Demand Growth and Commodity Promotions for Fresh Hass Avocados

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Shipments of fresh Hass avocados to the U.S. have increased dramatically in recent years, primarily in response to the opening of the U.S. market to imports from Mexico. Inflation-adjusted prices received by California growers have nonetheless remained nearly constant on average, despite considerable year-to-year volatility. Our analysis shows that consumer demand growth, fueled in part by a successful industry promotion program, has prevented falling prices.

California avocado growers' long-standing program to fund advertising and promotion programs for their fruit was extended to include imports of fresh avocados through the Hass Avocado Promotion, Research, and Information Act, signed into law on October 23, 2000. Mandatory program assessments of 2.5 cents per pound on all Hass avocados sold in the U.S. market commenced effective January 2, 2003 under the Hass Avocado Promotion, Research and Information Order (HAPRIO).

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). 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 assessments to fund activities such as nutrition research, marketing, and information programs intended to benefit all avocado producers. It rebates 85% of domestic assessments to the California Avocado Commission (CAC) and up to 85% of importer assessments to the certified importer associations for their own promotion programs. There are currently three certified importer associations operating under the HAB: the Chilean Avocado Importers Association (CAIA), the Mexican Hass Avocado Importers Association (MHAIA), and the Peruvian Avocado Commission (PAC).

This article summarizes the evaluation of the economic impact of promotional expenditures conducted under HAB's auspices on U.S. demand for fresh avocados, and estimates producer returns from the expenditures for the second five years of the HAB's operations—the period from 2008 through 2012. We estimated an aggregate annual model of demand for fresh avocados in the United States. A market simulation model was constructed using results from estimation of the annual model and utilized to estimate benefits and costs from the promotion program.

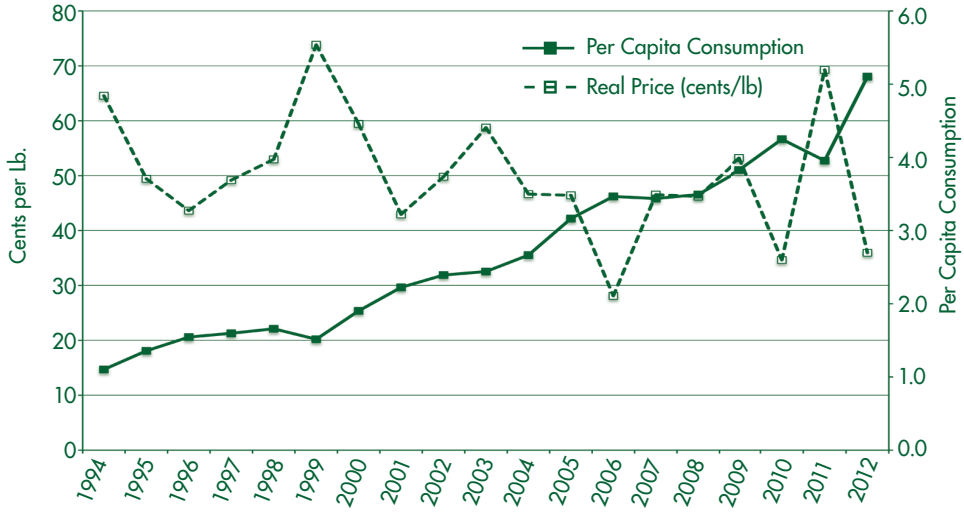
Supply and Demand of Avocados

Since HAB assessments to support avocado promotion began in 2003, avocado imports and total U.S. supplies (Hass and other varieties) have continued to increase to a record total of over 1.6 billion pounds in 2012. Mexican avocado exports to the U.S. increased significantly after Mexico gained year-round access to all states except California and Florida in 2005 and to all states in 2007. Mexican imports of 933.8 million pounds accounted for over 58% of the total U.S. supply of fresh avocados and for 86.7% of total fresh avocado imports in 2012. Market share for imports increased from 30% in 2000 to 67% in 2012.

The U.S. demand for avocados has grown substantially in the ten years since the HAB began funding promotional programs in January 2003. As shown in Figure 1, U.S. consumption has exceeded two pounds per capita annually since 2001, exceeding three pounds per capita in 2005, four pounds per capita in 2010, and five pounds per capita in 2012.

Figure 1 also depicts the average price per pound in real (inflation-adjusted, base year 1982-84) terms received by California growers for these same years. The farm-level demand for avocados is widely acknowledged to be quite price inelastic, with empirical estimates typically near -0.25. In the absence of substantial demand growth, one would have, thus, expected sharply lower prices to accompany an increase in avocado supply of over 200%. But, despite the real grower price

Figure 1. Per Capita Consumption and Real Producer Price for Fresh Avocados



Source: USDA, NASS

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

Year	CAC	CAIA	MHAIA	PAC	HAB	Total
			1,000 dollars			
2003	8,682	1,427	0	0	146	10,256
2004	10,756	3,010	700	0	859	15,325
2005	11,838	5,743	2,900	0	2,603	23,084
2006	10,499	2,661	4,500	0	2,562	20,222
2007	9,205	3,865	6,247	0	3,097	22,413
5-YR Sub-total	50,980	16,705	14,347	0	9,268	91,300
2008	10,470	3,819	7,141	0	3,102	24,532
2009	6,559	5,405	13,995	0	4,646	30,604
2010	8,780	2,351	13,379	0	5,908	30,418
2011	9,004	3,732	11,419	0	3,555	27,710
2012	11,632	1,994	17,713	952	4,220	36,510
5-YR Sub-total	46,444	17,301	63,647	952	21,430	149,774
Grand Total	**97,425**	**34,006**	**77,993**	**952**	**30,698**	**241,073**

exhibiting considerable year-to-year volatility (characteristic of a commodity with inelastic demand) it has, on average, remained stable over this time period, reflecting the substantial demand growth that has occurred.

Avocado Promotions

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

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

Table 2. Annual Model Regression Results

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

Promotion Evaluation

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

Annual Demand for Avocados

Economic theory posits that demand for a commodity is a function of that commodity's price, prices of goods that are used as substitutes or complements for the commodity, and consumer income. Successful promotions can also be an important factor in expanding demand for a product. We estimated annual per capita fresh avocado demand as a function of price, per capita income, a time trend, and total HAB and CAC promotions. The annual model analysis utilized data from 1994–2012. Table 2 contains the annual demand model results for four model specifications.

Model 1 in table 2 includes real f.o.b. price, real per capita income, and real promotion expenditures as explanatory variables. Model 2 adds a linear time trend, *YEAR*, to Model 1. Models 3 and 4 are adjusted to account for the fact that price and consumption are likely jointly determined. These models use U.S., Chilean, and Mexican avocado acreage as instrumental variables (i.e., a proxy) for price. Real promotion expenditures represent the key variable of interest in all 4 models.

In all cases, promotion expenditures have a statistically significant and positive impact on per capita U.S.

avocado consumption. The estimated coefficients for promotion expenditures range from 0.049 (model 2) to 0.113 (model 1). Models 3 and 4, which have the best statistical properties among the models, yield intermediate values for the promotion coefficient of 0.052 and 0.077, depending upon whether per capita income is included in the model.

Because the magnitude of the estimated coefficients depends upon the choice of units to measure the model variables, it is desirable to convert the coefficients to elasticities, which measure estimated percentage impacts and, thus, are unitless. The estimated promotion elasticities evaluated at the data means range from 0.153 (model 2) to 0.354 (model 1) (see table 2).

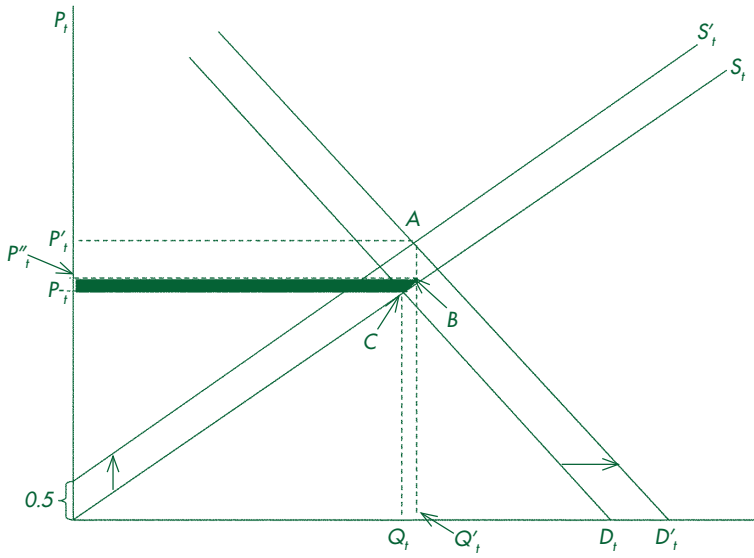
The other variables included in the model perform much as economic theory would predict and estimates are also consistent with prior work. The one exception is the impact of the income variable when it is included in a model with the time trend. These two variables are highly correlated and, in essence, it is impossible to isolate the unique impacts of growth in consumers' incomes on avocado consumption from other economic factors that are captured in the trend term.

Cost-Benefit Analysis of Promotional Expenditures

The annual demand analysis presents strong evidence that generic promotion of fresh avocados has worked to increase the demand for fresh avocados in the United States. The additional question to ask, however, is whether the expenditures have "paid off" in the sense of yielding benefits to producers from the demand enhancement that exceed the money expended to fund the programs.

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

Figure 2. Avocado Promotion Simulation Model



The marginal benefit-cost ratio (MBCR) measures the incremental profit to producers generated from a small expansion or contraction of a promotion program. MBCR answers the question of whether expansion of the promotion program would have increased producer profits, with MBCR $\geq$ 1.0 indicating a program that could have been profitably expanded.

Substantial diagnostic tests performed by CLS (2009) in their evaluation of avocado promotion supported use of a linear demand model, which we thus also utilized. For the linear model ABCR = MBCR, and the two questions "was the program profitable" and "could it have been profitably expanded" are one and the same.

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

The simulation framework is depicted in figure 2. The model begins with demand and supply functions for avocados that depict the U.S. market for a given year *t*. Thus, demand, D_t, is total U.S. demand in year *t*, on a per capita basis. Supply, S_t, is total supply to the U.S. market in year *t* from all sources. Under the current program, total U.S. consumption in year *t*, given functions S_t and D_t, is Q_t, and grower price is P_t. Implementation of a one-half cent per pound expansion in the program assessment increases producer costs per pound by that half cent, S'_t as depicted in figure 2.

The hypothetical increase in assessment generates incremental funds for promotions equal to the change in assessment multiplied by total shipments to the U.S. market. The marginal impact of the additional promotional expenditure on demand is determined by the regression coefficient for the promotion variable, which is reported for alternative model specifications in table 2.

The new demand curve is illustrated in figure 2 by D'_t. The new market equilibrium is found at the intersection of curves S'_t and D'_t at point A in figure 2. Thus, the model predicts that equilibrium price in year t would have

risen to P'_t and sales have risen to Q'_t with the incremental assessment.

Producer benefits from the hypothetical expansion of the promotion program are measured in terms of the change in producer surplus (PS). PS is the same as producer variable profits, namely revenue (producer price *x* output) minus the variable production costs associated with producing and selling the output.

We seek to measure the change in PS associated with the hypothetical expansion of the promotion program. In figure 2, PS after the program expansion is $PS' = P'_t \times Q'_t - 0BQ'_t$, but we must also account for the additional promotion expenditure, which is represented geometrically by the rectangle $P't\,P''_t$ $AB=(P'_t - P''_t)Q'_t$. Thus, the net increase in PS to producers from expansion of the promotion program is $\Delta PS = PS' - (P'_t - P''_t)\,Q'_t$, which is represented by the shaded area in figure 2.

Information required to estimate ΔPS consists of: (i) an estimate of the marginal impact of promotional expenditures on demand, (ii) an estimate of the slope or price elasticity, $\in_D$, of the grower-level demand curve, and (iii) an estimate of the slope or price elasticity, $\in_S$, of grower supply of avocados to the U.S. market. The results of the econometric estimates reported in table 2 provide estimates of (i) and (ii).

We evaluated these considerations, and specified three alternative values, 0.5, 1.0, and 2.0, as representing a plausible range of values for $\in_S$. Among the demand models included in table 2, we selected models 1 and 3 for use in the simulation. Benefits and costs were estimated for each of the five years, 2008–2012, under evaluation.

The model was implemented by fitting the demand and supply functions to the actual values observed for the real grower price and per capita consumption for each year of the review period. S_t was then shifted vertically to S'_t by the half-cent incremental assessment for each year, and D_t was shifted horizontally to D'_t by the estimated promotion coefficient times the funds generated by the incremental assessment, producing the equilibrium at point A in figure 2 and enabling us to compute the hypothetical changes in P and Q and the ΔPS.

Total net producer benefits are reported for each model by compounding the annual benefits and costs over the five-year period to 2012, using a 3% real rate of interest. The estimated benefit-cost ratios in this study range from 2.12 to 9.28. The lower bound is associated with model 3, which has a small coefficient for promotion relative to model 1, and the most elastic supply response, $\in_S$=2.0. The average annual increase in the grower price due to promotions for this simulation is 2.6%. The upper bound of 9.28 is associated with demand model 1, which has a high coefficient for promotion, and with the most inelastic supply response, $\in_S$=0.5. The average annual price increase for this simulation is 12.3%.

Space considerations preclude us from discussing results of the disaggregate model estimated using scanner data. Those results are available upon request from the authors and showed a statistically significant positive impact of promotions on weekly sales in those market areas receiving promotions through the HAB, thus reinforcing the results from the annual model.

Conclusion

Fresh avocados have seen remarkable growth in consumption per capita in the U.S., rising from about 1.5 pounds during the decade of the 1990s to over 5 pounds in 2012. This rapid increase in imports to the U.S. and commensurate consumption has been achieved while keeping real grower prices relatively constant on average over this time period. Such an outcome is only possible with substantial growth in fresh avocado demand in the U.S. over this time.

The econometric analysis of annual fresh avocado demand conducted in this study provides strong statistical evidence of this demand growth and support for the proposition that promotion expenditures have been an important causal factor. Benefit-cost analysis conducted based upon these econometric estimates yielded estimated average and marginal benefit-cost ratios in the range of 2.12 to 9.28. We conclude with considerable confidence that the promotion programs conducted under the HAB's auspices have been successful in both expanding demand for fresh avocados in the U.S. and yielding a very favorable return to those funding the program.

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For additional information, the authors recommend:

Carman, H.F., L. Li., and R.J. Sexton (2009). "An Economic Evaluation of the Hass Avocado Promotion Order's First Five Years." University of California Giannini Foundation of Agricultural Economics, Giannini Foundation Research Report 351.

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