



**NAVAL
POSTGRADUATE
SCHOOL**

MONTEREY, CALIFORNIA

Promotion Expenditure, Categories, Time Lag Structure,
and the Demand for Almonds

by

Mary A. Malina, PhD, Assistant Professor
Kenneth H. Doerr, PhD, Associate Professor
William R. Gates, PhD, Associate Professor

06 June 2005

Approved for public release; distribution is unlimited

Prepared for: Almond Board of California
1150 9th Street, Ste 1500
Modesto, CA 93354

**Naval Postgraduate School
Monterey, California 93943-5000**

RDML Patrick W. Dunne, USN
President

Richard Elster
Provost

This report was conducted without funding.

Reproduction of all or part of this report is authorized.

This report was prepared by:

Mary A. Malina, PhD
Assistant Professor
Graduate School of Business and
Public Policy

Kenneth H. Doerr, PhD
Associate Professor
Graduate School of Business and
Public Policy

William R. Gates, PhD
Associate Professor/Associate Dean of Research
Graduate School of Business and
Public Policy

Reviewed by:

Released by:

Thomas Hughes
Acting Dean
Graduate School of Business and
Public Policy

Leonard A. Ferrari, Ph.D.
Associate Provost and
Dean of Research

REPORT DOCUMENTATION PAGE			<i>Form Approved OMB No. 0704-0188</i>		
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington DC 20503.					
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE 06/06/05	3. REPORT TYPE AND DATES COVERED		
4. TITLE AND SUBTITLE: Promotion Expenditure, Categories, Time Lag Structure, and the Demand for Almonds			5. FUNDING NUMBERS Not Funded		
6. AUTHOR(S) Mary A. Malina, PhD, Assistant Professor, Kenneth H. Doerr, PhD., Associate Professor William R. Gates, PhD, Associate Professor					
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943-5000			8. PERFORMING ORGANIZATION REPORT NUMBER		
9. SPONSORING /MONITORING AGENCY NAME(S) AND ADDRESS(ES) Almond Board of California 1150 9 th Street, Ste 1500, Modesto, CA 95354			10. SPONSORING/MONITORING AGENCY REPORT NUMBER		
11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.					
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited			12b. DISTRIBUTION CODE		
13. ABSTRACT (maximum 200 words) The Almond Board of California (ABC) finances four promotional programs to increase the demand for California almonds: public relations, advertising, food services and nutrition research. This analysis relates ABC's expenditures by category to U.S. almond demand. It assesses ABC's return on investment and guides managerial decisions across programs. ABC expenditures have a significant effect on domestic almond shipments, explaining 16.7% of the variation in shipments. However, only advertising is strongly significant; each dollar spent increases almonds shipped eight months later by 8.25 pounds. Food services approached significance; each dollar spent increases almonds shipped 11 months later by 32.8 pounds.					
14. SUBJECT TERMS NONE			15. NUMBER OF PAGES 25		
			16. PRICE CODE		
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT SAR		

ABSTRACT

The Almond Board of California (ABC) finances four promotional programs to increase the demand for California almonds: public relations, advertising, food services and nutrition research. This analysis relates ABC's expenditures by category to U.S. almond demand. It assesses ABC's return on investment and guides managerial decisions across programs. ABC expenditures have a significant effect on domestic almond shipments, explaining 16.7% of the variation in shipments. However, only advertising is strongly significant; each dollar spent increases almonds shipped eight months later by 8.25 pounds. Food services approached significance; each dollar spent increases almonds shipped 11 months later by 32.8 pounds.

EXECUTIVE SUMMARY

Mary A. Malina, PhD, Assistant Professor, Graduate School of Business and Public Policy
Kenneth H. Doerr, PhD, Associate Professor, Graduate School of Business and Public Policy,
William R. Gates, PhD, Associate Professor, Graduate School of Business and Public Policy

The Almond Board of California (ABC) administers a grower-initiated federal marketing order, under the supervision of the United States Department of Agriculture (USDA), to promote consumption and to increase the market share of California produced almonds in domestic and international markets. In accomplishing this mission, it finances four different categories of promotional programs: advertising, public relations, food services and nutrition research. Most of the funding allocation decisions are made under uncertainty in supply, demand, and the relationship between promotional programs and demand. This research examines the latter relationship, with the intent of exploring the relative effectiveness of various program categories.

The model developed here relates ABC's four expenditure categories to the demand for almonds, as measured by monthly almond shipments. Acknowledging that the impact on shipments lags promotional expenditures, the model used a heuristic but conservative search procedure to uncover a parsimonious lag structure from a limited set proposed by ABC. The model controls for other factors that might affect almond shipments, including seasonality, almond prices, and personal income. In addition to assessing the overall return on investment that the ABC provides its members (a backward-looking measure of historical effectiveness) this research provides some limited diagnostic information to help guide future managerial decisions among the available opportunities.

This analysis differs from previous ABC studies in several ways. First, promotional expenditures are categorized to help inform ABC's managerial decisions. That is, the ABC would like to determine not only *if* their promotional expenditures are effective, but *which*

promotional expenditures are most effective. While this kind of analysis has not been applied to almond promotions before, it has been used to assess promotional expenditures for other commodities. Second, this analysis uses monthly rather than yearly expenditures. Monthly expenditures for almond promotion have not been examined before, but monthly expenditures have been used to analyze other commodity promotion programs. Third, this analysis examines the lag between promotional expenditures and their impact on demand, which is necessary with monthly expenditures. Lag structures have been used to analyze the almond export market and their use in measuring commodity promotion is not controversial. Fourth, this analysis uses shipments rather than consumption as the dependent variable, because monthly consumption information is not available. While shipments are certainly related to consumption, their use as a surrogate for consumption remains an untested assumption of this research. Finally, ABC predicted that nutritional research expenditures have an interaction effect on almond shipments; research results are disseminated through public relations and advertising.

U.S. domestic almond shipments by month were provided by ABC. Similarly, ABC provided monthly expenditure data for each of the four promotional expenditure categories, based on ABC's accounting records. As in prior studies, seasonality, price of almonds and personal income are used as control variables in assessing the impact of expenditures on almond demand. Finally, this analysis examined a single month lag structure for each promotional expenditure category and interactive variable. Clearly, promotional expenditures can affect shipments over several months. Estimating a single month lag provides conservative results.

Overall, this model indicates that ABC expenditures explain 16.7% of the variation in almond shipment data; the control variables explain 60.6% of the variation. The weighted elasticity for all ABC promotional expenditures is 0.14, which is consistent with earlier analyses

of ABC's promotional expenditures; this implies that a 1% increase in ABC promotional expenditures would increase almond shipments by 0.14%.

In terms of expense categories, only the advertising coefficient was strongly significant ($p = 0.033$); each dollar expended on advertising in month $t-8$ yielded an average increase of 8.25 pounds of almonds shipped in month t . The food service coefficient approached significance ($p = 0.105$) and indicated an average increase of 32.8 pounds of almonds shipped in month t per dollar expended on food service promotions in month $t-11$. Coefficients on interactive terms with research were far less significant, and their interpretation is only tentative. The coefficients indicate that each dollar expended on research in month $t-17$, given a corresponding \$492,000 expenditure on advertising in month $t-8$, increases almond shipments by 8.86 pounds ($492,000 * .000018$) in month t ; each dollar expended on research in month $t-13$, given a corresponding \$215,000 expenditure on public relations in month $t-6$, increases almond shipments by 8.38 pounds ($215,000 * .000039$) in month t . The direct public relations coefficient was insignificant and cannot be meaningfully interpreted.

The lack of statistical significance in several coefficients is not unexpected given the limited dataset, the number of variables estimated (including control variables), the conservative approach to estimating the lag structure and the 17 periods of data discarded to accommodate the proposed lag structure. However, the lack of significance in some coefficients may indicate greater volatility in the relationship between those independent variables and almond shipments. ABC certainly had the intuition that some categories of investment are riskier than others. Regression models need a larger sample to estimate the coefficients of riskier investments. These results are consistent with the claim that public relations expenditures are riskier than advertising expenditures, though they do not verify this supposition.

In conclusion, a model was estimated to explain the time-lagged relationship between categorized promotional expenditures and almond shipments. The model explains a significant amount of the variance in almond shipments beyond the control variables and indicates that ABC is an effective steward of its members' funds. In addition this discussion has provided limited diagnostic information as to the relative effectiveness of the categories of ABC's expenditures and demonstrated an approach through which categorized expenditures can be assessed on an ongoing basis as more data become available.

ACKNOWLEDGEMENTS

The authors are grateful for the help and insights provided by Richard Waycott and Craig Doerr from the Almond Board of California and for the research assistance provided by Vasileios Drakopoulos, Michael Georgiadis, and Thomas Markopoulos, MBA students at the Naval Postgraduate School. Any remaining errors, omissions or misinterpretations are the authors' responsibility.

TABLE OF CONTENTS

I. Introduction.....	1
II. Literature Review.....	2
III. Model Development.....	6
IV. Discussion.....	11
V. Limitations and Conclusions.....	13
References.....	15
Initial Distribution List	17

List of Tables

Table 1. Theoretical Time Lag Structure	8
Table 2. Time Lag Structures Analyzed	9
Table 3. Selected Time Lag Structure.....	9
Table 4. Results for Selected Model	10
Table 5. Monthly Average Expenditure and Elasticity by Expenditure Category	11

I. INTRODUCTION

The Almond Board of California (ABC) was established in 1950. It administers a grower-initiated federal marketing order under the supervision of the United States Department of Agriculture (USDA). Its role, in part, is to promote consumption and to increase the market share of California produced almonds in domestic and international markets through generic public relations, advertising, and nutrition research. In accomplishing this part of its mission, it must decide among investment opportunities (programs) to provide a fair return to the growers and other members that fund it.

This is not a clear-cut task, as most of the decisions associated with the allocation of funds to programs are made under uncertainty in supply, demand, and the relationship between programs and demand. This research examines the latter, with the intent of informing management about the relative effectiveness of various program categories.

ABC finances four different categories of promotional programs: advertising, public relations, food services and nutrition research. The authors' model relates ABC's four expenditure categories to the demand for almonds, as measured by monthly almond shipments. As the impact on shipments lags promotional expenditures, the authors describe a heuristic but conservative search procedure that seeks to uncover a parsimonious lag structure from among a limited set of lag structures proposed by management. The model also controls for other factors that might affect shipments, including seasonality, almond prices, and personal income. Results suggest which expenditure categories have been most effective. Thus, in addition to assessing the overall return on investment that the ABC has provided to its members (a backward-looking measure of historical effectiveness) this research seeks to provide some limited diagnostic

information to help guide future managerial decisions among the available opportunities. The approach taken here should be useful in evaluating other promotion programs as well.

II. LITERATURE REVIEW

Federal marketing orders are directives of the Secretary of Agriculture that require growers to contribute funds to a central organization whose mission may include funding product research, advertising, promotion and setting crop reserves to maintain price stability. Although the orders are initiated by grower petition, once established, all growers specified in the order must contribute. The marketing order organization is run by a grower-elected board, who decide how to allocate revenues contributed by members. Under the 1996 Federal Agricultural Improvement and Reform (FAIR) Act, all federal marketing orders operating promotional programs are required to conduct an independent economic evaluation of their programs to ascertain the extent of their market impact (Kaiser, Liu et al., 2003). In addition to the growers, other members of the supply chain, and indeed the consumers of the commodity, have a stake in the marketing order board's actions. Hence, a broad set of criteria have been proposed for evaluating board performance (Polopolus, Carman et al., 1986; French and Nuckton, 1991). These criteria are mostly stated in negative terms, that is, the board should *not*:

- (a) permit farmers to earn persistent above normal profits,
- (b) increase price variability and uncertainty,
- (c) impose disproportionate burdens on particular classes of growers or handlers,
- (d) contribute to chronic surpluses,
- (e) waste resources,
- (f) reduce net revenues to producers, or

- (g) drive consumer prices persistently higher than justified by costs including a normal profit.

A single analysis rarely examines all of these factors, partly because the scope of such an investigation would be too broad, and partly because of the diversity of data sources required to investigate these very different sorts of proscriptions. Indeed, many of the analyses of marketing order boards in the literature examine only a segment of the market, such as the export market (Onunkwo and Epperson, 2000), and yet still require multiple kinds of data, such as cross sectional and time series (Halliburton and Henneberry, 1995) or conduct analyses combining multiple techniques such as regression and simulation (Kaiser, Liu et al., 2003). Note that the proscriptions above fall into three categories: protecting consumers against the exercise of cartel or monopoly power by the board (criteria a and g), protecting one group of growers (or other supply chain members) from board actions that may favor another group (criterion c), and protecting all growers (and other supply chain members) from mismanagement by the board (criteria b, d, e and f).

Turning specifically to the analysis of almond promotion, there have been several studies that examined various market segments, such as export promotion (Kinnucan and Christian, 1987; Halliburton and Henneberry, 1995), and organic almonds (Carman, Klonsky et al., 2004). This analysis will focus on the major market segment (domestic shipments), and the economic performance of ABC as it supports the profit maximizing objectives of those covered by the marketing order.

Several authors have discussed the issue of protecting consumers against ABC exercising cartel or monopoly power (criteria a and g in the list above). There is a long history of analysis that takes a profit maximization objective as a given for industry behavior (Dorfman and Heien,

1988). Alston, et al. noted that “it is logical to assume that [ABC] will act in its self interest, i.e., it will seek to maximize in some form the profits accruing to the industry...an industry operating under a marketing order is modeled as an industry cartel” (Alston, Carman et al., 1995). However, in a recent analysis of this issue, Crespi and Chacon-Cascante (2004) found that ABC did not behave as a profit-maximizing cartel. They postulated two reasons for this: first, the board does not control plantings, hence their control over reserves is only a short term control over supply, which has limited impact on grower profitability; and second, because their control over reserves is subject to political pressure from various stakeholders (when a decision was made to increase reserves to 20% in 1999 proved costly for small handlers, several members of the board who had voted for the increase were replaced in the next election).

If Crespi and Chacon-Cascante (2004) are correct that political pressures were brought to bear on the board by a group of stakeholders who had been adversely affected by the board’s decision, that would provide evidence that the board is not acting contrary to proscription c in the list of criteria given above (in the long term at least). Certainly, ongoing litigation from stakeholder groups under other marketing orders (Crespi and Sexton, 2001; Carman, Klonsky et al., 2004), as well as recently settled litigation related to ABC, indicates that, while there is concern over board actions that favor one group at the expense of another, there is also active oversight from members themselves.

Hence, although the focus here on profitability represents only one of the three stakeholders covered by the proscriptions listed above, concerns related to the exercise of cartel power against consumer interests are adequately addressed in the recent analysis by Crespi and Chacon-Cascante (2004); while concerns about board actions favoring one group of members over another are being adequately addressed by the marketplace itself.

Turning to the analysis of the profitability of promotional expenditure in the domestic market: two previous studies have examined this issue. Both studies were time series analyses of yearly expenditures, which attempted to assess the aggregate impact of promotional expenditures on domestic demand. Both studies reported the elasticity of promotional expenditures as primary measures of the effectiveness of those expenditures.

Christian (1994) developed a double-logarithmic model to predict per-capita consumption from per-capita promotional expenditures (using Blue Diamond expenditures only, as his analysis time frame pre-dated ABC). His control variables were price and per-capita income. He reported an elasticity of 0.14 for promotional expenditures, indicating a 10% increase in promotional expenditures should yield about a 1.4% increase in consumption.

Crespi and Sexton (1999; 2001a; 2001b) developed a linear model to predict per-capita consumption from the square root of promotional expenditures. Their control variables were price and per-capita domestic consumption expenditures. They reported an elasticity of 0.13 for aggregate promotional expenditures.

This analysis differs from these two previous studies in several ways. First, promotional expenditures are categorized to inform managerial decision making at ABC. That is, the ABC would like to determine not only *if* their promotional expenditures are effective, but *which* promotional expenditures are most effective. While this kind of analysis has not been applied to almond promotion before, it has been used to assess promotional expenditures of other commodities (Kinnucan and Miao, 1999). Second, this analysis uses monthly, rather than yearly expenditures. This is done mostly because of the desire to categorize expenditures; more observations are needed than are available through an examination of yearly data. While monthly expenditures for almond promotion have not been examined before, monthly

expenditures have been used to analyze other commodity promotion programs (Hoover, Hayenga et al., 1992). Third, the analysis examines the lag between expenditures and their impact on demand. The examination of a lag structure is necessary with monthly expenditures (although, as shown below, the lag for research impact is greater than one year). Lag structures have been used in the analysis of the export market (Halliburton and Henneberry, 1995), and their use in measuring commodity promotion is not controversial (Forker and Ward, 1993). Fourth, the analysis uses shipments, rather than consumption, as the dependent variable. This is necessary because monthly consumption information is not available; and while shipments are certainly related to consumption, their use as a surrogate for consumption remains an untested assumption and a limitation of this research.

III. MODEL DEVELOPMENT

As described previously, the objective of this paper is to determine if, and to what degree, different categories of ABC expenditures impact almond demand. The model is:

$$\text{Demand} = f(\text{Public Relations, Advertising, Food Service, Nutritional Research})$$

The following section describes the dependent, independent and control variables, as well as the process for determining time lags between expenditures and the resulting impact on demand.

Since the dependent variable, monthly almond demand, is not available, monthly almond shipments in pounds is used to approximate monthly almond demand. U.S. domestic almond shipments by month (SHIP) were provided by ABC. The independent variables of interest are the four expenditure categories; public relations (PR), advertising (AD), food service (FS) and nutritional research (RES). Monthly outlays for each category are tracked by ABC accounting records and were provided on a monthly basis.

Seasonality, price of almonds and personal income are used in prior studies as control variables in assessing the impact of expenditures on almond demand. This analysis uses a series of dichotomous variables (SEAS1, SEAS2, SEAS3) based on four three-month growing seasons to control for the affect of growing season on almond shipments. The three seasonality variables represent an offset from the September through November peak growing season. Monthly almond prices (PRICE) were determined from the price of NPS 23/25 almonds (a specific category of almonds) provided by Ryan-Parreira Almond Company (RPAC). While this handler’s portion of NPS 23/25 class of almonds represent only a small share of the total market, ABC confirmed that almond prices across categories and handlers tend to move together. Analysis of price indices and time-series plots of the price data provided and confirmed this assumption. Personal income was measured using the monthly disposable personal income (DPI) from the U.S. Department of Commerce: Bureau of Economic Analysis. Combining all the variables described above, multiple regression was used to test the following equation:

$$\begin{aligned} \text{SHIP} = & \alpha_0 + \alpha_1\text{PR}_{\text{lag}} + \alpha_2\text{AD}_{\text{lag}} + \alpha_3\text{FS}_{\text{lag}} + \alpha_4\text{PR}_{\text{lag}}*\text{RES}_{\text{lag}} + \alpha_5\text{AD}_{\text{lag}}*\text{RES}_{\text{lag}} \\ & + \alpha_6\text{SEAS1} + \alpha_7\text{SEAS2} + \alpha_8\text{SEAS3} + \alpha_9\text{DPI} + \alpha_{10}\text{PRICE} + \varepsilon \end{aligned} \quad (1)$$

A delay was expected between a monetary outlay for promotion and the impact of that promotion on almond shipments. To form a basis from which to explore possible time lag structures, ABC offered its guidance. Based on collective experience, ABC provided the theoretical time lag ranges summarized in Table 1 for each expenditure category. For example, if ABC spends \$X on a magazine advertisement in January, it expects the impact of that ad to be reflected in almond shipments sometime between April and September of the same year. ABC predicts that expenditures for nutritional research will have an interaction effect on almond shipments such that research results are disseminated through public relations and advertising.

For example, if ABC spends \$X on nutritional research, the results of the research will be publicized through public relations and advertising, which will in turn impact almond shipments. They anticipate no direct effect of research expenditures on almond shipments.

Expenditure Category	Theoretical Time Lag Range
Public Relations	1-12 months
Advertising	3-8 months
Food Service	6-12 months
Research	12-20 months

Even within these theoretical limits (13 possible lags for PR, six for AD, seven for FS, and nine for each of the RES interactions) there were 44,226 different models ($13 \times 6 \times 7 \times 9 \times 9$) that could be investigated. The authors' approach was to investigate each variable one at a time, finding the two most significant lag structures within the theoretical range for that variable in isolation (two was selected arbitrarily), and then search the resulting 32 models ($2 \times 2 \times 2 \times 2 \times 2$) for significance. Having theoretical limitations on the lag structure and further limiting the search across the theoretically acceptable structure is important in avoiding the issue of capitalizing on the idiosyncrasies in the sample to find significance. While this approach is conservative, and preferred to data mining across the whole model space, it also may potentially fail to identify the true lag structure.

For the three non-interactive independent variables of interest (PR, AD, FS), individual stepwise regressions were run for each month within the theoretical range. The two time lag structures with a positive coefficient and the largest increase in R^2 over the control variables (SEAS1, SEAS2, SEAS3, DPI, PRICE) were identified for continued analysis. The time lag structures summarized in Table 2 were chosen for further analysis.

Variable time lag	Increase in R²
PR ₁	0.015
PR ₆	0.036
AD ₆	0.011
AD ₈	0.083
FS ₁₁ ^a	0.014

^a Only one lag within the theoretical range had a significant increase in R² over the control variables.

For the interactive independent variables (PR*RES, AD*RES), individual stepwise interactions were run within the theoretical range. Again, the analysis used the two time lag structures with a positive coefficient and the largest increase in R² over the control variables. The time lag structures summarized in Table 3 were chosen for further analysis. The research lag structures incorporate the lag for the associated interaction. For example, the AD₈*RES₁₇ time lag structure implies that nine months after the research expenditure, an advertisement expenditure occurs. This interaction impacts almond shipments eight months later.

Variable time lag	Increase in R²
PR ₆ *RES ₁₇	0.050
PR ₆ *RES ₁₃	0.037
AD ₆ *RES ₁₇	0.063
AD ₈ *RES ₁₇	0.049

Next, the full model was run for all 16 possible time lag combinations.¹ The model results that explains the most variation in almond shipments (SHIP) are shown in table 4 (control variables suppressed). Overall, the model shows a statistically significant fit to the data (F=

¹ Because food service had just one significant lag structure within the theoretical range, the total possible models decreased from 32 to 16.

8.499, $df = 22$, $p < 0.00$), explaining 77.3% of the variation (adjusted R^2) in monthly domestic almond shipments. The control variables comprise 60.6% of this model's explanatory power.

Table 4		
Results for Selected Model		
Variable	Regression Coefficient	<i>p</i>-value
PR ₆	2.22	0.720
AD ₈	8.25	0.033 *
FS ₁₁	32.80	0.105 †
PR ₆ *RES ₁₃	PR ₆ * 1.84E ⁻⁰⁵	0.376
AD ₈ *RES ₁₇	AD ₈ * 3.93 E ⁻⁰⁵	0.301

* Significant

† Marginally significant

The coefficients on the main effects listed in Table 4 indicate the change in pounds of almonds shipped for per dollar expenditure in the related category. Coefficients on interactive terms with research (RES) indicate the change in pounds of almonds shipped per dollar expenditure given the mean expenditure in the other term of the interaction, as will be discussed below. Unfortunately, except for advertising (AD) and food service (FS), the other coefficients are not statistically significant; thus, those estimates have limited value and should be interpreted with caution.

Table 5 reports the monthly average expenditures for each category and respective elasticity figures. The elasticity figures indicate the percent change in almond shipments, given a percentage change in each category of expenditure. For example, a 10% change in advertising expenditure is estimated to produce a 2.1% change in almond shipments 8 months later. Research expenditure elasticity is the effect of a dollar expended, given average investments in both advertising and public relations.

Variable	Monthly Average Expenditure	Elasticity
PR	\$215,000	0.053
AD	\$492,000	0.214
FS	\$41,000	0.051
RES	\$74,000	0.058

IV. DISCUSSION

Overall, this model indicates that ABC expenditures have a significant positive effect on domestic almond shipments. The control variables explain 60.6% of the variation in the data, while ABC expenditures explain an additional 16.7%. The weighted elasticity for all ABC promotional expenditures is 0.14, which is consistent with earlier work (Christian, 1994; Crespi and Sexton, 1999; Crespi and Sexton, 2001).

In terms of expense categories however, only the advertising (AD) coefficient was strongly significant. Results indicate that each dollar expended in the advertising category in month $t-8$ yielded an average increase of 8.25 pounds of almonds shipped in month t . The food service (FS) coefficient was approaching significance at $p = 0.105$, and indicated an average increase of 32.8 pounds of almonds shipped in month t , per dollar expended on food service promotions in month $t-11$. Coefficients on interactive terms with research (RES) were far less significant, and their interpretation can only be made tentatively, mostly in the interest of illustrating the way in which interactive terms are interpreted. Bearing this limitation in mind, the coefficients indicate that each dollar expended on research in month $t-17$, given a corresponding \$492,000 expenditure on advertising in month $t-8$, would result on average in an additional 8.86 ($492,000 * .000018$) pounds of almonds shipped in month t . Under the same

limitations, the coefficients indicate that each dollar expended on research in month $t-13$, given a corresponding \$215,000 expenditure on promotion in month $t-6$ would yielded an average of an additional 8.38 ($215,000 * .000039$) pounds of almonds shipped. The public relations (PR) coefficient was insignificant and cannot be meaningfully interpreted.

These results suggest that the main impact of advertising expenditures occurs on average eight months later, while the main impact of food service expenditures occurs 11 months later. However, it is clearly true that, for example, advertising expenditures may impact shipments in less than 8 months in many cases, or in more than 8 months in some cases. As noted above, examining a single month for the lag structure provides conservative results. The lag structures uncovered by this procedure are quite long, but are driven by the theoretical limits given to us by ABC management. The length of the estimated lag structures are themselves informative, however, as longer lags are clearly related to riskier investments because market structures are more likely to change over a longer time period.

The lack of statistical significance in so many of the coefficients is disappointing, but not unexpected given the limited size of the dataset, the large number of variables estimated (including control variables), the conservative approach to estimating the lag structure and the large amount of data that were discarded to estimate the lag structure². However, it may also be that the lack of significance in the coefficients is caused by greater volatility in the relationship between the independent variables and almond shipments. Management at ABC certainly had the intuition from the outset that some categories of investment are riskier than others. If this were so, it would show up in a regression model as a need for a larger sample to estimate the

² 17 observations were discarded from the beginning of the dataset in order to estimate the model with a 17-month lag. While other procedures (such as the substitution of a trend-adjusted estimate for missing data) may have increased the nominal power of the tests, and yielded statistically significant coefficients, this procedure is a conservative one.

coefficients of the riskier investments. Of course, this claim is not supported through the regression results. However, the results are consistent with, for example, the claim that public relations expenditures are riskier than advertising expenditures.

V. LIMITATIONS AND CONCLUSIONS

As with any research, these conclusions have a number of limitations. While the procedure used to estimate the lag structure was highly conservative, it may also have overlooked the true lag structure. There is no obvious search procedure that could have yielded better results (untainted by the charge that they were spuriously obtained), but nonetheless, the lag structure reported here must be seen as conditional until it is cross-validated on a larger dataset. As already noted, the lack of statistical significance on several coefficients limits the usefulness of this research, in terms of its managerial implications. While the analysis provides tentative interpretations of the research expenditure interaction terms, high p -values on these coefficients (0.30 and 0.38) indicate that there is a relatively high probability that the coefficients are inaccurate, and that the relationships themselves may not even exist. Hence the interpretation given to those coefficients should merely be considered to be illustrative examples, pending further analysis on a larger dataset. Even for those variables with statistically significant coefficients, the application of those coefficients to guide future decision-making must be made with caution. While these coefficients are more diagnostic than, for example, a generic elasticity reported for aggregate ABC expenditures, the predictive validity of the estimates cannot be established with a single study.

In conclusion, a model was estimated to explain the time-lagged relationship between categorized promotional expenditures and almond shipments. The model explains a significant amount of the variance in almond shipments beyond the control variables, and indicates that

ABC is an effective steward of its members' funds. In addition this discussion has provided limited diagnostic information as to the relative effectiveness of the categories of ABC's expenditures, and demonstrated an approach through which categorized expenditures can be assessed on an ongoing basis, as more data become available.

REFERENCES

Alston, J. M., H. F. Carman, et al. "Optimal Reserve and Export Policies for the California Almond Industry: Theory, Econometrics and Simulations. Davis, CA: Giannini Foundation of Agricultural Economics, 1995.

Carman, H. F., K. Klonsky, et al. Marketing Order Impact on the Organic Sector: Almonds, Kiwifruit and Winter Pears. Davis, CA: Giannini Foundation, 2004.

Christian, J. E. "The Economic Effects of Advertising in the California Almond Industry." Department of Agricultural Economics, University of California, Davis, 1994.

Crespi, J. M. and A. Chacon-Cascante. "Do U.S. Marketing Orders Have Much Market Power? An Examination of the Almond Board of California." Agribusiness, **20**(1), 2004, 1-15.

Crespi, J. M. and R. J. Sexton. "The Almond Board of California's Promotion Program: An Evaluation." Modesto, California: The Almond Board of California, 1999.

_____. "Almond Advertising Yields Net Benefits to Growers." California Agriculture, **55**(1), 2001, 20-25.

_____. "Got Lawyers?" Choices, First Quarter, 2001 18-23.

_____. "Have Expenditures to Advertise California Almonds Been Effective?" Agricultural and Resource Economics Update, **3**(2), 2001, 7-8.

Dorfman, J. H. and D. Heien. "The Effects of Uncertainty and Adjustment Costs on Investment in the Almond Industry." The Review of Economics and Statistics, **71**(2), 1988, 236-74.

Forker, O. D. and R. W. Ward. Commodity advertising: the economics and measurement of generic programs. NY, NY: Lexington Books, 1993.

French, B. C. and C. F. Nuckton. "An Empirical Analysis of Economic Performance Under the Marketing Order for Raisins." American Journal of Agricultural Economics, **73**, 1991, 581-93.

Halliburton, K. and S. R. Henneberry. "The Effectiveness of U.S. Nonprice Promotion of Almonds in the Pacific Rim." Journal of Agricultural and Resource Economics, **20**(1), 1995, 108-21.

Hoover, S., M. Hayenga, et al. (1992). "Evaluating the Effectiveness of Generic Pork Advertising: The First Fifteen Months," in Commodity Advertising and Promotion, edited by H. W. Kinnucan, S. R. Thompson and H. S. Chang. Ames, IA: Iowa State University Press, 1992, 235-60.

Kaiser, H. M., D. J. Liu, et al. "An Economic Analysis of California Raisin Export Promotion." Agribusiness, **19**(2), 2003, 189-201.

Kinnucan, H. W. and J. E. Christian. "A Method for Measuring Returns to Nonprice Export Promotion with Application to Almonds." Journal of Agricultural and Resource Economics, **22**(1), 1987, 120-132.

Kinnucan, H. W. and Y. Miao. "Media-specific returns to generic advertising: The case of catfish." Agribusiness, **15**(1), 1999, 81-99.

Onunkwo, I. M. and J. E. Epperson. "Export Demand for U.S. Pecans: Impacts of U.S. Export Promotion Programs." Agribusiness, **16**(2), 2000, 253-265.

Polopolus, L. C., H. F. Carman, et al. "Criteria for Evaluating Federal Marketing Orders: Fruit, Vegetables, Nuts and Specialty Crops." Washington, D.C.: National Technical Information Service, Identification Section, 1986.

INITIAL DISTRIBUTION LIST

<u>Agency</u>	<u>Number of Copies</u>
Defense Technical Information Center 8725 John J. Kingman Rd., STE 0944 Ft Belvoir, VA 22060-6218	2
Dudley Knox Library, Code 013 Naval Postgraduate School Monterey, CA 93943	2
Almond Board of California Richard Waycott, President 1150 9 th Street Ste. 1500 Modesto, CA 95354	4
Mary A. Malina, PhD Code GB/Ya Naval Postgraduate School Monterey, CA 93943	1
Kenneth H. Doerr, PhD Code GB/Nd Naval Postgraduate School Monterey, CA 93943	1
William R. Gates, PhD Code GB/Gt Naval Postgraduate School Monterey, CA 93943	10