Five-Year Evaluation of The Hass Avocado Board's Promotion Programs: 2013 – 2017

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Executive Summary

This report represents the third five-year evaluation of the promotion programs conducted under the auspices of the Hass Avocado Board (HAB), encompassing the period from 2013 through 2017. The evaluation involved five central components. Following a brief review of the history and legal foundation of the HAB, section 3 of the report provides a summary and assessment of recent trends in domestic and import shipments, consumption, and prices of fresh avocados in the United States. Section 4 contains a descriptive analysis and qualitative evaluation of the amounts expended and the nature of promotions conducted by each of the groups participating in the HAB's programs, the HAB itself, the California Avocado Commission (CAC), the Chilean Avocado Importers Association (CAIA), the Mexican Hass Avocado Importers Association (MHAIA) and its partner organization, Avocados from Mexico (AFM), and the Peruvian Avocado Commission (PAC). Section 5 develops and estimates an econometric model of fresh Hass avocado demand using weekly retail scanner data over the review period for 53 local market areas. Section 6 of the report develops and estimates an aggregate econometric model of fresh Hass avocado demand at the national level using retail scanner data. Finally, section 6 develops and implements a simulation model of the U.S. fresh avocado market to derive estimates of benefits and costs to California growers and importers from the promotion programs conducted under the auspices of the HAB for the five-year review period.

The growth in per capita consumption of fresh avocados in the United States since the creation of the Hass Avocado Board in 2003 has been quite remarkable. Fresh avocado consumption was relatively flat, averaging 1.6 lbs. per capita, during the decade of the 1990s. But since then demand has increased dramatically to an average of 7.1 lbs. per capita for 2014 – 16, an increase of 344%. Grower and importer prices for fresh avocados have fluctuated considerably during this period, reflecting supply volatility, but on average real prices have remained constant or increased slightly over the life of the HAB, reflecting the industry's ability to expand demand to at least keep pace with rising shipments.

This review period has seen an increasing presence in the U.S. market of avocados imported from Mexico, while shares from California, Chile, and the Dominican Republic have declined. Peru has emerged as an important player in the market, surpassing the import volume from Chile in 2014, making Peru the third largest supplier of Hass avocados to the U.S. market, following Mexico and California. Averaged over the final three years of this review period, Mexico's share of the U.S. market for fresh Hass avocados expanded to 79.0%, while Peru's share expanded to 4.8%. These share gains have come at the expense of the shares for California and Chile.

Turning to the promotion programs conducted by the individual associations, the HAB itself has focused on a dual strategy of funding research into the health and nutrition benefits of avocado consumption and then disseminating these results to key influencers in the health industry and to consumers themselves. The HAB spent on average nearly $1 million annually on research funding and $4.74 million annually on market research and promotion of the health and nutrition benefits of fresh avocado consumption.

The CAC augments its rebate funds from HAB with an assessment on revenues from its members that ranged from 1.75% to 2.3% over the review period. CAC spent an average of $9.13 million on its marketing programs over the review period, with campaigns focused on the Western U.S. designed to position California avocados as a premium ("most valued and desired") product. CAC's promotions stress the proximity of California production to the Western U.S. markets and the freshness and ability to harvest near peak ripeness that is associated with short hauls from orchard to market.

CAIA expended on average $885 thousand on its U.S. marketing campaigns over the review period, with the amount expended declining year by year. Chile's market window is counter-seasonal to California's and CAIA also targeted mainly Western U.S. markets, with a campaign designed to link the Chilean brand to the natural beauty and allure of Chile and to capitalize on the relatively short market window for Chilean Hass avocados in the U.S. market, with themes such as "Get 'em while they're Chile."

The lion's share of promotion expenditures for the review period were made by AFM, reflecting Mexico's increasing share of shipments and, hence, assessment revenue and an additional revenue stream from assessments levied on members of MHAIA's partner organization known as APEAM. AFM spent an average of $41.1 million annually on its marketing program over the review period, with the amount expended increasing annually. AFM targets most of its promotions nationally and its large and growing budget enables AFM to promote avocados from Mexico at major televised events such as the Super Bowl and the Oscars. AFM's general consumer marketing emphasizes the taste, healthfulness, and versatility of the avocado and stresses the positive elements of fresh Mexican avocados' year around availability in the U.S. market: "fresh 365 days a year."

PAC expended an average of $1.3 million on marketing programs from 2014 – 17. Peruvian Hass avocados are on the U.S. market in summer months, and campaigns promoted Peruvian avocados as the "summer avocado" and mainly targeted markets in the Eastern U.S., with "expansion markets" targeted in other regions. PAC has also emphasized the "superfood" concept to focus on the health and nutritional benefits of fresh avocado consumption.

The quantitative evaluation of promotion programs conducted under the HAB's auspices is discussed in sections 5 and 6 of the report. Section 5 presents an analysis of weekly retail scanner data for 53 market areas to estimate a demand model wherein weekly sales of fresh Hass avocados for each of the markets were expressed as a function of current and lagged average price in the market area and the sum of local/regional and national promotions impacting each market area during each week of the review period. In addition, control variables known as *fixed effects* were included in the econometric model to control for factors other than price and promotions that might impact weekly sales in the market area. Key results of the model were that weekly sales were inversely related to price charged in the market area in that week, with about one third of the price effect offset by an opposite effect in the subsequent week. Promotion expenditures had a positive and statistically significant impact on sales quantity, with the elasticity of sales with respect to promotions ranging from 0.007 to 0.016, depending on model specification.

Section 6 of the report presents a complementary analysis of aggregate U.S. retail demand based on retail scanner data aggregated to the monthly level. Price in this aggregate model was specified as the average monthly importer price, and promotions were summed across local/regional and national promotions for the month. Fixed effects variables were added as controls. The impact of price on sales was negative and significant, with a price elasticity of demand estimate of -0.19. Promotion expenditures had a strong positive impact on sales quantity, with an elasticity of sales with respect to promotion expenditures ranging from 0.058 to 0.06, depending on model specification. Promotion elasticities are larger in this aggregate monthly model than in the disaggregate weekly model because the longer time period (week vs. month) gives promotion expenditures a longer time window to impact demand.

The final component of the quantitative analysis was the simulation model constructed in section 7 based upon results of the aggregate econometric model. This model specifies supply and demand functions for fresh avocados in the U.S. market and simulates a small expansion of the HAB's promotion program to assess impacts on grower/importer costs (reflected as a shift in the supply function) and on demand (reflected as a shift in the demand function). Equilibrium sales and grower/importer price before and after this hypothetical program expansion are derived and compared to measure grower/importer costs and benefits. Depending on model specification, we estimated benefit-cost ratios ranging from 1.64 to 3.62, strong evidence that the promotion programs conducted under the auspices of the HAB were successful during the review period in increasing profits to California producers and importers of Hass avocados.

This key result should come as no surprise to people familiar with the industry. The Hass avocado success story in the U.S. in terms of the rapid increase achieved in per capita consumption, while maintaining or increasing real prices to producers and importers, has made avocados the envy of the produce industry. Our analysis demonstrates that the activities of the Hass Avocado Board and its member associations have played a fundamental role in this success.

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Five-Year Evaluation of The Hass Avocado Board's Promotion Programs: 2013 - 2017

1. Introduction

The growth in per capita consumption of fresh avocados in the United States since the creation of the Hass Avocado Board (HAB) in 2003 has been quite remarkable. Fresh avocado consumption was relatively flat, averaging 1.6 lbs. per capita, during the decade of the 1990s. But since then consumption has increased dramatically to an average of 7.1 lbs. per capita for 2014 – 16, an increase of 344%. By comparison, consumption in the total fruit category expanded by only 9.4% over this same period.

In 2017 avocados surpassed bananas to became the most important fruit import into the United States, with a 15% share of import value. The only other fruit that can rival the consumption growth of avocados in the United States is blueberries, which began from an extremely low consumption base of 0.3 lbs. per capita in the 1990s, reaching an average of 1.5 lbs. in the most recent years.

The key focus of this report is to understand the factors behind this remarkable growth in fresh avocado consumption in the U.S. and, in particular, to evaluate the role that promotions funded under the auspices of the HAB have played in stimulating the growth. This report is the third five-year review of the promotion activities of the HAB, covering the years 2013 through 2017. The first report, conducted by Carman, Li, and Sexton (2009), evaluated the first five years of promotion activities conducted under the auspices of the HAB—2003 through 2007. These authors found that advertising and promotion funded under the HAB increased the demand for fresh avocados and yielded a favorable rate of return to avocado producers and importers who invest in the program via assessments. The second five-year review, conducted by Carman,

Saitone, and Sexton (2013), evaluated HAB-funded promotion activities for the period 2008 – 2012. These authors concluded based on the results of econometric analysis of multiple data sets that the HAB's promotion programs were 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.

Nearly all fresh avocados consumed in the U.S. are of the Hass variety. For each of the five years studied in this report, 2013 – 17, the Hass variety accounted for in excess of 97% of retail sales of fresh avocados observed in retail data.[1] The mission of the HAB relates specifically to Hass avocados. When the data permit separation of Hass from other varieties, we focus specifically on data for Hass avocados. Both retail scanner data and shipments data compiled and reported by the HAB allow for this disaggregation, by price look up (PLU) code in the case of the scanner data and explicit reporting in the case of the shipment data. However, most governmental data sources (e.g., United States Department of Agriculture and United Nations) do not separate fresh avocados by variety. In these cases we often report data for the entire fresh avocado category, recognizing that the error in lumping Hass and non-Hass varieties is slight, given the dominant Hass share.

In the remainder of this report, we briefly review key background information regarding the HAB and then discuss major factors impacting the fresh avocado market. We then turn to analysis of avocado promotion programs conducted under the HAB's auspices during the 2013 – 2017 period. This analysis involves three dimensions. First, we describe and evaluate qualitatively the expenditures, programs, and activities undertaken by HAB and its member organizations in light of the major forces impacting food consumption in the U.S. Second, we examine the aggregate (national) demand for fresh avocados in the U.S. and estimate the overall

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[1] The average Hass share of retail sales over this time period was 97.7%.

impacts of promotion expenditures and price on demand. The results of this analysis are utilized to construct a simulation model that is used to estimate benefits and costs to domestic producers and importers from funding promotions. Finally, we conduct analysis of retail scanner data on fresh avocado sales in selected U.S. metropolitan areas and evaluate the impacts of local and regional promotions on avocado demand in those market areas. The national and metropolitan-area analyses are complementary and enable us to attain the fullest perspective on the impacts of promotion expenditures conducted under the auspices of the HAB.

2. Background and History of the Hass Avocado Board

The Hass Avocado Promotion, Research, and Information Act was 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 an 86.6% affirmative vote on July 29, 2002. The HAB was created at this time to administer the activities authorized under the HAPRIO. HAB is a 12-member board representing domestic producers (seven seats) and importers of Hass avocados into the U.S. (five seats).

Mandatory program assessments of 2.5 cents per pound on all Hass avocados sold in the U.S. market commenced effective January 2, 2003 as authorized under the HAPRIO. This assessment rate has been maintained throughout the life of the HAB. The assessment is collected by first handlers for California production and by the U.S. Customs Service for imports, with revenues 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% of the assessment revenues to fund generic activities including nutrition research, marketing focused on the nutritional benefits of fresh avocado consumption, market research and

information programs, and administration. The remaining 85% of assessment revenues are rebated in proportion to revenue generated to the California Avocado Commission (CAC) and the three certified importer associations authorized under the HAPRIO: the Chilean Avocado Importers Association (CAIA), the Mexican Hass Avocado Importers Association (MHAIA), and the Peruvian Avocado Commission (PAC). These associations utilize the funds to conduct promotions emphasizing the geographic origin of their avocados, e.g. California for CAC or Chile for CAIA.

Assessment income to support the activities of the HAB totaled $98.67 million during its first five years, $148.47 million during its second five years, and $248.69 million for the current review period. The rapid growth in available income reflects the growth in sales volumes over the life of the HAB, given the constant assessment rate of 2.5 cents per lb. on fresh Hass Avocados.

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

Through the 1980s most fresh avocados consumed in the U.S. were produced in California and Florida. Imported avocados accounted for an average of just over one percent of the total U.S. avocado supply from 1962 - 89. Most consumption accordingly was limited to the few months when California or Florida avocados were harvested and available on the market. However, beginning in the 1990s the market share of imported fresh avocados expanded rapidly, first due mainly to product entering the U.S. from Chile and the Dominican Republic and then from Mexico, beginning in 1997 when Mexico first gained access to portions of the U.S. market. Fresh avocado imports reached 146 million pounds, almost one-third of total U.S. supplies in 2000.

Mexico's access to the U.S. market was expanded in 2001 and 2002, resulting in total

Hass avocado imports increasing to over 251.42 million pounds (39.5% of total supply) in 2002. The final stages of liberalization of the U.S. market for Mexican avocados were reached in 2005 when Mexico gained year-round access to all states except California and Florida and in 2007, when access was granted to all states.

Figure 1 shows the total supply of fresh avocados to the U.S. market from 2004 – 17. Some major trends are apparent. First, fresh avocados supplied to the U.S. market continued to increase though 2015 and have been roughly level since then. Second is the increasing dominance in the U.S. market of avocados imported from Mexico, while shares from California, Chile, and the Dominican Republic have declined. Third is the emergence of Peru as an important player in the market in the most recent years. Peru began exporting significant volumes of Hass avocados to the U.S. in 2011 and the PAC became a USDA-certified importer association under the HAPRIO in 2011. In 2014 Peru exported 144.1 million lbs. of Hass avocados into the U.S., surpassing the import volume from Chile and making Peru the third largest supplier of Hass avocados to the U.S. market, following Mexico and California. In addition Peru is now the second largest avocado exporter in the world, following Mexico.

As recently as 2007, U.S. imports from Chile were nearly identical to California's production -- 233 million lbs., but by 2010 U.S. imports from Chile were only 142.3 million lbs. with further declines occurring in subsequent years, reaching a low point of only 20.7 million lbs. in 2015 before recovering somewhat to 80.9 million lbs. in 2017. Notably, this decline in Chilean exports to the U.S. does not reflect any decrease in the importance of avocado production in Chile. Rather, total Chilean exports increased from 194 million lbs. in 2013 to 390 million lbs. in 2017. The decline in sales to the U.S. reflects increasing sales in Chile's domestic market, and Chilean exporters directing their sales increasingly towards the European market,

mainly to the Netherlands, Spain, and the United Kingdom. The Netherlands is a major re-exporter of fruits and vegetables within the European Union, and its imports of Chilean avocados expanded from 83 million lbs. in 2013 to 144 million lbs. in 2017.

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

Source: Hass Avocado Board, Shipment Data.
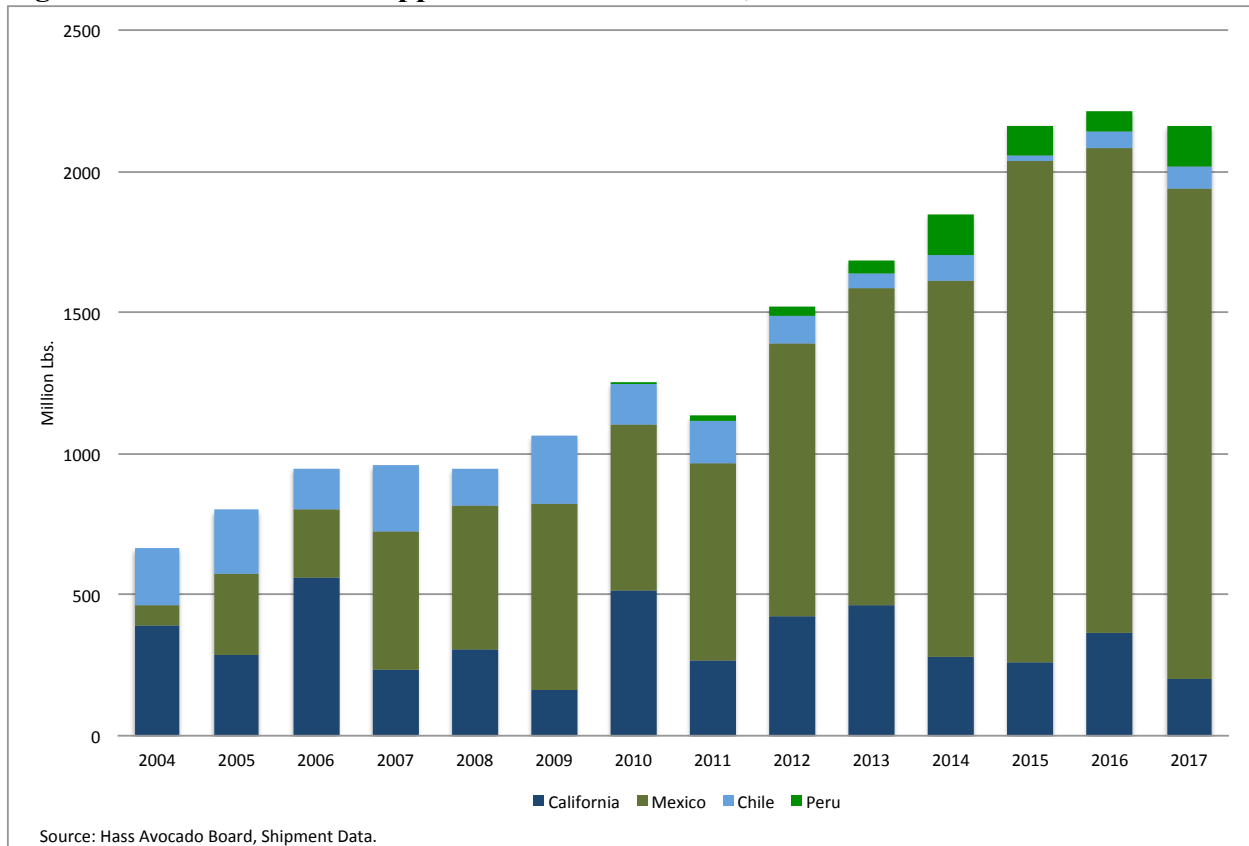
Table 1 lends further perspective to the rapid changes in the U.S. fresh avocado market that have occurred since the prior five-year review. It reports market shares for HAB member associations averaged for 2010 – 12 and for 2015 – 17, the final three years of the second and third five-year review periods, respectively. Mexico's share of the U.S. market has expanded from 57.7% to 79.0% during this period, while Peru's share expanded from 1.4% to 4.8%. These share gains have come at the expense of the shares for California and Chile, as the table indicates. Nearly all shipments of Hass avocados to the U.S. market are from HAB members,

given the inconsequential shares for the Dominican Republic and New Zealand.

Table 1. Fresh Avocado Market Share in the United States

	California	Mexico	Chile	Dom. Republic	New Zealand	Peru	Total Volume
				Millions of lbs.			
2015	262.6	1,772.8	20.7	18.5	0.3	106.2	2,181.0
2016	365.8	1,718.8	55.8	26.9	0.0	71.9	2,239.3
2017	202.1	1,734.1	80.9	33.4	0.0	141.7	2,192.1
2015-17 Avg.	830.5	5,226	157	79	0	320	6,612
% Share	12.6	79.0	2.4	1.2	0.0	4.8	100.0
2010	516.5	586.7	142.3	1.2	0.0	0.2	1,246.9
2011	264.5	700.3	150.9	3.9	1.3	16.8	1,137.7
2012	424.2	967.8	93.2	1.5	0.2	36.8	1,523.6
2010-12 Avg.	1,205.2	2,254.8	386.4	6.6	1.5	53.8	3,908.2
% Share	30.8	57.7	9.9	0.2	0.0	1.4	100.0

A fresh avocado is quite perishable, making timing of production and shipment an important consideration for the market and for the scheduling of promotions by the member associations. Figure 2 shows the average weekly distribution of fresh avocado shipments for the HAB member associations for 2015 – 17. We see that a key factor supporting Mexico's growth in share of the U.S. market is the ability of Mexican importers to supply avocados to the market over the entire year, although there is a distinct lull in Mexican shipments during the summer months. California's and Peru's shipments are quite counter seasonal to Mexico's, peaking in the late spring through early summer for California and mid to late summer for Peru. Chilean shipments, conversely, tend to peak at similar times to Mexican shipments. The difficulty in Chilean exporters competing head to head with Mexico, given the latter's locational advantage relative to the U.S. market, no doubt is an important factor in explaining the decline in Chilean avocado shipments to the U.S. and the redirection of their production to domestic sales and the European and domestic Chilean markets.

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

Source: Hass Avocado Board, Shipment Volume Data.
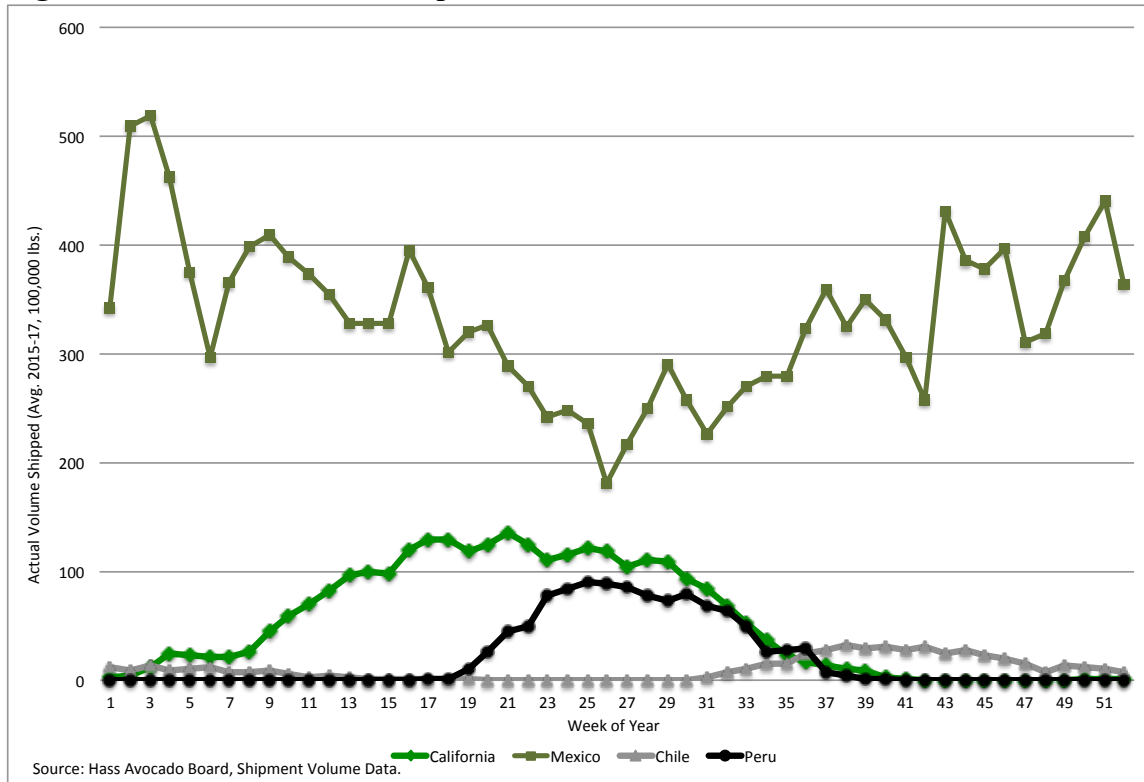
3.1. *Fresh Avocado Prices*

One key measure of the strength of the market for fresh avocados is the prices attained by the different participants in the market chain—producers, importers, and retailers. We know from prior discussion that avocado shipments to the U.S. market have expanded dramatically since the creation of the HAB. Fundamentally, expanded sales for a product can be achieved in two ways: (1) through lower prices, i.e., by moving "down" along a static demand curve, or (2) by increasing demand, i.e., shifting a demand curve outward or to the right to enable more product to be sold for any particular price. Of course, expanded sales may be achieved through some combination of these two factors.

The evidence on prices contained in figures 3 and 4 indicates quite conclusively that the expansion of sales in the U.S. market has been achieved primarily through factor (2), rising

demand for avocados in the U.S. Both figures show that the increase in avocado consumption in the U.S. has been achieved, while real prices have remained steady or increased slightly. Simultaneously rising consumption and constant or rising real prices can only be achieved through demand expansion.

Figure 3. Per Capita Consumption and Domestic Producer Price

Source: Per capita consumption data from USDA, Fruit and Nut Yearbook; price data from California Avocado Commission; prices deflated by U.S. Consumer Price Index, Bureau of Labor Statistics.
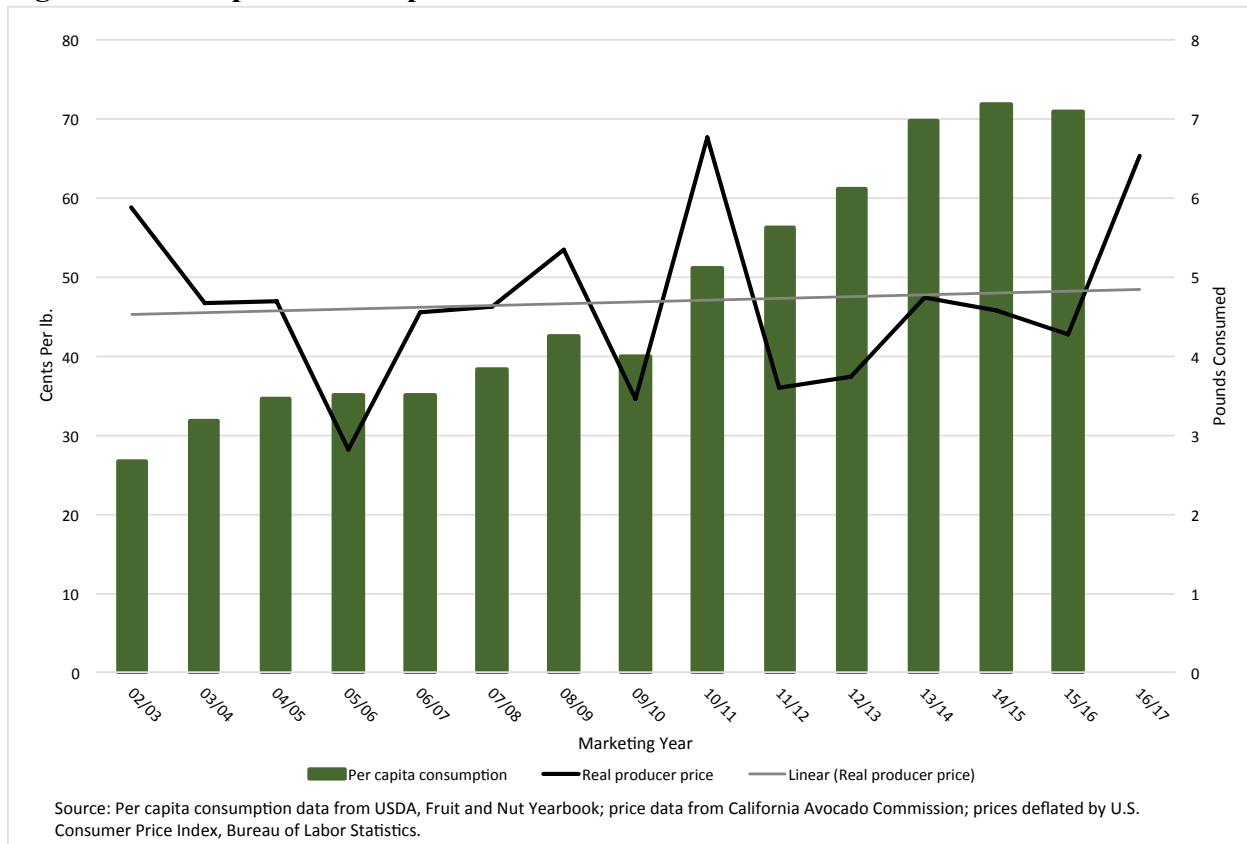
Figure 3 plots U.S. per capita avocado consumption relative to the real (deflated to base year 1982) price received by California producers over the life of the HAB—2002/03 – 16/17. Producer prices for avocados are quite volatile, as the figure shows, caused largely by year-to-year variability in supplies from California and the importing countries and inelastic demand,[2] but on average the real grower price has remained steady or even increased slightly over this 15-

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[2] An inelastic demand is relatively unresponsive to price changes or, equivalently, price is very responsive to supply changes. Thus, even modest shocks to supply can have a significant impact on prices in the supply chain.

year period. A trend line fitted to the price series is depicted in the graph. It suggests a real producer price increase of about ¼ cent per lb. per year on average, but this trend coefficient is not statistically different from zero, i.e., there is no solid statistical basis to conclude that the trend line is not flat and that the real California producer price has remained stable on average over this period.

Figure 4 examines the average real (deflated) price received by importers for fresh avocados at the U.S. ports of entry from 2009 – 2017 (data for earlier years are unavailable). The trend line depicted in the figure shows a real price that is increasing on average at a rate of 1.5 cents per pound per year, an estimated effect that is statistically significant at the 90% level of confidence.

Figure 4. Importer Price and Trend, 2009 - 2017

Source: USDA, Economic Research Service, Fruit and Tree Nut Import/Export Data; price deflated using the Consumer Price Index.
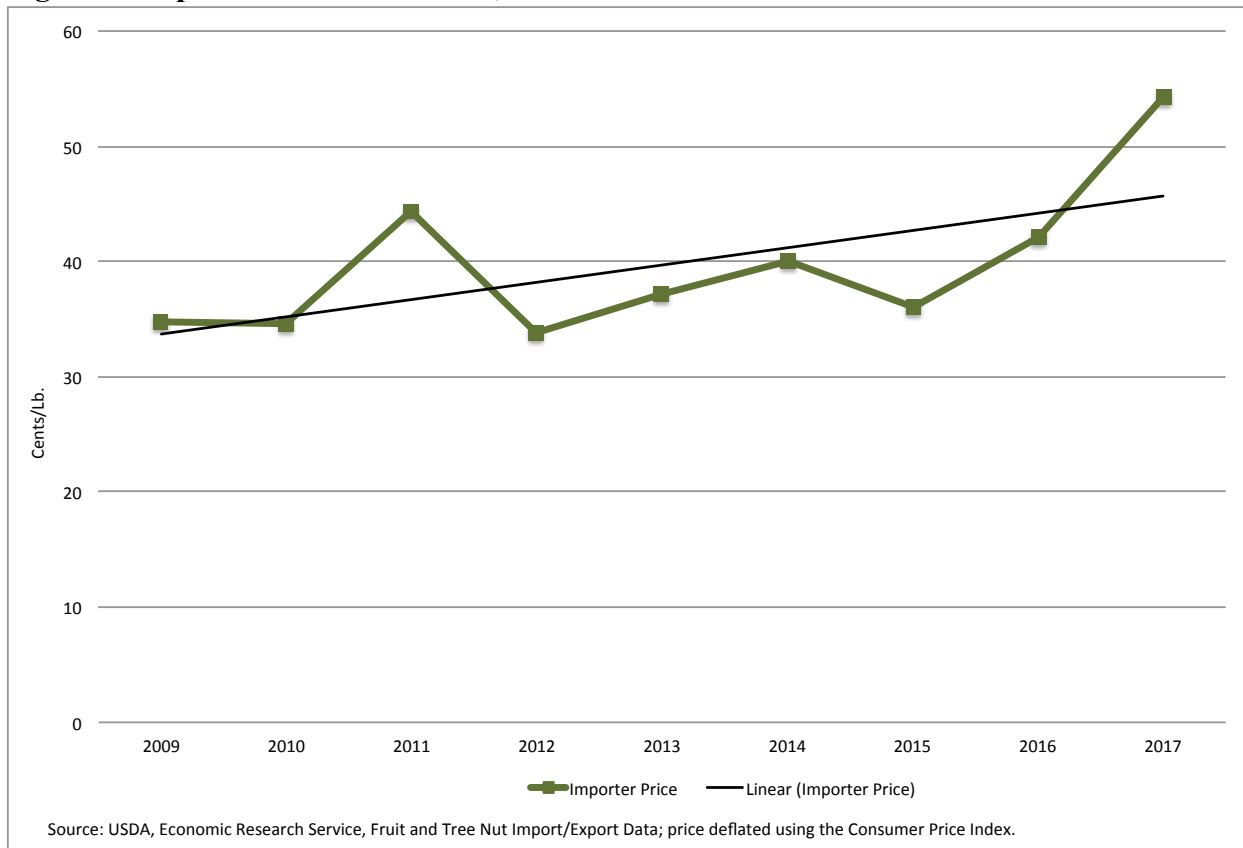
3.2.   Processed Avocado Sales

Although the HAB collects assessments only on the sales of fresh avocados and, accordingly, directs its activities towards the fresh segment of the market, the processing segment also deserves brief mention. Fresh and processed avocados are substitutes for some uses. It is also likely that the processed segment of the market benefits from promotions conducted under the auspices of the HAB. Most processed avocado products consumed in the U.S. are imported, and U.S. imports of processed (prepared or preserved, with additives) avocados since 2003 are shown in figure 5, with the volume of fresh avocado imports also presented to provide a comparison.

Figure 5. Fresh and Processed Avocado Imports

Source: USDA, Foreign Agricultural Service.

Fresh Hass Avocado Promotions in the United States: Description and Nearly all processed avocado products imported into the U.S. during this review period originated in

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Mexico. Processed avocado imports from Mexico from 2013 – 17 totaled just over $1 billion and increased over each of the five years, rising from $139.6 million in 2013 to $293.9 million in 2017. Peru was the only other country from which the U.S. imported any meaningful quantity of processed avocados, with $32.1 million in cumulative imports over 2013 – 17. Despite it being the second largest importer of processed avocado products to the U.S., Peru's imports over the review period were only 3% as large as Mexico's.

4. Qualitative Evaluation

Table 2 reports funding received by the HAB from California shippers and U.S. Customs for each year in the review period and the dissemination of funds to the member associations under the 85% rebate. Given the constant 2.5 cent per pound assessment rate, revenues are directly proportional to shipment volume. The table shows rising revenues through 2015, exceeding $50 million for the first time in that year, and then a leveling for 2016 and 2017, reflecting the same leveling in total shipments discussed earlier.

Table 2. HAB Assessments and Rebates to Member Associations

	HAB Assessments Collected ($)				
	2013	2014	2015	2016	2017
California	11,684,718	7,014,964	6,544,217	9,193,135	4,852,141
Customs	30,584,921	39,284,206	47,006,190	45,540,871	46,984,147
Total	*42,269,638*	*46,299,171*	*53,550,408*	*54,734,005*	*51,836,288*
	HAB Rebates to Member Associations ($)				
California	9,929,359	5,961,570	5,560,964	7,810,294	4,118,480
Mexico	23,841,408	28,071,728	37,333,304	35,899,279	35,141,821
Chile	1,029,003	2,064,740	422,222	1,266,955	1,732,927
Peru	1,009,786	3,001,464	2,122,899	1,444,464	2,945,079
Total Rebates	*35,809,556*	*39,099,503*	*45,439,389*	*46,420,992*	*43,938,307*

Member associations may choose to supplement the revenues they receive from HAB rebates with additional sources of funding. The California Avocado Commission levies an ad valorem assessment on revenue from sales of California avocados. This assessment was 1.75%

in 2012-13, 2.10% in 2013-14, and 2.30% over the remainder of the review period. That revenue is pooled with HAB-rebate revenues to comprise the total resources available to support the CAC's programs.

MHAIA partners with the Association of Avocado Producers and Packer Exporters of Avocados from Mexico (known as APEAM from its Spanish acronym) to jointly comprise Avocados from Mexico (AFM). APEAM collects funds from its members under a voluntary levy. These funds are pooled with revenues rebated to MHAIA from the HAB to comprise the resources available to AFM to promote sales of Mexican Hass avocados.

Because member associations with multiple revenue streams pool the revenues from the different sources and fund promotions from the total revenue pool generated in this manner, it is impossible to separate the impacts of promotions from HAB funds from impacts of funds from other revenue streams. Our strategy in the econometric analysis, described in the subsequent sections, is to evaluate the impacts of promotions of fresh Hass avocados in the U.S. by HAB, CAC, CAIA, MHAIA/AFM, and PAC regardless of the funding source, recognizing that the significant majority of these funds are generated through the HAPRIO. In what follows we first outline the major factors that in our view are shaping food consumption and food markets in the U.S. and should guide associations in designing their promotion programs. We then examine the promotion expenditures and marketing campaigns executed during this review period by the HAB, CAC, CAIA, MHAIA/AFM, and PAC.

4.1. Key Considerations Driving U.S. Consumer Demand

An important aspect of commodity promotion evaluation is to consider whether an organization's promotional activities are calibrated to capitalize on major factors driving

consumer demand in the relevant markets. It is important for the HAB, its member associations, and their marketing agents to identify, understand, and capitalize on these key trends in the design and execution of their marketing programs.

Consumers in the U.S. on average spend about 11 percent of their disposable incomes on food, a budget share that has been relatively stable since 2000. Declining budget shares expended on food at home have been offset by higher shares spent on food away from home. Based on the most recent data, the budget share for food consumed at home is about 6.0 percent; budget share is 5.4% or 47% of the total food budget for foods consumed away from home.

As food becomes a less important share of consumers' budgets, they are more willing to spend additional money for foods that contain particular attributes or characteristics important to them. In addition to traditional characteristics such as taste, appearance, convenience, brand appeal, and healthfulness, characteristics of the production process (e.g., usage of chemicals, sustainability, geographic location), and implications of production and consumption of the product for the environment also matter increasingly to many consumers. U.S. consumers are concerned more than ever with the safety of the foods they eat and implications for their health. General claims about health impacts tend to resonate much less than credible claims about specific health benefits from consuming particular foods.[3]

Avocados have a compelling story to tell that aligns closely with the evolution of consumer food preferences, a fact reflected in the remarkable growth experienced in per capita avocado consumption. Avocados are a nutrient dense food that provide relatively unique health benefits that include abundant nutrients (vitamins C, B5, B6, E, and K), potassium, folate,

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[3] Consumer willingness to pay for these "enhanced" attributes of foods has been studied extensively by agricultural economists, with results generally showing that consumers are willing to pay substantial premiums for environmentally or animal friendly products or products with certifications such as Fairtrade. See Saitone and Sexton (2017) for a summary of this work.

protein, and healthy fats. Seven of the nine grams of carbohydrates in a 100-gram serving are fiber, qualifying avocados as a low-carb food.

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

In the discussion that follows we will see that HAB members, led by the HAB itself, have worked hard to identify and communicate the health benefits of consuming avocados and to associate avocado consumption with an active, healthy lifestyle.

4.2. *Hass Avocado Board Direct Promotion Programs*

U.S. commodity boards have traditionally funded production research among their activities. Such research can improve production methods and benefit producers by lowering costs. However, through the ordinary workings of the market, lower production costs soon translate into increased supplies and lower producer prices, obviating the gains achieved from lower costs.

Further, it is difficult or impossible to prevent the improved production methods from being disseminated to producing regions and countries that did not support the research funding, causing a free-rider problem and putting further downward pressure on price.

An emerging trend for U.S. commodity boards is to direct some portion of research funding to study of health and nutritional benefits of their commodity. With a consuming population that is increasingly concerned about health and nutrition, discovery of specific positive health benefits from consuming the commodity, if disseminated widely to consumers, can increase demand for the product, enabling both greater sales and higher prices. The negative price impact of supply-shifting production research is avoided with demand-shifting research.

The HAB has adopted the strategy of funding research into the health and nutrition benefits of Hass avocados and then promoting these documented benefits to consumers directly through targeted media and also indirectly through outreach to key influencers such as physicians, dietitians, and media personnel.[4] Table 3 shows the HAB's expenditures by major category since 2008. We note from table 3 that the HAB has annually expended substantial amounts to provide market information on shipments and retail sales and prices locally, regionally, and nationally. Based upon our experience, the HAB's commitment to provide relevant market information to its members and other users is unparalleled. Although we don't consider these expenditures as directly pertaining to product marketing, they no doubt have considerable value to HAB members and others in the supply chain, who are engaged directly in the buying and selling of Hass avocados and designing and executing marketing campaigns.

The Board's commitment to fund nutrition research and disseminate the findings began in earnest in 2011 when nearly $1 million was expended to support such research. That amount

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[4] In a companion report to this study, Ma, Saitone, and Sexton (2018) evaluate the impacts of health and nutrition research funded by the HAB.

more than doubled in 2012 to in excess of $2 million, before settling into a pattern of spending close to $1 million per year—a five-year average expenditure was $989,400—over the 2013 – 17 review period at issue in this study.

The Board commensurately has ramped up its funding to promote the health and nutrition benefits of consumption of fresh Hass avocados. Throughout the review period the Board has divided its nutrition marketing effort into two components. One component is known as the "toolbox", which represents marketing and communications resources that support nutrition messages that are approved by USDA and have been tested on consumers. The toolbox materials are available for HAB's own uses, as well as use by its member organizations and strategic partners.

Table 3. HAB Expenditures by Category: 2008-2017

Year	Rebates	Promotion/Market Research	Nutrition Research	Information	Admin	Total
			Thousands of Dollars			
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
2013	35,810	4,037	732	542	1,608	42,729
2014	39,100	3,577	978	697	1,014	45,365
2015	45,439	5,143	1,073	842	1,190	53,687
2016	46,421	5,908	946	759	1,187	55,221
2017	43,938	5,015	1,218	852	1,208	52,232

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

Although the HAB has an active presence on the web and through social media, final consumers have generally been a secondary target audience for the HAB.[5] The Board's primary

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[5] We noted an increasing emphasis for the Board on marketing food and wellness issues direct to consumers in both the general and Hispanic markets in the most recent years of the review period.

target audience is key influencers within the scientific community, media, retail, and foodservice who the Board seeks to reach and inform regarding the fresh avocado research pipeline, updates on nutrition labels/nutrition affairs, and the Love One Today® theme that has been emphasized throughout the review period. HAB's marketing under the Love One Today® theme seeks to align with four key health benefits associated with consumption of fresh avocados: cardiovascular health, weight management, healthy living, and type 2 diabetes. The healthy living campaign seeks to promote avocado consumption as a first food for infants and a food to build healthy eating habits among children.

As the umbrella organization supporting the marketing and promotion of fresh Hass avocados by its member organizations, we regard the HAB's market focus on health and nutrition as synergistic complements with the programs undertaken by its members. Resources provided through the HAB's toolbox can inform and enhance member programs. The Board's focus on health and nutrition is consistent with key forces motivating U.S. consumers in today's market and is a good strategy in our view for building long-term demand growth.

4.3.   California Avocado Commission Promotion Programs

Revenues accruing to the CAC from HAB rebates and its own ad valorem assessment are

reported in table 4, along with CAC's aggregate annual promotion expenditures. CAC's revenue stream declined over much of the review period reflecting a generally smaller California harvest over time. The revenue stream from CAC's own assessment, however, increased over the first four years of the review period, reflecting the incremental increases in the assessment rate discussed earlier. Revenues from both HAB rebates and the CAC assessment were down sharply in 2017 reflecting the sharply lower California harvest in this year.

The CAC's overarching marketing strategy during the review period has been to stress the "California grown" aspect of its members' production including creation and marketing of California branding. As part of this emphasis, CAC's promotions stress the proximity of California production to the Western U.S. markets that are a major focus for its members and the freshness and ability to harvest near peak ripeness that is associated with short hauls from orchard to market. CAC promotions are timed relative to the late spring through summer harvest of California Hass avocados—Memorial Day through Labor Day, with the July 4 holiday having a major emphasis in the CAC's promotions.

Table 4. CAC Assessment Revenues, HAB Rebates, and Promotion Expenditures

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

[a] Rebate revenue numbers differ from those reported in table 2 given that CAC budgets are based on fiscal year while HAB reports on a calendar-year basis.

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

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

- Increasing demand for California avocados in target markets in season;

- Strengthening the California avocado brand identification;

- Increasing preference and loyalty for California avocados versus avocados of other origins.

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

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

The share of CAC's marketing budget devoted to its target audiences remained relatively stable over the review period. Over the five-year review period 58.3% of the promotion budget (table 4) was devoted to consumer marketing through the various media, ranging from a low of 55.3% in FYs 2013-14 and 2014-15 to a high of 63.3% in FY 2012-13. Merchandising and food service have comprised the second most important expenditure of funds, ranging from 23.4% in 2012-13 to 30.5% in 2015-16.

In our view, the CAC is pursuing a very sensible marketing strategy in terms of

emphasizing natural advantages of California production in the market place. This includes promoting the California brand and stressing potential quality advantages of California avocados due to their relatively short time farm to table transit time. The multifaceted focus on final consumers, key influencers, and merchandisers and food service is also sensible in light of the forces shaping U.S. food markets and complementary to the types of expenditures being made by the HAB itself.

4.4. Chilean Avocado Importers Association Promotion Programs

CAIA and its marketing partners have faced the challenge that Chilean Hass avocado exports to the U.S. have varied widely over the review period and, accordingly, so have their HAB rebate revenues. CAIA generates a small amount of funds from membership fees, but its primary revenue source is through the HAB. CAIA's revenues from HAB rebates and member assessments for the review period are summarized in table 5, along with CAIA's total marketing expenditures for each year.

CAIA reduced its marketing expenditures in the U.S. over each of the review period (table 5). Nonetheless, CAIA pursued an aggressive and diversified marketing campaign to promote U.S. sales of Chilean Hass avocados. Chilean Hass avocados are in the U.S. market for

a relatively short window—October through February, so one campaign, "Get 'em while they're Chile," is designed to capitalize on the short market window and create a sense of urgency among consumers.

CAIA has mostly targeted the western U.S. and has partnered with leading retail chains operating in this region for in-store displays, demonstrations, volume/promotion incentives, and dissemination of recipes. Key partners have included Costco, H.E.B. (a Texas and Northeast New Mexico chain), Sam's Club, and Walmart. The number of partner retailers has varied across years during the review period due to CAIA's variability in funding. San Jose, Los Angeles, San Diego, Sacramento, Phoenix, Portland, Seattle, and Salt Lake City have represented key target markets. CAIA seeks to add retail partners in the Midwest and Eastern U.S. when available supplies and funding permit it.

Table 5. CAIA Assessment Revenues, HAB Rebates, and Promotion Expenditures

	2012/13	2013/14	2014/15	2015/16	2016/17
	Chilean Avocado Importers Association				
Membership Dues	70,500	4,500	15,000	58,500	42,000
HAB Rebate Revenue	772,928	2,442,751	647,199	528,828	1,354,358
Marketing Program Expenditures[a]	1,737,113	909,457	720,088	585,791	475,477

[a] Total marketing and promotions less "meetings and travel."

A consistent theme in CAIA's promotion activity is to create a Chilean brand that capitalizes on the natural beauty and allure of Chile. Examples of such themes include "vibrant Chile," "Imported from Paradise," and "Chile. The land of avocados." As part of its branding of Chilean Hass avocados, CAIA designed and implemented a distinctive logo for Chilean avocados during the review period. A second consistent theme in marketing to consumers is to stress the health benefits of consuming fresh avocados and that avocado eating is part of a healthy and active lifestyle.

In addition to its retail partnerships, other media engaged by CAIA for consumer

marketing has included digital displays on users' devices, advertising on popular websites such as ESPN, magazine advertising in outlets such as People and Costco Connection, billboards, TV ads through Hulu, radio ads through Spotify, and extensive use of social media including Facebook, Twitter, Instagram, and Pinterest. Given that Chile's marketing season encompasses the U.S. holiday season, a key focus of CAIA's social-media presence has been to disseminate holiday-themed recipes.

CAIA has also worked to partner with key influencers including food bloggers, nutritionists, dietitians, and chefs. It has also engaged with the trade through outlets such as the Packer and Produce News. Among other goals, these relationships are intended to alert consumers and marketers regarding the availability of Chilean avocados on the U.S. market.

In our view CAIA has made significant progress enhancing the Chile brand through the new logo and marketing campaigns that link consumption of Chilean Hass avocados to the natural beauty of Chile. The "Get 'em while they're Chile" campaign seeks to turn what could be a limitation, namely Chile's relatively short marketing season in the U.S., into an advantage. Further, as available funding has declined and become more variable, CAIA has turned increasingly, and wisely in our view, to lower-cost forms of promotion that have the potential for high leverage. Its work on social media and with key food influencers represent prominent examples.

Members of CAIA of course make their own decisions as to where to allocate their product, and, as noted, Europe has become increasingly a preferred destination relative to the U.S. The current situation, where Chilean supplies to the U.S. vary widely from year to year and on average have been in decline, is challenging for marketers. Reliability as a supplier is integral to success as a produce marketer in the U.S. and the same is likely true in terms of reliability as a

partner in promotions. If CAIA must periodically retrench from promotion partnerships due to low supplies of product and limited funding, it challenges these relationships.

4.5.   Mexican Hass Avocado Importers Association/Avocados from Mexico Programs

Table 6 indicates the revenue streams flowing to AFM from HAB rebates to MHAIA and assessment income generated from APEAM members, and AFM's aggregate promotion expenditures during the review period. AFM's revenues increased each year during the review period, more than doubling over the five years. AFM's promotion budget now exceeds the combined budgets of CAC, CAIA, PAC, and the non-rebated revenues retained by the HAB.

Table 6. Avocado from Mexico Revenues and Marketing Program Expenditures

	2012/13	2013/14	2014/15	2015/16	2016/17
	Avocados from Mexico				
HAB Rebate Revenue[a]	23,985,350	21,036,522	31,253,507	35,972,737	40,545,869
APEAM Revenue	11,052	10,661,789	15,628,217	17,996,807	19,983,461
Marketing Program Expenditures[b]	23,069,409	30,755,515	44,148,885	51,185,100	56,294,714

Note: Revenue and expenditures for 2012/13 taken from MHAIA Annual Report, all other information taken from AFM financial statements.
[a] HAB rebate amounts differ from those in table 2 given that AFM financial reports are prepared on a fiscal year basis.
[b] AFM marketing expenses less administrative expenses.

The resources at its disposal enable AFM to advertise and promote Hass avocados from Mexico in national media, including the Super Bowl, annually the most watched TV event in the

U.S. In addition to its Super Bowl ads, AFM promotes Mexican Hass avocados at several other high-profile television events including the Oscars, Grammys, Golden Globes, and Emmys. Its commitment to televised sports includes Notre Dame football and the Kentucky Derby. AFM also tailors a distinct marketing campaign to Hispanic consumers.

AFM's general consumer marketing emphasizes the taste, healthfulness, and versatility of the avocado and stresses the positive elements of fresh Mexican avocados' year around availability in the U.S. market: "fresh 365 days a year." Other themes pursued during the review period include "this calls for avocados from Mexico," a concept that builds upon the idea that adding avocados can enhance many foods and dishes, "viva tradition," to build on the idea that avocados are part of major sporting events, and "made with love," which emphasizes the care that goes into the production process for avocados from Mexico, from grower to consumer.

In addition to its promotions on national television, AFM promotes to consumers through print and digital media.[6] AFM ads have been featured in magazines such as the Food Network Magazine, Dr. Oz, Cooking Light, People, Sunset, and Health, among others. As an example, in 2015, the midpoint of the review period, the media mix based on expenditure was 71% television, 15% digital, and 9% print, with the remainder allocated to search media and paid social media.[7]

AFM has allocated in excess of $3 million in each of the past two years, about 7% of the total marketing and trade budget, to promoting avocados from Mexico to the Hispanic market. A key theme of the Hispanic marketing program is "toast to your heritage," a concept that reminds Hispanic consumers that avocado consumption is an important part of their heritage and works to

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[6] AFM maintains three active websites targeted to (i) the general consumer, (ii) the Hispanic consumer, and (iii) food service.

[7] AFM is active on most social media platforms including Facebook, Twitter, Pinterest, Instagram, You Tube, and Google+. Concepts promoted on social media include avocado education, linking the avocado to Mexican culture, and sharing of recipes.

offset the tendency for avocado consumption to decline as Hispanic consumers acculturate to traditional American diets. The Hispanic campaign targets specifically millennial women in the 25 – 44 age group through a broad array of traditional and social media. Specific promotions have included partnering with Mexican beers including Tecate and Dos Equis, promoting avocados as a way to enhance meatless meals for Catholic Hispanics during the period of Lent, and developing soccer-themed promotions.

AFM also devotes substantial resources to market Mexican Hass avocados to the trade. Although there are year-to-year differences, AFM generally allocates slightly less than one third of its marketing resources to the trade. AFM partners with many retail chains to promote Mexican Hass avocados through in-store radio, displays, coupons, contests, demos, and point-of-sale branding. An interesting theme pursued in conjunction with retailers during the review period was to build demand and create an avocado-consuming "momentum" following the Super Bowl and leading into Cinco de Mayo. One key element of this promotion was the concept of the "fanwich," the idea that avocado slices should join tomatoes, lettuce, etc. as an essential ingredient to add to sandwiches.

Finally, AFM has also pursued an expansive promotion campaign to food service, generally allocating about 10% of the total marketing and trade budget to this category. The food service campaign has emphasized fast food (burger and sandwich/deli), casual and fast casual, steakhouses, and other high-volume restaurant chains and the distributors who supply them. Key goals have been to emphasize the year-round availability of avocados from Mexico and increase the menu presence of avocados in sandwiches, breakfasts, and other meals.

Through the rapid growth in sales volume for Hass avocados from Mexico and pooling revenues from HAB rebates and APEAM, Avocados from Mexico has achieved what few

commodity promotion organizations have been able to accomplish, namely generate sufficient funds to directly target consumers through national campaigns using leading media outlets such as broadcast television. AFM consumer promotions have capitalized on the consistent availability of Mexican avocados and highlighted fresh Hass avocados as a versatile and fun food for special occasions and for general consumption.

Given the large and growing Hispanic population segment in the U.S. and the strong connection of most Hispanic residents with a Mexican heritage, targeting promotions directly to the Hispanic population strikes us as a very wise strategy, particularly since this population segment is likely to prefer Mexican avocados relative to those from other points of origin. Worth noting in conclusion is that, despite its increasing expenditures on promotions to final consumers, AFM has not lost sight of the importance of marketing to the trade and food service.

4.6.   Peruvian Avocado Commission Promotion Programs

The rebate revenues received by the PAC from HAB and PAC's annual marketing program expenditures for the review period are provided in table 7. Our analysis of PAC promotion programs, however, considers only the 2014 – 2017 time period. The PAC changed its marketing

agency in 2014, and we were unable to obtain documentation to review marketing activities for 2013. Similar to its Southern neighbor, Peru experienced considerable volatility in its Hass avocado shipments to the U.S. and its rebate revenue during the review period. Unlike Chile, however, Peru is on average demonstrating an increasing presence in the U.S. market, with much of the volatility due to an exceptionally large export volume in 2014 that tripled rebate revenues from just over $1 million in 2013 to $3 million. Rebate revenues then declined to $2.12 million in 2015, declined further in 2016, before increasing substantially to nearly $3 million in 2017.

Avocados from Peru typically enter the U.S. market in late May, with the season continuing in most years through August. PAC has accordingly marketed Peruvian avocados as the "summer avocado." Traditional core markets have been in the Eastern U.S.: Boston, Baltimore, New York Philadelphia, and Washington, DC, but a large number of "expansion markets" have been identified, which include major cities across the U.S. PAC's primary focus on the Eastern U.S. limits head-to-head competition with California avocados, which share a similar marketing season, because California avocado marketers and the CAC place primary focus on the Western U.S.

Table 7. PAC Rebates from HAB and Promotion Expenditures

	2013	2014	2015	2016	2017
	Peruvian Avocado Commission				
HAB Rebate Revenue[a]	1,009,786	3,001,464	2,122,899	1,444,464	2,945,079
Marketing Program Expenditures[b]	NA	1,935,174	1,710,541	873,800	730,819

[a] From HAB Revenue and Rebates Data.
[b] Avocado from Peru Annual Campaign Summaries.

As its revenues have risen, PAC has modified its market strategy from one focusing mainly on the trade, with presence in outlets such as the Packer, Produce News, Produce Business, and Supermarket News, to emphasize direct-to-consumer marketing, while still maintaining its presence in the trade press. PAC has reached U.S. consumers mainly along the

Eastern seaboard through a variety of media. These include partnerships with major retailers including Costco, Sam's Club, Walmart, the Ahold retail chains Giant and Stop&Shop, and the Wakefern retailers Price Rite and Shop Rite. These partnerships involve radio, in-store displays, contests, point-of-sale demos, and in-store digital displays. Other media include TV ads on the Food Network, social media via Facebook and Instagram, radio ads generally targeted to cities along the Eastern Seaboard, billboards, bus wraps, and advertisements in magazines including Vogue, Vanity Fair, Women's Health, and Washington Life.

In addition to the "summer avocado" theme, PAC promotions have emphasized a "superfood" theme to focus attention on the documented health and nutrition benefits of avocado consumption. Although the effort is still somewhat in its nascent stages, PAC is exploring co-marketing with other major Peruvian food exports—asparagus, blueberries, pomegranates, and quinoa—to develop the "Peruvian Superfoods" theme.

Although 2017 was a comparatively light year for PAC in terms of promotion expenditures due to low 2016 exports to the U.S., the distribution of revenues, $217,000 to radio, $66,000 to outdoor, $42,000 to print, $63,500 to the trade, and $91,800 to digital, provides a sense of PAC's allocation of expenditures across outlets. We think PAC has sensibly adjusted its promotion mix to reflect its increasing presence in the U.S. market, and placing its primary focus on the Eastern U.S. also makes sense in limiting direct competition with CAC and California avocados. One suggestion for the next review period is for PAC to invest more in branding and developing and marketing advantages of the Peruvian brand.

5. Panel Econometric Model of Fresh Hass Avocado Sales in Local Markets

This section presents analysis of demand for fresh Hass avocados at retail utilizing weekly grocer scanner data aggregated to the market level. This disaggregate scanner-data analysis

complements the analysis based upon total U.S. monthly retail sales data, which is presented and discussed in the next section.

In constructing the data set for this analysis, expenditures for AFM, CAC, CAIA, and PAC and targeted to specific local or regional markets in a given week were aggregated to those market levels. National promotions conducted by AFM and CAC were added to the local/regional promotion total to yield a total promotion expenditure targeted during that time to the specific market area.[8] If a specific local/regional or national promotion spanned multiple weeks, as often was the case, we assumed that the expenditure was distributed uniformly across the weeks. Thus, for example, for an expenditure of $X total dollars on a marketing campaign in metropolitan area A that ran Y weeks, $X/Y was allocated for each week of the campaign to metropolitan area A. The same approach was used to allocate national expenditures by AFM and CAC across individual weeks. If a promotion was targeted regionally and encompassed multiple of the IRI market areas, the expenditure was divided equally across those market areas.

The retail sales data used for this analysis are based on scanner data collected by Information Resources, Inc. (IRI) and provided by the Hass Avocado Board. The data include total weekly retail sales in value and volume for fresh Hass avocados (aggregated across all relevant PLU codes) in 45 distinct local market areas and eight regions (53 cross sectional observations in total) for the five years spanning 2013 – 17.[9] These data represent an aggregation of retail outlets that includes the following channels: grocery, mass merchandisers, club stores, drugstores, dollar outlets and military commissaries. An average price or unit value is computed

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[8] See section 4 for a discussion of the types of promotions being conducted by each member association including media utilized, themes emphasized, and target audiences.

[9] Most of these local markets represent metropolitan areas, although a few are localized regions and not metropolitan areas per se. In particular, North Texas/New Mexico, South Carolina, and Northern New England are included in the 45 market areas. See table 8 for a complete listing of the market areas included in the IRI scanner data.

in each market and each week by dividing sales value by the number of fresh Hass avocados sold.

Population data for each market area were collected by IRI on an annual basis and we utilized these data to convert sales volume to a per capita basis. In this manner the analysis controls for changes in demand due to changing population levels within the metropolitan area.

To be included in the econometric analysis, a market area needed to be included in the IRI data set maintained by the HAB and also be the target of local or regional promotion activities by AFM, CAC, CAIA, or PAC. Table 8 lists the market areas targeted for local/regional promotions and those included in the scanner data. An X in the promotion column indicates that the area was targeted for local/regional promotions, and an X in the scanner data column indicates that the area had IRI scanner data available. Market areas with an X in both columns were utilized for the econometric analysis.

Table 9 provides summary data on the market areas included in the analysis, including population mean, mean and standard deviation of weekly per capita sales quantity of fresh Hass avocados, mean and standard deviation of average sales price (ASP), and mean and standard deviation of per capita retail sales value. (total in $ per week and per capita in cents per week), price, and per capita volume. The value of per capita weekly sales nationally averaged across the entire data period was $0.11. Notable in the table is the price variation across market areas and within market areas across time (based on magnitude of the reported standard deviations) and the variation in per capita consumption, both across market areas and weeks in the year. Such variation in the data presents a good opportunity to identify impacts of promotions and price on sales.

Table 8. Market Areas: IRI Scanner Data and Promotions

Market	Scanner data	Promotion data	Market	Scanner data	Promotion data
Alaska		X	Montana		X
Albany	X	X	Nashville	X	
Atlanta	X	X	New Orleans/Mobile	X	X
Atlantic City		X	New York	X	X
Austin		X	Northern New England	X	X
Baltimore/Washington	X	X	Orlando	X	X
Boise	X	X	Philadelphia	X	X
Boston	X	X	Phoenix/Tucson	X	X
Buffalo/Rochester	X	X	Pittsburgh	X	X
California	X	X	Portland	X	X
Charlotte	X	X	Raleigh/Greensboro	X	X
Chicago	X	X	Richmond/Norfolk	X	X
Cincinnati/Dayton	X	X	Roanoke	X	X
Columbus	X	X	Sacramento	X	X
Dallas/Ft. Worth	X	X	Salt Lake City		X
Denver	X	X	San Antonio		X
Detroit	X		San Diego	X	X
Fresno		X	San Francisco	X	X
Ft Wayne		X	Santa Barbara		X
Grand Rapids	X		Seattle	X	X
Harrisburg/Scranton	X	X	South Carolina	X	X
Hartford/Springfield	X		Spokane	X	
Houston	X	X	St. Louis	X	X
Indianapolis	X	X	Syracuse	X	X
Jacksonville	X	X	Tampa	X	
Kansas City		X	Toledo		X
Las Vegas	X		US Total	X	X
Los Angeles	X	X	West Tex/New Mexico	X	X
Louisville	X				
Miami/Ft. Lauderdale	X				

Table 9. Statistics by Market Area

Market	Mean	Mean [SD]	Mean [SD]	Mean [SD]
	Population (millions)	*Per capita avocados sold*	*ASP (per avocado) ¢*	*Per capita retail sales value ¢*
Albany	1.13	0.06 [0.03]	126 [18]	7.97 [3.84]
Atlanta	5.16	0.08 [0.02]	116 [17]	9.57 [2.29]
Baltimore/Washington	8.43	0.09 [0.02]	130 [18]	11.27 [2.36]
Boise	0.64	0.11 [0.02]	119 [20]	12.49 [3.07]
Boston	5.61	0.09 [0.02]	128 [19]	11.42 [3.05]
Buffalo/Rochester	2.46	0.05 [0.01]	140 [12]	6.91 [1.84]
California	38.31	0.14 [0.03]	112 [22]	15.79 [2.87]
Charlotte	2.76	0.07 [0.02]	127 [18]	8.28 [2.36]
Chicago	9.07	0.08 [0.02]	132 [29]	9.94 [2.68]
Cincinnati/Dayton	2.96	0.07 [0.02]	120 [23]	7.93 [2.56]
Columbus	2.04	0.07 [0.02]	115 [17]	8.06 [2.10]
Dallas/Ft. Worth	6.66	0.16 [0.03]	88 [13]	14.15 [2.56]
Denver	3.93	0.17 [0.04]	117 [17]	20.12 [3.62]
Detroit	4.78	0.07 [0.02]	118 [20]	7.72 [1.84]
Grand Rapids	1.7	0.09 [0.03]	130 [27]	11.64 [2.95]
Great Lakes	46.68	0.06 [0.02]	123 [19]	7.68 [1.93]
Harrisburg/Scranton	4.48	0.05 [0.01]	124 [14]	5.98 [1.62]
Hartford/Springfield	3.23	0.09 [0.02]	134 [20]	11.53 [2.58]
Houston	6.32	0.17 [0.03]	85 [13]	14.10 [2.82]
Indianapolis	2.26	0.06 [0.02]	127 [20]	7.94 [1.97]
Jacksonville	1.66	0.08 [0.03]	126 [22]	10.17 [3.12]
Las Vegas	2.06	0.14 [0.03]	104 [19]	14.21 [2.68]
Los Angeles	17.47	0.15 [0.03]	102 [22]	14.76 [2.94]
Louisville	1.27	0.06 [0.02]	125 [20]	7.03 [2.19]
Miami/Ft. Lauderdale	5.83	0.08 [0.03]	130 [23]	10.02 [3.20]
Midsouth	38.47	0.07 [0.02]	123 [15]	8.35 [2.01]
Nashville	1.86	0.09 [0.03]	112 [16]	9.80 [2.70]
New Orleans/Mobile	3.04	0.08 [0.02]	109 [17]	8.36 [2.11]
New York	19.82	0.06 [0.02]	138 [21]	8.76 [2.15]
Northeast	55.89	0.07 [0.02]	132 [17]	8.74 [2.26]
Northern New England	3.3	0.11 [0.03]	123 [18]	13.59 [3.94]
Orlando	3.35	0.08 [0.03]	124 [20]	10.09 [3.31]
Philadelphia	6.55	0.06 [0.01]	137 [18]	7.98 [1.85]
Phoenix/Tucson	5.04	0.2 [0.05]	75 [18]	14.60 [2.54]
Pittsburgh	2.51	0.04 [0.01]	137 [20]	4.70 [1.45]
Plains	20.95	0.08 [0.02]	120 [17]	9.10 [2.07]
Portland	3.28	0.15 [0.03]	121 [19]	18.14 [3.85]
Raleigh/Greensboro	3.49	0.07 [0.02]	123 [16]	8.76 [2.27]
Richmond/Norfolk	2.89	0.08 [0.02]	113 [14]	8.74 [2.11]

Table 9 Cont.

Market	Mean	Mean [SD]	Mean [SD]	Mean [SD]
	Population (millions)	*Per capita avocados sold*	*ASP (per avocado)*	*Per capita retail sales value*
Roanoke	2.36	0.05 [0.01]	115 [15]	6.23 [1.43]
Sacramento	2.92	0.14 [0.03]	124 [20]	17.59 [3.60]
San Diego	3.22	0.15 [0.03]	108 [23]	15.57 [2.90]
San Francisco	6.39	0.12 [0.03]	133 [28]	15.79 [2.63]
Seattle	3.62	0.13 [0.03]	137 [21]	18.09 [3.78]
South Carolina	5.27	0.06 [0.02]	119 [16]	6.72 [1.87]
South Central	38.19	0.14 [0.03]	90 [12]	12.39 [2.27]
Southeast	42.34	0.07 [0.02]	122 [19]	8.38 [2.39]
Spokane	0.63	0.12 [0.03]	125 [19]	14.31 [3.10]
St. Louis	2.61	0.07 [0.02]	127 [16]	8.26 [1.58]
Syracuse	1.16	0.05 [0.02]	136 [11]	6.41 [2.16]
Tampa	3.62	0.09 [0.03]	126 [22]	10.47 [3.31]
Us Total	314.94	0.1 [0.02]	112 [16]	10.68 [2.29]
West	34.09	0.16 [0.03]	106 [16]	16.74 [3.13]
West Tex/New Mexico	4.04	0.2 [0.04]	89 [12]	17.46 [3.05]
Total	15.24	0.1 [0.05]	120 [23]	10.95 [4.56]

5.1. *Model Specification*

The data set described herein represents what statisticians call a *panel* because it combines both a cross section of data, namely the different market areas included in the analysis (those with an X in both columns of table 8) and a time series of data, namely weekly observations across the five-year review period. Our econometric model seeks to explain weekly per capita consumption of fresh Hass avocados in each market area in the panel as a function of current and lagged values of the average price faced by consumers in the market area and the total amount of promotion expenditure directed to consumers in the market area during that week. A one-week lag in price has been found to have a statistically significant impact on current week sales in the prior HAB reviews and was also included in this study. The rationale is that consumers likely accelerate

their purchases in weeks when fresh avocados are on sale and then reduce them in the following week.[10]

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

We introduced three types of fixed effects into the econometric model. First is a fixed effects variable for each market area included in the study. For example, if an observation is from the Albany, NY market area, we create an "Albany" variable that records a value of 1.0 for each observation from Albany, and a value of zero for all market areas that are not Albany. We then create an "Atlanta" variable and do the same thing, and so on. These fixed effects variables account for differences in per capita consumption across market areas (e.g., due to differences in demographic characteristics) that are time invariant.[11]

We also needed to include fixed effects variables for time to handle seasonality in demand for avocados and growth in the demand over time. Two types of time fixed effects were utilized. First, a fixed effect was introduced for each month of the year, which took a value of 1.0

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[10] It would also be desirable to include lagged variables for promotions. This would enable us to test for dynamic impacts of promotions and their durability, i.e., a promotional expenditure in week *t* may impact sales in week *t* but also week *t+1* and so on. Including these dynamic effects is not possible for our model due to the manner in which weekly promotion expenditures were constructed, as described in this section. The need to allocate expenditures equally across weeks of a multiweek campaign means that the current value, i.e., period *t*, of a promotion expenditure and its lagged value, i.e., the promotion expenditure in week *t − 1*, are typically the same value. This creates a severe multicollinearity problem in the sense that the current and lagged values of promotion expenditures are highly correlated in our data set due to the manner of data construction, making it impossible to attribute separate and distinct sales impacts to them.

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

for observations for each market area in that month and a value of zero for every other month. Second, a "year" fixed effect was introduced to account for year-to-year changes in demand.[12] This variable was constructed in a parallel manner to the market-area and week fixed effects.[13]

A final consideration for fixed effects pertains to U.S. holidays. Most holidays are peak periods for consumption of fresh avocados, with the Super Bowl and Cinco de Mayo being most prominent among them. Both of the prior studies of HAB promotions by CLS (2009) and CSS (2013) established the importance of key holidays. Inclusion or exclusion of holiday fixed effects represents something of a conundrum for the analysis because avocado marketers logically often increase expenditures around major avocado-consuming holidays. Failure to include a fixed effect variable to account for, say, the week leading up to the Super Bowl can cause the model to attribute the sales boost during Super Bowl week to the avocado promotions conducted leading up to the game. In fact, however, sales would be higher during this week due to the event itself regardless of promotions. However, it is entirely possible and likely that promotions contribute to the sales spike around Super Bowl, Cinco de Mayo, and other major holidays. A fixed-effects variable for Super Bowl, Cinco de Mayo, etc., will potentially absorb the extraordinary variation in promotion expenditure that is driving sales, underestimating the effect of holiday promotions on sales.

Our solution to this problem is to run models both including fixed effects variables for major holidays and excluding them. In this manner, we attain estimates that likely bound the impact of promotions on sales, with the model containing holiday fixed effects representing a

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[12] Similar but less precisely estimated results are obtained if the model is estimated with the more flexible continuous time trend – a dummy variable for each month of the sample. We choose the model given above both for precision and the straightforward and helpful interpretation of the estimated month and year fixed effects.
[13] It is necessary to omit one variable from each set of fixed effects to avoid a multicollinearity problem known as the "dummy variable trap." Thus, one market area, month, and year are omitted from the model. Results are invariant to which fixed effect is omitted.

lower bound on promotion effectiveness and the model excluding these fixed effects representing an upper bound.

A final choice involved the functional form to utilize for the demand equation. The two functional forms most widely used by economists to conduct demand analysis are linear and double log. In the linear model a linear relationship is assumed to hold between the dependent variable (retail volume of fresh Hass avocado sales) and the explanatory variables (current price, lagged price, promotion expenditures, and the fixed effects). In the double log model all variables except the fixed effects are converted to their natural logarithms. The double log model presumes a nonlinear relationship between avocado sales and price and promotion. We estimated both the linear and double log demand models for the data set described here. Graphical representations of the data suggest that the relationship between price, sales, and promotions are non-linear in levels but linear in logs. Moreover, the coefficients from the double-log model can be easily interpreted as elasticities. For these two reasons, the double-log model is our preferred specification.

5.2.   Estimation Results

Results from estimation of the panel econometric model are presented in table 10. Results of four models are presented—double log model without and with holiday fixed effects, columns (1) and (3) respectively, and linear model without and with holiday fixed effects, columns (2) and (4) respectively. As the graphical analysis of the data suggested would be true, we find that the double log model fits the panel data somewhat better than its linear counterpart, as indicated by the R squared statistic at the bottom of each column. This statistic shows that, with or without the holiday fixed effects included, the double log model explains about three-fourths of the variation

in fresh avocado consumption across market areas and time, while the linear model explains about two-thirds.

Table 10. Panel Econometric Estimates

	(1)	(2)	(3)	(4)
	Natural logarithm retail eaches per capita	*Hass avocados sold per capita (eaches)*	*Natural logarithm retail eaches per capita*	*Hass avocados sold per capita (eaches)*
Natural logarithm, average sales price	-1.3595***		-1.3053***	
	(0.0391)		(0.0409)	
Natural logarithm, average sales price, lag	0.3943***		0.3700***	
	(0.0321)		(0.0323)	
Promotion expenditure elasticity	0.0162***		0.0094***	
	(0.0019)		(0.0020)	
Average selling price		-0.1041***		-0.0991***
		(0.0058)		(0.0056)
Average selling price, lag		0.0356***		0.0332***
		(0.0027)		(0.0027)
Weekly local and national promotion expenditure (million USD)		0.0033***		0.0015***
		(0.0002)		(0.0002)
Constant	-2.5717***	0.1547***	-2.6088***	0.1500***
	(0.0140)	(0.0055)	(0.0147)	(0.0053)
Holiday Fixed Effects	No	No	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
R-squared	0.7710	0.6407	0.7842	0.6692
Promotion Elasticity		0.0152		0.00705
Price Elasticity of Demand		-1.292		-1.229

*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Linear model elasticities evaluated at means; standard errors clustered by market; month and year fixed effects included.
All models have 13,621 observations over 53 market areas

The impact of average sales price on sales volume follows a similar pattern to that found in the prior evaluation studies. Average price in a market area during the week is strongly negatively correlated with sales volume. This effect is highly statistically significant in all four models. In fact, the models show that sales are quite responsive to current price; the estimated

price elasticity of demand based on the double log models is about -1.3, meaning that a 10% decrease in price is associated with about a 13% increase in sales.[14] The impact of lagged price, however, is positive. This means, not surprisingly, that a sale on avocados in week *t* causes lower sales in week *t+1* when price returns to its regular level. The offset is not complete, however. All four models show that only about a third of the effect on sales of current-period price is offset by an opposite change in sales in the following period.

Promotion expenditures are also positive and strongly statistically significant in all four models.[15] Increased promotional expenditures by the HAB member associations are associated with higher sales. The estimated elasticity of demand to promotion expenditures depends, as predicted, on whether the model includes holiday fixed effects or not. The estimated promotion elasticity from the double log model without holiday fixed effects is 0.016, e.g., a 10% increase in weekly promotion expenditures in a market area is associated with a 0.16% increase in sales.[16] The estimated effect is approximately halved if holiday fixed effects are introduced into the model. As previously noted, these estimates likely bound the true elasticities.

Similar results hold for the linear model. The linear model coefficients, columns (2) and (4) are estimates of marginal effects, not elasticities. Regarding promotion expenditure, based on column (2) an additional $1 million in weekly promotion expenditure expands per capita retail avocado consumption nationally from 0.1 avocado to 0.1033, an increase of 3.3%. The analyst must pick a "point" on the demand surface for evaluating the elasticity from a linear model, with the data means representing the point most commonly chosen. Promotion elasticities evaluated at

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[14] One feature of the double log model is that the estimated coefficients are elasticities. Thus, the price elasticity of demand and the promotion elasticity of demand can be read directly from the table.

[15] The statistical significance of these results implies for each model that we can say with 99% or more confidence that the true effect of promotions is not zero.

[16] It is a mathematical property of the double log model that this elasticity relationship holds for all values of sales and promotions.

the data means are shown at the bottom of table 10. Without holiday fixed effects, the estimated promotion elasticity at the data means is 0.015 and it is approximately halved when the holiday fixed effects are included. In other words, the promotion elasticities from the linear and double log models are nearly identical, increasing confidence in the accuracy of the results.

The coefficients on the fixed effects variables hold some independent interest because they inform us about the seasonality of demand for fresh Hass avocados and the year-by-year growth in demand over time. However, we defer discussion of these effects to the next section, which discusses construction and estimation of an aggregate model of U.S. retail demand for fresh Hass avocados.

6. Aggregate Econometric Model of U.S. Retail Demand for Fresh Hass Avocados

To supplement the panel econometric analysis in the prior section of Hass avocado demand at the level of local and regional markets, it is important to have a complementary analysis of aggregate fresh Hass avocado demand that focuses on the entire U.S. market. The aggregate demand model also provides input into the simulation model used to estimate benefit-cost ratios that is described in the next section.

We utilized a somewhat different approach to specifying and estimating the aggregate model in this study relative to the first two five-year reviews of promotions conducted under the auspices of the HAB. Those reviews relied upon annual shipments data and the average annual price received by California growers. In order to obtain sufficient observations to conduct econometric analysis, both groups of authors needed to include annual observations from years well prior to the time when HAB began conducting promotions in 2003.

Our approach in this review is to focus on total U.S. retail sales measured in numbers of fresh Hass avocados sold. These data are compiled by IRI based on sales by retail outlets that report their data to IRI. IRI's coverage of retailers is incomplete, but IRI's data scientists extrapolate from the data they do have to the total U.S. retail market.[17] We were able to construct a monthly price variable for fresh avocado importers from data provided by the USDA, Economic Research Service. The price data are "unit values" constructed by dividing total value of imports by the total imported quantity in pounds, thus yielding a monthly average importer price per pound.[18] To conform the weekly sales data to the monthly data on importer prices, we aggregated the sales data to the month level for the 60 months spanning January 2013 through December 2017.

The promotions variable for the aggregate model was constructed following the procedures utilized in the panel model discussed in section 5. We worked with two types of promotions: national promotions conducted exclusively by AFM, and promotions conducted at regional or metropolitan-area levels by CAC, CAIA, and PAC.[19] We summed all of these promotions in a given week and aggregated them to the monthly level following the same procedures used to aggregate weekly sales to the monthly level.

Although fresh Hass avocados are widely available and consumed year around in the U.S., there is a seasonal component to sales, which peak in the summer months and are lowest in

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[17] IRI does not reveal the process by which this aggregation is done. Our analysis assumes that the national retail sales data provided to the HAB by IRI are accurate.

[18] We preferred to use the importer price instead of the alternative of utilizing an aggregated average retail price for two reasons. First, the HAB's purpose is to benefit California avocado growers and importers from the member countries. Thus, conducting the analysis at the grower or importer level facilitates the subsequent benefit-cost analysis. Second, importer prices are more plausibly exogenous than U.S. retail prices, as they are subject to forces in the world market, not just the U.S. market. Additionally, they are not affected by time varying market level unobservables that could bias the estimate.

[19] As with the panel model, we excluded marketing expenditures made by the HAB because by design and intent those expenditures are designed to build demand over the long run, not in particular weeks or months. Further, there is no good way to apportion these expenditures across particular months during the review period.

the fall and early winter. Although this seasonal component to Hass avocado demand is of interest in its own right and is discussed briefly later in this section, our primary concern was that seasonal effects did not adversely influence estimates that were our primary focus, namely the response of fresh Hass avocado sales to price and promotion expenditures by HAB members. We thus followed a similar approach to that described in section 5 for the panel model. Specifically, we included month fixed effects in the model. These are variables that take a value of 1.0 during a particular month and a value of 0 for all other months. January was the excluded month to avoid the dummy variable trap (see footnote 14). All month fixed effects are then interpreted relative to the omitted month, which implicitly has a value of zero.

A second factor that needed to be considered is time trends in consumption across the five years of data. Fresh Hass avocado consumption continued to increase during this period. We accounted for these growth trends by introducing year fixed effects—one for each of the five years in the data, with 2013 excluded to avoid the dummy variable trap. Finally, as with panel model, we also specified the demand model with continuous variables (consumption, price, and promotions) specified in the linear and logarithmic forms (i.e., linear and double log models). Discussion of model specification can be found in section 5.1.

6.1.   Estimation Results

Our econometric model seeks to explain monthly fresh Hass avocado sales per month measured in millions of avocados. Estimation results are provided in table 8, with the linear model results contained in column (1) and the double log model results provided in column (2). Both models fit the data comparably well. Each explains about 2/3 of the variation in retail sales over the 60 months based on the R-squared statistic reported at the bottom of the table.

Key aspects of the estimation to note are that both coefficients on price and promotion expenditures are highly statistically significant (different from zero at a 95% or more confidence level) and of the expected sign—price and sales being negatively correlated, i.e., a negative price coefficient, and promotion expenditures and sales being positively correlated, i.e., a positive promotion coefficient. The linear model predicts, other factors constant, that an additional $1 million in monthly promotions is associated with 3.13 million additional retail sales of fresh avocados in that month. A one cent per lb. increase in import price is associated with 620,000 fewer monthly sales of fresh Hass avocados at retail across the United States.

Second, the month fixed effects, depicted in figure 6 for the linear model, show the seasonality noted earlier, although not all of these effects are statistically significant. The largest month fixed effects are (in order) May, June, and July. For example, holding other factors constant, 33.7 million more fresh avocados are sold in May than in January. The smallest (most negative) in order are November, October, and December—e.g., 10.8 million fewer fresh avocados are sold in November than January, holding other factors constant.

Finally, the year fixed effects demonstrate rising demand across each of the five years. The omitted fixed effect is 2013, while the coefficients on the fixed effects for 2014, 2015, 2016, and 2017 are all positive and increasing in sequence through the review period. Each year effect is highly statistically significant. Monthly fresh avocado sales in 2017 were 39.8 million greater than in 2013, other factors constant.

Returning to our key variables of interest, price and promotions, as noted one advantage of the double log model is that its coefficients are elasticities. Thus, we read the estimated price elasticity and promotion elasticity of demand directly from the table, -0.189 for the price elasticity, and 0.058 for the promotion elasticity. A linear model has a constant slope, but the

elasticities vary across the observations. Most commonly they are evaluated at the data means. For our study this yields an estimated price elasticity of demand of -0.20 and a promotion elasticity of demand of 0.06. The linear and double log models thus yield very comparable results for the key variables of interest.

The statistical significance of the promotion coefficient for both the linear and double log models means that we can say with a high degree of confidence that promotions conducted under the auspices of the HAB did have a positive impact on fresh Hass avocado sales in the U.S. In the next section we turn to the question of whether this impact was sufficient to "pay off" for growers and importers in the sense of yielding benefits in excess of the costs incurred through the assessment.

The aggregate model discussed in this section and the panel model discussed in section 5 present broadly consistent results regarding the impacts of price and promotions on sales of fresh Hass avocados. The magnitude of the price and promotion impacts differ somewhat across the models, however. The key factor explaining these differences is the use of monthly data for the aggregate model and weekly data for the panel model.

We re-estimated the panel model by aggregating sales and promotion expenditures to the month level, and computing a monthly average price for each market area. The promotion elasticities from estimating the monthly panel model are very comparable to those from the aggregate model—0.082 for the double log model and 0.056 for the linear model, with the linear-model elasticity evaluated at the data means. Monthly models capture more of the dynamic impacts of promotion expenditures. In particular, expenditures made in the first part of a month have an opportunity to impact sales at that time and also in later weeks of the month.

Table 11. Aggregate Demand Model Regression Results

VARIABLES	Linear Model	Double-Log Model
Real Importer Unit Value ($/Lb.)	-62.069**	
	(27.327)	
HAB Association Promotions ($ 000,000)	3.133**	
	(1.274)	
Natural Log of Real Importer Unit Value ($/Lb.)		-0.189*
		(0.100)
Natural Log of HAB Assoc. Promotions ($ 000,000)		0.058**
		(0.023)
February	4.634	0.050
	(8.080)	(0.052)
March	16.083	0.098
	(12.429)	(0.094)
April	11.013	0.041
	(8.926)	(0.060)
May	33.668***	0.202**
	(12.473)	(0.082)
June	24.108**	0.156**
	(9.192)	(0.071)
July	22.959*	0.133
	(11.838)	(0.089)
August	16.010	0.086
	(10.399)	(0.081)
September	5.820	-0.009
	(11.043)	(0.080)
October	-6.537	-0.111*
	(7.435)	(0.058)
November	-10.817	-0.140
	(11.181)	(0.090)
December	-2.936	-0.076
	(12.093)	(0.087)
2014	4.005	0.026
	(5.733)	(0.052)
2015	21.063***	0.176***
	(7.091)	(0.061)
2016	32.224***	0.235***
	(7.521)	(0.063)
2017	39.973***	0.306***
	(8.939)	(0.070)
Constant	115.891***	4.429***
	(10.392)	(0.126)
Observations	60	60
R-squared	0.675	0.693

Standard errors in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

The weekly model captures only the contemporaneous impact of promotions on sales because, as noted, due to construction of the promotions data, we were unable to include lagged impacts of promotions in the weekly model. Thus, in our view, although the weekly panel model gives a good sense of the immediate sales response to promotion expenditures, the monthly model gives a better indication of the full impacts of such expenditures.

Figure 6. Monthly Fixed Effects from the Linear Aggregate Demand Model

Source: Linear aggregate demand model estimates.
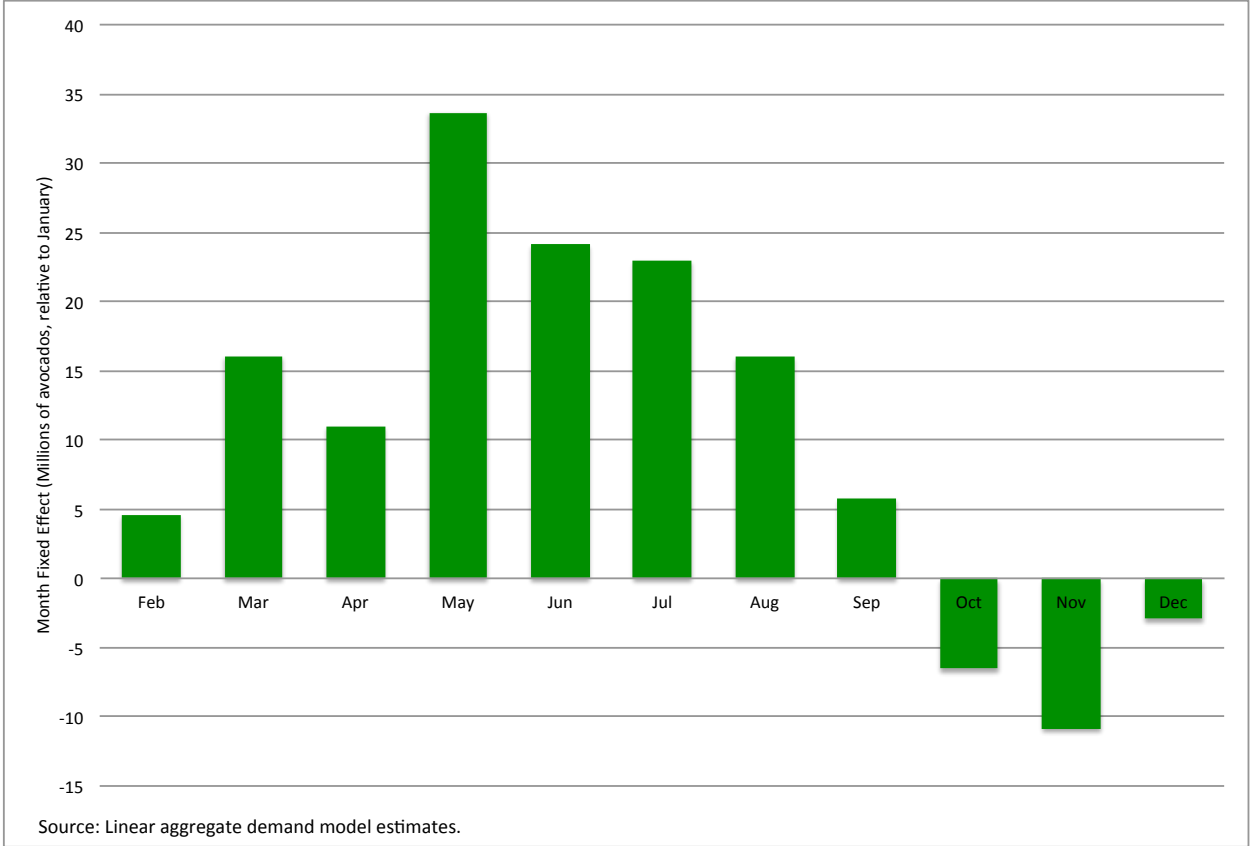
The price elasticity was also lower (more inelastic) in the monthly model, reflecting that temporary sales increases due to promotional pricing tend to average out over a longer period of time, i.e., higher sales in one week of the month are counterbalanced somewhat by lower sales in subsequent weeks in the month. This effect was also shown in the weekly panel model where the

coefficient on the lagged price variable was always positive in sign and offsetting the in part the impact of current-period price.

6.2.   Seasonality and Holiday Influences on Fresh Hass Avocado Demand in the U.S.

Figure 7 below provides an additional perspective to seasonality and the impact of key holidays on fresh Hass avocado demand in the U.S. It depicts weekly sales for 2016 and notes the timing of key holidays.[20] A key facet of figure 7 is that it depicts the incremental sales due to holidays, while also preserving the seasonal pattern of sales. It avoids the confusion of attributing high sales to a particular holiday when they would have been high without the holiday due to the holiday occurring at a peak time for fresh avocado demand.

Figure 7 shows that the Super Bowl is without question the most important holiday for fresh avocado consumption. It occurs during February, a relatively low-consumption month except for the Super Bowl. Super Bowl week causes sales to peak to their highest level in the entire year. Cinco de Mayo (in conjunction with Mother's Day) is clearly the second most important holiday for fresh avocado consumption. Although May is a peak period for consuming avocados in general, the week of Cinco de Mayo causes sales to expand considerably from their already-high level. Conversely, the fourth of July, often considered an avocado-consuming event, generates only a minor peaking of sales from the already-high levels experienced in July. Also notable is that the Thanksgiving and Christmas holidays do little to peak sales during the low-consumption months of November and December.

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[20] We constructed a similar diagram for each of the five years of the review period. The pattern of consumption is similar across years. Including each year on the same graph caused congestion and led to our decision to depict a representative year, 2016, for greatest clarity.

Figure 7. Influence of Holidays on Avocado Sales in the U.S., 2016
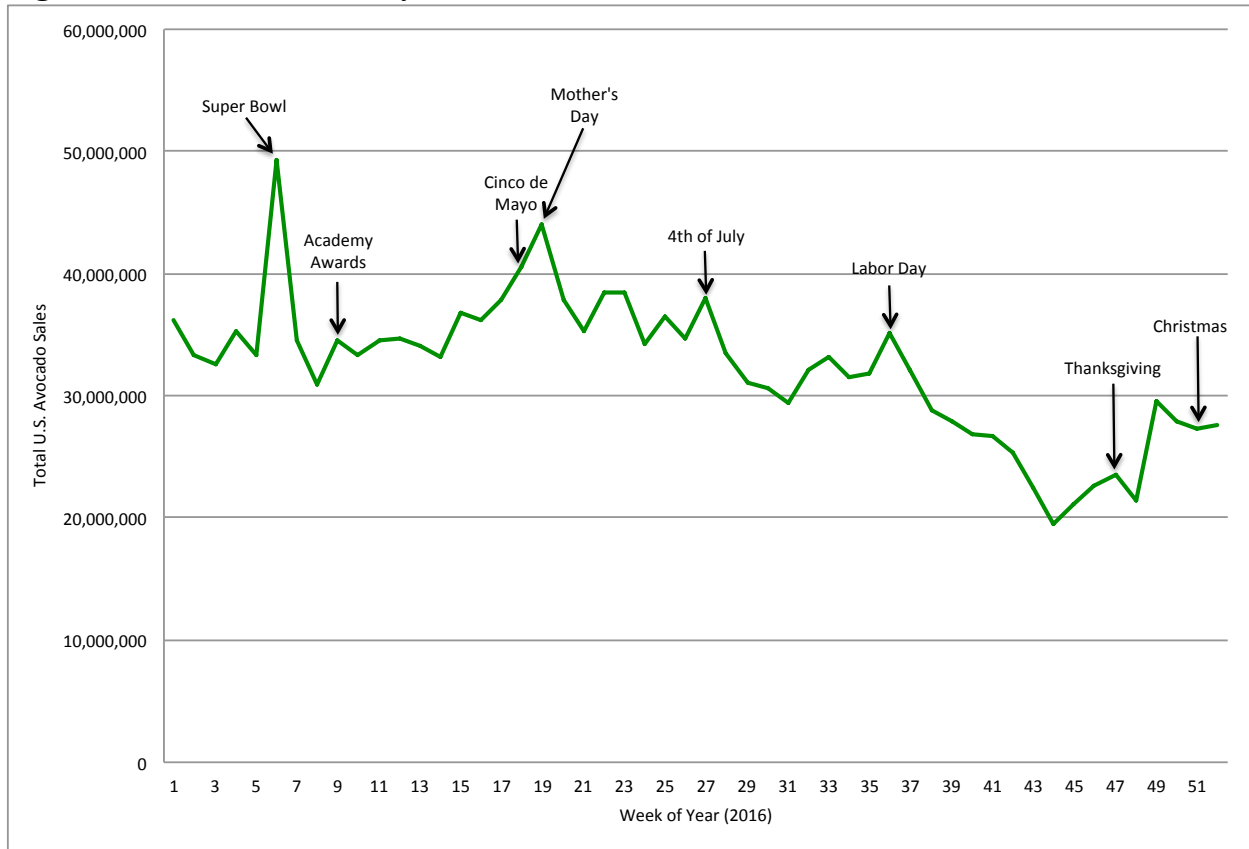
7. Simulation Model and Benefit-Cost Analysis

The econometric analysis reported in section 6 presents strong evidence that promotion of fresh avocados by HAB member associations has worked to increase the demand for fresh Hass avocados in the U.S. The additional question to ask, however, is whether the demand expansion has "paid off" in the sense of yielding benefits to California producers and importers from the member countries in excess of the money expended to fund the programs. We address that question in this section.

Analysts studying commodity promotion evaluation generally compute two types of benefit-cost ratios. First, the *average benefit-cost ratio* (ABCR) from a promotion program consists of the total incremental profit to producers and importers generated by the program over

a specified time interval divided by the total incremental costs borne by them to fund a program over the same time period. The ABCR is the key measure of whether a program was successful, with ABCR > 1.0 defining a successful program.

The *marginal benefit-cost ratio* (MBCR) measures the incremental profit to producers and importers generated from a small expansion of a promotion program. MBCR answers the question of whether incremental or marginal expenditures on the program were successful in increasing producer/importer profit and whether an incremental expansion of the promotion program would have increased producer and importer profit. MBCR > 1.0 indicates a program where the marginal expenditure yielded benefits in excess of costs and a program that could have been profitably expanded. We use a linear model for this phase of the analysis, in which case ABCR = MBCR, and, thus, the two questions "was the program profitable" and "could it have been profitably expanded" are one and the same.

Our approach follows the methods utilized in the first two evaluations of the HAB's promotion programs, an approach which is applied widely in commodity promotion evaluation studies. Specifically, we 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. The simulation model then "spends" the funds generated from the incremental assessment on fresh avocado promotions that are assumed to impact consumer demand in accordance with the econometric estimates generated in the prior section. We then solve the simulation model to find the hypothetical impacts on market price and sales and estimate the benefits and costs to avocado producers and importers from that assessment expansion based on this information.

The simulation framework is depicted in figure 8. The model begins with demand and supply functions for fresh avocados that depict the U.S. market for a given year, t, during the review period. Thus, demand, D_t, is total U.S. consumer demand for fresh avocados in year t from all sources (retail and food service), where $t = 2013 - 17$. Supply, S_t, is total supply to the U.S. market in year t from all sources—California production plus all imports.

Prior to the hypothetical expansion of promotions producer/importer price in year t is P_t and total shipments and consumption is Q_t. Implementation of a one-half cent per pound expansion in the program assessment increases producer/importer costs per pound by that half cent, which shifts supply upward by that amount, to curve S'_t depicted in the figure. The slope or elasticity of the demand curve and the demand shift from spending these incremental assessment funds on promotion are determined by the estimation results from the aggregate model described in section 6.

The new demand curve is illustrated in figure 8 by D'_t. The new market equilibrium is found at the intersection of curves S'_t and D'_t at point A in figure 8. Thus, with the demand and supply shifts illustrated in the figure, the model predicts that equilibrium price in year t would rise to P'_t and sales rise to Q'_t.

Figure 8 shows how successful promotions can benefit importers. Absent the incremental promotions, quantity Q_t of fresh avocados would have been sold in the U.S. market at price P_t. Instead that volume sells for net price P''_t, i.e. the actual price P'_t minus the per-unit cost due to the incremental assessment. The additional profit on volume Q_t is thus $(P''_t - P_t)Q_t$, which is represented in the figure as the blue-shaded area. In addition, more avocados are sold in the U.S. market, specifically the volume $Q'_t - Q_t$. These avocados also fetch net price P''_t, but producers and shippers also incur additional variable costs to produce these avocados and bring them to the

U.S. market.[21] Meaning that incremental profits from this incremental production is represented by the small red triangle in figure 8 and the total net profit from the assessment expansion is the sum of the blue- and red-shaded areas in figure 8.

Figure 8. Simulation Model
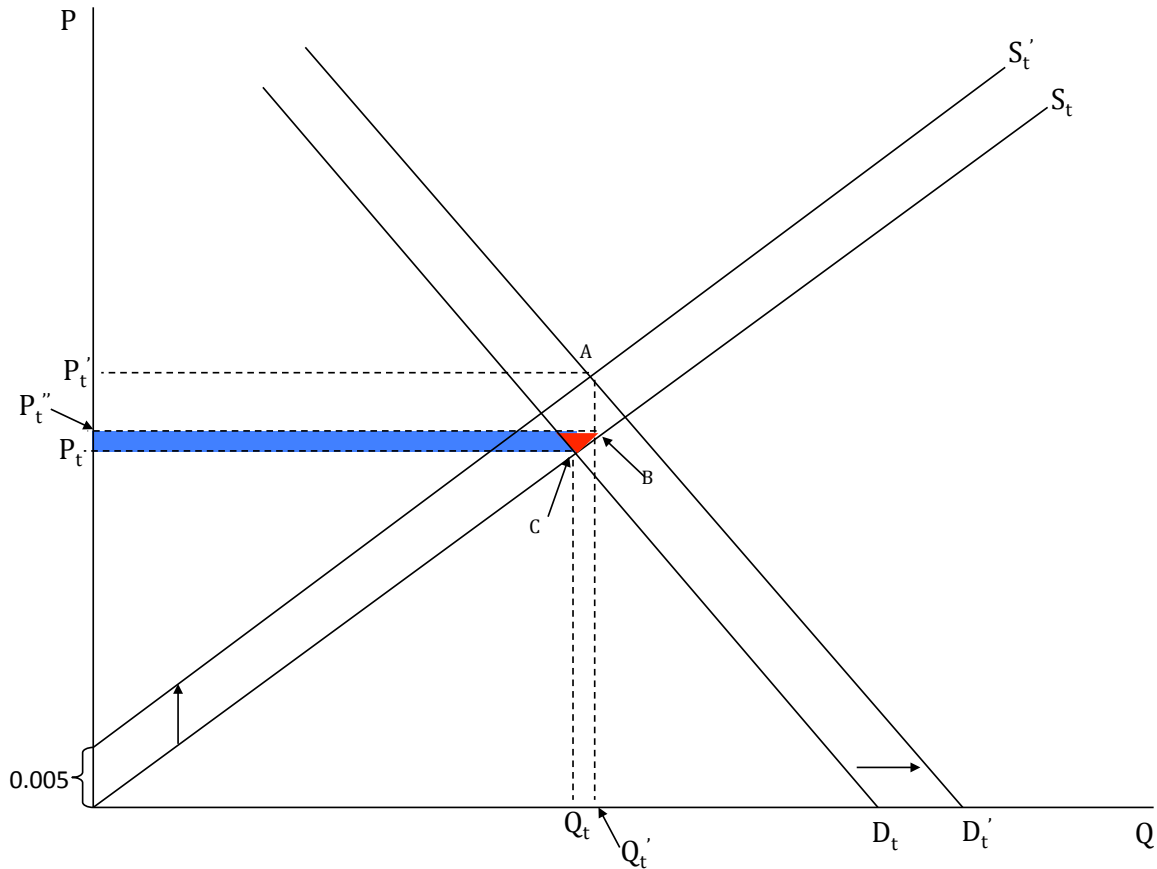
As noted, the information needed to specify the demand functions D_t and D_t' is provided by the econometric model estimated in section 6. In addition, we need information on the supply relationship, S_t. The new supply relationship, S_t', that reflects the incremental promotion expenditure is found by adding the incremental assessment to S_t. Most promotion evaluation studies do not attempt to estimate the supply relationship. Supply functions are difficult to estimate empirically, and the price elasticity of supply varies by the length of run (time frame)

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[21] Fixed costs incurred by California producers and importers are irrelevant to the calculation since they would be incurred in any event by definition of their fixity.

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 and importers, enabling them to better adjust supply to changing market signals.

Analysis of avocado supply relationships to the U.S. market is further complicated by the fact that significant supplies are entering the market from California production, as well as Chilean, Mexican, and Peruvian imports.[22] The importers supply the U.S. market, as well as their domestic markets and other export markets. Thus, importers' 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.[23]

The alternative approach utilized in prior reviews of the HAB's promotion activities and by authors of other promotion-evaluation studies is to estimate benefit-cost ratios for a range of plausible values for the price elasticity of supply. The analyst then evaluates whether conclusions are robust across the range of supply elasticity values chosen. If they are, then there is little need to worry about choosing among the plausible alternative values for this elasticity.

In terms of an appropriate range of supply elasticities for the present study, consider that the short-run total supply of a perennial crop is highly inelastic (unresponsive to price) because it is determined as 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

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[22] As noted in table 1, minor amounts of fresh avocados also enter the U.S. market from importers that not HAB members.

[23] 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.

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 importers to increase shipments to the U.S. by reallocating supplies from other destinations. Shippers' ability and willingness to reallocate supply among alternative markets outlets hinges on many factors including contractual commitments, ability to access expanded shipping capacity, and availability to access additional product in the home country that meets the specific standards of an importing country, among others.

We followed the practice in the two prior HAB evaluation studies and specified three alternative values, 0.5, 1.0, and 2.0, to reflect a plausible range of values for the overall price elasticity of supply to the U.S. market. The lower bound of these values states that a one percent grower/shipper 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 composition of supply (domestic vs. import) to the U.S market has changed significantly since the creation of the HAB (see section 3 of this report), and in particular Mexico's share of the market has expanded significantly. However, in our view the range of supply elasticities used in the prior HAB evaluations continues to represent a reasonable range of choices, and, accordingly, we adopted those values for this analysis.[24]

To perform the simulation, we estimated the impact of a half cent increase in the assessment rate for each year (2013 – 17) of the review period. Base quantity was total annual fresh avocado shipments provided on the HAB's website. The base price in each year was the

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[24] California's short-run supply is no doubt highly price inelastic given that nearly all California Hass avocados are sold domestically, whereas Chile's and Peru's supply to the U.S. is probably quite elastic, given the importance of other export markets to these countries. Mexico is now the dominant shipper to the U.S., and we believe that Mexico's supply of avocados to the U.S. is also likely to be quite inelastic, given the importance of the U.S. market to Mexican shippers.

average import unit value (total value of imports/total quantity of imports) in $/lb. for each year, with the raw data provided by the USDA Economic Research Service. Each year's total supply and demand was calibrated using the aforementioned price, quantity, and promotion data, along with price elasticities of the demand curve (from the econometric model discussed in section 6) and supply curve (0.5, 1.0, and 2.0). After the base equilibrium price and volume was found, (P_t, Q_t) in figure 8, we computed a new equilibrium price and quantity, (P'_t, Q'_t) in figure 8, based on the hypothetical of expanding the assessment by one-half cent per pound and spending it on fresh avocado promotions with sales impact as estimated in section 6. Finally benefits to California producers and importers were computed and compared to the assessment costs as described in this section and illustrated in figure 8.

Results of the simulation are provided in table 12. For each imputed elasticity of supply, we provide two estimates of impact on producer/importer price and benefit-cost ratio, with one estimate based on section 6 results from the linear model and the other based on elasticities estimated via the double log model. Depending on the elasticities used in the simulation, producer/importer price rises by 1.58% to 2.87%, and the benefit-cost ratios range from 1.635 to 3.616.

Lower values of price increase and benefit-cost ratio are associated mainly with more price elastic specifications of the supply curve. A more elastic supply means that more of the promotion-induced demand shift is reflected in expanded output and less price expansion. As figure 6 shows, price expansion is better for producers and importers because it adds profits to all sales, whereas incremental sales add profit only to the extent price exceeds the variable costs of bringing the additional product to market. Estimated price increases and benefit-cost ratios are

also slightly higher for elasticities from the linear model than the double log model because the former estimated a slightly stronger promotion effect.

Table 12. Benefit/Cost Simulation Results Summary

	Mean Increase (%)	
	Grower Price	**Benefit/Cost Ratio**
	Supply Elasticity = 0.5	
Linear Model	2.87%	3.616
Double Log Model	2.79%	3.498
	Supply Elasticity = 1.0	
Linear Model	2.03%	2.325
Double Log Model	1.99%	2.264
	Supply Elasticity = 2.0	
Linear Model	1.60%	1.667
Double Log Model	1.58%	1.635

In all cases the producer/importer benefit-cost ratio is considerably larger than 1.0, causing us to conclude that the promotion programs conducted under the auspices of the HAB were successful during the review period in increasing profits to importers and California producers of Hass avocados. Further, the results suggest that expansion of the program at the margin (i.e. by increasing the assessment rate by a small amount above its current $0.025 value), would increase grower and importer profits if the industry chose to consider such a strategy.[25]

Readers who are familiar with the first two five-year evaluations of promotions conducted under the HAB's auspices will note that these benefit-cost ratios, although still highly favorable from the perspective of a successful promotion program, are somewhat lower than those estimated in the first two studies. This study relied upon a different data set for the aggregate model than the two prior studies. Those studies estimated an annual model that, in

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[25] We offer this conclusion only tentatively because the primary purpose of our evaluation was to assess whether the amounts expended in the 2013 – 17 period were effective in increasing producer and importer profits. As noted, marginal and average benefit-cost ratios are the same in our linear model. A model focused specifically on the question of whether assessments and promotions could be profitably expanded would need to explore more flexible functional specifications that allowed marginal and average benefit-cost ratios to differ.

order to obtain sufficient observations to conduct econometric analysis, included years well before the HAB was constituted and started collecting assessments.[26]

As the authors of these studies noted at the time, the annual models presented some challenges in separating the impacts of promotions on demand from other factors, such as rising consumer income, that tended to move in parallel to promotion expenditures (what economists and statisticians call the multicollinearity problem). Key reasons for changing the approach to estimating the aggregate model in this study are that, by constructing monthly data, we were able to focus exclusively on the review period in question, 2013 – 17, and also avoid most of the econometric problems that were issues in the annual models estimated by CLS (2009) and CSS (2013). Thus, although the estimated promotion impacts in this study are somewhat lower than in the prior reviews, we have considerable confidence in them.

A second factor that may contribute to explaining the differences in benefit-cost ratios in this study compared to its predecessors is that it is quite plausible that the U.S. market for fresh avocados is maturing. The remarkable growth rate in demand that the industry has seen since the creation of the HAB may be slowing to a more stable and sustainable trajectory, and, promotions, although continuing to be highly effective based on our results, may no longer achieve the massive demand growth and stratospheric benefit-cost ratios achieved in the HABs first ten years.

8. Conclusions

This report represents the third five-year review and evaluation of the promotion activities conducted under the auspices of the Hass Avocado Board. As in the prior reviews, this study has found that promotions conducted by the HAB member associations have been highly effective in

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[26] Promotions conducted prior to 2003 were funded mainly by the California Avocado Commission.

expanding demand for fresh Hass avocados in the United States. We found a positive and statistically significant elasticity of retail sales with respect to promotion expenditures in both a panel econometric model focused on local market areas and weekly data and a model of aggregate retail sales in the U.S. estimated with monthly data. A benefit-cost analysis based on results from the aggregate model showed that promotion programs funded primarily by HAB assessments paid off handsomely for California Hass avocado producers and importers of Hass avocados during the review period, with benefit-cost ratios ranging from 1.6 to 3.6 depending upon the model specification. With total HAB and member association promotion expenditures over the five-year review period totaling $293.3 million, our results suggest that, ceteris paribus, industry profits increased in a range from $469.3 million to $1,055.9 million.

These results should come as no surprise to outside analysts or people involved in the industry as producers and marketers. The Hass avocado success story in the U.S. in terms of the rapid increase achieved in per capita consumption, while maintaining stable or increasing real prices to producers and importers, has made avocados the envy of the produce industry, as others try, most without notable results, to emulate avocados' successes. Our analysis and its predecessors demonstrate that the activities of the Hass Avocado Board and its member associations have played a fundamental role in this success.

9. References

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