Five-Year Evaluation of the Hass Avocado Board's Promotional Programs: 2008 - 2012

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Executive Summary

This report represents the second quinquennial evaluation of the promotion programs conducted under the auspices of the Hass Avocado Board (HAB) as authorized by the Hass Avocado Promotion, Research, and Information Act enacted into law in October 2000. The first five-year review, conducted by Carman, Li, and Sexton (CLS 2009), covered the period from 2003 through 2007. CLS found that advertising and promotion funded under the HAB increased the demand for fresh avocados during the program's first five years of operation and yielded a favorable rate of return for the assessment dollars invested by avocado producers and importers.

This evaluation focuses upon activities conducted under the auspices of the HAB from 2008 through 2012. The evaluation involved four central components: (i) review and assessment of recent trends in sales, prices, and promotions of fresh avocados in the U.S. market (section 3); (ii) a descriptive analysis of the amounts expended and the nature of expenditures by each of the groups participating in the program, the California Avocado Commission, the Chilean Avocado Importers Association, the Mexican Hass Avocado Importers Association, the Peruvian Avocado Commission, and HAB itself (section 4); (iii) econometric analysis of annual fresh avocado demand for the 19-year period from 1994 – 2012 (section 6); and (iv) econometric analysis of weekly fresh avocado sales at retail for 2008 – 2012 using scanner data for 38 designated marketing areas (section 8).

Fresh avocado consumption has grown rapidly in the U.S., rising from about 1.5 pound per capita during the decade of the 1990s to over 5.0 pounds per capita in 2012. This growth in consumption and supplies within the U.S. market has coincided with growing market share for imports, rising from 30 percent of total supplies in 2000 to 67 percent in 2012. With imports of

fresh avocados (mainly from Chile and Mexico) being largely counter-seasonal to California production, fresh avocados have become consistently available year around in the U.S.

The rapid increase in production targeted to the U.S. and domestic consumption have been achieved while keeping real grower prices relatively constant on average over this same time period. Maintenance of avocado prices despite rapidly increasing supplies has been made possible by substantial growth in fresh avocado demand in the U.S. The econometric analysis of annual fresh avocado demand conducted in this study provides strong statistical evidence in support of this demand growth and that it has been inspired to a considerable degree by successful promotions of fresh avocados. Depending upon model specification, we found a highly statistically significant impact of promotion expenditures on per capita consumption of fresh avocados. The elasticity of demand with respect to these promotion expenditures, depending upon model specification, ranged from 0.153 to 0.354, values consistent with those attained in prior studies of the impacts of avocado promotions.

A simulation analysis based upon the results of the econometric analysis was conducted to estimate the benefits and costs to growers from the promotion programs conducted under HAB's auspices. Results of this analysis yielded estimated benefit-cost (BC) ratios in the range of 2.12 to 9.28, depending upon the choice of demand model and assumed value for the price elasticity of supply. Even at their lower bound, these BC ratios imply a highly successful promotion program. For example, a 2.12 BC ratio implies that the program returns $2.24 in incremental profit to producers for each $1.00 expended, for a net gain of $1.24. These estimates are somewhat higher than obtained by Carman, Li, and Sexton (2009) in their evaluation of the HAB Program's first five years, but are not inconsistent with those results or with results that have been reported for other commodity promotion programs.

Econometric analysis of scanner data containing weekly sales of fresh avocados in the 38 designated marketing areas (DMA) for 2008 – 2012 also found a positive and statistically significant impact of targeted local/regional promotions on per capita sales in the targeted marketing areas. Results from the scanner data analysis also provided additional insights as to the impacts on fresh avocado consumption of price promotions, seasonality, and special holidays and events. Price reductions in a given week were found to increase sales in that week, but the sales improvement was fully offset by reduced purchases in subsequent weeks. Cinco de Mayo and Independence Day were shown to be the holidays/events associated with the greatest per capita consumption of fresh avocados, followed by Valentine's/Presidents' Day and Easter. May and July had the highest per capita expenditures on fresh avocados, while the lowest expenditures were recorded in November, December, and February.

The consistency of our results across the different analyses—evaluation of trends in avocado consumption and prices, econometric analysis of aggregate annual demand, and econometric analysis of disaggregate weekly demand within DMA—enable us to conclude with considerable confidence that the promotion programs conducted under the HAB's auspices have been successful in expanding demand for fresh avocados in the U.S. and yielding a very favorable return to the producers and importers funding the programs. Further, the evidence suggests that expansion of the HAB's promotion programs would also yield positive net benefits from increased assessments.

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1. Introduction

The U.S. demand for avocados has grown substantially in the ten years since the Hass Avocado Board (HAB) began funding promotional programs in January 2003. Fresh avocado supply and consumption in the U.S. has increased from an annual average of 1.51 pounds per capita during the decade of the 1990s to 5.10 pounds per capita in 2012. This period has also seen major developments in the avocado subsector associated with growing market share for imports (from 30 percent in 2000 to 67 percent in 2012), increased year-round availability of fresh avocados, year-round and permanent shelf space for avocados in retail outlets, and development of regions within the U.S., which heretofore had limited availability and consumption of avocados, into important markets for them. Accompanying these changes have been improvements in the distribution system for fresh avocados including the very effective ripe avocado programs.

The farm-level demand for avocados is widely acknowledged to be quite inelastic, with empirical estimates (including this study) typically near -0.25, depending on the time period and variables included in the demand equation. One would thus expect sharply lower prices to accompany an increase in avocado supply of over 200 percent. Yet real prices have remained relatively stable on average over this period, an outcome made possible only due to a significant increase in the demand for avocados.

Carman, Li, and Sexton (CLS 2009) conducted the first evaluation of the HAB promotion programs for the five-year period from 2003 through 2007. CLS found that advertising and promotion funded under the HAB increased the demand for fresh avocados during the program's first five years of operation and yielded a favorable rate of return to avocado producers who invest in the program via assessments on their production.

This report evaluates the economic impact of promotional expenditures conducted under HAB's auspices on U.S. demand for fresh avocados and estimates producer returns from the expenditures for the second five years of the HAB's operations, the period from 2008 through 2012. The CLS study is utilized to help guide specification and estimation of economic models for this evaluation, and for brevity's sake we do not repeat discussion contained in that report.

As in CLS, we estimate both an aggregate annual model of demand for fresh avocados in the U.S. and a disaggregate weekly demand model that relies upon retail scanner data collected for major metropolitan areas in the U.S. that is pooled across location for the five-year time period. A market simulation model is constructed using results from estimation of the annual model. This model is utilized to study what-if scenarios involving the benefits and costs of a hypothetical increase in promotion expenditures under the auspices of the HAB to estimate the net benefits accruing to producers from the HAB promotion programs.

In the remainder of this report, we briefly discuss the legislative history behind the HAB and touch upon major trends impacting the Hass avocado market in the U.S. We then turn to analysis of avocado promotion programs conducted under the HAB's auspices during the 2008 – 2012 period. This analysis involves three dimensions. First, we review the expenditures and activities undertaken by HAB and the state and member organizations that are certified by the U.S. Department of Agriculture. Second, we examine the annual demand for fresh avocados in the U.S. and measure the impact of promotion expenditures on demand. The results of this analysis are utilized to parameterize a simulation model that is used to estimate benefits and costs to producers from funding promotions. Finally, we conduct analysis of the retail scanner data and evaluate the impacts of local and regional promotions on avocado demand in those market areas.

2. The Hass Avocado Promotion, Research, and Information Act

California avocado growers' longstanding program to fund advertising and promotion programs for their fruit was extended to include imports of fresh avocados through the Hass Avocado Promotion, Research, and Information Act signed into law by President Clinton on October 23, 2000. This Act established the authorizing platform and timetable for the creation of the Hass Avocado Promotion, Research and Information Order (HAPRIO) that was approved in a referendum of producers and importers with 86.6 percent support on July 29, 2002.

Mandatory program assessments of 2.5 cents per pound on all Hass avocados sold in the U.S. market commenced effective January 2, 2003 under the HAPRIO. The assessment is collected by first handlers for California production and by the U.S. Customs Service for imports and forwarded to the HAB. These funds are then allocated to programs and activities designed to increase the demand for Hass avocados in the U.S. market. The HAB uses 15 percent of the assessments to fund activities such as nutrition research, marketing, and information programs intended to benefit all avocado producers and rebates 85 percent of domestic assessments to the California Avocado Commission

(CAC) and up to 85 percent of importer assessments to the certified importer associations for their own promotion programs. There are currently three certified importer associations operating under the HAB: the Chilean Avocado Importers Association (CAIA), the Mexican Hass Avocado Importers Association (MHAIA), and the Peruvian Avocado Commission (PAC).[2]

Assessment income to support the activities of the HAB totaled $98.67 million during its first five years and increased to a total $148.47 million during its second five years. During the second five-year period, 71.5 percent of the assessments were paid on imports and 28.5 percent were paid on California Hass avocado sales. Shares of the total assessment paid by importers were 56.7 percent by Mexico, 13.2 percent by Chile, almost 1.0 percent by Peru, and 0.6 percent by other countries.

3. The Changing U.S. Avocado Market

Through the 1980s most avocados consumed in the U.S. were produced in California and Florida, with only small amounts imported. For example, from 1962 through 1989 imported avocados averaged 3.16 million pounds annually and accounted for an average of just over one percent of the total U.S. avocado supply. Then in 1990, avocado imports jumped to nearly 26 million pounds, accounting for over nine percent of U.S. supplies. With growing avocado acreage and production in Chile and the Dominican Republic and with Mexico gaining limited access to the U.S. market beginning in 1997, avocado imports increased steadily (figure 1), reaching 145.98 million pounds, almost one-third of total U.S. supplies in 2000. With Mexico's access to the U.S. market expanding in 2001

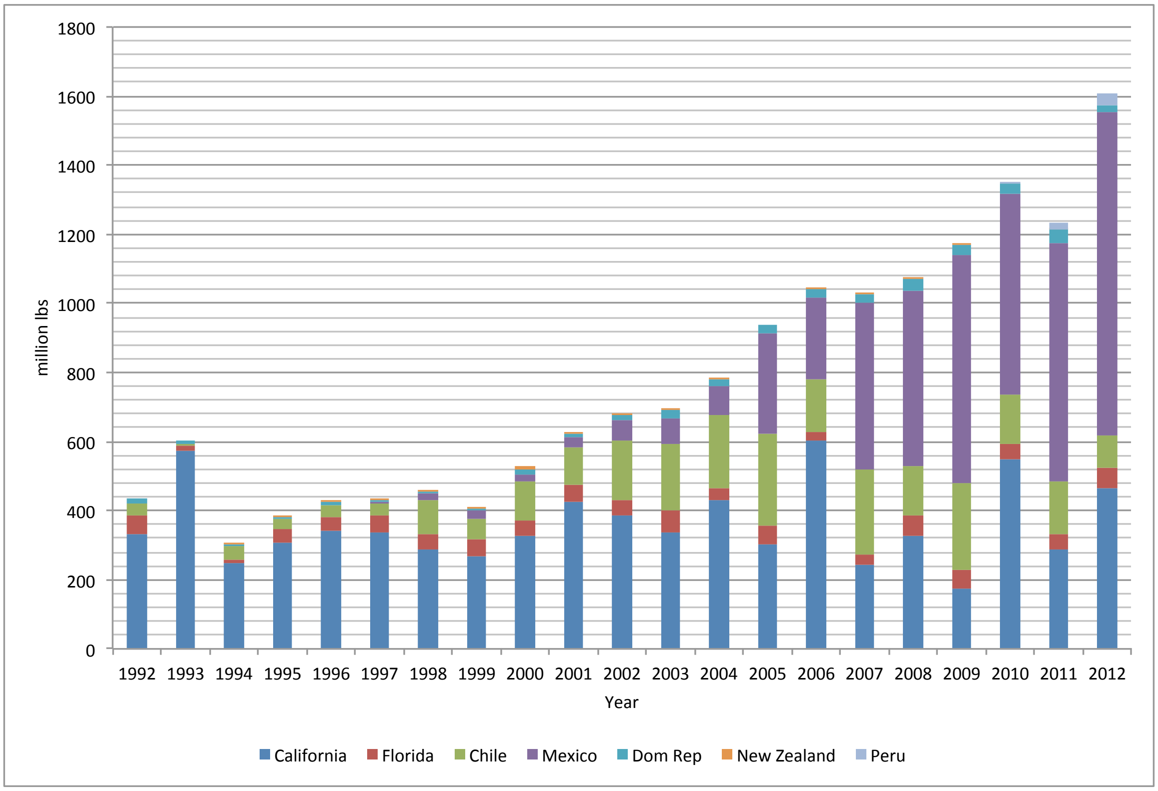
[2] Fresh avocado imports from Peru began in 2011.

and 2002, total Hass avocado imports increased to over 251.42 million pounds (39.5 percent of total supply) in 2002.

Since HAB assessments to support avocado promotion began in 2003, avocado imports and total U.S. supplies (Hass and other varieties) have continued to increase to a record total of over 1.605 billion pounds in 2012. Mexican avocado exports to the U.S. increased significantly after Mexico gained year-round access to all states except California and Florida in 2005 and to all states in 2007. Mexican imports of 933.8 million pounds accounted for over 58 percent of the total U.S. supply of fresh avocados and for 86.7 percent of total fresh avocado imports in 2012 (figure 1). Chilean imports reached a maximum of 267 million pounds in 2005 and have since varied in a range from 94 to 248 million pounds due primarily to variations in annual yields of the Chilean crop and diversification of exports from Chile to other countries. With a small crop in 2012, Chile's share of total U.S. avocado imports was only 8.7 percent.

The Hass variety of avocados accounts for the vast majority of the avocados consumed in the U.S. For example, in 2012 approximately 96.5 percent of all fresh avocados imported to the U.S. and about 97.0 percent of California production were the Hass variety. Florida avocado production is the only appreciable non-Hass supply in the U.S. Overall, Hass avocados have recently accounted for about 95.0 percent of total U.S. avocado supplies.

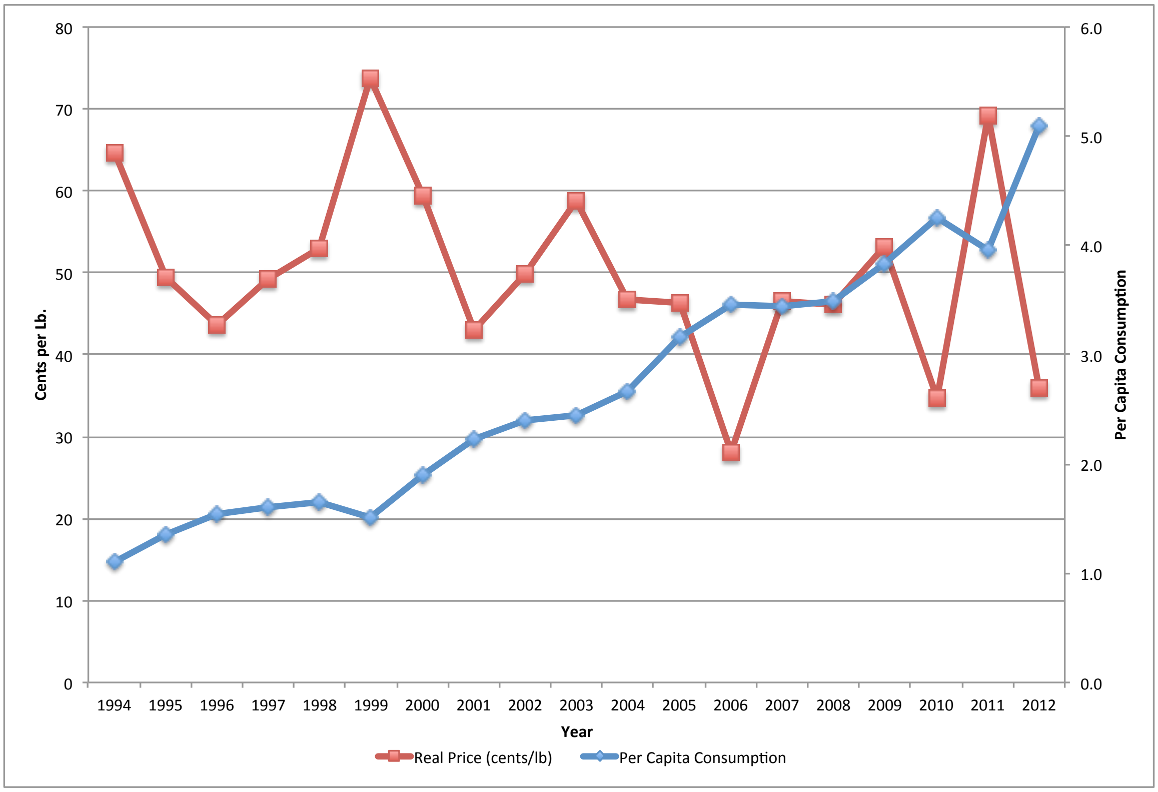
Figure 1. Sources of Fresh Avocados Supplied to the U.S. Market, All Varieties: 1992 -2012



Avocado consumption has grown commensurate with the expanded supplies over the past two decades. Prior to 2000, U.S. consumption of fresh avocados had exceeded two pounds per capita only four times, during the large California crop years of 1981, 1984, 1987, and 1993. As shown in figure 2, U.S. consumption has exceeded two pounds per capita annually since 2001, exceeding three pounds per capita in 2005, four pounds per capita in 2010, and five pounds per capita in 2012.

Figure 2 also depicts the average grower price per pound in real (inflation-adjusted, base year 1982-84) terms received by California growers for these same years. The real grower price evinces considerable year-to-year volatility. This is consistent with the notion that farm-level demand for fresh avocados is quite price inelastic (i.e., price responds more than proportionally to a given percent change in crop availability).

Figure 2. Per Capita Consumption and Real Producer Price for Fresh Avocados



Yet the fact that the average real grower price has remained relatively stable in the presence of an over 200 percent increase in supply and consumption during the 1994 – 2012 period, depicted in figure 2, is only possible due to significant increases in demand during this time.[3]

Although this analysis focuses on the market for fresh avocados, the market for processed avocado products deserves some mention. U.S. imports of both fresh and processed (prepared or preserved, with additives) avocados since 1989 are shown in figure 3.[4] Import volumes and values of processed avocados, as well as the number of

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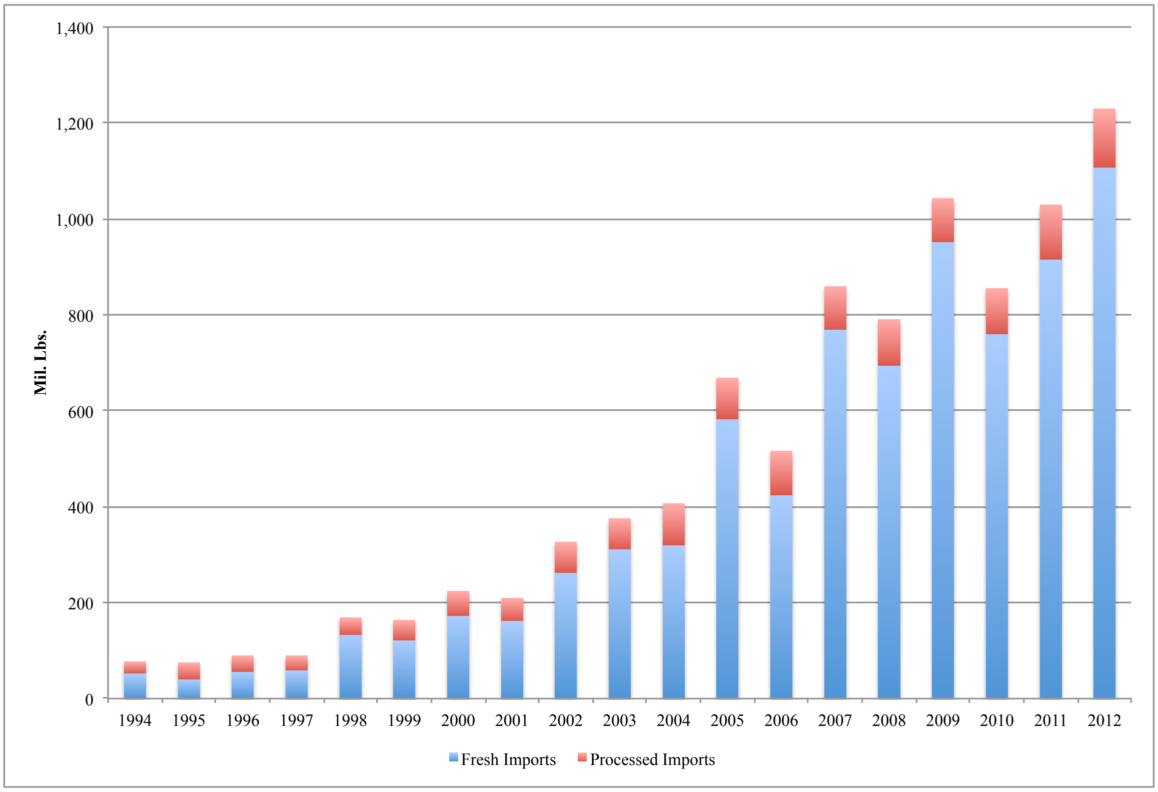
[3] A simple trend regression of the grower price over the period 1990 – 2012 yields the following equation: Price/lb. = 56.59 – 0.65 * Year, but the trend coefficient is not statistically significant with a t value of -1.38.

countries supplying the U. S. market, have increased substantially over time.

Figure 3. Fresh and Processed Avocado Imports: 1994 - 2012



Processed avocado imports reached 50 million pounds in 2000 and expanded to over 63 million pounds during 2002, the year before HAB promotion expenditures began. Import volume of products increased to 90 million pounds in 2007 and then to almost 122 million pounds in 2012. The majority of all processed avocado products consumed in the U.S. are imported.

Through 2012, processed avocados have represented less than 10 percent of total avocado consumption. However, in many instances processed avocado products may substitute closely for fresh avocados. The fact that real grower prices in the U.S. have remained relatively steady on average in the face of this rapid growth in imports of processed avocado imports is further testimony to the demand growth that has occurred in the U.S. over this period for fresh avocados and avocado products.

4. Avocado Promotion in The U.S. Market

Producer-funded advertising and promotion programs for fresh avocados in the U.S. market are notable for their long history and relative amount of funding. California avocado producers began funding advertising and promotion under the California Avocado Advisory Board in 1961-62, and continued under the California Avocado Commission, effective in 1978, prior to joining forces with importers under the Hass Avocado Promotion, Research, and Information Act of 2000. Thus, 2012 marks 50 years of continuous producer-funded advertising and promotion programs for fresh avocados.

While some producer-funded commodity promotion programs have annually spent more total dollars, none has matched avocado producers' investment as a proportion of crop revenues. Prior to the advent of the HAB, the CAC typically set its assessment in a range of 3.0 to 5.75 percent of gross grower receipts. Promotional expenditures averaged \$2.21 million annually during the 1970s, \$4.85 million annually during the 1980s, and \$6.85 million annually during the 1990s. When HAB began collecting 2.5 cents per pound on Hass avocados in 2003, CAC reduced its assessment to 1.75 percent of gross grower receipts, and from 2004 through 2012, CAC's annual assessment rate has ranged from 1.1 to 2.62 percent of gross grower receipts.

Initiation of assessments on all Hass avocados sold in the U.S. market in 2003 and increasing Hass avocado imports has significantly increased the availability of funds for promotion programs. Table 1 shows promotional expenditures by year for avocados from the U.S. (CAC), Chile (CAIA), Mexico (MHAIA), and Peru (PAC), plus promotional expenditures made by the HAB itself.

Table 1. U.S. Avocado Promotional Expenditures by Organization: 2003-2012

Year	CAC	CAIA	MHAIA	PAC	HAB	Total
	dollars					
2003	8,682,060	1,427,000	0	0	146,499	10,255,559
2004	10,756,130	3,010,060	700,000	0	859,284	15,325,474
2005	11,838,029	5,742,600	2,900,000	0	2,603,124	23,083,753
2006	10,498,717	2,660,763	4,500,000	0	2,562,140	20,221,620
2007	9,205,138	3,864,637	6,246,500	0	3,096,859	22,413,134
5-YR Sub-total	***50,980,074***	***16,705,060***	***14,346,500***	***0***	***9,267,906***	***91,299,540***
2008	10,470,094	3,819,326	7,140,759	0	3,101,649	24,531,828
2009	6,558,674	5,404,544	13,995,256	0	4,645,855	30,604,329
2010	8,779,703	2,350,872	13,379,400	0	5,907,535	30,417,510
2011	9,004,181	3,732,093	11,418,900	0	3,555,107	27,710,281
2012	11,631,799	1,993,673	17,712,562	951,869	4,219,789	36,509,692
5-YR Sub-total	***46,444,451***	***17,300,508***	***63,646,877***	***951,869***	***21,429,935***	***149,773,640***
Grand Total	**97,424,525**	**34,005,568**	**77,993,377**	**951,869**	**30,697,841**	**241,073,180**

During the HAB's first five years of operation, 2003 through 2007, CAIA, MHAIA and HAB spent $40.32 million promoting avocados in addition to $50.98 million spent by California producers. While total CAC promotional expenditures for the next five years, 2008 through 2012, decreased just over 10 percent as a result of relatively small crops in 2009 and 2011, promotional expenditures by HAB and country organizations financed by fresh avocado imports raised average avocado promotion from $18.26 million annually from 2003 to 2007 to $29.95 million annually from 2008 to 2012 (table 1).

4.1. California Avocado Commission Programs

The CAC has two major sources of income, an assessment on all avocados grown in California, collected at the first handler level, and the 85 percent rebate from HAB assessments on Hass avocados produced and sold to handlers in California. From 2008 through 2012, rebate income from HAB accounted for 49.5 percent of all CAC income, CAC assessments accounted for 45.6 percent, and income from other sources made up 4.9 percent of all available income.

Recent CAC consumer advertising and promotion programs have focused on California and other Western markets with messages designed to develop a premium image for California avocados.[5] CAC focuses its marketing programs on the time period from May through August when California fruit is now most available. During most years radio has been the main medium for consumer advertising for CAC. An exception was 2012 when an intensive 4th of July TV campaign was conducted in four major California markets (Los Angeles, San Francisco, San Diego, and Sacramento). Billboards, newspapers, cable television and the internet were also used, depending on the market and message.

4.2. Mexican Hass Avocado Importers Association Programs

MHAIA derives about 96 percent of its operating funds from the HAB rebate. As Mexican avocado imports have increased MHAIA has become the dominant avocado advertising and promotion spender in the U.S. market. From 2008 through 2012, MHAIA spent $63.65 million on advertising and promotion for avocados in the U.S. market, accounting for 42.5 percent of producer funded programs as compared to CAC's 31.0 percent share.

MHAIA advertising and promotion messages have reached a national audience through magazines, a NASCAR sponsorship, The Biggest Loser television program,

[5] The CAC's core markets in 2012 included Tier 1 (Los Angeles, San Francisco, San Diego, and Sacramento); Tier 2 (Denver, Phoenix, Seattle, Portland, and Salt Lake City); Tier 3, (Austin, Dallas, San Antonio, and Houston).

Super Bowl and Cinco de Mayo promotions, the Big Hit Major League Baseball promotion run during the playoffs, and spokespersons Cheryl Forberg, RD/nutritionist and chef for NBC's The Biggest Loser, and chef Roberto Santibañez. MHAIA also used spot radio with retailer-specific tags and in-store demonstrations in key markets including New York City, Chicago, Washington D.C, Boston, Baltimore, Cincinnati, Milwaukee, Louisville, Buffalo, Rochester, Albany, Syracuse, Ithaca, St. Louis, Pittsburgh, Memphis, Columbus, and Roanoke.

4.3. Hass Avocado Board Programs

Programs funded directly by the HAB have changed significantly over time. During its first five years HAB had two major programs, information technology (InfoTech) and marketing communications (MarCom) that accounted for most of its budgeted funds. The information technology consists of the *AvoHQ.com* intranet and the Network Marketing Center (NMC), designed to exchange marketing and strategic information from all suppliers of Hass avocados to the U.S. Marketing communications consist of consumer communications, online marketing, trade communications, industry communications, and marketing research. The majority of HAB expenditures during its first two years went to InfoTech. Then as InfoTech became established, funding shifted to MarCom programs. By 2007 about 80 percent of HAB program expenditures were for MarCom programs and about 20 percent for InfoTech.

The promotions category accounted for most of HAB's program expenditures during its second five years of operation (table 2). Promotions include four program areas: consumer promotions, trade promotions, industry communications, and market and nutrition research and communications. Consumer and trade promotions accounted for just over 80 percent of total promotion expenditures in 2008, 2009, and 2010. In 2011 and 2012, HAB's expenditures shifted from consumer and trade promotions in favor of increased emphasis on research and communications regarding nutrition. This change was set in motion in 2009 when HAB assumed responsibility for planning and implementing a comprehensive avocado nutrition research program. HAB's stated goal was to increase awareness and improve understanding of the unique benefits of avocados to human health and nutrition. Whereas marketing/nutrition research expenditures accounted for 12.6 to 16.5 percent of total promotion from 2008 to 2010, such expenditures grew to 38.4 percent of the promotion category in 2011 and further to 57.4 percent in 2012.

Table 2. HAB Expenditures by Category: 2008-2012

Year	Rebates	Promotion/ Market Research	Nutrition Research	Information	Admin**	Total
	--------------$1,000--------------					
2008*	21,991	3,005	0	590	1,676	27,262
2009	21,194	4,444	202	262	1,782	27,884
2010	24,955	5,363	544	101	1,530	32,493
2011	23,126	2,569	986	97	1,297	28,075
2012	31,879	2,104	2,115	229	1,243	37,570

*Includes 14 months of data, Nov and Dec 2007 plus calendar 2008 when HAB shifted from crop year to calendar year.

** The Program Implementation fee paid to USDA is included in the administration category.

4.4. Chilean Avocado Importers Association Programs

CAIA advertising and promotion programs are intended to increase the demand for Hass avocados from Chile. A key strategy is to focus program resources on activities designed to boost consumption of Hass avocados during the Chilean avocado season from

September through February. During the winter avocado season, most retail promotion support is by Mexico and Chile, with Chile most active in October and November and Mexico most active in December and January. CAIA's total promotional expenditures were slightly higher for 2008 through 2012 ($17.3 million) than during 2003 through 2007 ($16.7 million). However, since total Hass avocado promotion increased substantially, CAIA's share of expenditures dropped from 18.3 percent for 2003-2007 to 11.6 percent for the most recent five years.

CAIA's media allocations and emphasis have varied annually as available promotion funds changed. During 2008 and 2009 TV advertising was used in eight and six markets, respectively, including Denver, Houston, Los Angeles, Phoenix, Portland, San Antonio, Seattle and Rochester in 2008, and the same group minus Houston and San Antonio in 2009. Spot radio advertising was used in another group of markets in 2008 and 2009. In 2010 most of CAIA's promotion funds went to a joint national consumer campaign with MHAIA and HAB. CAIA's emphasis shifted to radio and outdoor advertising in 2011 and, with reduced funds in 2012, to consumer-oriented outdoor advertising in seven markets and retail promotions (in-store demos and promotions).

4.5. Peruvian Avocado Commission Programs

PAC is the newest member association, having completed its first 14 months of operations in December 2012. PAC's initial marketing budget included income of $1.148 million from HAB rebates and $101,222 from membership dues. Promotion activities included public relations campaigns ($103,000), media advertising ($409,120), and trade advertising and events ($100,000). The media activity included 200 billboards and spot radio ads in six markets: Los Angeles, San Diego, Sacramento, New York/New Jersey, Philadelphia, and Chicago. The billboards were in place for four weeks from mid-July through mid-August, while the radio ads aired for the week of August 6, 2012.

5. Summary of Results of Prior Evaluations of Avocado Promotions

Prior to reporting the results of our analysis of promotional expenditures conducted under the auspices of HAB for the period 2008 – 2012, we briefly summarize prior analyses of avocado demand and evaluation of avocado promotion expenditures. Prior studies include Carman and Green (1993), Carman and Cook (1996), Carman and Craft (1998), and CLS (2009). On balance this work has indicated that avocado promotion programs have induced statistically significant increases in demand. Producer returns from advertising and promotion programs have been estimated based upon these results and shown to have yielded attractive returns to avocado producers. For example, Carman and Craft (1998) estimated benefit-cost ratios for avocado promotion in a range of 2.84 to 6.35. A benefit-cost ratio of 2.84 would mean that avocado producers receive an increase of $2.84 in crop revenue for every $1.00 spent on promotion, resulting in a net return of $1.84 for every dollar spent.

Most recently, CLS (2009) examined both annual and weekly models of U.S. avocado demand using alternative empirical specifications in their study to gauge effectiveness of promotional programs conducted under the auspices of HAB in its first five years of operation. The estimated elasticity of demand of promotion expenditures ranged from 0.15 to 0.37 in the annual models, depending upon specification. Trend variables were included in the annual models to capture impacts on demand due to growth in consumer incomes and changing demographics, such as growth in the Hispanic share of the U.S. population. However, this same trend variable would also capture demand growth due to changing tastes and preferences for avocados, which, in turn, are likely due at least in part to marketing programs. Thus, the low estimate of the promotion elasticity was viewed by CLS as a conservative lower bound on promotion's demand impact.

Simulation of benefit/cost ratios using the highest and lowest estimated promotion response and price elasticities of supply of 0.50, 1.0, and 2.00 indicated that promotions not only expanded demand for avocados but provided a positive return on funds spent.[6] The estimated average and marginal benefit-cost ratios ranged from 1.12 to 6.73, meaning that the promotional programs supported by the HAB during its first five years (a) yielded net benefits to producers and (b) could have been profitably expanded during the 2003-07 period of analysis. Given the range of promotion and supply elasticities used for the simulation, CLS's best estimate of the benefit-cost ratio for HAB promotion programs was in the middle of the simulated range, in an interval between 2.5 and 4.0.

Analysis of avocado promotion programs in major retail markets by CLS suggested that radio promotion significantly increased the average weekly retail sales in promotion markets compared with non-promotion markets. Previous results also suggested that radio is a more effective media than outdoor advertising but the difference in effects was not statistically significant. The opportunity for CLS to conduct evaluation

[6] As CLS explain in some detail, the price elasticity of supply measures the percentage response of production to a one percent increase in price. This elasticity will vary greatly for a perennial crop based upon length of run. In the short run the supply elasticity of domestic production is likely nearly zero because bearing acreage is fixed. Import supplies may, however, be more elastic because importers can shift supplies from their domestic markets or other export markets to the U.S. market in response to higher prices in the U.S.

based upon the available retail scanner data was limited by the industry's inability at that time to systematically provide disaggregate promotion expenditure information.

6. Econometric Models of the Annual Demand for Avocados

Economic theory posits that demand for a commodity is a function of that commodity's price, prices of goods that are used as substitutes or complements for the commodity, and consumer income. Successful promotions can also be an important factor in expanding demand for a product. Demographic variables such as age, ethnicity, education, and gender may also help explain consumption of some commodities. Previous studies of U.S. avocado demand have specified per capita consumption as a function of real prices, per capita income, promotional expenditures, and share of Hispanic consumers. Attempts to identify substitute or complement goods to avocados have generally been unsuccessful.

Let QA_t denote per capita consumption of avocados in pounds in year *t* PA_t the period *t* average real f.o.b. farm price per pound for California avocados,[7] Y_t real average per capita income for U.S. consumers, and M_t the real expenditure on promotions in year *t*.[8] Finally, let D_t represent a vector of demographic variables, such as the Hispanic population share, that may influence demand for avocados. We can then express the U.S. avocado demand function as

(1) $$QA_t = f(PA_t, M_t, Y_t, D_t) + \varepsilon_t ,$$

where ε_t denotes a random error component.

[7] Choice of variable to utilize to represent price is discussed by CLS. Ideally the price variable would be a measure of average retail prices faced by consumers in year *t*. Such a variable is not available. Prices throughout the market chain, however, should be closely related due simply to the workings of the market place, especially for a long time period such as a year, which gives markets full opportunities to adjust to shocks in demand and supply. Thus, movements in the annual price received by California avocado growers should closely approximate annual changes in prices observed by consumers in the U.S.
[8] All monetary variables were deflated by the Consumer Price Index, base year = 1982-84.

The fundamental task in analyzing annual demand for fresh avocados in the U.S. is to estimate a version of (1) econometrically. An immediate problem is that we seek to evaluate the effectiveness of promotions conducted under the HAB's auspices for the five-year period from 2008 – 2012. Five observations are not nearly enough for statistical estimation of (1). The same problem confronted CLS in their evaluation of the Program's first five years. They chose to estimate demand over the entire time period for which promotion data were available, 1962-2007. This approach presented some challenges that CLS discuss in detail, notably dealing with some structural breaks in the demand relationships that appeared in the data between 1980 and 1981 and between 1993 and 1994.

The addition of five more years of data gives us some flexibility that CLS did not have. We, thus, chose to focus the annual model analysis on the period 1994 – 2012, i.e., the period after the last structural break identified by CLS. Although this results in considerably fewer observations than CLS analyzed, the benefit in terms of (a) avoiding issues of structural breaks and (b) focusing the analysis on the more recent data wherein HAB-funded promotions were in place for more than half of the observations made this the clear choice in our view.

Another common problem in time-series analysis of demand using aggregate annual data is that a number of variables thought to influence demand tend to move smoothly together over time, making it difficult or impossible to isolate the effects on demand of one such variable relative to another. CLS specifically noted this problem, observing in particular that per capita income and the Hispanic share of the U.S. population increased smoothly over time in a manner closely approximated by a linear trend. The same issue confronts this analysis. Table 3 contains the correlation matrix for 1994 – 2012 for the key variables included in the annual model. Correlation coefficients range from -1.0 (perfect negative correlation) to +1.0 (perfect positive correlation). A correlation coefficient of zero denotes variables that exhibit no correlation or co-movement. The correlation coefficient between per capita income and the U.S. Hispanic population share is very high, 0.964. Moreover, both of these variables are highly correlated with a simple annual trend variable, *YEAR,* in table 3.

The bottom line is that it is impossible with the available data to identify unique effects of income and Hispanic population share on fresh avocado consumption. Fortunately, these variables are only of passing interest in a study focused on promotion effectiveness. The key consideration is to control for these factors so that they do not introduce a bias into the estimated impact of the promotion variable. The simplest way to do this is through including *YEAR* as a time-trend variable wherein it can account for changes over time in income, Hispanic population share, and any other variables that change over time in a smooth, linear fashion.[9]

Table 3. Correlation Coefficients for Demand Model: 1994-2012

Variable	QA_t	PA_t	M_t	D_t	Y_t	t
Per Capita Consumption (QA_t)	1.000					
Real CA Price (PA_t)	-0.446	1.000				
Real Total Promo Expenditures (M_t)	0.962	-0.398	1.000			
Hispanic Share of Pop. (D_t)	0.964	-0.343	0.921	1.000		
Real Per Capita Dispos. Income (Y_t)	0.895	-0.356	0.868	0.959	1.000	
Year (**t**)	0.977	-0.318	0.941	0.993	0.946	1.000

[9] Promotions are also quite highly correlated with per capita income, Hispanic population share, and YEAR, but there is enough independent movement in our view to identify the unique effect due to promotion expenditures.

Table 4 contains summary data on the key variables utilized in the annual demand model analysis. Results of the analysis for several alternative specifications of the model are contained in table 5.

In all cases the models in table 5 are corrected for autocorrelation in the error term, ε_t, using the Prais-Winsten procedure. Model 1 in table 5 includes real f.o.b. price, real per capita income, and real promotion expenditures as explanatory variables. Model 2 adds a linear time trend, *YEAR,* to Model 1.

Table 4. Variable Definitions and Summary Statistics: 1994 – 2012

Variable	Definition	Units	Range of Values	Mean Value	St Dev
QA_t	Annual average per capita U.S. sales of all avocados, (California, Florida and all imports)	pounds per capita	1.10 to 5.10	2.689	1.14
PA_t	Average annual f.o.b. price of California avocados deflated by the consumer price index (CPI) for all items (1982-1984=1.00)	real cents per pound	28.10 to 73.83	50.08	11.53
Y_t	U.S. per capita disposable income, deflated by the CPI for all items (1982-1984=1.00)	thousands of real dollars	13.24 to 16.81	15.32	1.27
M_t	Annual advertising and promotion expenditures funded by HAB and CAC deflated by the CPI for all items (1982-1984=1.00)	millions of real dollars	3.44 to 15.90	8.42	4.24

Table 5. Annual Model Regression Results

Variable	Model 1 (GLS) Estimate	Model 1 (GLS) t-stat	Model 2 (GLS) Estimate	Model 2 (GLS) t-stat	Model 3 (2SLS) Estimate	Model 3 (2SLS) t-stat	Model 4 (2SLS) Estimate	Model 4 (2SLS) t-stat
California FOB Price (cents/lb.)	-0.012***	-3.67	-0.015***	-5.28	-0.011*	-1.64	-0.001	-0.20
Per Capita Income	0.276*	1.92	-0.287***	-3.62	-0.155*	-1.85		
Total Promotion	0.113***	4.18	0.049**	2.19	0.052***	2.48	0.077**	2.93
Time Trend			0.214***	8.17	0.180***	6.40	0.132***	7.46
Constant	-1.633	-0.71	5.279***	4.75	3.349**	2.33	0.754*	1.88
Durbin-Watson Statistic	1.310		1.465		-		-	
Observations	19		19		18		18	
Adjusted R^2	0.981		0.986		0.993		0.982	
Advertising Elasticity	0.354		0.153		0.163		0.241	

Models 3 and 4 take account of possible endogeneity of PA_t in the regression model because f.o.b. price and consumption are determined jointly through the workings of the market.[10] Specifically these models utilize two-stage least squares estimation wherein in stage 1, PA_t is regressed on a set of instrumental variables that contribute to explaining PA_t but are not factors in explaining QA_t. Following CLS, instruments chosen for this purpose included U.S., Chilean, and Mexican avocado acreage. Fitted or predicted values for PA_t from this first-stage regression are then used in place of actual PA_t in the second-stage regression involving QA_t as the dependent variable.

Real promotion expenditures represent the key variable of interest in these models. In all cases promotion expenditures have a statistically significant and positive impact on per capita U.S. avocado consumption. The estimated coefficients for promotion expenditures range from 0.049 (mode1 2) to 0.113 (model 1). The two-stage least squares models, which have the best statistical properties among the models, yield

[10] See CLS for an expanded discussion of possible endogeneity problems in estimation of the annual model and solutions to the problem.

intermediate values for the promotions coefficient of 0.052 and 0.077, depending upon whether per capita income is included in the model.

Because the magnitude of the estimated coefficients depends upon the choice of units to measure the model variables, it is desirable to convert the coefficients to elasticities, which measure estimated percentage impacts and, thus, are unitless. The estimated promotion elasticities evaluated at the data means range from 0.153 (model 2) to 0.354 (model 1), a result consistent with the range of estimates reported by CLS for the time period spanning 1962 – 2007. The differences in the estimates relates primarily to whether the trend variable *YEAR* is included in the model or not. Because the promotion variable, M_t, is also collinear with *YEAR*, including *YEAR* in the model takes "explanatory power" away from M_t. As CLS noted, successful promotions are most likely a key factor explaining the positive trend growth in per capita avocado consumption since 1994, so the lower estimated coefficients and elasticities for the promotion variable when *YEAR* is included in the model likely understate the true impact of promotions on fresh avocado demand.

The other variables included in the model perform much as economic theory would predict and estimates are also consistent with prior work. The f.o.b. price is negatively related with per capita consumption in all models as predicted by the law of demand, and the effect is statistically significant in all estimations except model 4. In the cases where the price coefficient is statistically significant, the estimated price elasticity of demand (evaluated at the data means) ranges from -0.205 (model 1) to -0.279 (model 2), results that are consistent with prior estimates.[11]

[11] These price elasticity estimates are somewhat lower, however, than the range of -0.41 to -0.46 estimated by CLS. However, this difference can be explained by the rapid growth in per capita consumption in the

Basic economic theory would suggest that demand for fresh avocados rises as consumers' per capita income rises, i.e., fresh avocados are what economists call a normal good. However, as noted, it is not possible to isolate the impact of changes in income on avocado consumption from the other factors that are changing in consonance with income over time. This is why the coefficient on per capita income changes from positive to negative when *YEAR* is added to the model.

The trend variable *YEAR* itself captures the average annual increase in per capita consumption of fresh avocados in the U.S. that is not directly accounted for by changes in other variables in the model, notably real promotion expenditures and real price. Depending upon the model, the estimate ranges from 0.132 pounds (model 4) to 0.214 (model 2) additional pounds per year. However, as noted, it is reasonable to assume that some of this trend growth is in fact due to the impact of promotions, but is not reflected in the estimated coefficient on the promotions variable.

7. Cost-Benefit Analysis of Fresh Avocado Promotion Expenditures

The econometric analysis reported in section 6 presents strong evidence that generic promotion of fresh avocados has worked to increase the demand for fresh avocados in the U.S. The additional question to ask, however, is whether the expenditures have "paid off" in the sense of yielding benefits to producers from the demand enhancement that exceed the money expended to fund the programs. We address that question in this section.

The benefit-cost analysis conducted for this study follows the methodology utilized by CLS (2009), which is applied widely in commodity promotion evaluation

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presence of relatively stable prices. This means that consumers are operating in the more inelastic portions of the linear demand curves estimated in this study and supported by the data (CLS 2009).

studies. The average benefit-cost ratio (ABCR) from a promotion program consists of the total incremental profit to producers generated by the program over a specified time interval divided by the total incremental costs borne by producers to fund a program. The ABCR is the key measure of whether a program was successful, with ABCR $\geq$ 1.0 defining a successful program.

The marginal benefit-cost ratio (MBCR) measures the incremental profit to producers generated from a small expansion or contraction of a promotion program. MBCR answers the question of whether expansion of the promotion program would have increased producer profits, with MBCR > 1.0 indicating a program that could have been profitably expanded. For the linear model utilized in this study ABCR = MBCR, and, thus, the two questions "was the program profitable" and "could it have been profitably expanded" are one and the same.[12]

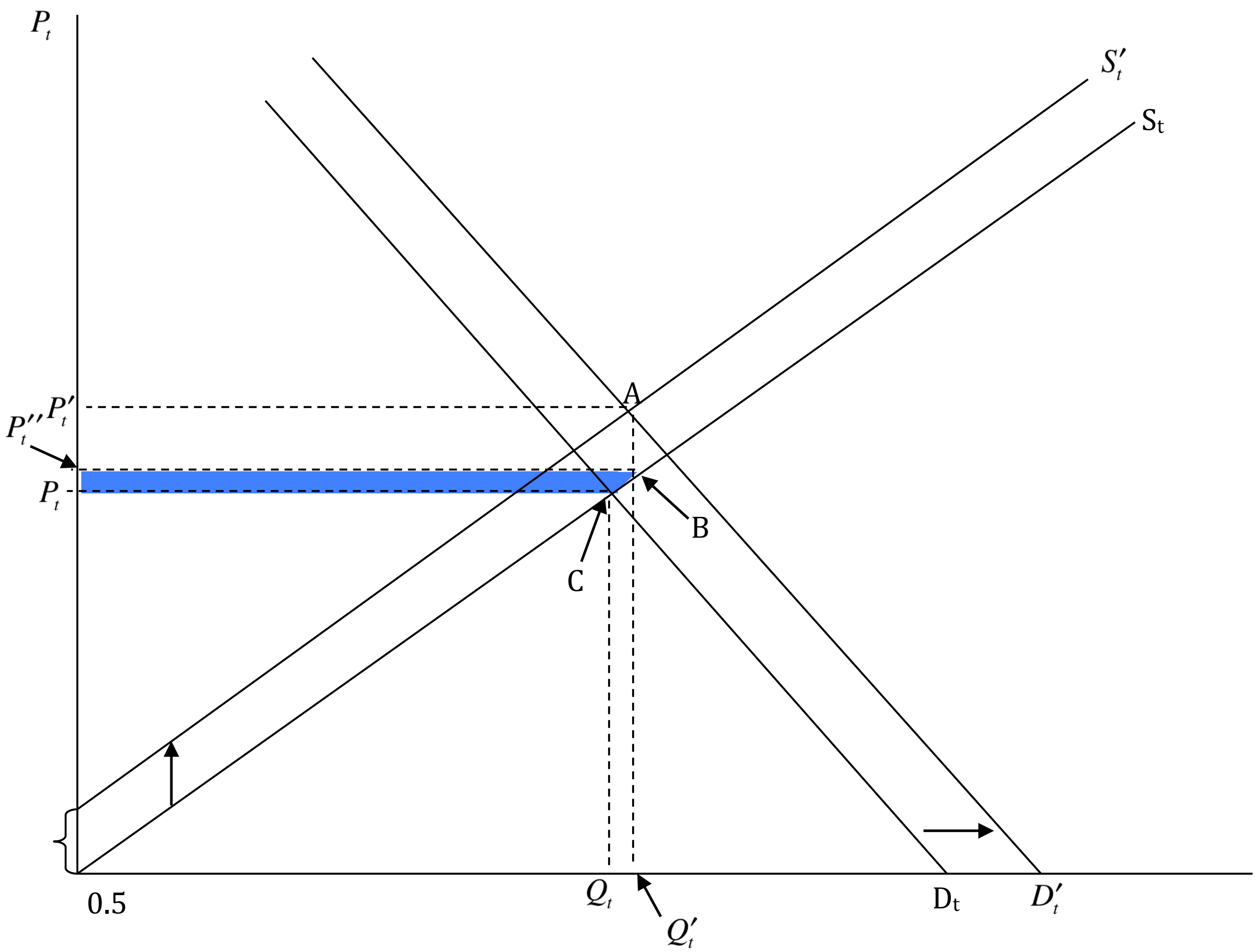
Our strategy in estimating ABCR and MBCR for the promotion programs conducted under HAB's auspices was to simulate the impact of a small hypothetical increase in the HAB assessment rate from the current level of \$0.025/lb. to \$0.03/lb., i.e., an increase of one-half cent per pound, and estimate the benefits and costs to avocado growers from that assessment expansion based upon the results of the econometric analysis discussed in the previous section.

The simulation framework is depicted in figure 4, which is adapted from the CLS study. The model begins with demand and supply functions for avocados that depict the U.S. market for a given year *t*, say 2008, during the review period. Thus, demand, D_t, is total U.S. demand in *t* = 2008, as estimated in section 6 on a per capita basis. Supply, S_t,

[12] CLS conducted exhaustive statistical tests, which supported use of the linear functional form to depict demand for fresh avocados in the U.S. market.

is total supply to the U.S. market in t = 2008 from all sources—domestic production plus all imports. Under the current program, total U.S. consumption in 2008, given functions S_t and D_t, is Q_t, and grower price is P_t. Implementation of a one-half cent per pound expansion in the program assessment increases producer costs per pound by that half cent, which shifts supply upward to curve S_t' as depicted in figure 4.

Figure 4. Avocado Promotion Simulation Model



The hypothetical increase in assessment generates incremental funds for promotions equal to the change in assessment multiplied by total shipments to the U.S. market. The marginal impact of the additional promotional expenditure on demand is determined by the regression coefficient for the promotion variable, M_t, which is reported for alternative model specifications in table 5. The new demand curve is illustrated in figure 4 by D_t'. The new market equilibrium is found at the intersection of curves S_t' and D_t' at point A in figure 4. Thus, the model predicts that equilibrium price in 2008 would have risen to P_t' and sales have risen to Q_t' with the incremental assessment.

Producer benefits from the hypothetical expansion of the promotion program are measured in terms of the change in producer surplus (PS). PS is the same as producer variable profits, namely revenue (producer price x output) minus the variable production costs associated with producing and selling the output. Fixed costs are irrelevant to the calculation since they would be incurred in any event by definition of their fixity.

In figure 4, PS in the absence of the promotion program is measured by the revenue rectangle $P_t \cdot Q_t$ minus the area below the supply curve, i.e., the triangle OCQ_t, which represents the total variable costs associated with producing and selling output Q_t. We seek to measure the change, Δ, in PS associated with the hypothetical expansion of the promotion program. In figure 4 PS after the program expansion is $PS' = P_t' \cdot Q_t' - 0BQ_t'$, but we must also account for the additional promotion expenditure, which is represented geometrically by the rectangle $P_t'P_t''AB = (P_t' - P_t'')Q_t'$. Thus, the net increase in PS to producers from expansion of the promotion program is $\Delta PS = PS' - (P_t' - P_t'')Q_t'$, which is represented by the shaded area in figure 4.

Information required to estimate ΔPS consists of: (i) an estimate of the marginal impact of promotional expenditures on demand, (ii) an estimate of the slope or price elasticity, ε_D, of the grower-level demand curve, and (iii) an estimate of the slope or price elasticity, ε_S, of grower supply of avocados to the U.S. market. The results of the econometric estimates reported in table 5 provide estimates of (i) and (ii).

Most promotion evaluation studies do not attempt to estimate the elasticity of the supply relationship. Supply functions are difficult to estimate empirically, and the elasticity varies by the length of run (time frame) under consideration. Any supply relationship becomes more elastic (responsive to price) as the time horizon under consideration expands because more productive inputs become variable to producers, enabling them to better adjust supply to changing market signals.[13]

Analysis of avocado supply to the U.S. market in particular is complicated is by the fact that both Chile and Mexico are important suppliers to the U.S. market, as well as to their domestic markets and to other export markets. Thus, Chilean and Mexican supply to the U.S. market is a residual supply that is based both upon total supply relationships within each country and also domestic demand in each country and demand from all importing countries except the U.S.[14]

The alternative approach utilized by CLS and by many other authors of promotion evaluation studies is to estimate benefit-cost ratios for a range of plausible values for ε_S. The analyst then evaluates whether conclusions are robust across the range of supply

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[13] See Carman and Craft (1998) for detailed discussion of supply response in the California avocado industry.

[14] Formally the residual supply of fresh avocados for any of the importing countries to the U.S. consists of the total supply in the country minus the domestic demand and the demands of all other importing countries. Thus, determining the price elasticity of the residual supply to the U.S. market would require estimates of the price elasticity of the total supply, as well as estimates of the price elasticity of the domestic demand and the demands of all other importing countries.

elasticity values chosen. If they are, then there is little need to worry about choosing among the plausible alternative values for ε_S.[15]

The short-run total supply of a perennial crop is highly inelastic because it is the product of bearing acreage and yield, neither of which is likely to be influenced much by current price. Thus, the total supply of avocados in California, Chile, Mexico, and Peru is likely to be highly inelastic or unresponsive to current price signals. The residual supply to the U.S. from the importing countries, however, is apt to be more elastic because the total supply in each country can be allocated to domestic consumption or to various export markets in response to price signals. Thus, an increase in price in the U.S. relative to other locations due to successful promotions is likely to cause Chilean and Mexican shippers to increase supply into the U.S. Shippers' ability and willingness to reallocate supply among alternative market outlets hinges on the totality of the factors discussed in footnote 14.

CLS evaluated these considerations, and specified three alternative values, 0.5, 1.0, and 2.0, as representing a plausible range of values for ε_S. The lower bound of these values states that a one percent grower price increase in year *t* causes a 0.5 percent increase in supply in year *t*, whereas the upper bound posits a 2.0 percent supply increase in response to the same price signal. The five years that have ensued since CLS conducted their analysis have seen imports' share of the U.S. market continue to rise, as discussed in this report, but our view is that the range of elasticities chosen by CLS continues to represent a reasonable range of choices, and, accordingly, we adopted those values for this analysis.

[15] In addition to CLS, studies using this approach include Alston et al. (1997) for California table grapes, Alston et al. (1998) for California prunes, and Crespi and Sexton (2005) for California almonds.

Among the demand models included in table 5, we selected models 1 and 3 for use in the simulation. These two models give a considerable range of values for the impact of promotions on demand, and accommodate a range of assumptions on the statistical properties of the demand model, most notably endogeneity or exogeneity of the grower price.

Benefits and costs were estimated for each of the five years, 2008 – 2012, under evaluation. The model was implemented by fitting the demand and supply functions to the actual values observed for the real grower price and per capita consumption for each year, thereby generating curves D_t and S_t intersecting at observed quantities, Q_t, and price P_t in figure 4 for each year of the review period. S_t was then shifted vertically to S_t' by the half cent incremental assessment for each year and D_t was shifted horizontally to D_t' by the estimated promotion coefficient times the funds generated by the incremental assessment, producing the equilibrium at point A in figure 4 and enabling us to compute the hypothetical changes in P and Q and the ΔPS, as described in the prior paragraphs.

Results of the benefit-cost simulation are reported in table 6. Six sets of estimates are reported, one for each combination of the three price elasticities of supply and two demand models chosen for the simulation. For each simulation, table 6 reports the mean increase in the real f.o.b. price in cents/lb. averaged over the five-year review period, and the estimated benefit-cost (BC) ratio. Total net producer benefits are reported for each model by compounding the annual benefits and costs over the five-year period to 2012 using a three percent real rate of interest. The BC ratio for each simulation was then computed by adding the program cost to the estimated net benefits to produce gross benefits and dividing gross benefits by the incremental cost:

$$\text{MBCR} = \text{ABCR} = \frac{\Delta \text{PS} + \text{assessment costs}}{\text{assessment costs}}.$$

In general, impacts on grower price and the BC ratio will be greater the more effective promotions are in shifting demand and the more price inelastic are the demand and supply functions. Price responsiveness of the demand and supply functions matters importantly because the more inelastic these functions are, the greater the extent that a given promotion-induced demand shift induces higher prices instead of greater production and consumption. The benefit to producers from increased sales is limited to the profit margin on those incremental sales, whereas a price increase benefits a producer's entire production.

Table 6. Estimated Benefit-Cost and Grower Price Impacts from Expansion of the HAB Promotion Program

	Supply Elasticity = 0.5	
	Mean Grower Price Increase (%)	Benefit/Cost Ratio
Model 1	12.3	9.28
Model 3	6.2	4.75
	Supply Elasticity = 1.0	
	Mean Grower Price Increase (%)	Benefit/Cost Ratio
Model 1	7.4	5.68
Model 3	3.9	3.10
	Supply Elasticity = 2.0	
	Mean Grower Price Increase (%)	Benefit/Cost Ratio
Model 1	4.4	3.51
Model 3	2.6	2.12

The estimated BC ratios in this study range from 2.12 to 9.28. The lower bound is associated with model 3, which has a small coefficient for promotion relative to model 1, and the most elastic supply response, $\varepsilon_s = 2.0$. The average annual increase in the grower price due to promotions for this simulation is 2.6 percent. The upper bound of 9.28 is associated with demand model 1, which has a high coefficient for promotion, and with the most inelastic supply response, $\varepsilon_s = 0.5$. The average annual price increase for this simulation is 12.3 percent.[16]

The estimated BC ratios for this study in general exceed those estimated by CLS for the Program's first five years, which ranged from 1.12 to 6.73. The differences are due to two effects: (i) the estimated impacts of promotions on demand are slightly higher in this study than in CLS, and (ii) the price elasticity of demand estimated in this study is lower than estimated by CLS. See footnote 11 for further discussion of this difference between the two studies. As noted, a given promotion-induced shift in demand will produce a higher benefit the more price inelastic is the demand curve.

The simulation results contained in table 6 were based upon estimated advertising and price impacts on demand that were highly statistically significant and a plausible range of values for the price elasticity of supply based upon economic theory. Thus, we can conclude with a high degree of confidence that the promotional programs supported by the HAB (i) have yielded net benefits to producers and (ii) could have been profitably expanded.

[16] The rank order of the price impacts and the BC ratios for the six simulation models is not the same. Models with inelastic demand and supply functions yield greater price impacts, other factors constant, but the more inelastic is producer supply, other factors constant, the greater the share of the incremental assessment actually borne by producers vs. shifted forward to buyers through the workings of the market. The degree to which the assessment is shifted also impacts the BC ratios.

To place these BC ratios in perspective, the most conservative ratio of 2.12 indicates that the 2.5 cents per pound assessment returned 5.3 cents per pound for a net return of 2.8 cents per pound. At the upper bound, the BC ratio of 9.28 indicates that the 2.5 cents per pound assessment returned 23.2 cents per pound for a net return of 20.7 cents per pound. These, of course, are impressive rates of return, and might even strike some observers as implausibly high. However, these rates of return are not inconsistent with estimates derived by other authors in promotion studies conducted for other commodities.[17]

In general the high rates of return found here and in a number of other studies reflect some common features of agricultural commodity promotions. First, the advertising intensity of these promotion programs (e.g., as measured by advertising-to-sales ratios) is low compared to food products promoted by the leading brand manufacturers. Promotions are subject to diminishing marginal effectiveness as the amounts expended increase. Arguably expenditures from most commodity promotion programs have not encountered diminishing returns due to the relatively modest amounts collected and expended.[18] Second, a characteristic of many agricultural products is that both their demands and supplies are price inelastic. Such commodities are ideal candidates for successful promotions because any promotion-induced demand shift will produce a comparatively large price impact.

An additional observation in considering these results is that the findings reported here, based upon economic and statistical analysis, confirm what is probably obvious to

[17] The book by Kaiser et al. (2005) summarizes much of the prior work done on promotion evaluation with a particular focus on California commodities.

[18] This argument is supported by the econometric analysis in CLS, which showed that a linear relationship between promotion expenditures and per capita consumption, implying constant returns, could not be rejected by the data.

most observers of the industry. Fresh avocados have gone from being a somewhat exotic, niche product in the U.S., perhaps to be served on the occasional holiday, to a mainstream fresh produce commodity consumed nowadays by many as a staple part of their diets. As we have noted, many factors are involved in the remarkable growth of this industry in the U.S., but highly successful promotion programs have surely played a prominent role.

Finally, one should note that benefits from avocado industry growth and industry sponsored promotional programs extend to U.S. avocado consumers, who have enjoyed access to increased regional and seasonal availability of high quality fruit that contributes to a healthy diet. Consumers now typically find year-round, permanent fresh avocado displays in the retailers' produce section containing fruit of varying maturities with "ripe stickers" and/or instructions for determining if an avocado is ripe and how to care for it. Retailer support and point-of-purchase promotional materials inform interested consumers about the nutritional characteristics of avocados and provide menu suggestions and recipes. Similar information is available on websites maintained by HAB, CAC and the three certified importer associations. HAB's nutrition research programs should continue to develop information that is very useful to avocado consumers.

8. Fresh Avocado Demand Analysis at the Retail Level

This section presents analysis of demand for fresh avocados at retail utilizing weekly grocer scanner data aggregated to the market level. Promotional expenditures for CAC, CAIA, and MHAIA targeted to specific regional markets in a given time period were aggregated for the purposes of this analysis.[19] The scanner-data analysis complements the analysis based upon aggregate annual data and provides another vehicle to analyze the impacts of promotions conducted under HAB's auspices. Analysis of this disaggregate data also enables us to make some observations about impacts of holidays and special events and marketing strategies that may have value to the industry.

CLS also conducted similar analysis utilizing scanner data in their evaluation of the promotions conducted under HAB's auspices in its first five years. This analysis differs in two important ways relative to CLS. First, CLS had access to scanner data for individual retail chains in selected market areas, whereas the scanner data utilized here were aggregated across chains operating within a market area by the data vendor. Second, CAIA and MHAIA were unable to provide a breakdown of their promotional expenditures by region and time period for the CLS study, so their analysis focused solely on CAC expenditures. In contrast we were provided with disaggregate expenditures for CAC, CAIA, and MHAIA, although disaggregated MHAIA data are missing for 2008.

8.1. The Data

The data used for this analysis were collected by Information Resources, Inc. (IRI) and supplied for this study by the Hass Avocado Board. The data include scanner data on retail sales for fresh avocados in 38 designated marketing areas (DMA), collected on a weekly basis for the five years spanning 2008 to 2012. Not all food retailers participate in

[19] Given that there is temporal overlap in the expenditures made by the three associations, it is not possible to attribute estimated impacts to any single association's expenditures.

the IRI program, so the sales reported for a DMA are not comprehensive.[20] Population data were also provided at the county level for 2010 only. Each of the DMAs is comprised of a distinct set of counties. Thus, to obtain DMA population estimates, county level populations were aggregated to the level of the DMA. The 2010 population data were used to convert total DMA sales into weekly per capita sales for the entire 2008 – 2012 period. This unavoidably introduces some error into the analysis because we were unable to account for population changes within DMAs during the study period.

Retail sales in quantity and dollar value were recorded at the price look-up (PLU) or universal product code (UPC) level. Whereas PLU codes are specific to fruit size and whether or not a product is organic, UPC codes are retailer specific, with some retailers selling multiple product types and/or sizes under a single UPC. The inclusion of UPCs in the dataset also precludes isolating sales of Hass avocados from other types of avocados. For this reason, we aggregate all fresh avocado sales, in terms of quantity and dollar value, in each week for each DMA. After this aggregation, a weighted average per-unit price was calculated.

Table 7 provides population and means and standard deviations of price and sales for each of the 38 DMAs contained in the scanner dataset. Avocado promotions were not conducted in all 38 of these DMAs. Further, local and regional promotions were conducted in some metropolitan areas not contained within the IRI data. Table 8 compares DMA coverage in the dataset to the metropolitan areas that received targeted promotions for fresh avocados. All of the DMAs with an "X" in the Scanner Data column in table 8 were included in the analysis of retail level demand for avocados.

[20] The data vendor indicates that grocery stores are included in the coverage, but that supercenters and club stores are excluded. Small retailers that stock fresh avocados such as green grocers would also be excluded.

Table 7. Sales and Price Summary Statistics by DMA

DMA		Sales (,000)		Price ($/unit)		DMA		Sales (,000)		Price ($/unit)	
	Population	*Mean*	*S.D.*	*Mean*	*S.D.*		*Population*	*Mean*	*S.D.*	*Mean*	*S.D.*
Albany	425,963	51,388	11,841	1.00	0.21	Memphis	1,801,520	74,231	23,562	1.08	0.25
Atlanta	6,546,126	274,808	104,296	1.25	0.22	Miami	4,340,266	134,849	71,790	1.45	0.34
Baltimore	2,881,558	135,330	54,076	1.18	0.20	New England	2,159,039	164,734	50,828	0.91	0.14
Boise	721,514	67,595	23,769	1.35	0.27	New York	21,015,004	787,466	285,918	1.33	0.28
Boston	6,390,760	406,334	122,292	0.97	0.15	Orlando	3,612,518	136,238	82,385	1.43	0.31
Buffalo	1,587,380	32,615	15,247	1.43	0.29	Philly	7,966,601	283,577	97,188	1.06	0.11
Charlotte	2,933,357	147,675	88,838	1.21	0.68	Phoenix	513,472	769,496	200,626	0.85	0.19
Chicago	9,751,961	472,276	157,694	1.25	0.23	Portland	3,149,015	405,045	143,197	1.17	0.29
Cincinnati	2,360,306	73,153	29,937	1.10	0.21	Raleigh	2,859,950	149,704	86,273	1.14	0.53
Columbus	2,365,889	78,232	28,519	1.17	0.18	Richmond	1,395,669	45,120	19,092	1.05	0.21
Dallas	7,090,433	966,266	210,575	0.90	0.19	Roanoke	1,119,979	25,381	11,109	1.13	0.22
Denver	4,034,999	627,861	207,849	1.24	0.28	Sacramento	4,167,523	651,427	209,377	1.13	0.22
Detroit	4,945,785	212,626	90,974	1.00	0.18	San Diego	3,053,793	420,130	120,788	0.96	0.19
Houston	6,184,414	1,028,500	241,112	0.89	0.19	San Francisco	6,860,566	1,136,743	371,334	1.08	0.23
Indianapolis	2,793,170	116,070	47,551	1.11	0.18	Seattle	4,753,047	504,375	173,899	1.30	0.28
Jacksonville	1,720,079	62,797	35,360	1.36	0.26	South Carolina	1,016,189	29,969	11,702	1.28	0.19
Las Vegas	1,951,862	281,251	70,658	0.87	0.18	Spokane	1,102,140	118,904	40,896	1.20	0.26
Los Angeles	17,838,186	2,535,799	745,104	0.94	0.18	St Louis	3,190,020	153,073	54,729	0.96	0.18
Louisville	1,669,191	55,213	30,325	1.31	0.32	Tampa	4,287,277	151,354	77,917	1.32	0.25

CAC provided information on media types, geographic locations, timing, and expenditures for the advertising programs it conducted from 2008 thru 2012. Regional promotions were conducted via radio, television, displays (indoor and outdoor), and bulletins. CAC advertising programs were generally conducting in the same DMAs (Los Angeles, San Francisco, San Diego, Sacramento, Denver, Seattle, Portland, Phoenix, Salt Lake City, Austin, Houston, and Dallas) during the 5-year review period.

CAIA provided information on geographic location, timing, target audience, and expenditures for the promotions it conducted during the 5-year review period. CAIA provided its total budget for each promotional activity and the time period, in weeks, over which the promotions were conducted. There was significant variation in CAIA's marketing strategy during the review period. For example, in the 2010/11 marketing year CAIA did not conduct regional promotions, while in the 2011/12 marketing year it conducted regional promotions in more than 20 markets.

MHAIA provided information on the geographic location, timing, target audience, and budgeted expenditures for the promotions it conducted from 2009 – 2012. MHAIA also had significant variation in the markets wherein it conducted promotions during the review period. In 2010 and 2011 MHAIA only conducted promotions on a national scale, while in 2012 MHAIA conducted radio and "Wow Tour" promotions in more than 15 markets.

Table 8. DMAs Contained in Scanner Data and Where Promotions are Conducted

DMA	Promotions	Scanner Data	DMA	Promotions	Scanner Data
Albany	X	X	Nashville	X	
Atlanta	X	X	New England		X
Austin	X		New Orleans	X	
Baltimore	X	X	New York	X	X
Boise	X	X	Orlando		X
Boston	X	X	Palmdale	X	
Buffalo	X	X	Phoenix	X	X
Central Valley	X		Philadelphia	X	X
Charlotte	X	X	Pittsburg	X	
Chicago	X	X	Portland	X	X
Cincinnati	X	X	Providence	X	
Cleveland	X		Raleigh	X	X
Columbus	X	X	Richmond		X
Dallas	X	X	Riverside	X	
Denver	X	X	Roanoke	X	X
Detroit	X	X	Rochester	X	
Fort Myers	X		Sacramento	X	X
Grand Rapids	X		Salt Lake City	X	
Greensboro	X		San Antonio	X	
Harrisburg	X		San Bernardino	X	
Hartford	X		San Diego	X	X
Houston	X	X	San Francisco	X	X
Indianapolis	X	X	San Jose	X	
Ithaca	X		Seattle	X	X
Jacksonville	X	X	South Carolina		X
Las Vegas		X	Spokane		X
Los Angeles	X	X	St. Louis	X	X
Louisville	X	X	Syracuse	X	
Memphis	X	X	Tampa	X	X
Miami	X	X	Virginia	X	
Milwaukee	X		Washington DC	X	

Because CAC, CAIA, and MHAIA all provided total or budgeted expenditures for a given promotional activity and the time period, in weeks, over which the promotion was conducted, it was necessary to convert these expenditures to a weekly basis to conform with the scanner data. Thus, promotional expenditures were allocated to each week in the dataset by dividing total promotional expenditures for each program by the number of weeks the promotion ran.

National promotional activities cannot be disaggregated in order to isolate the impact of these activities upon the DMAs contained in the scanner data and thus national promotions were not included in this analysis of impacts at the retail level. Their omission is not important in evaluating the impacts of local and regional promotions because their impacts are accounted for through the month and year fixed effects included in the regression model.

8.2. Model Specification

Two model frameworks were utilized to examine retail sales at the DMA level. One model specified weekly fresh avocado retail sales within each DMA as a function of promotional expenditures within the DMA as a continuous variable, current and lagged prices, and control variables as follows:

$$\begin{aligned} q_{a,t} &= \alpha + [\delta_1 p_{a,t} + \cdots + \delta_p p_{a,t-s}] \\ &\quad + \tau Ad_{a,t} + \alpha_t + \alpha_a + \varepsilon_{a,t} \end{aligned}, \qquad (2)$$

where $q_{a,t}$ is weekly sales per capita of fresh avocados in retail DMA *a* in week *t* measured in cents, $p_{a,t}, p_{a,t-1}, \ldots, p_{a,t-s}$ represent contemporaneous and lagged retail prices in DMA *a* in cents per pound, $Ad_{a,t}$ is total promotion expenditure measured in thousands of dollars by CAC, CAIA, and MHAIA in retail market *a* at time *t*, individual retail market fixed effects are represented by {0,1} indicator variables, α_a, time-control indicator variables, α_t, account for fixed effects due to month and year, as well as to indicate holidays and events thought to be associated with the consumption of fresh avocados,[21] and $\varepsilon_{a,t}$ is a random error.[22]

A second specification follows what is known as the difference-in-difference framework (see CLS for a detailed discussion) and examines the impact of presence or absence of a promotion program in a DMA at a given time period without regard to the magnitude of expenditure in the DMA, i.e., the presence of a promotion program in DMA *a* at time *t* (treatment period) is denoted by an indicator variable $D_{a,t} = 1$, whereas the absence of a promotion program in market *a* at time $t' \neq t$ (control period) is denoted by $D_{a,t'} = 0$. The estimated coefficient on this indicator variable measures the strength of the treatment effect.

8.3. Results

Results of estimating equation (2) are presented in table 9.[23] Three versions of the model are presented which differ based upon the number of lags for the retail price included in the model. Model 1 includes only the contemporaneous price, model 2 includes the contemporaneous price plus a one-period lag on price (i.e., price in the preceding period), and model 3 includes two lagged prices. All three models yield very consistent results regarding the impact of expenditures on promotions.

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[21] Following CLS we denoted the presence of holidays and special events in the data by introducing a {0,1} indicator variable in the week preceding the actual event to account for purchases made to be served at the time of the event.

[22] Standard errors for this analysis were clustered on DMA to account for likely correlations among errors within a DMA.

[23] Table 9 excludes results for the account fixed effects, which hold little interest.

In each case the coefficient is positive and statistically significant at a 99 percent confidence interval. The results indicate that an additional $1,000 in weekly promotion expenditures within a DMA is associated on average with about $0.000125 in additional expenditure per capita on fresh avocados.

Table 9. Retail Demand Model Regression Results

	Model 1		***Model 2***		***Model 3***	
Dep. Var: Per Capita Sales (cents)	Coeff.	t-stat clustered	Coeff.	t-stat clustered	Coeff.	t-stat clustered
Price per unit ($)	-0.4451	-1.49	-2.5076	-5.82**	-2.6598	-5.85**
Price (t-1)			2.6501	7.34**	2.3471	7.49**
Price (t-2)					0.5400	2.98**
Regional Promotions ($1,000)	0.0125	3.03**	0.0121	3.06**	0.0121	3.10**
Super Bowl	0.9537	9.70**	0.6968	10.18**	0.7376	10.79**
Valentine's/President's Day	1.8638	8.74**	1.7112	9.58**	1.5546	10.08**
Academy Awards	0.5796	4.05**	0.3682	3.35**	0.3364	3.26**
Easter	0.2039	3.54**	0.1935	3.65**	0.1971	3.62**
Cinco de Mayo	0.2590	4.53**	0.1072	2.19*	0.0881	1.73+
Independence Day	0.0885	1.40	0.1056	1.82+	0.0978	1.69+
Labor Day	0.2865	6.08**	0.2381	4.86**	0.2338	4.81**
Thanksgiving	0.1677	3.57**	0.1241	2.84**	0.1268	2.99**
Christmas/New Years	-0.0636	-1.61	0.0594	1.21	0.0765	1.52
February	-0.7769	-4.33**	-0.5711	-3.81**	-0.4498	-3.49**
March	0.3924	3.81**	0.3583	3.62**	0.3901	3.90**
April	0.7091	7.32**	0.6940	7.05**	0.7297	7.31**
May	1.8579	12.91**	1.7915	13.30**	1.8199	13.69**
June	1.6014	12.75**	1.5090	12.26**	1.5358	12.64**
July	1.9387	12.49**	1.8445	12.55**	1.8765	12.92**
August	1.2104	10.73**	1.0712	9.34**	1.0883	9.38**
September	0.8275	8.26**	0.6755	7.44**	0.6819	7.04**
October	0.1491	1.63	0.0265	0.31	0.0361	0.40
November	-0.7633	-5.76**	-0.7165	-5.72**	-0.6762	-5.48**
December	-0.5185	-4.50**	-0.7125	-5.04**	-0.6990	-4.94**
2009	0.7764	9.82**	0.8167	9.92**	0.8273	10.04**
2010	1.5181	7.94**	1.6910	8.46**	1.7224	8.58**
2011	2.2245	10.27**	2.2592	10.56**	2.2711	10.61**
2012	2.8300	13.71**	3.0160	14.33**	3.0486	14.54**
DMA Fixed Effects	Yes		Yes		Yes	
Constant	10.0063	32.73**	9.4064	34.78**	9.2745	36.07**
R^2	0.93		0.94		0.94	
N	9,880		9,842		9,804	

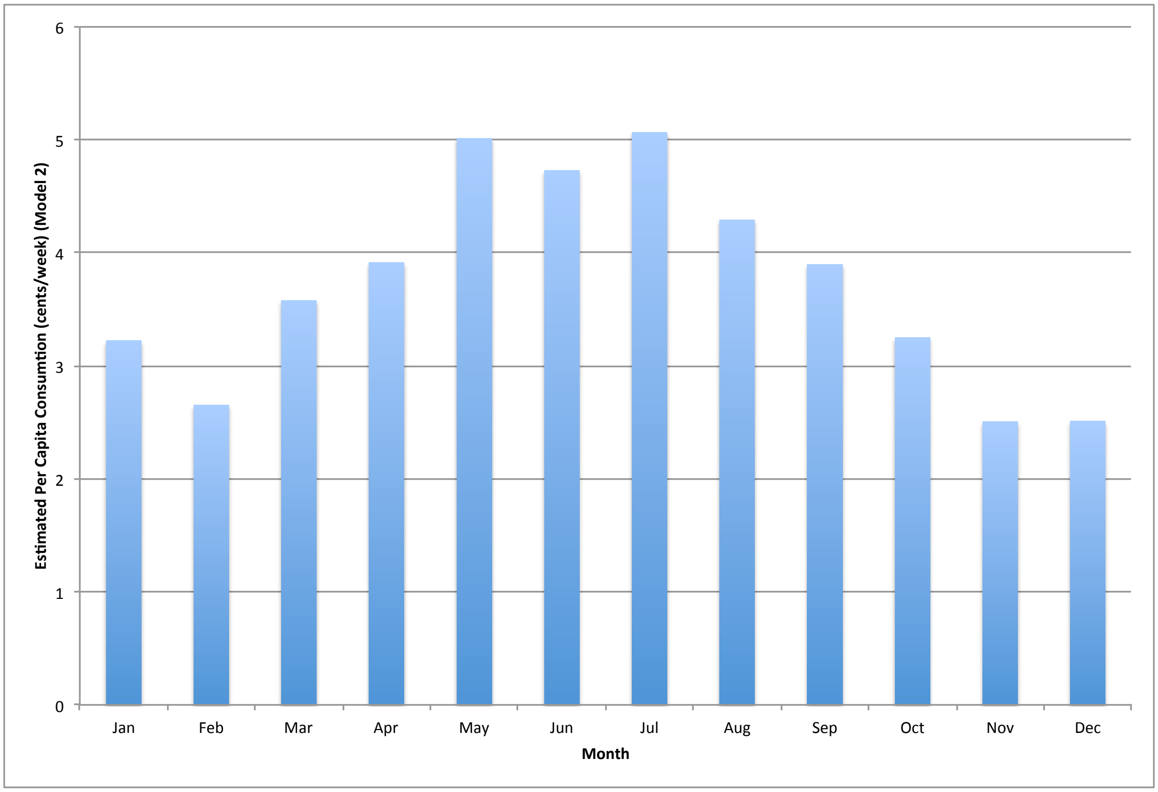
+p<0.10; * p<0.05; ** p<0.01; Standard Errors are Clustered on DMA

Current period prices are inversely related to weekly per capita consumption as expected, but, through inclusion of lagged prices within the model, we see that this effect is fully offset by dynamics in consumer response. For example, low prices in week *t*, e.g., due to price promotions, increase fresh avocado purchases in week *t*, but this impact is fully offset by an opposite impact in the following week. This result suggests that, even though fresh avocados are a perishable product, consumers respond to price signals by moving purchases forward into weeks when avocado prices are low and reducing purchases in the subsequent week(s). These results suggest that price promotions targeted towards retailers who offer fresh avocados on sale are not an effective tool to increase overall consumption.

The seasonal dimension to fresh avocado consumption is indicated by the {0,1} indicator variables used to denote the month of the year. The omitted month (to avoid what is known as the dummy variable trap) is January, and all monthly coefficients should be interpreted relative to the base month of January, which has an implicit coefficient of zero. Thus, we see, not surprisingly, that fresh avocado consumption is highest in the late spring and summer months of May – September and lowest during the late fall and winter months of November – February. The highest monthly consumption per capita is in July, where weekly per capita consumption is $0.0184 (model 2) greater than in January, and the lowest per capita consumption is in February, where weekly per capita consumption is $0.0057 lower than in January, other factors constant, based upon model 2 results. Figure 5 illustrates the monthly profile of fresh avocado consumption for 2012 based upon model 2, holding price and promotion expenditures constant at mean

2012 values and setting all holiday/event and DMA market indicator variables equal to zero.

Figure 5. 2012 Per Capita Fresh Avocado Consumption by Month



Indicator variables to denote year within the five-year review period reveal the persistent increase in per capita consumption of fresh avocados throughout the review period. The omitted year is 2008. Its coefficient is implicitly set to zero. We see that weekly per capita consumption rose very consistently by from \$0.006 to \$0.008 per year throughout the five-year period.[24]

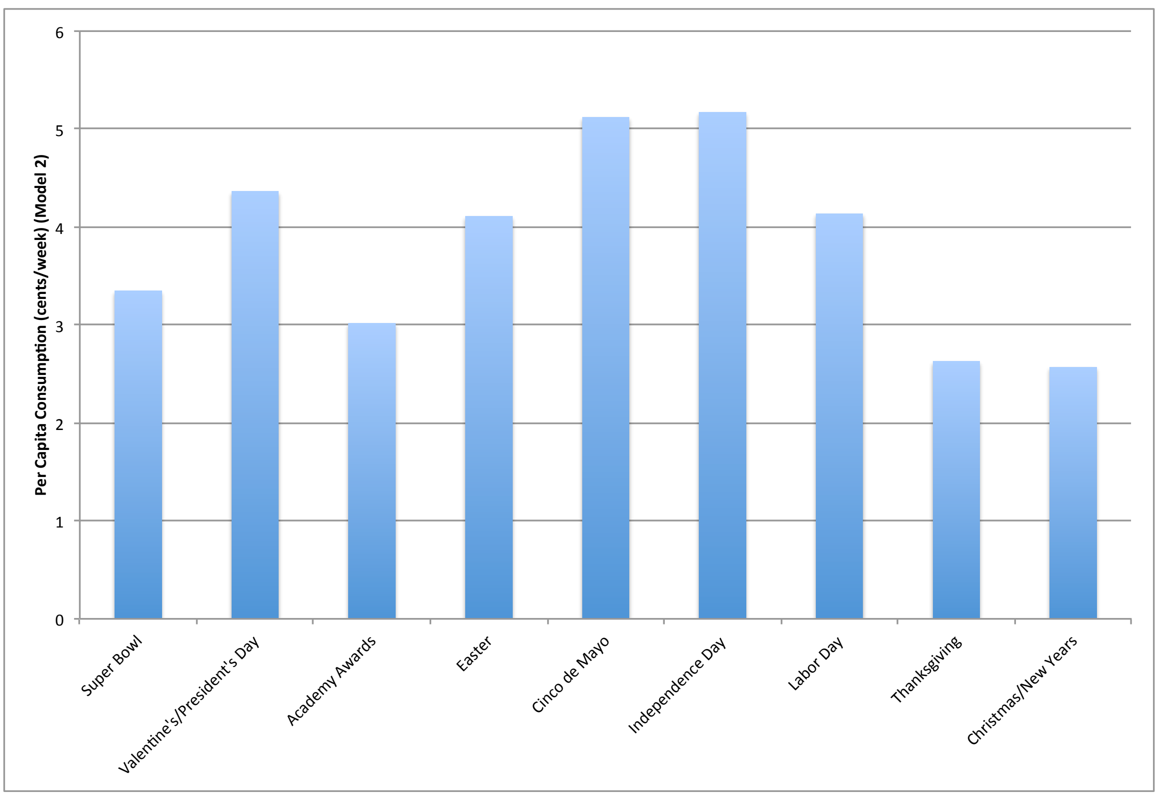
Consistent with the results reported by CLS, we find that holidays and special events continue to be important factors driving fresh avocado consumption. To fully account for the impact of a holiday/event on consumption, one needs to take account both

[24] For example, the indicator variable for 2009 is 0.8167 or \$0.008167 in additional weekly per capita avocado consumption in 2009 compared to 2008. Weekly per capita consumption in 2012 was \$0.03016 greater than 2008, or, when summed across weeks, \$1.57 more than in 2008.

of the event itself and the month in which it takes place. The largest incremental impacts in table 9 from a holiday or event are due to the Presidents' Day/Valentine's Day period and the Super Bowl. However, these events occur in February, a month with very low per capita avocado consumption apart from these special events (figure 5). Conversely, holidays such as Cinco de Mayo and Independence Day occur during months of high seasonal avocado consumption, so the incremental effect of these events is smaller, although the overall avocado consumption is very high during these time periods.

Figure 6 demonstrates this point by graphing the estimated mean per capita consumption in 2012 associated with each of the holidays/events included in table 9.

Figure 6. Per Capita Fresh Avocado Consumption During Holidays: 2012



These estimates are constructed by inputting the relevant price and promotion information for the 2012 holiday/event into the regression equation and also taking account of the 2012 year fixed effect and the fixed effect for the month when the holiday/event occurs. This analysis reveals that Cinco de Mayo and Independence Day are associated with the greatest per capita consumption of fresh avocados, with, somewhat interestingly, the Valentine's/Presidents' Day period having the third highest per capita consumption, followed next by Easter.

Table 10 contains results for the difference-in-difference model wherein the presence of local/regional promotions (aka "treatment") at time *t* in DMA *a* is indicated by an indicator variable, $\mathbf{D_{a,t}}$, set equal to 1.0, and absence of a program is denoted by $\mathbf{D_{a,t} = 0}$, i.e., a "control" period and location. The results from the difference-in-difference analysis are very consistent with the results reported in table 9. The estimated impacts of price, month, year, and holidays/events in table 10 are almost identical to what is reported in table 9.

The presence of a local/regional promotion program in a DMA during a given week *t* is associated with higher per capita sales of fresh avocados in that DMA, although the effect is only statistically significant at the 90% confidence level for each of the three models in table 10. The estimated impact of the presence of a promotion program in week *t* in DMA *a* is very consistent across models—per capita sales are about $0.0026 greater during a treatment location and time period (i.e., when a promotion is being run) than in a control period and location when no local/regional promotions are being run.

Table 10. Retail Demand Model Regression Results

	Model 4		Model 5		Model 6	
Dep. Var: Per Capita Sales (cents)	Coeff.	t-stat clustered	Coeff.	t-stat clustered	Coeff.	t-stat clustered
Price per unit ($)	-0.4364	-1.47	-2.5021	-5.83**	-2.6526	-5.86**
Price (t-1)			2.6539	7.33**	2.3545	7.46**
Price (t-2)					0.5338	2.94**
Regional Promotions (dummy)	0.2665	1.84+	0.2585	1.86+	0.2531	1.84+
Super Bowl	0.9569	9.61**	0.6998	10.06**	0.7403	10.61**
Valentine's/President's Day	1.8672	8.78**	1.7142	9.62**	1.5592	10.10**
Academy Awards	0.5808	4.08**	0.3690	3.35**	0.3377	3.27**
Easter	0.2096	3.63**	0.1990	3.75**	0.2024	3.70**
Cinco de Mayo	0.2759	4.61**	0.1235	2.41*	0.1051	1.97+
Independence Day	0.1566	2.60*	0.1717	2.95**	0.1639	2.80**
Labor Day	0.2874	5.96**	0.2389	4.80**	0.2347	4.75**
Thanksgiving	0.1693	3.47**	0.1256	2.81**	0.1281	2.96**
Christmas/New Years	-0.0629	-1.64	0.0602	1.23	0.0771	1.53
February	-0.7756	-4.34**	-0.5693	-3.80**	-0.4489	-3.46**
March	0.3932	3.73**	0.3593	3.54**	0.3911	3.80**
April	0.7060	7.17**	0.6913	6.90**	0.7270	7.13**
May	1.8617	13.12**	1.7954	13.55**	1.8245	13.96**
June	1.5983	12.83**	1.5062	12.38**	1.5342	12.87**
July	1.9269	12.79**	1.8333	12.86**	1.8661	13.27**
August	1.1945	10.93**	1.0558	9.43**	1.0738	9.51**
September	0.8097	8.57**	0.6583	7.64**	0.6657	7.24**
October	0.1399	1.54	0.0177	0.21	0.0278	0.31
November	-0.7717	-5.84**	-0.7242	-5.82**	-0.6838	-5.59**
December	-0.5315	-4.61**	-0.7251	-5.11**	-0.7109	-5.02**
2009	0.7755	9.83**	0.8160	9.97**	0.8269	10.10**
2010	1.5208	7.88**	1.6940	8.39**	1.7253	8.50**
2011	2.2315	10.13**	2.2661	10.40**	2.2780	10.44**
2012	2.8339	13.44**	3.0203	14.13**	3.0535	14.36**
DMA Fixed Effects	Yes		Yes		Yes	
Constant	9.9857	32.42**	9.3850	34.05**	9.2539	35.21**
R^2	0.93		0.94		0.94	
N	9,880		9,842		9,804	

+p<0.10; * p<0.05; ** p<0.01; Standard Errors are Clustered on DMA

8.4. Discussion

Whereas the results of the aggregate annual model analysis are very conducive to the calculation of grower benefits and costs, as was done in section 7 of this report, such analysis cannot be performed from the estimations based upon the disaggregate scanner data. We were only able to estimate impacts of local/regional promotions on sales in the grocery chains that participate with IRI. As has already been noted many food retailers do not participate. For example, Walmart, the largest grocery retailer in the U.S. by a considerable margin and Costco Wholesale, the third largest grocery retailer, are not in the IRI data. Moreover, most of the media used by CAC, CAIA, and MHAIA in their local/regional promotion campaigns extend beyond the boundaries of the target DMA, and incremental sales of fresh avocados generated in these peripheral areas are missed completely.

Finally, any promotion campaign is intended to have a dynamic impact on consumption, increasing it beyond the period when the promotions are actually running. By analyzing sales over an entire year, an annual model minimizes (but probably does not eliminate) the problem of exclusion of dynamic impacts of promotions that spill beyond the study period. But they are a serious problem for a weekly model such as was studied in this section. An analyst can in principle address this problem by including lagged values for the promotion variables. For example, an analyst who regresses $q_{a,t}$ on $Ad_{a,t}$ and $Ad_{a,t-1}$ allows promotions to impact sales over two time periods. Additional lags can be added as needed. However, that approach is not possible in this study because we knew only the total amount expended in a DMA over a multi-week promotion, and, thus, had no choice but to apportion the expenditure equally across those weeks. In this case $Ad_{a,t} = Ad_{a,t-1}$ and it is impossible to include both variables in the regression model.

Despite these limitations, we view analysis of the weekly DMA data as providing an important complement to and check upon the analysis of the aggregate annual data. We were able to find a statistically significant positive impact of promotions on fresh avocado consumption for each of the models run, as reported in tables 9 and 10. This disaggregate analysis is not subject to the data confounds that plague analysis of annual economic data that were discussed in detail in section 6. Thus, finding a statistically significant and positive impact from promotion expenditures in the disaggregate data represents an important verification of the conclusions reached based upon results from the aggregate annual model.[25]

9. Conclusion

This study has evaluated the impact of promotions of fresh avocados conducted under the auspices of the Hass Avocado Board during the second five years, 2008 – 2012, of the Program's existence. Our evaluation involved four central components: (i) review and evaluation of recent trends in sales, prices, and promotions of fresh avocados in the U.S. market (section 3); (ii) a descriptive analysis of the amounts expended and the nature of expenditures by each of the groups participating in the program, the California Avocado Commission, the Chilean Avocado Importers Association, the Mexican Hass Avocado Importers Association, the Peruvian Avocado Commission, and HAB itself (section 4);

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[25] We also note in passing that we re-examined a question addressed by CLS concerning the issue of whether retailers adjusted price in response to targeted promotions by the industry. If retailers adjusted avocado prices upward in response to demand-increasing promotions conducted under the HAB programs, then the sales growth necessary to increase grower prices would be stifled. CLS found no evidence that retailers increased prices and, rather, found weak evidence that retailers reduced prices in response to industry promotions. We reaffirmed this conclusion based upon analysis of scanner data for the 2008 – 2012 period. It is not uncommon for food retailers to reduce prices during periods of high demand for a commodity as a way to drive traffic to the store. Observing this effect for fresh avocados means that retailer behavior, through lowering prices and featuring avocados on sale during promotion periods, complements the effects of the promotions themselves.

(iii) econometric analysis of annual fresh avocado demand for the 19-year period from 1994 – 2012 (section 6); and (iv) econometric analysis of weekly fresh avocado sales at retail for 2008 – 2012 using scanner data for 38 designated marketing areas (section 8).

Fresh avocados have seen remarkable growth in consumption per capita in the U.S., rising from about 1.5 pound during the decade of the 1990s to over 5.0 pounds in 2012. This rapid increase in production targeted to the U.S. and consumption has been achieved while keeping real grower prices relatively constant on average over this time period. Such an outcome is only possible with substantial growth in fresh avocado demand in the U.S. over this time.

The econometric analysis of annual fresh avocado demand conducted in this study provides strong statistical evidence of this demand growth and support for the proposition that promotion expenditures have been a primary causal factor. Depending upon model specification, we found a highly statistically significant impact of promotion expenditures on per capita consumption of fresh avocados. The elasticity of demand with respect to these promotion expenditures, depending upon model specification, ranged from 0.153 to 0.354, values consistent with those attained in prior studies of impacts of avocado promotions.

Benefit-cost analysis conducted based upon these econometric estimates yielded estimated average and marginal benefit-cost ratios in the range of 2.12 to 9.28, depending upon the choice of demand model and assumed value for the price elasticity of supply. Even at their lower bound, these benefit-cost ratios imply a highly successful program that could be profitably expanded to yield additional net benefits to growers. For example, our lower bound estimate of a 2.12 benefit-cost ratio implies that the program returns \$2.24 in incremental profit to producers for each \$1.00 expended, for a net gain of \$1.24. Alternatively stated, the 2.5 cent per pound assessment yielded at least a 2.8 cent net increase in price per pound. These estimates are somewhat higher than obtained by Carman, Li, and Sexton (2009) in their evaluation of the HAB Program's first five years, but are not inconsistent with those results or with results that have been reported for other commodity promotion programs.

Analysis of the disaggregated scanner data also found a positive and statistically significant impact of targeted local/regional promotions on per capita sales in the targeted marketing areas. Results from the scanner data analysis also provide important insights for the industry as to the impacts on fresh avocado consumption of price promotions, seasonality, and special holidays and events.

The consistency of our results across the different analyses—evaluation of trends in avocado consumption and prices, econometric analysis of aggregate annual demand, and econometric analysis of disaggregate weekly demand—enable us to conclude with considerable confidence that the promotion programs conducted under the HAB's auspices have been successful in both expanding demand for fresh avocados in the U.S. and yielding a very favorable return to the producers funding the program.

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