

Economic Impacts of the California Avocado Commission's Advertising and Promotion Programs: 2013 - 17

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Executive Summary

This report presents results of a study of retail promotions conducted by the California Avocado Commission (CAC) for the five-year review period from 2013 – 17. The CAC funds promotions through revenues generated from its grower assessment and 85% return on the 2.5 cents per pound assessment paid by California Hass avocado growers to the Hass Avocado Board (HAB). Per capita consumption of avocados in the U.S. reached 7.1 lbs. in 2014, an increase of 344% relative to the 1.6 lb. average in the 1990s. Mexico's share of the U.S. market has continued to expand and represented on average 79% of shipments over the last three years of the review period. Despite the rapid increase in shipments to the U.S. market and per capita consumption, the prices received by California growers have held steady, on average, over the past 15 years.

The CAC spent an average of \$9.13 million annually on its marketing programs over the review period. The major emphasis of the CAC's marketing programs over the review period has been to promote the "California grown" aspect of its members' production, including creation and marketing of California branding. The CAC has focused heavily on key Western U.S. markets and timed promotions to the peak availability of California avocados from late spring through Labor Day. Whether marketing direct to consumers, key influencers, or the trade, the CAC has sought to position California avocados as a premium product and to create loyalty for California avocados relative to avocados of other origins. This, in our view, is a very sensible strategy emphasizing: (i) natural advantages of California production in the market place, (ii) marketing most heavily in the U.S. West, where those natural advantages are strongest, (iii) promoting the California avocado as the premium avocado product, and (iv) turning its emerging status as a niche product into a marketing advantage.

We developed econometric models to evaluate the impacts of the CAC's promotions on weekly per capita consumption of fresh Hass avocados in markets where the CAC conducts promotions and where retail scanner data were available. The econometric model sought to explain weekly per capita consumption of fresh Hass avocados in each market area as a function of current and lagged values of the average price faced by consumers in the market area, the total amount of promotion expenditure directed to consumers in the market area during that week by the CAC, and "fixed effects" variables to control for factors outside of the model.

Results from estimation of the models showed that CAC promotions had a highly statistically significant (at the 99% level of confidence) positive impact on per capita consumption. The estimated elasticity of per capita consumption with respect to promotion expenditures was highly robust to model specification at around 0.015, meaning, for example, that a 10% increase in promotion expenditures in a market area would be associated with a 0.15% increase in per capita consumption. This estimated impact is almost identical to the impact estimated by the authors for all retail promotions conducted under the auspices of the HAB. The leading funder of fresh avocado promotions in the U.S. today is Avocados from Mexico (AFM). We interpret these results to indicate that the CAC and AFM have been comparably effective in promoting fresh avocados in the U.S. over the past five years. Although we cannot estimate a benefit-cost ratio for just CAC's promotions, the comparable effectiveness found for CAC's promotions to the aggregate promotion expenditures leads us to conclude that benefit-cost ratios estimated for total avocado promotions in the U.S., which ranged from 1.64 – 3.62, apply also to the CAC's promotions. This represents a substantial return on California growers' expenditures to promote fresh avocados in the U.S.

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1. Introduction

California avocado growers have continuously funded advertising and promotion programs to build demand for their product since the 1961/62 marketing year. The magnitude and structure of the U.S. market for fresh avocados has changed dramatically over this time, with remarkable growth in per capita consumption achieved. Despite massive growth in the number of avocados imported into the U.S., real (inflation adjusted) prices received by California growers have, despite year-to-year fluctuations, held steady on average. In this study we examine the role played by promotions funded by California growers and implemented by the California Avocado Commission (CAC) in facilitating the demand growth that has made this outcome possible. Our specific focus is on the most recent five-year period from 2012/13 – 2016/17.

The California avocado marketing programs were initially conducted under a California state marketing order program, and since September 1978 have operated under the California Avocado Commission law. Beginning in 2003, following approval in July 2002 of the Hass Avocado Promotion, Research and Information Order via grower referendum, California Hass avocado producers have paid assessments of 2.5 cents per pound to the Hass Avocado Board (HAB) for Hass avocados produced and sold to handlers in California, with 85% of the assessments being returned to the CAC. These funds augment revenues generated by CAC's own assessments.

In what follows, we first summarize major trends in production, consumption, and grower prices of fresh avocados in the U.S., before turning our attention to a description and qualitative review of the CAC's marketing programs for the five-year review period. We then present the results of an econometric evaluation of the impacts of the CAC's marketing programs

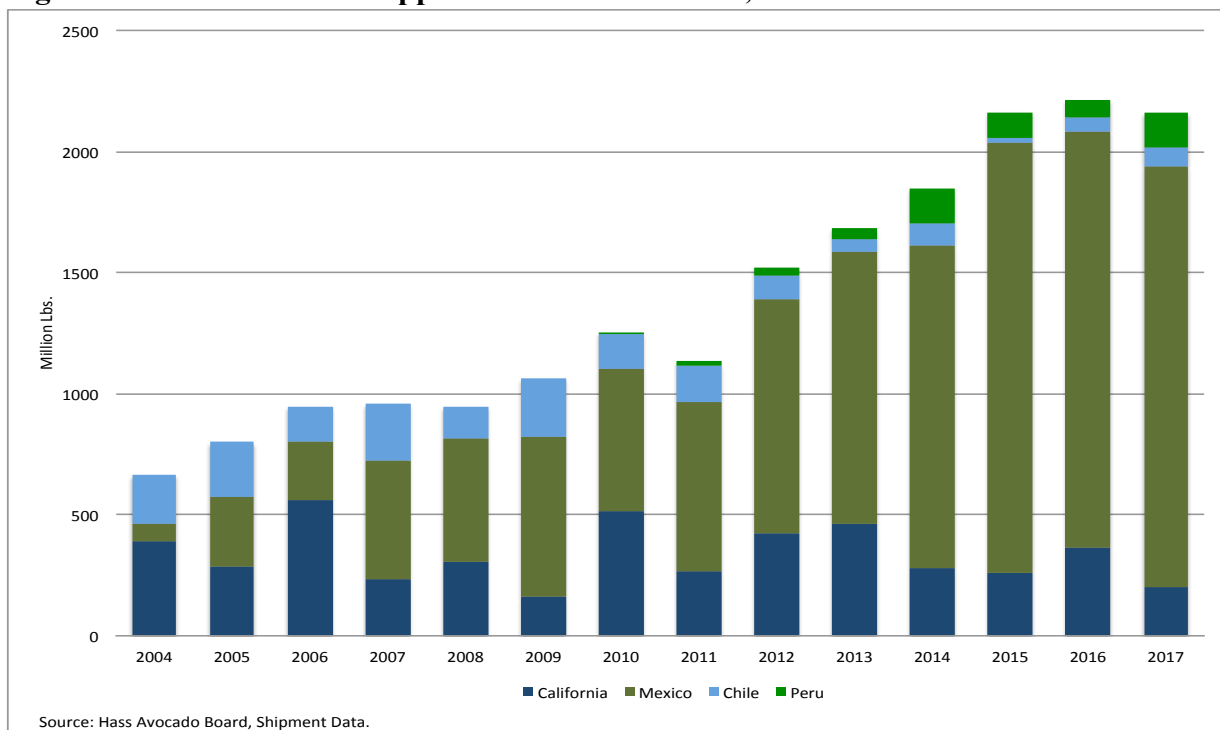
on avocado sales and consumption in the market areas where the CAC has focused its promotion efforts.

2. The U.S. Market for Avocados: Trends and Current Status

Fresh avocado consumption in the U.S. was relatively flat, averaging 1.6 lbs. per capita, during the decade of the 1990s. But since then consumption has increased dramatically, reaching an average of 7.1 lbs. per capita for 2014 – 16, an increase of 344%. By comparison, consumption in the total fruit category expanded by only 9.4% over this same period.

Figure 1 shows the total supply of fresh avocados to the U.S. market from 2004 – 17. Shipments continued to increase through 2015 and have been roughly level since then. The share of Mexican avocados in the U.S. market has grown rapidly, while shares from California, Chile,² and the Dominican Republic have declined.

Figure 1. Fresh Avocados Supplied to the U.S. Market, 2004-2017

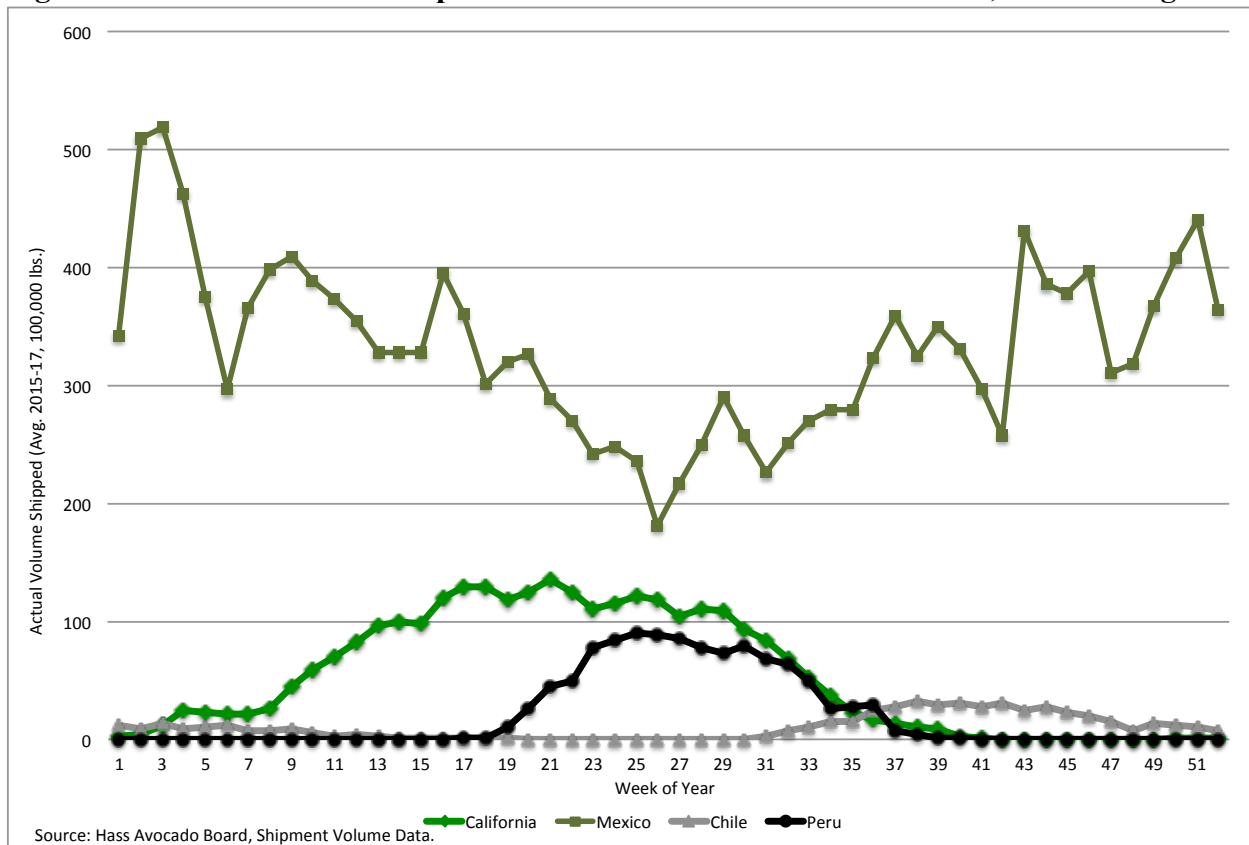


² The decline in Chilean sales to the U.S. reflects increasing domestic sales in Chile and Chilean exporters directing their sales increasingly towards the European market, mainly to the Netherlands (a major re-exporter of produce within the European Union), Spain, and the United Kingdom.

Peru has emerged recently as an important player in the market, surpassing the import volume from Chile in 2014 and making Peru the third largest supplier of Hass avocados to the U.S. market, following Mexico and California. Averaged over 2015 – 17, the final three years of this review period, Mexico’s share of the U.S. market was 79.0% (compared to 57.7% for the three-year average five years previously). California was second in shipments with 12.6%, followed by Peru at 4.8%, and Chile with 2.4%.

Figure 2 shows the average weekly distribution of fresh Hass avocado shipments to the U.S. for 2015 – 17. California’s and Peru’s shipments are quite counter seasonal to Mexico’s, peaking in the late spring through early summer for California and mid-to-late summer for Peru. Figure 2 is important in understanding the evolution of market shares for fresh avocados across countries.

Figure 2. Seasonal Avocado Shipments from HAB Member Associations, 2015-17 Avg.



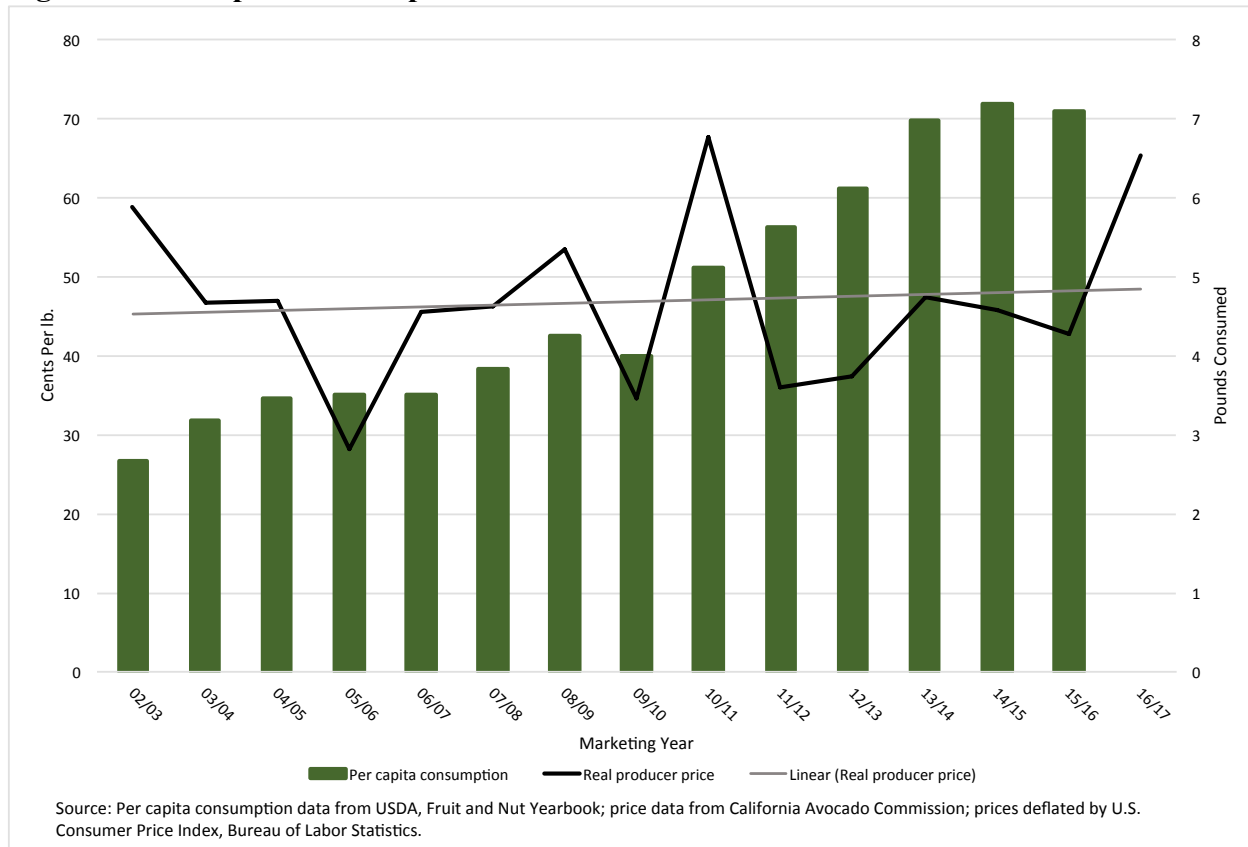
California's and Peru's ability to compensate for the lull in Mexican shipments is an important advantage. In contrast, Chile's peak shipments occur during peak Mexican shipments. Mexico's locational advantage relative to Chile in accessing the U.S. market has no doubt led to Chile's declining U.S. market share and its decision to focus its exports primarily on the European market.

2.1 Fresh Avocado Prices

One key measure of the strength of the market for fresh avocados is the prices attained by growers. Figure 3 plots U.S. per capita avocado consumption relative to the real (deflated) price received by California producers over the past 15 years. Per capita consumption increased during this period from less than 3 pounds per capita in 2002/03 to over 7 pounds per capita in 2013/14 onward. California producer prices over this period have been quite volatile (figure 1), reflecting year-to-year variability in shipments to the U.S. from California and the importing countries, but on average the real (deflated) grower price has remained steady or even increased slightly over this 15-year period, as evidenced by the price trend line in figure 3.

The evidence on grower prices contained in figure 3 shows quite conclusively that the expansion of sales in the U.S. market has been achieved primarily through rising demand for avocados in the U.S. Rising consumption and constant or rising real prices at the same time can only be achieved through demand expansion.

Figure 3. Per Capita Consumption and Domestic Producer Price



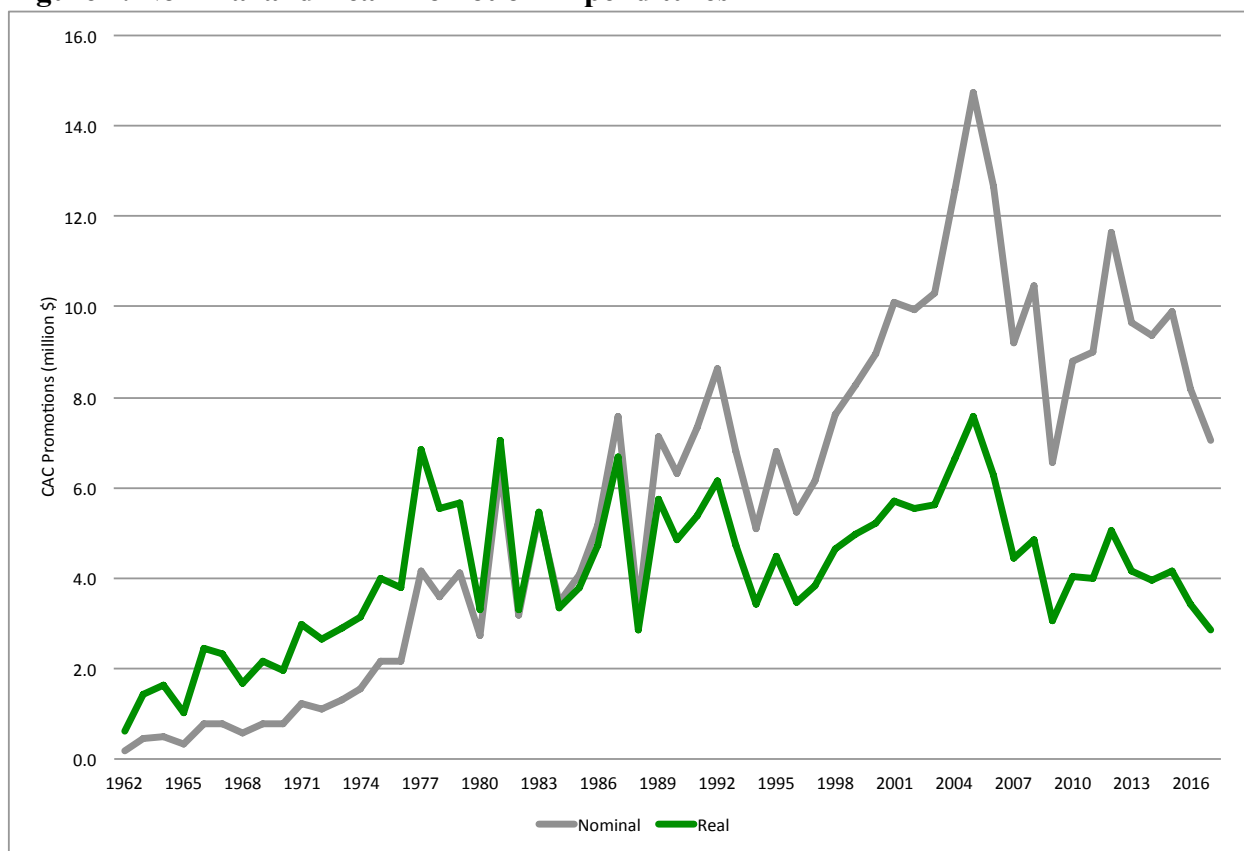
3. California Avocado Commission Marketing and Promotion Programs

Figure 4 lends perspective on promotions funded by California avocado growers since inception of their promotion programs. It charts promotion expenditures from 1962 onward in both nominal and real (1982 base) dollars. Figure 4 illustrates the variability in promotion expenditures caused by the year to year volatility in supplies and, hence, assessment revenues, and it also shows that in real terms the amount of promotion expenditure by the CAC has on average been constant or declining for a number of years, reflecting California’s declining share of this expanding market.

The total support to the CAC from HAB refunds and its own assessment, as well as dollars expended on marketing and promotion programs, over the five-year review period is summarized in table 1. Revenues from HAB rebates declined over much of the review period

due to smaller California harvests, with the 2015/16 marketing year representing a notable exception.

Figure 4. Nominal and Real Promotion Expenditures



The revenue stream from CAC’s own assessment, however, increased over the first four years of the review period, reflecting in part incremental increases in the assessment rate.³ CAC assessments represented 53.9% of revenues received by the Commission during the most recent five-year period. Revenues from both HAB rebates and the CAC assessment were down sharply in 2017 reflecting the low California harvest in this year.

Table 1. CAC Assessment Revenues, HAB Rebates, and Promotion Expenditures

	2012/13	2013/14	2014/15	2015/16	2016/17
Assessment Revenue	7,626,903	6,930,317	6,972,742	9,493,670	7,951,777
HAB Rebate Revenue	9,773,493	6,114,760	5,569,677	7,768,571	4,148,826
Marketing Program Expenditures	11,389,666	9,659,537	9,362,120	8,192,468	7,028,805

Note: Data from CAC FY Year End Actual Budget Summaries, CAC Annual Reports.

³ For the five-year review period from 2013 – 17, the CAC’s assessment rates as a percent of grower revenues were 1.75% in 2012-13, 2.10% in 2013-14, and 2.30% for 2015-16 and 2016-17.

3.1 Major Themes in the CAC's Marketing Programs: 2012/13 – 2016/17

An important aspect of commodity promotion evaluation is to consider whether an organization's promotional activities are calibrated to capitalize on major factors driving consumer demand in the relevant markets. In our view, there are a handful of key considerations regarding behavior of U.S. food consumers that should be at the forefront in the design and execution of food marketing programs. First is that consumers in the U.S. now spend on average only about 11 percent of their disposable incomes on food, a budget share that has been relatively stable since 2000. Declining budget shares expended on food at home have been offset by higher shares spent on food away from home. The budget share for food consumed at home is now about 6.0 percent and for food consumed away from home is 5.4% or 47% of total food expenditure.

The fact that American consumers now spend nearly half their food budgets on food consumed away from home emphasizes the importance of the food-service sector in design and execution of successful commodity marketing campaigns. Although consumers no doubt influence food-service providers in terms of foods they choose in restaurants and cafeterias, food marketers need to target food service providers directly in order to maximize their shares of the 47% of the food budget targeted to these providers.

As food has become a less important share of most consumers' budgets, they have become more willing to spend additional money for foods that contain particular attributes or characteristics important to them. Traditional product characteristics, such as taste, appearance, convenience, and brand appeal have been augmented with new product attributes. They include characteristics of the production process (e.g., usage of chemicals, sustainability, geographic

location), and implications of production and consumption of the product for the environment. Various studies have shown that consumers indicate willingness to pay substantial premiums for products that embody suites of characteristics important to them (Saitone and Sexton 2017). U.S. consumers are also concerned more than ever with the safety of the foods they eat and implications for their health. General claims about health impacts tend to resonate much less than credible claims about specific health benefits from consuming particular foods.

Avocados have a compelling story to tell that aligns closely with the evolution of consumer food preferences. Avocados are a nutrient dense food that provide relatively unique health benefits that include abundant nutrients (vitamins C, B5, B6, E, and K), potassium, folate, protein, and healthy fats. Seven of the nine grams of carbohydrates in a 100-gram serving are fiber, qualifying avocados as a low-carb food.

The fresh avocado market in the United States has changed dramatically with the opening of U.S. markets to avocado imports from Mexico and the subsequent creation of the HAB. With Mexico now having nearly an 80% share of the fresh avocado market, California avocados are now and for the foreseeable future a niche product that becomes available in substantial volumes in late spring and continuing through the summer. These months represent periods of peak demand for fresh avocados.

The growth in Mexican avocado imports into the U.S. presents both challenges and opportunities for California growers and the CAC in designing and executing marketing strategies. The key challenge of course is the downward pressure increased shipments place on price unless demand is expanded commensurately.

However, opportunity is created through the substantial funds raised for fresh avocado promotion through HAB rebates to the Mexican Hass Avocado Importers Association (MHAIA) and from voluntary assessments collected by its sister organization, APEAM. These funds are

pooled and expended on promotions by their joint marketing organization, Avocados from Mexico (AFM), which has sufficient resources to promote fresh avocados nationally including at major events on network TV such as the Super Bowl and the Oscars.

AFM's promotions, of course, urge consumers and food-service buyers to purchase Mexican avocados, but successful promotions by AFM will expand the entire fresh avocado category, which creates the opportunity for CAC to capture a premium segment of this growing market by stressing the cachet associated with California-grown foods and the natural advantages of increased freshness, optimal ripeness, and lower shipping costs associated with California's locational advantages relative to its key Western U.S. markets.

An overarching marketing strategy for the CAC during this review period that seeks to capitalize on these key market trends has been to stress the "California grown" aspect of its members' production, including creation and marketing of California branding. As part of this emphasis, CAC's promotions to Western U.S. markets do indeed stress the proximity of California production and the freshness and ability to harvest near peak ripeness that is associated with short hauls from orchard to market. CAC promotions are timed relative to the late spring through summer peak harvest of California Hass avocados—Memorial Day through Labor Day. CAC seeks to capitalize on the major U.S. holidays (Independence Day in particular) that occur during its marketing season by promoting the idea that California avocados are the perfect choice to help celebrate these holidays.

CAC's promotions have sought to position California avocados as a premium ("most valued and desired") product in order to optimize value to market participants across the supply chain, from growers to consumers. Specific objectives have included:

- Increasing the real and perceived value of California avocados in target markets in season;
- Increasing demand for California avocados in target markets in season;

- Strengthening the California avocado brand identification;
- Increasing preference and loyalty for California avocados versus avocados of other origins.

The CAC has pursued multifaceted marketing strategies in support of its priorities and objectives. A key first pillar has been to promote directly to consumers in its target western region during the Memorial Day through Labor Day peak market window. In this regard CAC has utilized a wide range of traditional and digital media including video, radio, print, and in-store displays that feature the California label, website and email, and social media.

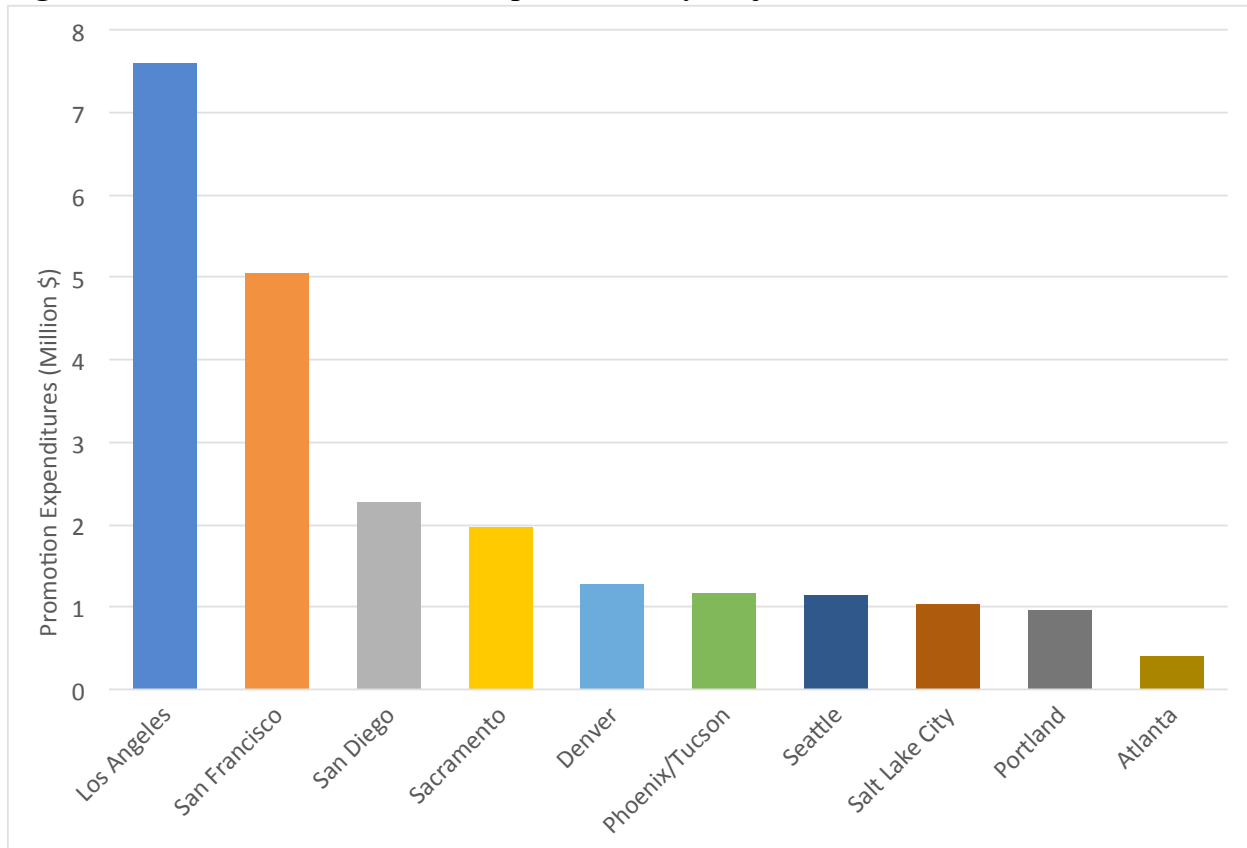
The CAC's total promotional expenditure over the five-year review period in 10 key markets is summarized in figure 5. The top nine markets for CAC promotions are all in the U.S. West. Los Angeles is the leading target for CAC expenditures, as it has been for many years. Over \$5.3 million was spent in the review period promoting California avocados to the Los Angeles market. The second most highly promoted market for CAC was San Francisco, with just over \$3.3 million expended during the review period. Both San Diego and Sacramento received about \$2 million in CAC promotion expenditures, while other western cities including Denver, Phoenix/Tucson, Salt Lake City, Seattle, and Portland each received close to \$1 million in promotion expenditures from 2013 – 17.⁴

A second pillar is to reach influencers such as artisan chefs, registered dietitians, and food bloggers to communicate advantages of the California avocado brand. The third target audience is food merchandisers and the trade, including retailers and food service. Regardless of the target group, the CAC's campaigns emphasize the same consistent priorities and objectives noted here, with specific initiatives designed to build the perception of the California avocado as a valued product that can command a price premium for sellers and is an ideal food for American summer

⁴ Note that amounts here may not precisely equal CAC records of promotions because of differences in accounting practices, data aggregation, and omission of food away from home categories that are not observable in the retail scanner data. Major non-Western markets listed in order of expenditure included Atlanta, New Orleans, Minneapolis, Chicago, and Kansas City. Smaller amounts (under \$100,000) were spent in a number of other market areas including St. Louis, New York, and Boston.

holidays.

Figure 5. Total CAC Promotional Expenditures by Major Market, 2013-2017

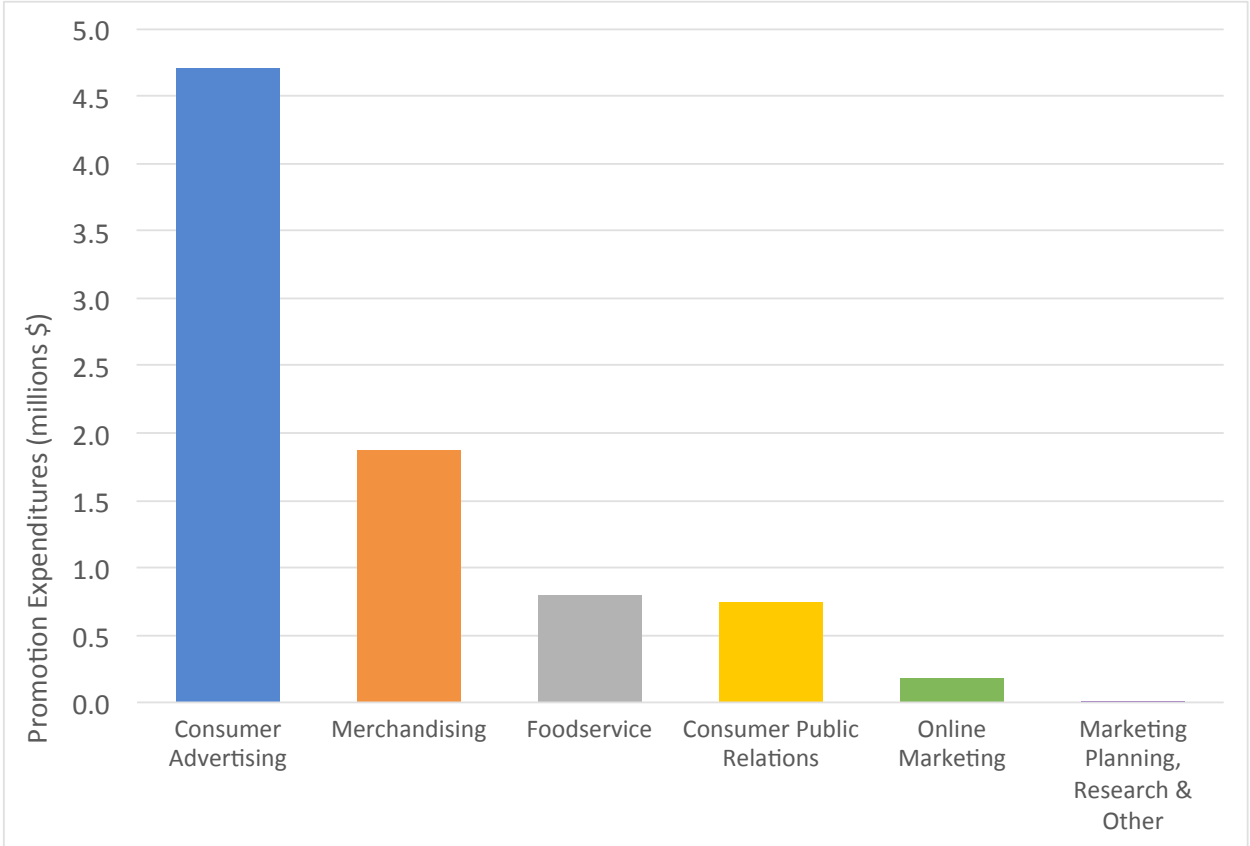


The breakdown of CAC’s average annual marketing budget to the different target audiences is shown in figure 6. Over the 2013 – 17 review period the CAC spent more than half of its marketing budget (over 4.6 million) annually on consumer promotions. The next largest budget share, nearly \$2 million annually, went to merchandising, while nearly three-quarters of a million dollars were expended annually on average for food-service marketing and consumer public relations.

In our view, the CAC is pursuing a very sensible marketing strategy in terms of emphasizing natural advantages of California production in the market place, marketing most heavily in the U.S. West, where those natural advantages are strongest, promoting the California avocado as the premium avocado product, and turning its emerging status as a niche product into

a marketing advantage. This overarching strategy is reflected in promoting the California brand and stressing quality advantages of California avocados due to their relatively short time in transit from farm to table. The multifaceted focus on final consumers, key influencers, and merchandisers and food service is also sensible in light of the forces shaping U.S. food markets.

Figure 6. Average CAC Promotion Expenditures by Target Audience, 2013-2017



4. Econometric Analysis of the Impacts of CAC Promotions on Fresh Avocado Sales

The acid test for promotion programs, no matter how carefully they are designed and executed is the market test: did the programs expand demand in a statistically and economically significant way? We address this question in this section by utilizing statistical methods to test the impact of CAC promotions on retail sales of fresh avocados in its key market areas. We lack data to test the impacts of promotions targeted to food service.

The retail sales data used for this analysis are scanner data collected by Information Resources, Inc. (IRI) and provided by the Hass Avocado Board. The data include total weekly retail sales in value and volume for fresh Hass avocados (aggregated across all relevant PLU codes) in 45 distinct local market areas and eight regions (53 cross sectional observations in total) for the five years spanning calendar years 2013 – 17.⁵ The data set, thus, is a panel; it combines both a cross section of data, namely the different market areas included in the analysis and a time series of data, namely weekly or monthly observations across the five-year review period.⁶

These data represent an aggregation of retail outlets in each of the designated markets that includes the following channels: grocery, mass merchandisers, club stores, drugstores, dollar outlets and military commissaries. An average retail price or unit value is computed in each market and each week by dividing sales value by the number of fresh Hass avocados sold. Population data for each market area were collected by IRI on an annual basis. We utilized these data to convert sales volume in all market areas to a per capita basis. In this manner the analysis controls for changes in demand due to changing population levels within the metropolitan area.

Our econometric model seeks to explain weekly per capita consumption of fresh Hass avocados in each market area in the panel as a function of current and lagged values of the average price faced by consumers in the market area and the total amount of promotion expenditure directed to consumers in the market area during that week by the CAC.⁷

⁵ A small amount of non-Hass avocados, generally less than 10 million pounds annually, are produced and marketed in California. Most of these non-Hass varieties are Hass lookalikes and may be marketed at retail under Hass PLU codes, in which case they are part of the data captured in the Hass Avocado Board's scanner data.

⁶ Most of these 45 local markets represent metropolitan areas, although a few are localized regions and not metropolitan areas per se. In particular, North Texas/New Mexico, South Carolina, and Northern New England are included in the 45 market areas.

⁷ A one-week lag in price has been found to have a statistically significant impact on current week sales in the prior studies of fresh avocado demand. The rationale is that consumers likely accelerate their purchases in weeks when fresh avocados are on sale and then reduce them in the following week.

It would also be desirable to include lagged variables for promotions. This would enable us to test for dynamic impacts of promotions and their durability. For example, a promotional expenditure in week t may impact sales in week t but also week $t+1$ and so on. Including these dynamic effects is not possible for our model due to the manner in which weekly promotion expenditures were constructed, as described in this section. The need to allocate expenditures equally across weeks of a multiweek campaign means that the current value, i.e., period t , of a promotion expenditure and its lagged value, i.e., the promotion expenditure in week $t - 1$, are typically the same. This means the current and lagged values of promotion expenditures are highly correlated, making it impossible to attribute separate and distinct sales impacts to them. The close correlation between current and lagged values of promotion expenditures means that the current value will capture much of the impact of the omitted lagged values. Nonetheless, our inability to test for dynamic impacts of promotions means our estimates of promotion impacts on sales are likely conservative in that they fail to account fully for the dynamic sales effect described above. Also missed are impacts on consumers who shop outside of market areas captured in the IRI data but who come into contact with the CAC's promotional messages.

We undertook several steps to construct a variable to represent CAC promotions in each market area and each time period. First, promotion expenditures by CAC targeted to specific local or regional markets in a given week were identified, as were national promotions conducted by CAC during the same week. The national expenditures were added to the local/regional promotions to yield a total promotion expenditure targeted during that time to the specific market area by the CAC. If a specific local/regional or national promotion spanned multiple weeks, as often was the case, we assumed that the expenditure was distributed uniformly across the weeks. If a promotion was targeted regionally and encompassed multiple of the IRI market areas, the expenditure was divided equally across those market areas.

Other factors besides price and promotion likely impact sales as well, but are not of immediate interest for this study. However, these factors cannot be ignored because their omission from the econometric model could bias estimates of impacts for the variables of interest. One approach is to try to identify these factors, obtain data on them, and include them in the econometric model. The more common approach, however, is to account for factors outside of the primary model using *fixed effects*.

We introduced three types of fixed effects into the econometric model. First is a fixed effects variable for each market area included in the data. This is accomplished by “demeaning” the data—subtracting mean or average sales from each weekly or monthly observation on sales. This process accounts for differences in per capita consumption across market areas (e.g., due to differences in demographic characteristics) that are time invariant.⁸

We included fixed effects variables for time to handle seasonality in demand for avocados and growth in the demand over time. A fixed effect was introduced for each month of the year, which took a value of 1.0 for observations for each market area in that month and a value of zero for every other month.⁹ Second, a “year” fixed effect was introduced to account for year-to-year changes in demand. This variable was constructed in a parallel manner to the month fixed effects.¹⁰ This model structure flexibly estimates seasonal and trend effects on demand.

Although inclusion of these fixed effects is necessary for a well-specified econometric model, their presence can also “rob” key explanatory variables of some of their predictive power.

⁸ Standard errors for this analysis were clustered by market areas to account for likely correlations among errors within a market area. This functional form also allows error terms to be distributed non-uniformly across observed price and promotion levels within a market area.

⁹ It is necessary to omit one variable from each set of fixed effects to avoid a multicollinearity problem known as the “dummy variable trap.” Thus, one month and one year are omitted from the model. Results are invariant to which fixed effect is omitted.

¹⁰ An example of how time fixed effects can account for factors influencing avocado demand that are not expressly part of the model is promotions made by Avocados from Mexico. AFM was conducting national promotions during each week of the five-year review period. Exclusion of AFM promotions from the model is not a problem if they vary systematically across months of the year and across years because impacts from AFM promotions will then be captured in the month and year fixed-effect variables.

In the present analysis, the CAC promotes most heavily in the summer months, which are high consumption months for fresh avocados, and in major Western markets, which are high per capita consumption markets for fresh avocados (table 2). Including fixed effects for month and location removes mean values. The impact of CAC promotions is thus identified by deviations from the mean values as a function of CAC promotion expenditures and prices. Some of the CAC's contributions to causing the high mean values for summer months and Western U.S. markets could be lost in this de-meaning process.

A final consideration for fixed effects pertains to U.S. holidays. Certain holidays are peak periods for consumption of fresh avocados, with Memorial Day, Independence Day, and Labor Day being most prominent during the marketing season for California avocados. The decision on whether to include or exclude holiday fixed effects in the statistical model is challenging for reasons similar to those discussed in the prior paragraph. The CAC may logically increase marketing expenditures around major avocado-consuming holidays. Failure to include a fixed effect variable to account for, say, the week leading up to the Fourth of July can cause the model to attribute a sales boost during this time to the avocado promotions targeted to the holiday. In fact, however, sales would be higher due to the event itself regardless of promotions. However, it is entirely possible and likely that promotions contribute to the sales spike around major holidays. Adding a fixed-effects variable for holidays such as Independence Day will potentially absorb the component of extraordinary variation in promotion expenditure that is driving sales, underestimating the effect of holiday promotions on sales.

Our solution to this problem is to run models both including fixed effects variables for major holidays and excluding them. In this manner, we attain estimates that likely bound the impact of the CAC's promotions on sales of fresh avocados around major holidays, with the

model containing holiday fixed effects representing a lower bound on promotion impacts during holidays and the model excluding these fixed effects representing an upper bound.

A final choice involved the functional form to utilize for the demand equation. Two functional forms widely used by economists to conduct demand analysis are linear and double log. In the linear model a linear relationship is assumed to hold between the dependent variable (retail per capita volume of fresh Hass avocado sales) and the explanatory variables (current price, lagged price, promotion expenditures, and the fixed effects). In the double log model all variables except the fixed effects are converted to their natural logarithms. The double log model presumes a nonlinear relationship between avocado sales, price, and promotion.

We estimated both the linear and double log demand models for the data set described here. Graphical representations of the data suggest that the relationship between price, sales, and promotions are non-linear in levels but linear in logs, supporting the logarithmic model as the better choice. This perception was confirmed in the actual estimation where the explanatory power of the double log model significantly exceeded the explanatory power of the linear model.¹¹ For these reasons, we regard the double-log model as the preferred specification. The coefficients from the double-log model can also conveniently be directly interpreted as elasticities.¹²

Table 2 provides summary data on the market areas in the analysis, including mean population, mean and standard deviation (indicated in square brackets) of weekly per capita sales quantity of fresh Hass avocados, mean and standard deviation of average sales price (ASP) in cents, and mean and standard deviation of per capita retail sales value in in cents per week.

¹¹ Stated somewhat differently, the double log model explains more of the variance observed in the fresh Hass avocado sales data than does the linear model.

¹² Elasticities are percentage responses. For example, the promotion elasticity of demand is the percentage change in per capita consumption due to a small (1%) increase in promotion expenditure. Elasticities are pure numbers and are not dependent on units the analyst is using to measure quantities or monetary values.

Table 2. Summary Statistics

Market	Average Population	Per Capital Retail Sales	Average Sales Price (cents)	Per Capita Retail Value (cents)
	<i>Millions</i>	<i>Mean [SD]</i>	<i>Mean [SD]</i>	<i>Mean [SD]</i>
Atlanta	5.16	0.08 [0.02]	116 [17]	9.57 [2.29]
Baltimore/Washington	8.43	0.09 [0.02]	130 [18]	11.27 [2.36]
Boston	5.61	0.09 [0.02]	128 [19]	11.42 [3.05]
California	38.31	0.14 [0.03]	112 [22]	15.79 [2.87]
Chicago	9.07	0.08 [0.02]	132 [29]	9.94 [2.68]
Dallas/Ft. Worth	6.66	0.16 [0.03]	88 [13]	14.15 [2.56]
Denver	3.93	0.17 [0.04]	117 [17]	20.12 [3.62]
Detroit	4.78	0.07 [0.02]	118 [20]	7.72 [1.84]
Grand Rapids	1.7	0.09 [0.03]	130 [27]	11.64 [2.95]
Great Lakes	46.68	0.06 [0.02]	123 [19]	7.68 [1.93]
Harrisburg/Scranton	4.48	0.05 [0.01]	124 [14]	5.98 [1.62]
Hartford/Springfield	3.23	0.09 [0.02]	134 [20]	11.53 [2.58]
Houston	6.32	0.17 [0.03]	85 [13]	14.1 [2.82]
Las Vegas	2.06	0.14 [0.03]	104 [19]	14.21 [2.68]
Los Angeles	17.47	0.15 [0.03]	102 [22]	14.76 [2.94]
Louisville	1.27	0.06 [0.02]	125 [20]	7.03 [2.19]
Miami/Ft. Lauderdale	5.83	0.08 [0.03]	130 [23]	10.02 [3.2]
Midsouth	38.47	0.07 [0.02]	123 [15]	8.35 [2.01]
Nashville	1.86	0.09 [0.03]	112 [16]	9.8 [2.7]
New Orleans/Mobile	3.04	0.08 [0.02]	109 [17]	8.36 [2.11]
New York	19.82	0.06 [0.02]	138 [21]	8.76 [2.15]
Northeast	55.89	0.07 [0.02]	132 [17]	8.74 [2.26]
Northern New England	3.3	0.11 [0.03]	123 [18]	13.59 [3.94]
Orlando	3.35	0.08 [0.03]	124 [20]	10.09 [3.31]
Philadelphia	6.55	0.06 [0.01]	137 [18]	7.98 [1.85]
Phoenix/Tucson	5.04	0.2 [0.05]	75 [18]	14.6 [2.54]
Pittsburgh	2.51	0.04 [0.01]	137 [20]	4.7 [1.45]
Plains	20.95	0.08 [0.02]	120 [17]	9.1 [2.07]
Portland	3.28	0.15 [0.03]	121 [19]	18.14 [3.85]
Richmond/Norfolk	2.89	0.08 [0.02]	113 [14]	8.74 [2.11]
Roanoke	2.36	0.05 [0.01]	115 [15]	6.23 [1.43]
Sacramento	2.92	0.14 [0.03]	124 [20]	17.59 [3.6]
San Diego	3.22	0.15 [0.03]	108 [23]	15.57 [2.9]
San Francisco	6.39	0.12 [0.03]	133 [28]	15.79 [2.63]
Seattle	3.62	0.13 [0.03]	137 [21]	18.09 [3.78]
South Central	38.19	0.14 [0.03]	90 [12]	12.39 [2.27]
Southeast	42.34	0.07 [0.02]	122 [19]	8.38 [2.39]
Spokane	0.63	0.12 [0.03]	125 [19]	14.31 [3.1]
St. Louis	2.61	0.07 [0.02]	127 [16]	8.26 [1.58]
Tampa	3.62	0.09 [0.03]	126 [22]	10.47 [3.31]

Table 2 Cont.

Market	Average Population	Per Capital Retail Sales	Average Sales Price (cents)	Per Capita Retail Value (cents)
West	34.09	0.16 [0.03]	106 [16]	16.74 [3.13]
West Tex/New Mexico	4.04	0.2 [0.04]	89 [12]	17.46 [3.05]
US Total	314.94	0.1 [0.02]	112 [16]	10.68 [2.29]

As noted in section 3 and figure 5, the CAC’s monetary marketing commitment varies considerably across target markets, with major Western markets representing the primary targets. Thus, we performed an additional analysis by estimating the model for a panel formed only by the major Western markets (those indicated in figure 5 except Salt Lake City, for which no IRI data were available) and then for a panel containing all other market areas that were targeted more lightly for CAC promotions. This analysis can help to discern whether there are scale effects due to the intensity of the CAC’s promotions in a market area.

4.1 Estimation Results

We estimated several variants of the basic model to test for robustness of the key results to alternative model specifications. To avoid overloading the reader with statistical output, we present only a subset of the results, while providing brief discussion of results not presented in detail here.

Table 3 presents key results for the econometric model with the full panel (43 market areas where CAC conducted promotions and IRI data were available through the HAB). The first two columns in table 3 present results for the linear model, while the next two columns present results for the double log model. The models differ due to the presence (columns (2) and (4)) or absence (columns (1) and (3)) of lagged price as an explanatory variable.

As noted, the double log models yield elasticity estimates directly. Thus, we see that CAC promotions had a highly statistically significant positive impact on per capita consumption.

The effect in both models is statistically significant at the 99% confidence level, meaning we can say with 99% or more confidence that the true effect of CAC promotions is not zero. The estimated elasticity of promotion expenditures is 0.015 for both double log models, meaning, for example, that a 10% increase in promotion expenditures in a market area would be associated with a 0.15% increase in per capita consumption.

Table 3. Econometric Results: Full Panel

<i>Dep. Var. Per Capita Avocado Sales</i>	(1)	(2)	(3)	(4)
Model:	Linear	Linear	Double Log	Double Log
Promotion Expenditure (\$ million)	0.004*** (0.000)	0.003*** (0.000)		
Avg. Sales Price (¢ per avocado)	-0.087*** (0.006)	-0.111*** (0.007)		
Lagged Avg. Sales Price (¢ per avocado)		0.037*** (0.003)		
Natural Log(Promotion)			0.015*** (0.002)	0.015*** (0.002)
Natural Log(Avg. Sales Price)			-1.138*** (0.043)	-1.375*** (0.046)
Lagged Natural Log(Avg. Sales Price)				0.385*** (0.033)
Constant	0.181*** (0.006)	0.168*** (0.006)	-2.471*** (0.011)	-2.483*** (0.012)
Month FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Observations	11,137	11,051	11,137	11,051
R-squared	0.617	0.642	0.761	0.785
Number of Markets	43	43	43	43
Advertising elasticity	0.0161	0.0144		
Price elasticity	-0.990	-1.267		

*** p<0.01, ** p<0.05, * p<0.1

Note: Linear model elasticities evaluated at means; standard errors clustered by market.

Price was strongly negatively associated with per capita consumption, as basic theory would predict. The estimated price elasticity of demand is -1.38 for model (4), meaning a 10% decrease in retail price in a market area is associated with a 13.8% increase in sales, other factors constant. The impact of lagged price is opposite, as predicted. The elasticity of lagged price is

0.38. Thus, for example, the positive sales impact of a price promotion in a given week would be offset by about a factor of between one-fourth and one-third ($0.38/1.38 = 0.28$) the following week, when the product was off sale.

The results for the linear model in columns (1) and (2) strongly reinforce results for the double log model, increasing our confidence in the veracity of those results. The effects of both CAC promotions and retail price are highly statistically significant and with the expected positive and negative signs, respectively. The linear model does not directly yield elasticities. Rather, they must be computed for particular values of the underlying data, with the data means representing a common and intuitive choice. The estimated elasticity of per capita consumption with respect to CAC promotions at the mean values of promotion and per capita consumption are 0.016 and 0.014 for the two models, nearly identical to the estimates from the double log model. The estimated price elasticity of demand evaluated at the means of price and per capita consumption are -0.99 and -1.27 for the two models, slightly smaller, but on balance very consistent with the estimates from the double log model.¹³

Finally, note the statistical superiority of the double log model based on the R-squared statistic, which measures the percentage of variation in the dependent variable (weekly per capita consumption by market area) that is explained by the statistical model. We see that the double log model explains in excess of 75% of the variation in per capita consumption, while the linear model explains only 60 – 65%.

Table 4 shows results for the split panel, with the left columns showing results for CAC's major Western U.S. markets and the right columns showing results for the remaining market areas where CAC has promoted more lightly. Given its statistical superiority, we present results only for the double log model. The results for the split panel are closely comparable to those for

¹³ Adding holiday fixed effects to either model reduces the explanatory power of CAC promotions as expected, but the effect continues to be positive and statistically significant in most cases.

the full panel. The CAC's promotions have a highly statistically significant impact on per capita consumption. For the major western markets the elasticity of promotions ranges from 0.012 to 0.014, depending on model specification. For the less-heavily-promoted market areas, the promotion elasticity is slightly higher, 0.015 – 0.016. The slightly larger impact in the less-heavily-promoted markets suggests that scale effects are not working against the CAC in these markets and, perhaps, that these markets, having been less heavily promoted by CAC over the years, are somewhat more responsive to promotions than the CAC's traditional core markets.

Table 4. Econometric Results: Split Panel

<i>Dep. Var. Ln Per Capita Avocado Sales</i>	(1)	(2)	(3)	(4)
Model:	Major Markets	Major Markets	Other Markets	Other Markets
Log(Avg. Sales Price)	-1.026*** (0.042)	-1.157*** (0.074)	-1.154*** (0.052)	-1.421*** (0.046)
Lagged Log(Avg. Sales Price)		0.217** (0.062)		0.447*** (0.027)
Log(Promotion Expenditure[million \$])	0.012*** (0.003)	0.014*** (0.003)	0.016*** (0.002)	0.015*** (0.002)
Constant	-1.996*** (0.016)	-1.988*** (0.018)	-2.577*** (0.012)	-2.598*** (0.013)
Month FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Observations	2,072	2,056	8,806	8,738
R-squared	0.747	0.762	0.771	0.799
Number of Markets	8	8	34	34

*** p<0.01, ** p<0.05, * p<0.1; standard errors clustered on market.

5. Discussion

These results for the CAC's promotion expenditures, which are highly robust to alternative specifications of the base model, indicate that the CAC's promotions have increased retail consumption of fresh avocados in its target markets by a statistically significant amount. We believe that the promotion elasticities reported here are likely conservative estimates of the CAC's overall impact for reasons noted in this report.

A final piece to the promotion-evaluation puzzle is to translate demand impacts into benefit-cost ratios for the growers funding the program. This requires a model of supply and demand for fresh avocados in the U.S. market so that impacts of promotions on grower prices and sales can be sorted out. We cannot construct a model to evaluate just the CAC's promotion expenditures because grower price for fresh avocados is determined in a national market that is influenced by international factors. Sales increases in local markets where the CAC promotes contribute to demand growth in the national market, but the impact on overall market prices and sales volumes cannot be evaluated in isolation.

The authors of this report also conducted a five-year evaluation of promotions conducted under the auspices of the Hass Avocado Board. This study was able to estimate a national model of demand for fresh Hass avocados that evaluated promotion expenditures of the HAB and its member associations. This demand model was combined with expressions for the supply of fresh Hass avocados to the U.S. market from California growers and also importers. Depending on model specification, this analysis produced benefit-cost ratios for California growers and Hass avocado importers ranging from 1.64 to 3.62. Given that a benefit-cost ratio in excess of 1.0 indicates a program where benefits exceed costs, these results represent strong evidence that the fresh avocado promotion programs conducted by the CAC and other HAB member associations were successful during the review period in increasing profits to California producers and importers of Hass avocados. For example, if we take the midpoint of the 1.64 – 3.62 benefit-cost range, a dollar invested by California growers in promoting California avocados returned \$2.63 in additional profits.

As part of the HAB review the authors also estimated a weekly panel econometric model for all promotions conducted under HAB's auspices for the five-year review period. For versions of the that model that did not contain holiday fixed effects, the estimated elasticities of per capita

consumption with respect to promotion expenditures were 0.015 – 0.016, essentially identical to what we estimated here for CAC promotions. Of course, the CAC’s promotions are included in this model of overall promotion effects, but the major player is Avocados from Mexico (AFM), and the significant marketing apparatus it has assembled, given its growing resources. Based on this comparison, we conclude that the CAC’s effectiveness in promoting fresh avocados over the five-year review period was comparable on a dollar-for-dollar basis to AFM’s, with both being very successful in increasing returns to their members.

These conclusions should come as no surprise. The avocado success story in the U.S. in terms of achieving a stunning increase in per capita consumption, while maintaining or increasing real prices to growers, has made avocados the envy of the produce industry. This analysis and previous reviews of CAC and HAB promotions demonstrate that the CAC, through its long history of promoting avocados in the U.S. market and, more recently, its partnership with importers through the HAB, have played a fundamental role in the growth of this industry.

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