

Optimal Seasonal Allocation of Generic Dairy Advertising Expenditures

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U.S. milk producers contribute \$0.15 for every hundredweight of milk sold to support generic advertising, promotion, and product research, designed with the ultimate goal of enhancing producer returns. Fluid milk processors additionally contribute \$0.20 per hundredweight of fluid milk sales for fluid milk advertising through the MilkPEP program. While generic advertising efforts have received the most attention and share of checkoff budgets, investigation of alternative forms of product promotion and escalating advertising costs have prompted a shift away from generic advertising in recent years. As advertising budgets become tighter, determining the optimal seasonal allocation of those funds is particularly important.

Since 1997, average generic advertising spending indicates higher spending in the first two quarters for fluid milk (Table 1), but a closer look at quarterly spending levels indicates no consistent seasonal trend. This is due, in part, to the fact that seasonal spending patterns for the farmer and processor advertising programs differ. Cheese advertising does seem to indicate some drop in expenditures in the third quarter, but patterns over the last two years indicate reasonably equal quarterly levels.

Optimal seasonal allocation decisions are determined by seasonal price elasticities of supply and demand, advertising elasticities, and product expenditure shares. The allocation rule applied clearly distinguishes the two key components driving allocation decisions – season-specific revenue shares and the ability of generic advertising activity to influence price.

To put it simply, if generic advertising's impact on price was the same throughout the year, producers would be best served with advertising concentrated in those seasons with the highest revenue shares. Conversely, if producer revenue shares are constant throughout the year, advertising efforts should be focused on seasons where generic advertising has the greatest price impact. A simulation model is applied here to more precisely estimate optimal spending patterns.

Input Data and Parameters

To determine optimal allocation decisions for fluid milk and cheese generic advertising, we use quarterly class prices and product disappearance levels to estimate seasonal revenue shares to the industry. Prices received by milk producers are based on the distribution of product to alternative uses. As such, fluid milk processors pay a higher Class I price, while cheese processors pay the Class III price. While no strong seasonal trends were exhibited since 1997, Class I prices were higher on average in the first and fourth quarters, while the third (primarily) and fourth quarters were highest for cheese (Table 1).

Stronger seasonal trends were exhibited in disappearance levels, with fluid milk disappearance higher in the first and fourth quarters and cheese disappearance higher in the final two quarters. As such, the complementary price and disappearance patterns are reinforced

in the computed seasonal revenue shares, with first and fourth quarter average revenue shares highest for fluid milk, and third and fourth quarters for cheese (Table 1). However, changes in seasonal variation across years were also apparent; most notably for fluid milk in 2000 and 2001 where shares increased throughout the year.

To estimate seasonal generic advertising and price elasticities, we used a time-varying parameter demand model for fluid milk and cheese. Both price elasticities of demand (i.e., the percent change in demand, for a 1% change in price) and generic advertising elasticities (i.e., the percent change in demand for a 1% change in advertising expenditures) were used to compute the seasonal price impacts of generic advertising (i.e.; the percent change in price for a 1% change in generic advertising).

Average quarterly retail price elasticities of demand for fluid milk and cheese since 1997 were approximately -0.051 and -0.303, respectively (Table 1). Neither product's price elasticities over time exhibited a consistent seasonal pattern, although fluid milk price elasticity levels were generally lower in the first and fourth quarters. Using this information alone would indicate advertising more intensely in these two quarters would be most effective. Less seasonal variation was exhibited in the cheese price elasticities of demand; however, average cheese price elasticities were slightly lower in the first two quarters of the year.

Quarterly long-run generic advertising elasticities for fluid milk and cheese since 1997 were similar in magnitude, with average estimates of 0.029 and 0.030 for fluid milk and cheese, respectively (Table

1). While the level of the change is not large, clearer seasonal patterns existed in generic advertising demand response, particularly for cheese. Cheese advertising elasticities were higher in the first two quarters of the year, while fluid milk generally showed higher advertising elasticities in the first and fourth quarters. Both patterns would also indicate advertising more intensely in the same periods as illustrated by the price elasticities above.

From the price and generic advertising demand elasticities, quarterly price elasticities with respect to generic advertising were calculated over the sample time period. A clear seasonal pattern was depicted for cheese showing higher elasticities in the first half of the year, relative to the second half. A seasonal pattern was less apparent with fluid milk; however, on average, elasticities were higher in the first and fourth quarters (Table 1).

Results

Combining the estimates of seasonal revenue shares and advertising price impacts for each year (1997-2001) into the seasonal allocation rule resulted in the optimal allocation results in Figures 1 and 2. For each year, the allocation rule was applied, taking annual expenditure budgets as given and using time-specific computed parameter values. As is evident from the figures, seasonal allocation decisions varied considerably by year. For example, from 1997-99 allocations for fluid milk were U-shaped reflecting higher allocations in the 1st and 4th quarter; however, in 2000 and 2001 the allocation patterns were nearly reversed (Figure 1). This was due to the seasonal flattening of price elasticities with respect to advertising for 2000 and 2001 and revenue shares that increased throughout these years.

Even larger differences across years existed when comparing optimal seasonal allocations for cheese. Seasonal allocations were U-shaped in the first two years, mixed in 1999, and

hump-shaped in 2000 and 2001 (Figure 2). Given that seasonal revenue shares and advertising price elasticities demonstrated largely offsetting effects (i.e. revenue shares were generally higher in the final two quarters of the year, while advertising's impact on price was larger in the first two quarters), a higher level of sensitivity to the final allocation decisions resulted. Given no consistent seasonal spending pattern in actual expenditure levels, relative changes from actual to optimal levels varied widely for both products.

It is clear from these varying annual results that forecasting appropriate seasonal allocations would be difficult, *ex ante*. As such, rather than simply using actual annual historical levels and seeing what "should have been done," we adopt a simple operational decision for forecasting the needed parameters, and then apply the allocation rule. Specifically, we assume that class prices, product disappearance, price elasticities, and generic advertising elasticities are expected to be equal to their historical 5-year averages (e.g., see Table 1). The allocation results of this approach are shown in Figures 1 and 2 as "Opt2".

Using Rule 2, optimal fluid milk quarterly advertising allocations were estimated to be 0.27, 0.23, 0.23, and 0.27 for quarters 1 through 4, respectively (Figure 1), compared with actual 5-year averages of 0.27, 0.26, 0.23, and 0.24, respectively. Thus, compared with average actual historical spending patterns, the optimal allocations from Rule 2 indicate spending less in quarter 2 and more in quarter 4.

Given the changes in the annual optimal allocations decisions for cheese from Rule 1, it is not surprising that the Rule 2 allocation results are even more similar across quarters. Specifically, optimal quarterly allocations were estimated to be 0.26, 0.24, 0.25, and 0.25 for quarters 1 through 4, respectively (Table 2), compared with actual 5-year averages of 0.26, 0.25, 0.22, and 0.28, respectively. This more even distribution of advertising would

imply relatively significant increases in third quarter spending and decreases in fourth quarter spending, compared to actual historical averages.

Implications

To evaluate economic gains from the optimal allocation decisions, changes in producer surplus were calculated for each quarter, 1997-2001. Given shifts in seasonal advertising expenditures in both positive and negative directions, some quarters may see producer surplus gains, while others will see reductions. However, on an annual basis, producer welfare will be improved from the reallocations. Average gains by quarter for both investment rules are displayed in Table 2. Producer surplus losses in quarter two (four) for fluid milk (cheese) result from the reductions in advertising spending compared to actual historical levels.

As expected, gains from the Rule 1 approach were larger than Rule 2. Average annual producer surplus gains from expenditure reallocations were approximately \$30 million for fluid milk and \$13 million for cheese (Table 2). While relative to annual industry revenues these gains are small (less than 0.5%), relative to the annual advertising investment, the gains are substantial. That is, gains in producer welfare from reallocating existing annual budgets are approximately 18% and 24% of annual advertising investments for fluid milk and cheese, respectively.

The results from Rule 1 give estimates of producer welfare changes if optimal allocation decisions were made each year. That is, the allocation results indicate what should have been implemented optimally to maximize producer returns to advertising if one knew *a priori* what the actual market parameters were going to be. The Rule 2 approach is based on a prediction of what the parameter estimates will be to come up with an allocation decision for the future. As such, welfare gains from the Rule 2 approach are likely more realistic. Annual

welfare gains from the second approach are approximately two-thirds of those realized by the Rule 1 approach. As such, gains remain substantial, with producer surplus changes relative to annual advertising investments from 12% to 14%. Gains from both scenarios highlight the importance of considering seasonal advertising allocation decisions to achieve greater benefits from existing advertising investments.

Given that optimal seasonal allocations were sufficiently variable across years, using mean historical data as a forecast tool may be insufficient. Future applications should consider determining appropriate price, elasticity, and advertising forecasts to better predict forthcoming advertising budget allocations. Also, unless separate estimates of advertising's effectiveness

by farmer and processor groups are available, achieving optimal allocations will require the collaboration of both participants. Finally, while seasonal allocation decisions are an important component of maximizing returns to farmer-funded advertising efforts, a more complete analysis should investigate both the level and distribution of advertising dollars.

	Generic Adv. Expend. (\$mill)		Class & Farm Prices			Fluid Supply & Product Disappearance (MFE)		
Quarter	Fluid Milk	Cheese	Class I	Class III	Blend Price	Milk Supply	Fluid Milk	Cheese
1	43.454	13.943	16.38	12.21	14.47	40.48	14.00	15.97
2	43.080	13.324	15.57	11.97	13.93	41.85	13.49	16.64
3	37.211	11.567	15.97	14.09	15.13	39.72	13.59	16.92
4	39.211	15.055	17.11	12.95	15.30	39.77	14.16	17.70
Average	40.739	13.472	16.26	12.81	14.71	40.45	13.81	16.81

	Price Elasticities		Generic Adv. Elasticities		Revenue Shares		Price Elasticity w.r.t. Gen. Adv.	
Quarter	Fluid Milk	Cheese	Fluid Milk	Cheese	Fluid Milk	Cheese	Fluid Milk	Cheese
1	0.046	0.298	0.0304	0.0336	0.255	0.226	0.085	0.055
2	0.052	0.297	0.0290	0.0305	0.234	0.231	0.079	0.050
3	0.055	0.307	0.0286	0.0273	0.241	0.276	0.078	0.044
4	0.050	0.308	0.0290	0.0277	0.270	0.266	0.080	0.045
Average	0.051	0.303	0.0293	0.0298	0.250	0.250	0.080	0.048

Note: Advertising expenditures and prices are in real \$2001, product disappearance is on a Milk Fat Equivalent basis (MFE). Revenue shares are based on class prices and product disappearance.

Average Quarterly Changes, 1997-2001 (\$million, 2001\$)				
Quarter	Fluid Milk		Cheese	
	Rule 1	Rule 2	Rule 1	Rule 2
1	6.04	1.31	1.25	0.56
2	-21.01	-21.35	0.02	-1.62
3	22.57	17.42	21.40	20.47
4	22.50	22.34	-9.84	-11.84
Total	\$30.10	\$19.72	\$12.83	\$7.58
Average Annual Advertising Expn.	\$162.96	\$162.96	\$53.89	\$53.89
PS Proportion	0.18	0.12	0.24	0.14

*Note: Rule 1 applies the allocation rule to each year's estimated quarterly parameters. Rule 2 uses historical 5-year average parameters.

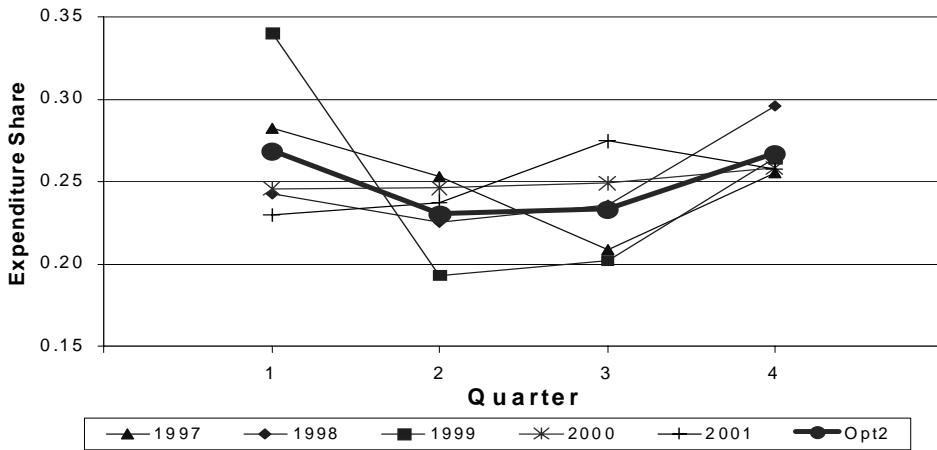


Figure 1. Optimal Seasonal Advertising Allocations, Fluid Milk

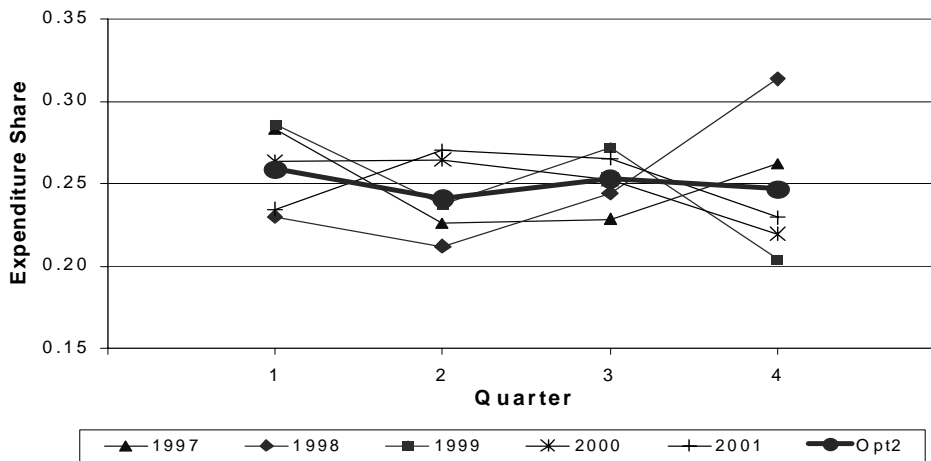


Figure 2. Optimal Seasonal Advertising Allocations, Cheese

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