

Estimation of Multi-City Demand for Hass Avocados Using Panel Data

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Abstract

Avocado (*Persea americana*) is a Latin American and the Caribbean native fruit. The United States is among the largest avocado importer in the world, accounting for 44.4% of total world imports. U.S. per capita avocado consumption has grown by almost 78% from 2008 to 2015 (USDA, 2015) and continues to grow aggressively. In the same period of time, imports of avocado more than doubled from 476,000 tons in 2008 to 956,000 tons in 2015 (USDA, 2015). The common varieties of avocados are Hass, Reed Fuerte, Zutano and Bacon (grown in California) as well as Choquette, Hall, and Lulu (grown in Florida). Due to year-round production and longer shelf-life, the Hass variety is the dominant and the most popular commercial type. Hass avocados account for more than 95% of total avocado imports.

In the United States, the main Avocado producer states are California and Florida. California is essentially a Hass avocado producer and accounts for more than 90% of all U.S. avocado production. Several studies were conducted dealing with U.S. demand for avocados (Carman, Li, and Sexton, 2009; Evans and Ballen, 2015). Additionally past studies have centered attention on the economic evaluation of the promotion (Carman, Li, and Sexton, 2009; Carmen and Sexton, 2011). Other studies have concentrated on avocado trade expansion and import evaluation (Orden, 2004; Peterson and Orden, 2006) and economic benefits to the U.S. economy of Hass avocado imports from Mexico (William, Capps, and Hanselka, 2014 and 2016).

Avocados are consumed in every state of the United States. Therefore, demand estimation with accompanying estimates of own-price and income elasticities by city would be beneficial to stakeholders of the avocado industry. The present study contributes to the extant literature in that it empirically focuses solely on city level demand estimation. To accomplish this objective, a seemingly unrelated regression (SUR) analysis was conducted using panel data collected from the Hass Avocado Board (HAB) and the United States Census Bureau.

Data Collection

Data were pulled from two different sources to create the data set for our analysis. Monthly sales (in U.S. dollars) and volume (in pounds) measures were obtained from the Hass Avocado Board (HAB). Data pertaining to real per capita income, population and Latino\Hispanic ethnicity (share of the population that fits this demographic profile) by city came from the U.S. Census Bureau.

The data from the Hass Avocado Board (HAB) correspond to multi-outlet retail data for 45 cities that includes an aggregation across the following channels: grocery, mass, club, drug, dollar and military. We use the HAB data that were collected monthly for the period 2012-2015 in 35 major cities. The raw data for sales and volume were reported in 28-day intervals. Adjustments were made for sales and volume information to place these data on a monthly basis.

To obtain monthly avocado prices per pound, we divide sales by volume. As such, these prices correspond to unit values. Then we adjusted the imputed unit values (prices) by dividing by the CPI for fresh fruits and vegetables. In our analysis, for each of the aforementioned 35 cities, the dependent variable in the respective SUR equations was per capita volume sold. To

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achieve the values for this variable, volume sold variable was divided over the corresponding city population. The U.S. Census Bureau provides information about inflation adjusted per capita income, population and Latino/Hispanic share by city level annually. To place per capita income and population data on a monthly basis, linear interpolation techniques were employed. Data associated with marketing expenditures was not available by city. As a proxy, we used marketing expenditures provided for the United States as a whole. This information was available on an annual basis. Consequently, linear interpolation techniques were used to place this information on a monthly basis. Subsequently, these data were deflated by the CPI to adjust for inflation.

Model Development

A 35-equation SUR model was developed. The dependent variable corresponds to per capita consumption of avocados by city. The explanatory variables in each equation corresponds to real per capita income, the unit value of avocados deflated by the CPI for fresh fruits and vegetables, real marketing expenditures from the Hass Avocado Board, and the share of the population associated with Latino/Hispanic ethnicity. As well, to account for seasonality, we employ monthly dummy variables. The number of observations available associated with this panel data set was 1,680 (48 months of time-series for each of the 35 cities or cross-sectional units).

Preliminary Results

The results show degrading collinearity between Latino/Hispanic share and per-capita income; thus we drop the Latino/Hispanic share variable from the model. A positive and statistically significance is evident between marketing expenditures and per capita consumption. Income elasticities are statistically significant for a majority of the cities and have the expected positive sign. Seasonal patterns in per capita consumption are similar across the respective 35 cities. Own-price elasticities across the 35 cities vary from -0.2 to -1.6. Hence, depending on the city, the demand for avocados may be considered elastic or inelastic, or even close to unitary elastic. Thus, retailers should implement different price strategies in each major city to help increase profits.

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