International Food and Agribusiness Management Review
Volume 14, Issue 4, 2011

Effective Marketing of Hass Avocados: The Impacts of Changing Trade Policy and Promotion/Information Programs

Hoy Carman[Ⓘa] and Richard J. Sexton[b]

[a] *Professor Emeritus, Department of Agricultural and Resource Economics, and member of the Giannini Foundation of Agricultural Economics University of California, Davis, 1 Shields Avenue, Davis, California, 95616, U.S.A.*

[b] *Professor, Department of Agricultural and Resource Economics, and member of the Giannini Foundation of Agricultural Economics, University of California, Davis, 1 Shields Avenue, Davis, California, 95616, U.S.A.*

Abstract

U.S. avocado producers faced major economic challenges in 1996, when opening of the U.S. market to Mexican avocados was approved. Fearing introduction of new pests and diseases as well as severe economic impacts, U.S producers were able to gain a phased opening of regional markets and legislation authorizing an assessment of 2.5 cents per pound on all Hass avocados sold in the U.S. to support promotion programs. Promotion programs expanded demand sufficiently to maintain real producer prices even though Mexican imports exceeded USDA forecasts by a factor of three.

Keywords: avocado, promotion, Mexico

Ⓘ Corresponding author: Tel: + 1 530.756.2448
Email: hcarman@pacbell.net

R. J. Sexton: rich@primal.ucdavis.edu

Problem Statement

U.S. avocado producers faced a growing economic crisis during the late 1990s. Consumer demand was increasing slowly, imports of avocados from Chile, The Dominican Republic and New Zealand were increasing as bearing acreage increased and Mexico, the world's largest avocado producer, was gaining entry to the U.S. market for the first time in nearly a century. Rapidly increasing supplies in the face of inelastic demand at the producer level would place serious downward pressure on prices and had the potential to result in a much smaller domestic industry. In addition, imports were free riding on the California Avocado Commission's (CAC) well-established and effective promotional programs. Leadership of the California avocado industry, which had been fighting a delaying action against Mexican fresh avocado imports, decided to pursue several proactive initiatives and programs while continuing the fight. These forward-looking actions included increased expenditures on a well-organized political effort to include funds from imported avocados in the industry's advertising and promotion programs, expansion of a data-base program to include imports combined with internet technology to improve the timeliness and dissemination of marketing information to all market participants, and increased attention to the nutritional characteristics of avocados.

Objectives

The objectives of this study are to:

1. Describe the phased entry of Mexican Hass avocados into the U.S. market.
2. Outline the features and summarize the impacts of the Hass Avocado Promotion, Research and Information Order (HAPRIO) on U.S. avocado demand and producer returns.
3. Evaluate the impact of avocado industry information programs.
4. Outline avocado nutrition research and the nutrition message to consumers.

Procedures

This paper combines a description of marketing Hass avocados with analysis of the U.S. demand for fresh avocados and producer returns from marketing programs and expenditures. [1] The opening of the U.S. market to imports of Mexican avocados together with implementation of the HAPRIO will be described and discussed. Changes in avocado imports and U.S. per capita consumption will be outlined and U.S. demand for avocados will be estimated using econometric methods. Factors affecting avocado demand will be discussed and the contributions of advertising and promotion to growth in demand will be analyzed. Previous research has found that transmission of farm-level (f.o.b.) price changes to retail is asymmetric for avocados. These results will be used together with information on price variability to assess the results of HAPRIO information programs on avocado producers and consumers. Simulation of weekly changes in marketing margins resulting from f.o.b. price changes will be used for the assessment of information programs. Information on nutrition research, use of this research in promotional programs, and anecdotal results are outlined.

[1] This analysis is for fresh avocados as HAPRIO and CAC assessments and promotion programs are only for the fresh fruit.

The Phased Opening of U.S. Markets to Mexican Avocados

Mexico, the world's largest avocado producer, was unable to export fresh avocados to the U.S. prior to 1997 because of pest and disease problems. The USDA's Animal and Plant Inspection Service (APHIS), after studies extending over six years, announced that it would allow avocados from Mexico to be sold in 19 Northeastern and Midwestern states and the District of Columbia from November through February beginning in 1997. The States eligible for Mexican imports are shown in Table 1. The timing of shipments and the selection of states eligible to receive Mexican avocados were chosen to minimize the probability of a fruit fly infestation and the probability that avocados infested with stem weevil, seed weevils and seed moth would be re-shipped to avocado producing areas. To minimize the risk of introducing pests to the conterminous United States, APHIS used a systems approach to establish redundant safeguards in Michoacán, Mexico avocado orchards and packing facilities. Risk mitigation measures included pest field surveys; orchard certification; and packinghouse, packaging, and shipping requirements, including cutting and inspection of samples from all shipments.

Table 1. Phased Reduction of Shipping Restrictions for Mexican Avocados to the U.S. Market, 1997 –2007.

Phase and Dates	States Eligible for Mexican Avocado Shipments	Cumulative Share California's U.S. Shipments 1995-2005
I – November through February each marketing year beginning in November 1997 and through February 2001	Connecticut, Delaware, Illinois, Indiana, Kentucky, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, Virginia, West Virginia, Wisconsin and Washington, D.C.	16.1 percent
II –November 1, 2001 to April 15, 2002, and October 15 to April 15 each marketing year beginning in 2002 through January 31, 2005.	Colorado, Idaho, Iowa, Kansas, Minnesota, Missouri, Montana, Nebraska, North Dakota, South Dakota, Utah, and Wyoming	22.9 percent
III – January 31, 2005 to January 31, 2007	Mexican avocado shipments permitted year-round in all states except California and Florida	60.8 percent
IV – After January 31, 2007	Mexican avocado shipments permitted year-round in all U.S. states	100.0 percent

Sources: U.S. Department of Agriculture, 1997, 2001, 2003 and 2004.

Responding to persistent Mexican requests and the apparent success of the systems approach, APHIS in 2001 increased the number of states allowed to import Mexican avocados from 19 to 31 and increased the shipping season to six months. The 12 additional states are shown in Table 1. The initial shipping season extended from November 1, 2001 to April 15, 2002, with subsequent seasons extending from October 15 through April 15. Finally, beginning on January 31, 2005, Mexican imports were allowed to enter all U.S. states except California and Florida year-round. California and Florida markets were opened to Mexican imports after January 31, 2007. The last column of Table 1 shows that the states included in phases 1 and 2 received less than a quarter of California avocado shipments during 1995 through 2005. California is the most im-

portant market for California-produced avocados, accounting for almost 38 percent of total shipments.

An empirical analysis of U/S. demand for avocados conducted before the entry of avocados from Mexico found that demand is seasonal, with the highest monthly demand occurring in August and the lowest demand occurring in December (Carman and Craft). The lowest demand months were October through March, with demand increasing steadily from March through August and then decreasing in September to a level comparable to May.

California avocado production is seasonal with the largest weekly shipments typically occurring from April through August and the lowest weekly shipments occurring from November through February. A monthly index of California avocado shipments for four marketing years is shown in Figure 1.[2] An index value of 1.0 is average monthly sales for the year being considered. The 1989 marketing year illustrates the shipping pattern before avocado imports began increasing—total imports were only 10 million pounds. As imports have increased the seasonal pattern of California avocado shipments has shifted substantially.

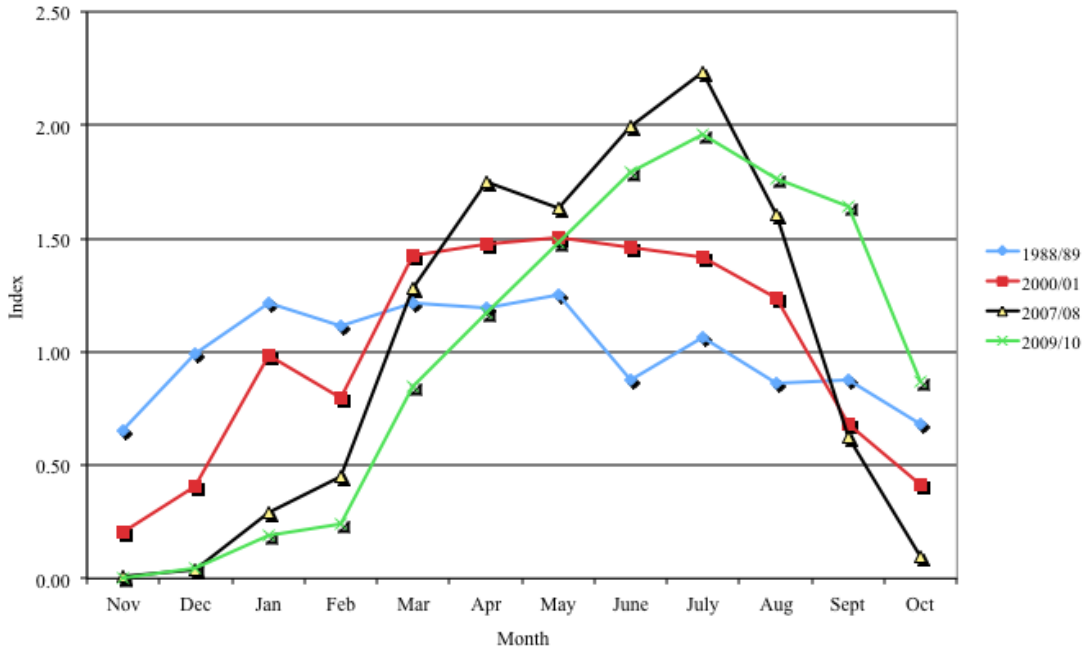

Figure 1. Seasonal Index of California Avocado Sales, Various Marketing Years

During the 2001 marketing year imports from Chile were significant, Mexican imports were beginning to grow (24.9 million pounds), and total imports were 169 million pounds; during 2008 California had a medium sized avocado crop (almost 329 million pounds), Mexican imports had grown to over 491 million pounds and total imports were 686 million pounds; California had a very large avocado crop in 2010 (over 534 million pounds), Mexican imports totaled 562.6 mil-

[2] The California avocado marketing year extends from November 1 through October 31 of the following year. The marketing year is designated by the second year, i.e., November 1, 2000 through October 31, 2001 is the 2001 marketing year.

lion pounds, and total imports were 769 million pounds. In total, imports' share of the U.S. avocado supply increased from less than three percent in 1989 to a range of 70.5 to 87.7 percent during the 2007 – 2010 marketing years.

Figure 1 demonstrates that California grower-shippers have responded to increased imports by shifting shipments from the low demand months of October through March to May through August when demand is the highest. California producers have shifted away from avocado varieties that mature in the low-demand months, which are also high supply months for imports, to the Hass and Lamb varieties that mature in the summer months. They appear to have also delayed harvest at the beginning of the marketing year in response to the pattern of imports.

The selection of states and months for Mexican avocado imports was made to minimize the probability that pests or diseases from Mexico would be introduced to U.S. orchards and especially to U.S. avocado production areas. An unintended consequence was that consumers in Northeast and Midwest markets who had previously experienced limited seasonal supplies of avocados now had increased year-round availability of the fruit. This, combined with increased promotion and the public relations program about the health benefits of consuming avocados, resulted in a very effective phased market development process as new states became eligible for Mexican shipments and the shipment period was lengthened.

Projected Economic Impact of Mexican Imports

Before each proposed change in rules for avocado imports from Mexico, APHIS published a regulatory impact analysis of the economic effects of increased imports. APHIS forecasts of the increase in Mexican avocado imports, price impacts on California avocado producers, and impact on California avocado producer revenue for each change in rules (Phase) are shown in Table 2. The last column shows actual Mexican avocado imports during each of the first three phases and average Mexican imports since 2007.

Data in Tables 1 and 2 illustrate that there were two major sources of concern to California growers. First was the possibility of introduction of a new pest or disease that would threaten the viability of avocado production in California. Second was the forecasted economic impact of a 25 percent reduction in grower prices and almost $85 million reduction in total revenue. These price and revenue projections were based upon import projections that were consistently and seriously underestimated by APHIS. Actual Mexican imports were 1.82, 1.61, 1.80 and 3.04 times greater than the APHIS forecasts in phases I through IV, respectively (Table 2). The low APHIS forecasts appear to be due to underestimating the growth in U.S. avocado demand and not fully recognizing the attractiveness of the U.S. market to Mexican avocado producers. APHIS forecasts were for Mexican imports to have a market share of 18.0 and 23.8 percent in Phases III and IV, respectively while the actual shares were 26.3 percent in Phase III and 47.6 percent from 2007 through 2010.

Table 2. APHIS Forecasts For Mexican Avocado Imports, Impacts on California Prices and Impacts on California Producer Revenues, with Comparison to Actual Imports.

Phase & Start Date	Forecasted Mexican Imports (mil lb)	Forecasted Impact on CA Price (%)	Forecasted Impact on CA Revenue ($mil)	Mexican Imports Annual Average (mil lb)
I – 1997	13.00	-2.00	-$3.9	23.66
II – 2001	37.66	-12.03	-$17.93	60.57
III – 2005	140.97	-15.60	-$52.39	254.09
IV – 2007	178.83	-25.60	-$84.50	543.52

Source: U.S. Department of Agriculture, 1997, 2001, 2003 and 2004.

The Hass Avocado Promotion, Research and Information Order

The phasing in of Mexican avocado imports combined with increasing imports from Chile provided California avocado producers with a sense of urgency and limited time to respond. California avocado producers had been spending millions of dollars annually since 1961 to promote their product, first using a California state marketing order and then the California Avocado Commission (CAC). Increased avocado imports through the 1990s were not only placing downward pressure on prices, importers were also free-riding on CAC promotion programs. Efforts to require all Hass avocados sold in the U.S. to financially support promotion programs cumulated with President Clinton signing the Hass Avocado Promotion, Research, and Information Act of 2000 into law on October 23, 2000. This Act established the authorizing platform and timetable for the creation of the HAPRIO that was approved in a referendum of producers and importers with 86.6 percent support on July 29, 2002. The HAPRIO became effective on September 9, 2002, with mandatory program assessments of 2.5 cents per pound on all Hass avocados sold in the U.S. market effective January 2, 2003. The assessment is collected by first handlers for California production and by the U.S. Customs Service for imports and forwarded to the Hass Avocado Board (HAB).

The 12-member HAB that administers the program is appointed by and operates under USDA supervision. The HAB, consisting of 7 domestic producers and 5 importers, is required to rebate 85 percent of domestic assessments to the California Avocado Commission (CAC) and up to 85 percent of importer assessments to importer associations, that use the funds for their own promotion programs. There are currently two importer associations, the Chilean Avocado Importers Association (CAIA) and the Mexican Hass Avocado Importers Association (MHAIA). The HAB uses the remaining 15 percent of assessments for its operations, promotion, and information technology programs.

During its first five years of operation, HAB collected assessments totaling $98.67 million and rebated $77.6 million to country producer organizations, including $38.64 million to the CAC, $20.54 million to the CAIA, and $18.42 million to the MHAIA. Total five-year promotional expenditures were as follows: CAC, $50.98 million; CAIA, $16.71 million; MHAIA, $14.35 million; and HAB, $9.27 million, for an overall total of $91.3 million spent on Hass avocado promotion in the U.S. market. We next discuss estimation of a demand function for avocados in the U.S. that can be used to estimate the economic impacts of HAB promotional and information programs.

U.S. Avocado Demand

Evaluation of the impacts of HAB promotion and information programs requires an empirical estimate of U.S. avocado demand. The model used for this analysis is based on previous empirical studies of the U.S. demand for avocados by Carman (2006) and by Carman, Li and Sexton (2009). Results of these studies are in line with expectations based on the economic theory of demand. That is, the per capita consumption of avocados is a function of the price of avocados, consumer income, advertising and promotion, and tastes and preferences. The estimated coefficients for the advertising/promotion and price variables were consistent and statistically significant across a variety of model specifications and estimation techniques. The coefficients for other variables, however, vary depending on the variables included in each demand equation estimated. Detailed analysis of the estimated equations and extensive statistical testing revealed strong positive correlations of the time-series data for several variables, including income, share of Hispanic population, and a linear time trend included to account for possible excluded variables and changes in tastes and preferences. [3] Multicollinearity was, thus, likely responsible for variability of coefficients on these variables depending upon model specification.

Carman, Li and Sexton specified and tested various combinations of variables, functional forms (linear and log linear) and estimation methods (OLS and 2SLS). Their linear demand equations specified two trend variables to capture the major impacts of the highly correlated variables, while still measuring consistently the effects of promotion programs. We used their specifications and methods to estimate an updated demand equation specifying U.S. per capita avocado consumption as a function of real prices and advertising/promotion expenditures (2008 = 1.00) with annual observations from 1962 to 2008. Our demand equation also includes a dummy variable to account for a mid-1990's shift in demand and two trend variables. The first trend variable (Trend) accounts for uniform annual increases in demand over the entire 47 years of observations while the second trend variable (T94-08) measures a much larger annual increase in demand beginning in 1994 and continuing through 2008. The estimated demand equation is:

$$Qa_t = 0.932 - 0.005\ Pa_t + 0.025\ A_t - 0.680\ D94\text{-}08 + 0.093\ T94\text{-}08 + 0.036\ Trend$$
$$\quad (7.63) \quad (-9.30) \quad (2.71) \quad (-4.33) \quad (5.33) \quad (6.73)$$

where the t-statistics are shown in parentheses below each estimated coefficient and $R^2 = 0.96$ The variables are defined in Table 3.

The signs for each of the estimated coefficients are as expected and all are statistically significant at a 95 percent or higher level. Using these results, the estimated annual price elasticity of demand for avocados at the f.o.b. level is -0.36 and the estimated promotion/advertising elasticity of demand is 0.168 at the sample mean values for the variables. The total for the two trend coefficients (.036 + .093 = .129) is the estimated annual increase in per capita demand that has been occurring since 1994 as a result of highly correlated factors noted previously.

[3] Effects captured by the trend variable may include (i) the development of new regional markets, (ii) increased year-round availability of avocados, (iii) the growth in Mexican restaurants and increased popularity of Mexican food, price, and (iv) increased knowledge about the nutritional benefits of consuming avocados.

Table 3. Variable Definitions

Variable	Definition	Units
Qa_t	Annual average U.S. per capita sales of all avocados (California, Florida, and all imports)	Pounds per capita
Pa_t	Average annual f.o.b. price of California avocados deflated by the consumer price index (CPI) for all items (2008 = 1.00)	Real cents per pound
A_t	Annual advertising and promotion expenditures by the CAC, HAB, CAIA and MHAIA deflated by the CPI (2008 = 1.00)	Millions of real dollars
D94-08	Dummy variable with a value of 1 for each year from 1994 through 2008 and zero for other years	
T94-08	Time trend with value of zero for each year from 1962 through 1993; value of 1 in 1994, increasing by 1 each year to 15 in 2008	
Trend	Time trend equal to 1 in 1962, increasing by 1 each year to 47 in 2008.	

The hypothesized linear functional relationship between demand and promotion expenditures was not rejected by econometric tests.[4] However, the linear relationship would not be expected to hold for large increases in promotion expenditures; at some point the marginal effect of another dollar spent on promotion is expected to decrease.[5] We conclude that HAB promotion expenditures are not yet large enough to cause a decrease in marginal effectiveness.

Benefit-Cost Analysis of Avocado Promotion

Agricultural commodity organizations typically use benefit-cost analysis to determine the estimated returns from their advertising and commodity expenditures. Two types of benefit-cost ratios (BCR) are relevant in promotion-evaluation analysis—average benefit-cost ratio (ABCR) and marginal benefit-cost ratio (MBCR). Producers' ABCR from a promotion program consists of the total incremental profit to producers generated by the program over a specified time interval divided by the total incremental costs borne by producers to fund a program. Both the profit and cost streams should be properly discounted or compounded to a common point in time. The ABCR is the key measure of whether a program was successful, with $ABCR \geq 1.0$ defining a successful program.

[4] A number of statistical tests were utilized for the specification and estimation of the demand function. Formal tests for the time-series properties of the model variables show that the real price has no significant trend and is covariance-stationary (i.e., stationary without a deterministic trend) and that per capita consumption and real promotion expenditures are trend-stationary (stationary after removal of a linear trend). Using 2SLS results, we cannot reject promotion expenditures as exogenous based on the Sargan statistic, and we fail to reject the null hypothesis that California price is exogenous using the Durbin-Wu-Hausman chi-square test. Homoskedasticity of residuals is not rejected based on the Pagan-Hall test, and the hypothesis that the residuals are not autocorrelated of order 1 cannot be rejected under any versions of the Cumby-Huizinga tests.

[5] A square root function is often used to represent the relationship between promotion and demand, as this functional form guarantees a declining effect of marginal promotion dollars on sales (see Alston et al. 1997). We estimated various models with a nonlinear relationship between promotion expenditures and per capita consumption but none improved the model's performance. This outcome is consistent with results from the Ramsey/Peseran-Taylor Reset test that cannot reject the null hypothesis that the true relationship between the variables is linear.

The MBCR measures the incremental profit to producers generated from a small expansion or contraction of a promotion program. MBCR answers the question of whether expansion of the promotion program would have increased producer profits, with MBCR > 1.0 indicating a program that could have been profitably expanded. The ABCR is not equal to the MBCR when promotion expenditures are modeled as having a nonlinear effect on demand. However, for the linear model utilized in this study ABCR = MBCR, and, thus, the two questions "was the program profitable" and "could it have been profitably expanded" are one and the same. Our strategy was to simulate the impact of a small hypothetical increase in the HAB assessment rate from the current level of $0.025/lb. to $0.03/lb., i.e., an increase of one-half cent per lb., and estimate the benefits and costs to avocado growers from that assessment expansion. The ratio of estimated benefits to costs is then the estimated MBCR, and, given that the functional relationship is linear, it is also an estimate of the entire program's ABCR.

Measurement of the MBCR requires three pieces of information: (1) an estimate of the marginal impact of promotional expenditures on demand; (2) estimates of the slope or price elasticity of demand; and (3) estimates of the slope or price elasticity of supply of avocados in the U.S. market. Our estimated demand function provides the first two items, but we do not have a current estimate of the price elasticity of supply. Most promotion evaluation studies do not attempt to estimate the price elasticity of the supply relationship. Supply functions are difficult to estimate empirically, and the elasticity varies by the length of run, with supply becoming more elastic (responsive to price) over time as more productive inputs become variable to producers. Supply analysis is particularly difficult for perennial crops because the analyst must normally specify a dynamic model containing equations for plantings, removals, bearing acreage (as a function of plantings and removals), and yield. Carman and Craft (1998) specified and estimated a dynamic supply response model for California avocados but their study was conducted before imports from Chile and Mexico became important.

The short-run supply of a perennial crop is highly inelastic because it is the product of bearing acreage and yield, neither of which is likely to be influenced much by current price.[6] Thus, the supply of avocados from California is very inelastic for a given marketing year. The supply to the U.S. emanating from Chile and Mexico, however, is apt to be more elastic because the total supply in each country can be allocated to domestic consumption or to various export markets. Thus, an increase in price in the U.S. due, say, to successful promotions is likely to cause Chilean and Mexican shippers to increase supply into the U.S. We followed the lead of other studies and specified two values for the elasticity of supply, 1.0 and 2.0. We could specify other values but it would not add much information because the estimated dollar benefits and BCR both decrease as the supply function becomes more elastic.

Measurement of Benefits and Costs

Producer benefits from the hypothetical expansion of the promotion program are measured by the net increase in producer surplus. The estimated change in producer surplus from a hypothetical ½ cent per pound increase in promotion expenditures minus promotion costs was calculated

[6] In the case of avocados there will be a lag of five years from the time a decision is made to plant avocado trees until new production is available.

for each year 2003 through 2008.[7] The annual BCR was computed by adding program costs to net benefits to produce gross benefits and then dividing gross benefits by program costs. Results are presented in Table 4.

Table 4. Annual Estimated Average and Marginal Benefit Cost Ratios for HAB Promotion Programs by Marketing Year for Supply Price Elasticities of 1.0 and 2.0, 2003 – 2008.

Marketing Year	MBCR for Supply Elasticity =1.0	MBCR for Supply Elasticity =2.0
2003	8.4582	4.7177
2004	7.1232	3.7857
2005	7.9946	4.2925
2006	8.9943	4.8859
2007	7.9108	4.2013
2008	8.1642	4.3044
Annual Average	7.7817	4.2188

The estimated annual BCR range from 3.79 to 8.99, but, importantly, each exceeds 1.0, meaning it is highly likely that (a) the promotional programs supported by the HAB from 2003 through 2008 yielded net benefits to producers and (b) could have been profitably expanded each year for the period of analysis.[8] To place these BCR in perspective, the ratio of 3.79 indicates that the 2.5 cents per pound assessment paid by each avocado producer returned 9.48 cents per pound for a net return of 6.98 cents per pound. At the other end of the spectrum (less elastic supply), the BCR of 8.99 indicates that the 2.5 cents per pound assessment returned 22.48 cents per pound for a net return of 19.98 cents per pound.

HAB Information Program

HAB conducts an innovative internet information program through its network marketing center www.avohq.com. Growers, packers, shippers and wholesalers in the U.S., Chile, Mexico, Dominican Republic and New Zealand, as well as U.S. retailers, have access to the HAB website where they share harvest and shipment planning information. This program has an "orderly marketing" objective and is designed to help all marketers in the U.S. market develop a framework to ensure orderly flow of fruit and market stability. Producers and consumers can benefit from decreased price variability when price transmission is asymmetric. An analysis of the price transmission process for avocados by Li (2007) found that retail prices for avocados respond more fully to shipping-point price increases than to shipping-point price decreases. As a result, retail price margins for avocados will tend to increase with larger and more frequent price changes or decrease with smaller and less frequent price changes. Thus, information programs that smooth the flow to U.S. markets will reduce price variability, leading to smaller marketing margins that benefit producers with higher average f.o.b. prices and consumers with lower average retail prices.

[7] We followed the detailed steps for computing producer surplus in Carman, Li and Sexton (2009), pp. 18-20.
[8] Note that Carman and Craft's (1998) estimate of the average benefit-cost ratio for CAC's promotion programs from 1961 to 1995 was 2.84 while estimates for the first five years of HAB programs by Carman, Li and Sexton (2009) ranged from 1.12 to 6.73.

Changes in Price Variability and Marketing Margins

The HAB information program was initiated during the 2003 marketing year. The variance and standard deviation of weekly California f.o.b. avocado prices were calculated for each year of the ten-year period 1998 through 2007. This period was selected to include the five years before (1998 through 2002) and the five years after (2003 through 2007) initiation of the HAB information program. While there was not an evident trend over time, the standard deviation of weekly average prices for the most recent five years averaged 0.2045, a decrease from the first five-year weekly average standard deviation of 0.2843. Thus, the average annual standard deviation of weekly prices decreased 28 percent in the five years after initiation of the HAB information program relative to the last five years prior to its initiation. At the same time the annual average standard deviation of California weekly shipments increased from the first five years (1998 through 2002) to the most recent five years (2003 through 2007), while the standard deviation of total weekly shipments (California plus all imports) decreased. This indicates that coordination of imports with California shipments has smoothed total weekly avocado shipments and prices during the marketing year. While growing imports had the potential to introduce additional quantity and price variability into the U.S. market, the opposite has occurred. Imports have been timed to maintain a rather steady flow of avocados to retail markets, which tends to stabilize prices at both the f.o.b. and retail levels. A portion of the smoothing of quantity and prices as imports increased significantly likely can be attributed to the active HAB information programs.

The results from Li's research on price transmission in the marketing channel were used to estimate weekly changes in gross marketing margins between the shipping point (f.o.b.) and the retail price of avocados. Based upon Li's results on asymmetry of transmission of f.o.b. price changes to retail, we assumed that retail prices increased 76 percent of an increase in shipping-point prices and decreased 29 percent of a decrease in shipping-point prices. We used the aggregate estimated adjustment without attempting to account for the two to three weeks required for the total price adjustment, based upon Li's analysis. The changes in estimated gross marketing margins from week to week are based on total weekly shipments, the change in average weighted shipping-point price per pound for all Hass avocados and Li's estimated adjustment ratios. The estimated total five-year (2003-2007) increase in marketing margins as a consequence of price variability is $31,661,000. Considering that this figure represents a reduced value due to the presence of the information programs, the reduction of 28 percent in margins would have been worth a five-year (undiscounted) total of $12.3 million in terms of reduced margin that is reflected in both lower retail prices paid by consumers and higher prices to growers at the shipping point.[9] This comparison of the variability of prices immediately before initiation of the information program with variability of prices after beginning the information program has a limitation that the entire change in price variability is attributed to the information program, even if there were other factors contributing to more stable prices.

[9] Let M_0 denote the increase in margin due to price variability in the absence of the HAB programs and $M_1 = 31,661,000$ equal the value in the presence of the programs. Then we have $(M_0 - M_1)/M_0 = 0.28$. Solving for M_1 and subtracting M_0 from it yields $12.3 million.

Annual expenditures for HAB's information programs ranged from $340,179 to $1,090,228 over the five years from 2003 through 2007 with a total cost of $3,749,840 and average annual cost of just under $750,000. Given an estimated benefit of $12.3 million and costs of $3.75 million, the net benefit from reduced marketing margins attributed to HAB's information programs is $8.55 million. The division (incidence) of the total benefit, as well as the assessment cost to fund the information program, between consumers and producers depends upon the value of consumers' price elasticity of demand, ε_D, relative to producers' price elasticity of supply, ε_S, of avocados to the U.S. market. The share of a change in margin going to consumers in terms of lower price is $\Delta P = \frac{\varepsilon_S}{\varepsilon_S - \varepsilon_D}$. Using two values for the elasticity of supply (1.0 and 2.0) and an estimated price elasticity of demand of -0.20, based on the estimated demand equation and average prices and quantities for the most recent 10 years, we can estimate the portion of the benefits from reduced margins going to consumers and producers. The share going to consumers is estimated at 0.91 for a supply elasticity of 2.0 and 0.83 for a supply elasticity of 1.0 with the remaining 0.09 and 0.17 shares going to producers. Thus, the five-year information program net benefits are estimated to be $7.09 or $7.78 million to consumers and $.77 or $1.46 million to producers, depending on the elasticity of supply. While the majority of estimated benefits flowed to consumers, producers still received an attractive return for their share of expenditures.

Nutrition Based Public Relations

The CAC made a strategic decision in 1997 to fund nutritional research and to proactively communicate the nutritional benefits of consuming avocados through their public relations and outreach programs. Research focused initially on a detailed analysis of the composition and nutrient content of avocados, including fatty acids, vitamins, and minerals, and then emphasis shifted to quantifying and qualifying various phytochemicals (i.e. pytosterols, carotenoids, glutathione), as well as their health benefits and effects on disease processes. The CAC's public relations program emphasizing health and nutritional benefits associated with avocado consumption garnered the attention of news organizations, and the health and nutrition message has been widely disseminated with a modest expenditure of funds. In addition, the public relations program has been very effective since most consumers place much more credibility on a news story about health and nutrition benefits of consuming a product than they do on advertising with the same message. Internet readers can access recipes, read about the health and nutrition benefits of eating avocados, obtain nutrition facts, read news releases on health research, and learn about healthy eating by accessing partner websites.

HAB has continued funding nutrition research and has developed a new nutrition research plan with three strategic research pillars: heart health, weight/diabetes management, and healthy living. In a recent issue of AvoAction (2010), HAB announced that it is commissioning three nutrition studies that will get underway in the coming months. Researchers at Pennsylvania State University will evaluate the benefits of avocados on heart disease risk factors, Loma Linda University researchers will evaluate the effects of avocados on weight/diabetes management, and researchers at Ohio State University will determine the effects of avocado consumption on cardiovascular health.

Concluding Comments

Increasing the annual supply of avocados marketed in the U.S. from 406 million pounds in 1996 to 1.056 billion pounds in 2008 given inelastic demand was a recipe for a "price disaster." Instead, a combination of effective promotion, innovative information programs, and favorable demand trends interacted to increase avocado demand in pace with expanding supply, resulting in real (2008) prices of 94.8 cents per pound in 1996 and 99.5 cents per pound in 2008. During the same time period U.S. per capita avocado consumption increased from 1.51 to 3.47 pounds.

Few commodities have experienced this type of demand growth, and actions taken by the U.S. avocado industry in the face of rapidly increasing supplies can provide lessons for other produce industries facing similar challenges. Lower producer prices and profits are inevitable in these settings without demand expansion commensurate with the increasing supply. Such demand expansion in an agricultural industry involving many domestic and international producers and shippers is difficult to achieve without industry organization, leadership, and collective action in the form of government-sanctioned mandatory marketing programs. Voluntary programs will, even if they are effective, invite free riding, which will lead inevitably to their demise, in which case competition will be based solely upon pricing and only the lowest-cost producers will survive. U.S. growers of fresh produce commodities are unlikely to be the low-cost producers due to their high labor and regulatory costs relative to most importers.

Importers are free riders with respect to most U.S. mandatory agricultural marketing programs. The genius of leaders of the U.S. avocado industry was to seek and obtain legislation bringing importers under the auspices of the mandatory marketing program, both eliminating free riding and substantially expanding the resources available to promote avocado consumption in the U.S. The avocado industry also designed its programs wisely to maximize the impact of its expanded resource base. It implemented research and marketing programs that were in sync with growing interests of consumers in the health and nutritional benefits of food and with public policies promoting fruit and vegetable consumption to combat obesity and improve overall health. Results from industry-financed research helped secure mention of avocados in USDA diet recommendations, listing of avocados in Mediterranean diets and on diet pyramids, and partnerships with organizations promoting health and diet.

Our estimation results provide quantitative support for this assessment of the effectiveness of the industry's programs. They indicate that HAB promotion expenditures have been effective in increasing avocado demand and generating very favorable returns for producers. Indeed it appears that avocado producers could profitably increase promotion assessments and expenditures.

Fresh produce industries tend to be highly volatile and market participants can benefit from sharing production, shipping, and price information. Yet public market information programs for agricultural commodities have been scaled back or eliminated in recent years. Industry marketing programs operating with government sanction have exemption from antitrust laws and enable producers and shippers to actively share market information, which can stabilize shipments and prices. The HAB seized upon this opportunity and stepped into the information void with an innovative program that facilitated information sharing among market participants at all stages of the market chain. Our results showed that improved information flows likely reduced marketing

margins, benefitting both producers and consumers. Implementing similar programs relying on advanced information technology and rapidly evolving information delivery systems likely represents an opportunity for similar industries.

In sum, the actions of the U.S. avocado industry to obtain legislative approval of the Hass Avocado Promotion, Research and Information Order enabling creation of the HAB have prevented a financial disaster for U.S. avocado growers and shippers. The actions of the industry and the programs that it created in the aftermath of the legislation serve as a model for other produce industries facing similar challenges.

References

California Avocado Commission. AMRIC Industry Statistical Data, Pounds and Dollars by Week, November 1998 to October 2007.

Carman, H.F. 2006. Offsetting Price Impacts From Imports With Generic Advertising and Promotion Programs: the Hass Avocado Promotion and Research Order. *Rev. of Agric. Econ.* 28(4): 463-481.

Carman, H.F. and R.K. Craft. 1998. "An Economic Evaluation of California Avocado Industry Marketing Programs, 1961-1995." Giannini Foundation Research Report No.345, July http://giannini.ucop.edu/ResearchReports/345-Avocado.pdf.

Carman, H.F., L. Li and R.J. Sexton. 2009. "An Economic Evaluation of the Hass Avocado Promotion Order's First Five Years." Giannini Foundation Research Report No.351, December. http://giannini.ucop.edu/ResearchReports/351-Avocado.pdf.

Hass Avocado Board. 2010. *AvoAction* VI(5): Nov.

Li, L. 2007. "Retailer Pricing Behavior for a Fresh Produce Commodity: The Case of Avocados." Ph.D. Dissertation, University of California, Davis, 528 pp.

U.S. Department of Agriculture. 1997. "USDA Lifts Import Ban on Mexican Avocados." Economic Research Service, *Agricultural Outlook* June: 17-23.

U.S. Department of Agriculture. 2001. "Regulatory Impact and Regulatory Flexibility Analyses, The Potential Economic Impact of Expanded Importation of Hass Avocados from Mexico." Animal and Plant Health Inspection Service, Washington DC, October.

U.S. Department of Agriculture. 2003. "Importation of 'Hass' Avocado Fruit (Persea Americana) from Mexico, A Risk Analysis," Animal and Plant Health Inspection Service, Plant Protection and Quarantine, Washington DC, June.

U.S. Department of Agriculture. 2004. "Proposed Rule to Allow Fresh Hass Avocados Grown in Approved Orchards in Approved Municipalities in Michoacan, Mexico, to Be Imported Into All States Year-Round," Animal and Plant Health Inspection Service (APHIS DOCKET NO. 03-022-3), Washington DC, May.

