processed food markets. The empirical results do not support the conventional wisdom and the conclusions of prior empirical work (e.g., Rogers 1993) that cooperatives in food processing spend less intensively on advertising than investor-owned firms.

Background on Advertising by Marketing Cooperatives

Cooperatives differ from investor-owned firms in many respects. Their equity is held by farmer members rather than stockholders. As such, a marketing cooperative integrates its farmer members forward into food processing and distribution. Although various alternative objectives have been ascribed to cooperatives, it is clear that cooperatives' focus must be related to members' returns both as suppliers of the raw input and as owners of the cooperative and its processed output. Thus, a cooperative might not be expected to behave similarly to a profit-maximizing, investor-owned processor.

Cooperatives also often accept all of the raw commodity that their members produce and, hence, do not control output, thus lacking a fundamental tool needed to exercise market power. In addition, cooperatives that maintain open membership are unable to enhance prices over time because years of superior performance trigger growth in membership and, hence, increases in supply of the raw commodity. Because they often serve as a "home" for farmer production, cooperatives are sometimes said to have a production rather than a marketing focus which, for example, can cause a reluctance to eliminate unprofitable product lines that use a large volume of raw commodity.

A related consideration is that cooperatives tend to be most active in commodity-oriented markets, where products are rather homogeneous (e.g., Sun-Maid in raisins and Land O'Lakes in butter). In these industries, advertising by any one firm will spill over to benefit the entire industry, a classic free rider problem. Thus, these industries tend to be supported by industry-wide generic advertising programs that operate under the auspices of marketing orders. As table 1 shows, agricultural associations out spent cooperatives in advertising for 1987 by a three-to-one margin.

An additional factor that is unique to cooperatives is the horizon problem. Because members benefit from a cooperative's investments only during their tenure as active patrons, there may be a tendency for a cooperative to under invest in activities where the payoff occurs over a long time horizon. Examples of investments likely to be under funded by a cooperative include research and development, capital construction, and, perhaps, advertising.

How do these various considerations that are unique to cooperatives interact to determine their expenditures on advertising relative to an otherwise comparable IOF? In general, agricultural cooperatives are not large food advertisers in total, as table 1 documents for 1987. In 1987 agricultural cooperatives accounted for roughly 7% of the total sales of processed food products in the U.S., yet they accounted for only about 1% of the media advertising spent on those products.

Table 1. 1987 Media Advertising Totals in the Food Processing Industries

	1987 Total ($ millions)[1]	Adjusted Total ($ millions)[2]	Study Total ($ millions)[3]	Study % of Adj. Total
All advertisers	5,284.0	4,563.6	582.6	12.8
Investor-owned firms	5,028.2	4,364.7	466.7	10.7
Agricultural co-ops	63.0	54.5	33.2	60.9
Agricultural associations	192.8	144.4	82.7	57.2

[1] Source: Rogers (1993).
[2] Adjusted totals reflect the elimination of categories not monitored by Selling Area Marketing Information (SAMI), the main data source for this study.
[3] Totals based on the advertising amounts in the SAMI product categories used in this study.

Optimal Advertising by an Agricultural Marketing Cooperative

Although advertising by IOFs has been investigated extensively, to date there has been no analytical investigation of conditions for optimal advertising by agricultural cooperatives. However, related problems, such as optimal advertising by labor-managed firms and agricultural associations have been investigated, and this body of work provides input into the present investigation.

Consider an agricultural cooperative that manufactures and sells a processed product, Q, from a farm input, R, and other processing inputs. Consistent with traditional theory of cooperative behavior, we assume fixed proportions in converting R into Q and choose measurement units so that $R = Q$. Let P represent the output price received by the cooperative and let $P = D(Q|A)$ represent the inverse market demand curve for the cooperative's processed product, where A denotes the expenditure on advertising. To create an incentive for the cooperative to advertise, we assume $\partial D/\partial Q < 0$, i.e., the demand curve facing the cooperative slopes downward. The cooperative's total revenue from sales is $TR(Q|A) = D(Q|A)Q$, and marginal revenue is $MR(Q|A) = dTR/dQ$.

Supply of the farm product by the member-patrons to the cooperative is denoted by $W = S(Q)$, where W is the net price received by farmers, and $S'(Q) > 0$. The cooperative's processing costs net of farm product costs are $C(Q)$, and marginal processing costs are $MC(Q) = C'(Q) > 0$. Useful concepts that are familiar from the economic theory of cooperatives are the net average revenue product (NARP) and net marginal revenue product (NMRP) of the farm product. $NARP(Q|A)$ is simply $D(Q|A) - C(Q)/Q - A/Q$, i.e., processed product price less average processing and advertising costs. $NARP(Q|A)$ measures the maximum price the cooperative can pay members for any volume of Q after accounting for its costs, given a level of expenditure on A. $NMRP(Q|A) = MR(Q|A) - MC(Q)$ measures the incremental value of an additional unit of the farm product, given a level of A, i.e., it is the marginal revenue from an additional unit of sales, less the marginal costs incurred in processing the unit.

As the formal theory of behavior for agricultural cooperatives developed from the 1940s through the 1960s, three alternative objectives for a cooperative emerged:

- *The member welfare maximum.* The cooperative sets its output and level of farm product purchases, Q^*, so that $NMRP(Q|A) = S(Q)$. This solution, proposed first in the marketing cooperative context by Ohm (1956), maximizes the members' return as producers of the raw product and as joint owners of the cooperative and, thus, has an obvious appeal. A problem with the solution is that, in general, NARP(Q|A) ≠ NMRP(Q|A). If members are paid according to the NARP schedule and NARP(Q|A) > NMRP(Q|A), members will wish to produce more than Q*, meaning that the cooperative will have to restrict member deliveries.

- *The maximum NARP(Q|A) solution.* By restricting its membership or by restricting member production, the cooperative can maximize the price paid for the farm product by procuring the amount, Q^o, that maximizes the NARP(Q|A) schedule. Although this solution, proposed first by Clark (1952), results in the maximum price for the farm product, in general it does not maximize the welfare of a given membership and, like the welfare maximizing solution, it requires restriction of membership and/or member deliveries.
- *The breakeven solution.* Associated most commonly with the work of Helmberger (1964) and Helmberger and Hoos (1962), this solution posits that the cooperative will act as a home for member deliveries and set price according to the NARP(Q|A) schedule, i.e., pay the maximum price for any volume delivered, subject to covering processing costs. Under this solution, the NARP(Q|A) curve acts as the cooperative's demand function for the farm product, and output occurs where NARP(Q|A) intersects the member supply curve, S(Q). This solution has nice equilibrium properties because members can supply all they want at the prevailing price, but, in general, it does not maximize member welfare.

No general agreement has emerged as to which of these solutions best represents an agricultural marketing cooperative's behavior, and, indeed, each may be appropriate for given circumstances. Rather than choose arbitrarily among the alternative solutions, our approach is to derive conditions for optimal advertising under each. Further discussion on the alternative price-quantity solutions for marketing cooperatives can be found in the surveys by LeVay (1983), Sexton (1984), and Staatz (1987).

Advertising under the Welfare-Maximizing Solution

When advertising is a choice variable for the cooperative, it must choose both the level of A and either output price, P, or sales/purchases, Q, so as to maximize members' welfare as producers and as joint owners of the cooperative. Because it simplifies the mathematics, we use P as the choice variable, with Q then determined by the inverse demand curve. The cooperative's optimization problem can be stated as follows:

$$\max_{\{P,A\}} D(P,A)P - C(D(P,A)) - \int_0^{D(P,A)} S(Q))dQ - A. \tag{1}$$

Assuming an interior optimum, the first-order conditions necessary to maximize (1) can be arranged as follows:

$$\partial D/\partial A[P - MC(Q) - S(Q)] = 1, \tag{2}$$

$$\partial D/\partial P[P - MC(Q) - S(Q)] = -Q. \tag{3}$$

Combining (2) and (3) and converting the resulting expression to elasticities obtains the following:

$$\frac{A}{PQ} = \frac{\epsilon_{Q,A}}{\epsilon_{Q,P}}, \tag{4}$$

where $\epsilon_{Q,A} = (\partial Q/\partial A)(A/Q)$ and $\epsilon_{Q,P} = -(\partial Q/\partial P)(P/Q)$ are, respectively, the advertising elasticity of demand and the price elasticity of demand. Most readers will recognize equation (4) as the famous Dorfman-Steiner (D-S) condition that defines the optimal advertising for a monopoly IOF seller. In words, the D-S condition states that at the optimum, the advertising-to-sales ratio is set equal to the ratio of the advertising elasticity of demand to the price elasticity of demand. Optimal advertising intensity will increase the more effective advertising is in shifting demand and the more price inelastic is the demand curve.

Using equation (3), the D-S expression in (4) can be rewritten as follows:

$$\frac{A}{PQ} = \epsilon_{Q,A}\frac{(P - MC - W)}{P}. \tag{5}$$

Equation (5) expresses the optimal advertising-to-sales ratio as the product of the advertising-elasticity of demand and the relative price-cost margin, including the member marginal cost of producing the farm product. Equation (5) illustrates an interesting empirical problem in that advertising is chosen simultaneously with price, implying that no causal link exists between price and advertising. We will address this endogeneity problem in the empirical work.

Advertising under the Farm Price Maximizing Solution

The cooperative seeking to pay the maximum price for farmers' raw product faces the following optimization problem:

$$\max_{\{A,P\}} W = NARP(P,A) = \frac{D(P,A)P - C(D(P,A)) - A}{D(P,A)}. \tag{6}$$

Again assuming an interior optimum, the first-order conditions to this problem can be written as follows:

$$\partial W/\partial P = \frac{1}{D(P,A)}[(\partial D/\partial P)P + Q - (\partial D/\partial P)(\partial C/\partial Q)] - \frac{\partial D/\partial P}{Q^2}[D(P,A)P - C(Q) - A] = 0, \tag{7}$$

$$\partial W/\partial A = \frac{1}{D(P,A)}[(\partial D/\partial A)P - (\partial D/\partial A)(\partial C/\partial Q) - 1] - \frac{\partial D/\partial A}{Q^2}[D(P,A)P - C(Q) - A] = 0. \tag{8}$$

Equations (7) and (8) can be combined to form the following expression:

$$\frac{1}{\partial D/\partial P}[(\partial D/\partial P)P + Q - (\partial D/\partial P)(\partial C/\partial Q)] = \frac{1}{\partial D/\partial A}[(\partial D/\partial A)P - (\partial D/\partial A)(\partial C/\partial Q) - 1]. \tag{9}$$

In turn, (9) can be simplified quite readily to yield equation (4), i.e., the cooperative that seeks to pay the maximum price for members' raw product also finds its optimal advertising intensity via the D-S condition. This result coincides with the result obtained by Ireland and Law (1977) for advertising by a labor-managed firm.

Advertising under the Breakeven Solution

Under the breakeven solution, farmer-members choose how much product to supply to the cooperative, and the cooperative pays a breakeven price $W = NARP(Q|A)$ for whatever volume is supplied. In contrast to the welfare maximum and price maximum objectives, the cooperative that pursues the breakeven strategy does not have P or Q as a choice variable. Rather, Q is determined by farmers, and P is determined by the demand function, given Q and A. Thus, the cooperative under this scenario is limited to the strategic choice of A. However, member production will be determined in part by the level of advertising, a functional dependence we denote by Q(A).

This scenario is very similar to the case of an agricultural association that chooses industry advertising expenditures under the auspices of a marketing order. Funds for such expenditures are generated by per-unit taxes or "check offs" levied on producers and/or handlers. Let τ represent the check off. Then, given advertising expenditure, A, we have $\tau Q = A$, or $\tau = A/Q$.

For the cooperative that selects advertising expenditure under the breakeven objective, $NARP(Q(A),A) = D(Q(A),A) - C(Q(A))/Q(A) - A/Q(A)$. To facilitate comparison to prior work, let $C(Q) = CQ$, and thus $CQ/Q = C$, i.e., constant returns to size in processing. Then we have

$$NARP(Q(A),A) = D(Q(A),A) - C - \tau. \qquad (10)$$

Equation (10) shows that, under patronage-based breakeven financing, advertising by a marketing cooperative is financed and conducted exactly analogously to advertising that is financed and conducted through a marketing order by an agricultural association. Neither entity controls production or price of the farm product or finished product(s), and each funds its expenditure through a charge per unit of production. In the case of an agricultural association, the levy is a direct per-unit tax, τ, whereas for the cooperative, advertising reduces price $W = NARP$ paid to members by the ratio A/Q, an effect that is identical to a per-unit tax.

Given that the cooperative breaks even under this scenario, member welfare can be measured solely in terms of variable profits from farm production, as represented by the magnitude of producer surplus. The objective then is to choose A or, equivalently, τ, to maximize producer surplus:

$$\max_{\{A\}} NARP(Q(A),A)Q(A) - \int_0^{Q(A)} S(Q)dQ.$$

The solution to this problem is to choose A so that $dQ(A)/dA = 0$ (Alston, Carman, and Chalfant (ACC) 1994) or, equivalently, so that $dNARP(Q(A),A)/dA = 0$ (Holloway 1998). This result follows because producer surplus, given supply curve S(Q), is an increasing function of Q. The cost of advertising reduces NARP and, hence, Q, but the expanded demand from advertising increases NARP and Q. The optimal expenditure on advertising occurs where the marginal impacts are just balanced, i.e., where $dQ(A)/dA = 0$ or $dNARP(Q(A),A)/dA = 0$.

ACC (1994) show, in the context of an agricultural association, that the D-S condition also holds for this problem. However, ACC's model does not incorporate costs of processing the farm product into the finished product. Given our assumption of fixed proportions in converting farm product to finished product and constant returns to size in processing, this omission is unimportant. However, economies or diseconomies of size in processing will affect incentives to advertise in this model. In the presence of economies of size, C(Q)/Q is a decreasing function of output, providing an additional incentive for a cooperative to advertise, not captured in the ACC (1994) formulation. Diseconomies of size have the opposite effect.

This analysis suggests that conventional arguments proposing that cooperatives advertise less than their investor-owned firm counterparts are flawed, if one accepts the traditional cooperative objective functions and the static model formulation of Dorfman and Steiner (1954). Given the potential importance of the horizon problem to cooperatives' investments in long-lived assets, including, possibly, advertising, a future research need is to develop a dynamic model of the cooperative, wherein advertising's role as a capital asset can be examined. Such a model was first developed for investor-owned firms by Nerlove and Arrow (1962), who assumed that advertising has a capital good effect by adding to the firm's stock of goodwill, which depreciates over time. Nerlove and Arrow's model yields a dynamic analog to the static Dorfman-Steiner condition.

Empirical Model

The predictions of the theory stand in contrast to the conventional wisdom regarding cooperatives' advertising. To test the predictions, we developed an empirical model that explains a food manufacturer's advertising intensity, as measured by the advertising-to-sales (A/S) ratio. We then placed restrictions on the data set to control for the various market factors that may affect the optimal advertising strategy. Our first qualification required that each market in the data set must have at least one cooperative present. Therefore, markets like the heavily advertised and highly differentiated ready-to-eat cereal market were excluded from the study. This restriction resulted in a data set that accounted for less than 11% of all processed food advertising done by IOFs, but included about 60% of such advertising by cooperatives and agricultural associations (table 1). The difference in coverage is not surprising as there were no agricultural cooperatives among the top twenty food advertisers in 1987. The leading cooperative advertiser, Ocean Spray, ranked forty second among all food advertisers.

In addition, our empirical model included several control variables to help explain differences in advertising intensity among firms. From equations (4) and (5), the Dorfman-Steiner condition suggests that, in addition to the advertising elasticity of demand, the price-cost margin or, equivalently, the price elasticity of demand affect advertising intensity. Of course, we do not know the advertising elasticity of demand in the markets under investigation. However, we can identify several proxy variables, based both on economic reasoning and prior empirical work, that are likely to influence the effectiveness of advertising and, hence, contribute to determining a firm's A/S ratio. These control variables are discussed in some detail following the description of our data set (for a complete discussion of the data, see Lewis 1997).

The model was estimated with private sector data, since no public data exist that provide the necessary level of detail on narrowly defined product markets (e.g., raisins). Our data are from two primary sources. The first, Selling Area Marketing Information (SAMI) is a private source of market data on branded goods for the food industry. By sampling warehouse withdrawals, SAMI measures sales for household consumption only and ignores non-household consumer channels of distribution. SAMI data are no longer available, because the company exited the data business, but we bought annual data for their food categories for the 1980s.

The second data source was Leading National Advertisers (LNA), which provided 1987 brand-level expenditures on seven measured-media (network, spot, and cable television, network radio, magazines, newspapers, and billboards). There were some difficulties in matching our two data sources, as the coding for SAMI categories differed from that used by LNA, and, in a few cases, the two sources had different manufacturers listed for the same brand. (LNA used the 1987 manufacturer, while SAMI used 1989 manufacturer, and often a divisional name was used rather than the parent company.) These problems were overcome by directly assigning expenditures for each brand's advertising to the corresponding brand's sales, then aggregating brands to the manufacturer level and using the LNA manufacturer as the true manufacturer.

Although the data permitted us to examine some narrowly defined markets where cooperatives actually dominate, in some cases the markets may have been defined too narrowly (e.g., Refrigerated Orange Juice) or not defined clearly (e.g., Frozen Miscellaneous Fruit Drinks). Typically, such "miscellaneous" categories were dropped, even if at least one cooperative was present. In these poorly defined categories it is unclear whether the products in the category are actually competitors (e.g., in Frozen Miscellaneous Fruit Drinks, Bacardi, who produces frozen mixes for alcoholic beverages, does not compete with Welches No Sugar Added juices). One SAMI category, Dried Figs, was dropped from the data set even though it had a cooperative present, because the category was dramatically smaller than the other categories included, based on volume of sales. A small IOF yogurt manufacturer that ranked 23/28 firms in its category was dropped as an outlier because its A/S ratio was 44.6% (compared to 17.1% for the next highest IOF A/S ratio), and its growth rate was the highest in the data set.

Together the SAMI and LNA data sources provided a data set of 49 SAMI markets, each having at least one agricultural cooperative present, with over 30 agricultural cooperatives and 200 IOFs included in total in the study. Pooling observations across the 49 markets resulted in 697 observations, each representing either the sole product sold by the processor or the aggregation to a single observation representing the manufacturer of all brands within the SAMI product market. From the data, we were able to calculate implicit prices, market shares, and advertising levels and then calculate the remaining variables used in our model, including a measure for advertising intensity. In table 2, we summarize key information from the data set for both agricultural cooperatives and IOFs.

Of our nearly 700 observations, 61 represented agricultural cooperatives that advertised at least one brand of processed food product. This group had a mean A/S ratio of 1.9% and a median of 0.84%. Only 38 observations for agricultural cooperatives had no advertising expenditures to support their products. Among the cooperatives, those that advertised had a higher mean price-cost margin (PCM) and market share than those who did not advertise. Among the IOFs in our study, the 171 observations with advertising expenditures had a mean [median] A/S of 3.0% [2.0%], with both statistics being higher than for the cooperatives that advertised. The advertising IOFs also had a mean PCM that was double the mean for the cooperatives that advertised, yet their average market share was less. The higher PCMs for the IOFs, whether they advertised or not, is consistent with other empirical work. It was common to find an IOF with an A/S ratio exceeding 5% for a product (27 observations or 16% of the IOF products that advertised),

Table 2. Means [and Medians] for Selected Variables in the SAMI/LNA Data Set

Category[1]	Sample Size	A/S Ratio (%)	Price-Cost Margin (%)	Branded Market Share (%)	Unbranded Market Share (%)
All manufacturers	697	0.89% [0.00]	42.2% [23.7]	7.0% [1.3]	26.5% [26.4]
Cooperative advertisers	61	1.87[2] [0.84]	31.5 [25.7]	19.6 [6.1]	27.6 [31.5]
IOF advertisers	171	2.97 [2.01]	62.2 [33.6]	13.2 [4.9]	21.7 [18.3]
Cooperative nonadvertisers	38	0.00 [0.00]	21.4 [12.7]	5.1 [1.3]	29.0 [32.7]
IOF nonadvertisers	427	0.00 [0.00]	37.5 [17.5]	2.9 [0.7]	28.0 [27.5]

[1] See the text for description of variables, except branded market share, which is the average market share among only the branded segment of the product category.
[2] Includes an observation for Tri-Valley's Libby brand canned pie filling with A/S = 26.1%, the highest observed A/S included in the study. The mean A/S ratio excluding this observation is 1.47%.

but only three cooperatives (5% of the 61 products) had such a large A/S ratio. However, the largest observed A/S ratio in our study was for a cooperative in the canned pie filling category, with A/S = 26%.

It appears, based on table 2, that agricultural cooperatives in food processing advertise less intensely than their IOF rivals. However, the averages in table 2 fail to control for other factors that affect advertising intensity. A formal econometric model is needed to account for the influence of the various factors that may contribute to determining advertising intensity. Our estimating equation, based on the D-S formulation and other control variables that have been demonstrated in prior studies to be important determinants of advertising intensity, was as follows:

$$\begin{aligned} A/S = {} & b_0 + b_1\,COOP + b_2\,PCM + b_3\,RANK + b_4\,\%UNBRD \\ & + b_5\,N + b_6\,NSQ + b_7\,GRO + b_8\,NEW + b_9\,AAS \\ & + b_{10}\,SIZE + b_{11}\,RANKSIZE + b_{12}\,MS1MS2 + u, \end{aligned} \quad (11)$$

where the b's are the parameters to be estimated, and u is the unexplained residual. The model's variables are defined as follows:

Advertising-to-sales ratio (A/S): The advertising-to-sales ratio has been used in several previous studies on advertising intensity (e.g., Zellner 1989, Rogers and Petraglia 1994, and Willis and Rogers 1998). Alternative specifications for advertising intensity have been used (e.g., Farris and Buzzell 1979 and Connor and Weimer 1986), but have not demonstrated a clear superiority. The advertising-to-sales ratio is equal to the summation of a brand's 1987 mass-media advertising, given by LNA, aggregated to the manufacturer level, divided by the manufacturer's volume of sales, as reported by SAMI in 1987, but expressed as a percentage of sales.

Cooperative presence (COOP): We use a binary variable to indicate whether the firm is a cooperative or not. Our primary interest is to investigate whether there is a difference between the advertising intensity of a cooperative and that of an investor-owned firm, when all else is held constant. As noted, conventional wisdom and prior empirical assessments have suggested that cooperatives advertise less intensely than their IOF counterparts. However, the theory set forth here suggests that the optimal advertising intensity for a cooperative in most cases is the Dorfman-Steiner condition. Thus, the expected influence of COOP on the advertising-to-sales ratio is not clear. Based on the conventional wisdom, the effect will be negative; but based on the theory, COOP should not be a significant determinant of advertising intensity.

Price-cost margin (PCM): From (5), we can infer that increases in price above costs will have a positive effect on the advertising-to-sales ratio, given $\epsilon_{Q,A} > 0$. Additional sales generated from advertising are more valuable, the greater the advertiser's price-cost margin. Obtaining information on a manufacturer's costs is difficult because such data are generally regarded as confidential. However, Connor and Peterson (1992) have suggested that the average private label price can serve as a proxy measure of marginal cost in a market. Because the private label segment of the food industry has relatively low barriers to entry, it is reasonable to assume that this segment is competitive and, thus, sets price equal to marginal cost. Thus, to the extent that private label manufacturers and brand manufacturers have the same marginal costs, the private label price represents a good proxy for the unobserved brand manufacturer's marginal costs. The processed food industries are ideal for application of this concept because both brand and private label manufacturers are generally present. We calculated the PCM as the percentage difference between the brand price and the average private label (including generic) price in the category.

Manufacturer rank (RANK): Rank reflects the branded manufacturer's rank based on market share within the SAMI category. Although market share itself is commonly used as a measure of market power within a category, we encountered collinearity problems with its use. Therefore, we used the manufacturer's rank as a surrogate for market share. We expect that as we move away from the market leader, advertising intensity will decrease, and, therefore, the expected sign on RANK is negative.

Unbranded share of the market (%UNBRD): The unbranded percentage share is comprised of all private label and generic private label manufacturers within the product category. This strategic group has relatively low barriers to entry and, therefore, tends to be competitive, with rivalry often taking the form of price competition. The presence of a large unbranded segment tends to reflect a market with low-to-modest product differentiation and, thus, a situation where firm advertising will spill over to benefit the entire industry and encourage free riding. We expect, therefore, that the larger the unbranded segment, the less the category will engage in nonprice forms of rivalry including advertising.

Number of branded firms (N and NSQ): The number, N, of branded firms can affect advertising behavior by influencing each manufacturer's conjectures about the behavior of its rivals. In the polar case of monopoly there is no concern with current rivals so the monopolist can operate in an independent manner. Likewise, under perfect competition, the number of rivals is so great that manufacturers also act independently of their rivals. What happens for the intermediate structures between monopoly and pure competition is less clear, and, therefore, no strong predictions emerge as to the effect of number of competitors on advertising intensity. However, following Waterson (1984), we allow for a nonlinear effect from the number of branded manufacturers by including both N and N squared (NSQ) as explanatory variables.

Industry growth rate (GRO): We calculated growth as the annualized percentage change in volume of sales over the period from 1982 to 1987. In a small number of cases, the manufacturer did not operate over the entire period from 1982 to 1987, and, hence, we estimated their growth as the annualized growth rate over the period they did operate. Growing markets are expected to encourage higher advertising because market growth will augment the return over time from any investment in advertising. In addition, innovations and new product introductions associated with growing markets likely stimulate manufacturers to inform consumers of such developments. Therefore, the expected effect of GRO on advertising intensity is positive.

New manufacturers (NEW): Some researchers (e.g., Zellner 1989) believe that advertising associated with new manufacturers, and hence new products, is greater than the advertising an extant firm must do to maintain market position and/or deter entry. A new manufacturer was defined as a manufacturer who entered the market in 1987 and, thus, had no growth over the period from 1982 to 1987. There were 21 new manufacturers in 1987 and for each the binary variable was set equal to one.

Association advertising-to-sales ratio (AAS): Association advertising, which occurs most commonly in markets with relatively homogeneous products, provides industry-wide promotion intended to increase aggregate demand. Such advertising actually de-emphasizes any brand differences. Manufacturers in industries with significant association advertising are expected to rely heavily upon this advertising as a means of promoting their collective product. Thus the expected effect of association advertising intensity, expressed as a percentage of sales, on a manufacturer's advertising intensity is negative.

Size of the SAMI category (SIZE): SIZE is measured by the volume of sales in the entire SAMI category. Farris and Albion (1981) argue that advertising intensity is lower, *ceteris paribus*, in large markets than in small markets. The rationale is that there may exist economies of scale in advertising and, as such, the level of advertising will not increase proportionately with the size of the market. Also, many expect a threshold effect in advertising, suggesting that advertising must first reach some critical amount before proving useful. Thus, we expect the sign of this variable to be negative.

Interactive effect of rank and size (RANKSIZE): We also included a variable that will work in conjunction with both the rank of the manufacturer and the size of the market. The intent is to capture whether a market leader in a small-sized market will advertise more or less intensively than a market leader in a larger market. Likewise, we can see if the smaller players in a market will advertise more intensely in larger or smaller markets. The interaction term is created by multiplying the manufacturer's rank within the category by the volume of sales of the entire SAMI category.

Market share dispersion (MS1/MS2): Holding concentration constant, an oligopoly that is comprised of equally sized rivals is hypothesized to spend more on advertising than an oligopoly with one dominant firm. Therefore, in addition to measuring the concentration in a market, it is also important to examine the market share variance among leading firms. Willis and Rogers (1998) found that the ratio of the market share of the leading firm to that of the number two firm was a simple measure that captured the likelihood for nonprice advertising rivalry in oligopolistic processed food markets. Since the ratio is an increasing function of the leading firm's market share dominance, the sign of this variable is expected to be negative.

The Empirical Results

Our model controls for the market factors affecting a firm's optimal advertising strategy to a greater degree than has been done previously and, hence, allows us to test whether cooperatives differ in their advertising intensity from that of investor-owned firms. Perhaps surprisingly, our empirical results support the conclusion that agricultural marketing cooperatives do not advertise less intensively than otherwise comparable IOFs. In fact, there is some support for the conclusion that marketing cooperatives actually advertise *more* intensively, when other factors are held constant.

We began the empirical analysis with the ordinary least squares (OLS) estimation procedure. However, concerns with the properties of the OLS estimates led us to consider alternative estimation techniques. First, as others have shown (e.g., Martin 1979) there was the issue of endogeneity of certain critical variables, especially the price-cost margin (PCM) and market share rank (RANK). Second was the fact that two thirds of our observations were for nonadvertisers, resulting in zero values for the dependent variable.

A Hausman test was performed to test for the endogeneity of PCM and RANK. The Hausman test involved regressing each variable suspected of endogeneity on the remaining exogenous variables in the regression model in equation (11), plus some additional variables not used in the model. The predicted values from these auxiliary regressions, RANKHAT and PCMHAT, were then added as explanatory variables to the model in (11), and tests were conducted to determine if they had an incremental explanatory power. The Hausman test rejected the exogeneity of RANK, but the exogeneity of PCM was not rejected. We, thus, estimated a two-stage least squares (2SLS) model, substituting the fitted value, RANKHAT, into the model in place of RANK.

Truncation of the dependent variable causes OLS coefficients to be biased and inconsistent, with the bias tending to be proportional to the percentage of truncated observations. The solution to the truncation problem is to run maximum likelihood estimation using the Tobit estimation procedure (see, for example, Greene 1990).

The results from all three estimation procedures (OLS, 2SLS, and Tobit) are presented in table 3. Because the Tobit results have the best statistical properties, our discussion focuses on them. The OLS and 2SLS results provide useful indications of the sensitivity of results to the choice of estimation procedure.

The explanatory variable of primary interest in our study is the indicator variable COOP denoting the presence of a marketing cooperative. Although COOP is not significant in either the OLS and 2SLS models, it is positive and marginally significant (10% level but not 5% level, based on a two-tailed test) in the Tobit model. The estimated coefficient suggests, *ceteris paribus*, that a cooperative's advertising-to-sales ratio is about one percentage point higher than an IOF's. This result contradicts the conventional wisdom that a cooperative will advertise less intensively, *ceteris paribus*. It also does not support the static theory developed here, which suggests that, in most cases, a cooperative's incentives to advertise are identical to the incentives of a comparable IOF faced with identical circumstances. However, given the marginal significance of the estimated coefficient for COOP and its unforeseen positive effect, this latter conclusion is rather tenuous.

Turning now to results for the other explanatory variables, we find that the price-cost margin is a strong positive determinant of advertising intensity in all of the estimated

Table 3. Estimation Results for OLS, 2SLS, and Tobit Models

Variable	OLS Results[1]	2SLS Results[1]	Tobit Results[2]
INTERCEPT	0.9811*	0.8795*	-2.7379**
	(2.45)	(2.38)	(7.56)
COOP	0.2934	-0.1152	0.9511
	(1.20)	(0.51)	(3.38)
PCM	0.0037**	0.0026**	0.0071**
	(4.13)	(3.17)	(14.50)
RANK (RANKHAT)	-0.1277**	-0.7511**	-2.4146**
	(5.17)	(12.41)	(200.71)
%UNBRD	-0.0225**	-0.0255**	-0.0771**
	(3.70)	(4.54)	(24.88)
N	0.1201**	0.6473**	2.0310**
	(3.23)	(11.07)	(154.92)
NSQ	-0.0018**	-0.0097**	-0.0304**
	(2.69)	(10.40)	(136.18)
GRO	0.00005**	0.00001	-0.00005
	(2.92)	(0.59)	(2.03)
NEW	-0.2405	0.7812	1.4478
	(0.48)	(1.67)	(0.61)
AAS	0.0591	-0.2793	-0.7224
	(0.34)	(1.69)	(2.87)
SIZE	-0.0003	-0.0029**	-0.0095**
	(1.47)	(9.96)	(131.83)
RANKSIZE	0.00003**	0.0003**	0.0008**
	(3.09)	(11.50)	(165.84)
MS1/MS2	-.0197	-0.0451	-0.1222*
	(0.79)	(1.94)	(4.97)
R^2	0.122	0.255	

[1] Coefficients in parenthesis are absolute t statistics.
[2] Coefficients in parenthesis are χ^2 statistics.
* Denotes significance at 0.05% level.
** Denotes significance at 0.01% level.

models, as predicted by the Dorfman-Steiner theory. The rank of the manufacturer within the product category has a negative and significant effect on advertising intensity, also as expected, indicating that firms advertise less intensively as their rank declines. However, the RANK and SIZE interaction term was positive and significant, meaning that the negative impact of RANK on advertising is moderated in larger industries. This result makes sense in that firms who are not among the market leaders may, nonetheless, have high absolute sales in high-volume markets, enabling them to support and benefit from an advertising program. The unbranded share of the market also performed as we expected by producing a negative and significant effect on the advertising-to-sales ratio.

Estimation results provide support for a nonlinear, inverted U-shape relationship between advertising intensity and concentration, implying that as the number of branded manufacturers increases, the advertising intensity increases (due to greater nonprice rivalry) but at a decreasing rate. Based on the results from the Tobit model, the maximum A/S ratio occurs for $N^* = 33$ firms, a number that seems implausibly high, but is within our data range of 1 to 47 firms in a SAMI category.

Size of the market, as measured by sales volume in the entire SAMI category, was inversely related to advertising intensity, supporting the earlier conclusion by Farris and Albion (1981) that economies of size in advertising may force advertisers in small markets to advertise more intensively to communicate their message. Also consistent with prediction was the negative impact on advertising intensity of market share dispersion between the two market leaders. Advertising expenditures conducted by agricultural associations had a negative impact on advertising intensity in the Tobit model as expected, but the effect was only marginally significant (5% with a one-tail test). Industry growth rate, GRO, was negatively, but not significantly, related to advertising intensity, contrary to prediction. Finally, new firms exhibited no significant tendency to advertise more, despite predictions by some that they would.

Conclusions

This study involved both a conceptual and empirical analysis of advertising intensity by food marketing cooperatives. As table 2 documents, in absolute terms cooperatives advertise less intensively than their IOF counterparts. This result has led to concerns that cooperatives have not used nonprice methods of competition to their full advantage. Our conceptual analysis, however, demonstrated that optimal advertising for a cooperative is generally indicated by the same Dorfman-Steiner condition, which describes optimal advertising intensity for an investor-owned firm. Thus, the theory does not support the notion that cooperatives advertise less intensively.

To test this proposition empirically, we assembled a data set involving 697 observations in 49 food product markets that each contained at least one marketing cooperative. Given that about two-thirds of the sample observations involved manufacturers who conducted no advertising, Tobit analysis represented the preferred estimation procedure. In general, the Tobit model performed very well, with all but three explanatory variables being statistically significant. In all cases where a clear prediction could be made as to a variable's impact on advertising intensity, the prediction was supported by the Tobit estimation, except for market growth rate. Surprisingly, the estimated effect of a cooperative on advertising intensity was positive, suggesting that marketing cooperatives have an advertising-to-sales ratio that is about one percentage point higher than a comparable IOF. However, this result was only weakly significant and significance is lost entirely if one industry with an influential co-op observation is dropped (see footnote 2 to table 2).

Thus, the *appearance* that cooperatives advertise less intensively than IOFs is due to cooperatives' association with other explanatory variables that correlate negatively with advertising. A key variable in this respect is probably the price-cost margin (PCM). Empirical research by Wills (1985), Rogers and Petraglia (1994), and Haller (1994) and Cotterill's (1997) theoretical work support the proposition that cooperatives often act as "competitive yardsticks," driving markets toward perfect competition and reducing price-cost margins. In this case, as the Dorfman-Steiner condition postulates and as our empirical results confirm, advertising intensity falls.

In addition, cooperatives are often most active in commodity-oriented markets that feature considerable product homogeneity and a high percentage of unbranded, generic or private-label sales. Again, this condition is associated with reduced advertising, as our empirical results document, regardless of the organizational form of the processor. Indeed, the descriptive statistics shown in table 2, reveal that as a group cooperatives have lower price-cost margins and are more active in markets with higher a percentage of unbranded sales than are IOFs. Once price-cost margin, percent of unbranded product sales, and other determinants of advertising intensity are controlled for properly, as in our econometric model, cooperatives are revealed not to advertise less intensively than their investor-owned counterparts.

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