Price Determination in the Strawberry Market: A Regional Analysis

by

Colin A. Carter, James A. Chalfant, Rachael E. Goodhue, and Tian Xia

American Agricultural Economics Association
2002 Annual Meeting, July 28-31, 2002, Long Beach, California
Selected Paper

Price Determination in the Strawberry Market: A Regional Analysis

Colin A. Carter, James A. Chalfant, Rachael E. Goodhue and Tian Xia
Department of Agricultural and Resource Economics
University of California, Davis

May 15, 2002

1. Introduction

Since the late 1980's, significant shocks and structural changes have affected the California strawberry industry. The Cyclospora scare of 1996 and the upcoming methyl bromide ban have received the most publicity, but there have also been weather shocks, changes in the seasonal pattern of production, and increased use of advanced pricing arrangements through marketing contracts. Meanwhile, the average fresh market price of California strawberries declined by 30% in real terms between 1988 and 1994. Price recovery after 1994 has not been significant. In addition, price variability within a year has decreased, apparently due to increased production in the first part of the season, when prices have historically been highest. Understanding changes in price behavior is very important to strawberry producers, retailers, and shippers.

Price determination for fresh strawberries varies across different growing regions in California and Florida. Each region supplies fresh strawberries for only part of the total harvest season. Fresh strawberries are highly perishable, so competition between any two regions is limited to times when both are harvesting. Regional differences in marketing windows also mean that different regions face different substitute fruits, and other differences in demand. For instance, advertising concentrated around Easter or Mother's Day will benefit primarily those regions with the most production at that time of the season. Since all California strawberries face the same per tray assessment to fund industry research and promotion efforts, the distribution of the benefits from advertising and promotions is an important question.

Analysis using data aggregated across production regions, though it is simpler, may ignore essential characteristics of price determination that are region-specific. Perhaps most importantly, aggregate analysis ignores the impact that strawberry production in one region can have on the price obtained by competitors in a different production region. For example, the introduction of a new variety that enables earlier harvests in one area may result in a decline in total industry revenues, if it reduces the price in competing regions more than proportionately. Some industry members believe that increased strawberry acreage in the Santa Maria region has depressed prices for the Watsonville region at the beginning of its production period, when its prices are generally highest. Due to quality differences between the two regions, some even argue that this price reduction is greater than if the Watsonville region itself had increased production by an equivalent amount.

We estimate the price determination process for four California production regions and Florida. We use our results to answer two questions of interest to members of the strawberry industry:

1. Do all production regions benefit equally from retailer promotions?
2. Does increased production in the Santa Maria region disproportionately reduce the price of fresh strawberries grown in other regions, especially Watsonville?

2. The Regional Nature of the Fresh Strawberry Industry

In each region, the strawberry harvest generally begins with the onset of warm weather. Strawberries from more southern regions are harvested and available on the market in the early portion of the season. Florida (6,000 acres planted annually), Mexico (1,300-1,400 estimated acres planted annually), Orange County (2,800 acres planted annually), and San Diego (400 acres planted annually) are the primary suppliers during the high-value winter months of November, December, January and February. Starting in March, Orange County and San Diego become the major supply regions, and the volumes from Florida and Mexico become smaller and smaller. Florida and Mexico usually drop out of the market by mid- to late- April. The coastal regions of Oxnard County begin harvesting 5,000 acres in late February and March and continue through June. Santa Maria is located 60 miles north and its strawberries from 3,700 acres are available from late February through September. The strawberry season for Watsonville/Salinas, which has 10,000 annual planted acres, is between March and October.

3. Model

Our study consists of has five regional price determination models, four for regions in California and one for Florida. We do not estimate a model for Mexico, since comparable weekly price data are unavailable. In each model, the weekly price for each region is specified as a function of fresh volumes from both that region and outside regions, volumes of substitute fruits in season during the region's production period, retailer advertising, stage dummies, holiday dummies, lagged values of the region's own fresh price and volume, and other explanatory variables. We do not use a system of equations in this analysis because the timing of harvest and availablility of strawberries from each region varies significantly. For a certain week during the season, only some regions can supply fresh strawberries while other regions do not.

From economic theory, for a given price-quantity demand relationship, the market price of a normal good is negatively associated with the volume of supply. The lagged price can influence the current price in our empirical models, which use a weekly data set. Each production region can only

supply for a limited and different portion of the season. For any given week, volumes and variety characteristics of fresh strawberries vary across regions. Thus, fresh strawberries from other regions act as close substitute goods for the products of a specific region during the specific weeks when the regional harvest periods overlap. Differences in strawberry quality across regions determine the degree of substitutability. Therefore, we need to include the volumes of other production regions in our models to capture those substitution effects. As usual, other substitute fruits of each region, such as citrus, peach, plum, cherry, and grape, can also have negative effects on the regional fresh strawberry price, depending on the price and availability of these fruits in a given week.

We divide the strawberry season into five stages: Stage I is from the beginning of the season to Easter, Stage II is from Easter to Mother's Day, Stage III is from Mother's Day to July 4th. Stage IV is from July 4th to Labor Day, and Stage V is from Labor Day to the end of the season. Also, we include dummies for four important holidays during the strawberry season: Easter, Mother's Day, July 4th, and Labor Day. Consumers tend to buy more fresh fruits—including strawberries—during the weeks that include one of those holidays. We use dummy variables for these stages and holidays to capture possible differences in consumer demand in different time periods. Retailers usually promote a set of products to lure customers into their stores. For a given supply, retailer's promotion is believed to increase customers' awareness, and demand for the product. Therefore, retailers' promotion activities are included in our model, and are expected to have a positive effect on the fresh strawberry price. We also use a trend variable for each week, and the square of the trend term, to capture the normal trend in price fluctuations during the whole season. The variable for each year is used to account for the structural changes in production and demand across years.

3.1. **Florida.** Florida producers have a warmer climate, so they harvest and supply in the early portion of the season, usually from November to April. During this period, there are almost no fresh strawberries from the Watsonville region in the market. Therefore, we include the fresh volumes for the other three California regions, and Mexico, in the Florida model. Of the set of substitute fruits we consider, only Florida citrus is available at the same period in significant volumes. Consequently, the Florida model includes only Florida citrus as a substitute fruit. Other explanatory variables include dummies for Stages II and III, holiday dummies for Easter and Mother's Day, lagged values of the regional price and volume, retailers' promotion activities, interaction terms for the regional volume and the stage dummies, the trend variables of the week, and year dummies.

3.2. **Orange County/San Diego (OCSD).** Orange County/San Diego producers also have a relatively warm climate. They can harvest and supply fresh strawberries from November to May. All other production regions have fresh strawberries available and compete with OCSD during some parts of the OCSD season. Accordingly, the volumes of all other regions are included in the model. For the substitute fruits, there are four products: Florida citrus, California peaches, California nectarines, and California table grapes. Other explanatory variables, including stage dummies, lagged values, retailers' promotion activities, interaction terms, etc. are the same as those in the Florida model.

3.3. **Oxnard County.** The coastal region of Oxnard County can start to harvest and supply fresh strawberries as early as February. Oxnard County producers continue to supply strawberries through June. Accordingly, the Oxnard model also has all other production regions' fresh strawberry volumes. In addition to the 4 substitute fruits in the OCSD model, California cherries are added to the Oxnard model. Other explanatory variables, including stage dummies, lagged values, retailer's promotion, interaction terms, etc. are the same as those in the Florida and OCSD models.

3.4. **Santa Maria (SM).** Santa Maria fresh strawberries will come to market in March and continue through September. The volumes of all other production regions are in the SM model, as well as all stage and holiday dummy variables. All of seven substitute fruits we consider (Florida citrus, California peaches, California plums, California nectarines, California cherries, Washington cherries, and California table grapes), are available during this. The SM model includes the same other explanatory variables of lagged values, retailers' promotion activities, etc. as the other models do.

3.5. **Watsonville (WA).** The harvesting and marketing period for Watsonville producers is from late March to late September or early October. Watsonville strawberries account for most of the fresh market volumes during the Watsonville season. The explanatory variables in WA model are the same as those in the SM model.

4. Data

We have weekly data for 9 years, from 1990 to 1998. The weekly data consist of fresh strawberry prices and volumes by region, substitute fruit volumes, retailers' promotion activities, and other variables used in the estimation.

The FOB price and volume of fresh strawberries come from "The Berry Report" of USDA's Federal State Market News Service (FSMNS). Average weekly fresh price and volume are constructed based on daily prices and volume listed in "The Berry Report" which are collected by USDA- FSMNS market reporters through phone surveys of strawberry shippers. Retailer's promotion activities are measured by the weekly percentage of the national market running retail promotions. The weekly percentage comes from the Leemis Marketing Database. Leemis Marketing monitors retailers' promotion activities in approximately 50 cities or regions.

The volumes of California cherries and Washington cherries come from the California Cherry Advisory Board, the Washington State Fruit Commission Northwest Cherry Growers, and "Marketing of California Cherries" by USDA-FSMNS. The weekly shipments are calculated from the original data of daily shipments. The data source of the volume of California table grapes is the California Table Grape Association Annual Report. The volumes of California peach, plum, and nectarines come from the California Treefruit Agreement (CTFA) Annual Report.

5. Estimation Results

We find the following general results. (1) The price of fresh strawberries in a given region is affected by fresh strawberry volumes from some other regions. Other regions' production is a close substitute for the given region's strawberries in some cases, generally where the marketing windows for the regions in question overlap significantly. (2) Most substitute fruits do not show significant effects on strawberry prices. Only California peaches in Santa Maria and Watsonville have significant negative effects. (3) Retailers' promotions increase the fresh market price for Santa Maria and Watsonville, but not for the other regions. (4) Price is relatively lower from Easter through July 4th, in some regions, holding other conditions constant.

From the results for the Florida model, we can see that the model fits the data very well (R^2 is 0.83). The estimated coefficient for Florida's own fresh volume is of the expected sign (negative) and statistically significant at the 95 percent level (hereafter, the level of significance is 95 percent when an estimated coefficient is termed statistically significant). The fresh volume of Santa Maria strawberries has a significant negative effect on Florida's fresh price. That means that fresh strawberries from Santa Maria substitute for Florida's fresh strawberries, as predicted. The fresh strawberries from all other regions do not show significant substitution effects. The estimated coefficient on Florida citrus volume is neither of the expected sign nor significant. All stage and holiday

dummies, own volume-stage interaction variables, retailers' advertisement, and other trend and year variables are not significant. The Durbin-Watson statistic is 2.15, so there is no autocorrelation problem.

The Orange County/San Diego model also fits the data quite well, with a very high R^2 value (0.86). Both the current and one-period lagged values of own region volumes have significant negative effects on the OCSD fresh strawberry price, as predicted. Florida and Santa Maria fresh strawberries have significant negative substitution effects on the OCSD fresh price. None of the coefficient estimates for substitute fruits are significant. The coefficient estimates for both Stage II and III dummies are negative and significant. Therefore, the OCSD fresh price tends to be lower in the period between Easter and July 4th than the beginning of the season (in Stage I), other things equal. The estimated coefficient for the own volume-stage dummy for Stage II is significant and positive. It shows that OSCD own fresh volume has a weaker effect on the fresh price during Stage II (from Easter to Mother's Day).

The Oxnard County model has a reasonably good R^2. In the Oxnard County model, the 1-period lagged own fresh volume has a significant negative effect on Oxnard fresh price. The current fresh volume's effect is not significant. Three regions' fresh strawberry volumes have a significant negative effect on the price of Oxnard fresh strawberries. These three regions are Florida, Orange County/San Diego, and Santa Maria. The coefficient estimates for substitute fruits are not significant. Retailers' promotions do not seem to affect the fresh strawberry price.

The R^2 value shows that the Santa Maria model explains the data very well. The coefficient estimate for current own fresh volume is of the expected sign but not significant, while the 1-period lagged own volume has a significant positive coefficient estimate. There are also fresh strawberries from three other regions, Florida, Orange County/San Diego, and Watsonville, that act as close substitutes for Santa Maria fresh strawberries, as shown by their negative significant coefficients. California peaches are the only substitute fruit with a significant negative effect on the fresh strawberry price. The results indicate that the fresh strawberry price in Santa Maria is lower from Easter to Mother's Day than at the beginning of the season (Stage I), other things equal. Retailers' promotion activities are shown to have a significant positive impact on the Santa Maria fresh strawberry price. The Durbin-Watson statistic is 1.98, which allow us to reject the hypothesis of autocorrelation.

In the Watsonville model, the coefficient on current own volume is negative and significant. The fresh strawberries from two other regions, Oxnard County and Santa Maria, serve as substitutes for Watsonville fresh strawberries. California peaches have a significant substitution effect. The coefficient estimate for Florida citrus is statistically significant, but not of the expected sign. The coefficient estimate for the Stage II dummy indicates that the fresh price is significantly lower in Stage II (from Easter to Mother's Day) than Stage I, other things equal. The results also tell us that the Watsonville fresh strawberry price is relatively lower for the week of July 4th. The own volume-stage interaction variables of Stage II and III have statistically significant coefficient estimates, which means that current own fresh volumes have weaker negative effects on fresh price from Easter to July 4th. Retailers' promotion activities have a statistically significant, positive effect on the fresh strawberry price in Watsonville.

6. Analysis

6.1. **Effect of advertising on price.** Examining the regression results, the percent of retailers on ad was statistically significant and positive for only two production regions: Santa Maria and Watsonville. This suggests that the impact of advertising that is separable from holidays is most prominent during the months when these regions are the primary suppliers: June through August. For the other California regions, the estimated coefficient for retailer promotions is not statistically different from the coefficients for Santa Maria and Watsonville. Thus, we cannot reject the hypothesis that the impact of the percent of retailers on ad is identical across California production regions. The coefficient for promotions in the model for Florida, however, is statistically lower than Santa Maria and Watsonville.

6.2. **Effect of increased Santa Maria volume on regional prices.** We used our results to examine the effect of increased volume from Santa Maria on the fresh price in Watsonville and other production regions. We consider three cases:

1. Increased Santa Maria volume either has no effect on the Watsonville price, or a small positive one.
2. Increased Santa Maria volume has the same effect on the Watsonville price as increased Watsonville volume does.
3. Increased Santa Maria volume has a larger effect on the Watsonville price than increased Watsonville volume does, due to quality differences.

More broadly, we examine whether the effects of current volume on current regional price differ with the volume's source. In the limit, if volume from all sources affected all regional prices equally, an aggregate model would represent the price determination relationship.

For the Watsonville region, we find that increased production from Santa Maria has a statistically significant, negative effect on price that is considerably larger in magnitude than the effect of increased volume from Watsonville itself, or from other production areas.

The story is less clear for the other regions. In Oxnard, for example, Florida, OCSD, and Santa Maria all have a significantly larger effect on the Oxnard fresh price than does Oxnard's own volume. The effect of the three substitute regions, however, are not significantly different from each other.

7. Conclusions

State-level results for California as a whole, in previous analyses, have shown that increased promotions lead to higher prices, although the evidence is not always strong or consistent across model specifications. Regional results show that the positive promotion effects are limited to Santa Maria and Watsonville.