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Regional Wholesale Price Relationships: The Case of Peaches

by

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Introduction

An important characteristic of agricultural commodity markets is the extent to which those markets respond to price changes in related markets. Given a competitive market structure, the Law of One Price (LOP) postulates that spatial price relationships are determined by transfer cost[1] among regions and that spatial arbitrage restores market equilibrium (Tomek and Robinson, 2003). Spatial price relationships are of particular relevance to farmers in designing market strategies. Measurements of spatial price relationships provide insights about the dynamics of price movements, thus increasing understanding of likely behavior of supply or demand areas in the market (Jordan and Van Sickle, 1998). For example, knowledge of which regions lead prices, the degree to which market shocks are transmitted via prices among regions, and the regional market reaction time can all be useful in designing market strategy.

This study analyzes spatial wholesale price relationships for fresh U.S. peaches using vector autoregressive analysis (VAR) on weekly prices from the primary wholesale markets of four U.S. regions. Primary objectives of the study are: (1) to determine the degree of market segmentation as well as the direction and magnitude of market integration among regions, and (2) to evaluate the sensitivity of U.S. fresh peach wholesale markets to individual shocks in the five regions. The study is organized as follows. We first present an overview of the U.S. fresh peach sector. Next, the relevant methodology and data is described. Results and conclusions follow.

Overview of the Fresh Peach Sector

Consumption data for fresh peaches suggests that this is a mature market in the U.S., though there does appear to be export growth potential. Domestic per capita consumption of fresh peaches has remained steady at approximately 10 pounds per year since the 1980's, while consumption of processed peaches has fallen from 7 pounds per capita in the 1970's to 4.2 pounds per capita in 2002 (Agricultural Marketing Resource Center).

The U.S. is second only to China in fresh peach production and ranks third in exports with approximately 10% of world trade (USDA-NASS, 2002). The bulk of U.S. fresh peach exports are consumed by Canada, Taiwan, and Mexico (USDA-FATUS). Supply source for the U.S. fresh peach market is bimodal due to the seasonal nature of domestic production. Fresh peaches produced in the southern hemisphere are imported from December to May when there is little or no domestic production. Chile is the major supplier of fresh peaches during the winter season, accounting for 98% of imports (USDA-FATUS). Since 2002, a seasonal import tariff of 0.2 cents per kilogram for fresh peaches has been imposed from June to November (Brunke 2003). No tariff exists for imports from December through May.

Though Georgia is commonly known as “The Peach State”, California produces nearly half of the nation’s fresh peaches (48.7%) and virtually all of the nation’s processing peaches (USDA-NASS, 2004). South Carolina and Georgia rank second and third in fresh peach production with 11% and

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[1] Transfer cost includes a variety of costs beyond transportation rates; it could even include barriers to trade.

8% of U.S. production, respectively (Table 1). The volume of U.S. peach production has remained steady at about 2.4 million pounds since 1994. Michigan ranked 9th among states in fresh peach production in 2004 and is a relatively small player in the marketplace, contributing only 2% of national production with farm level value of $10.3 million.

Consistent and timely cost estimates for the various U.S. fresh peach production regions are difficult to find. We recognize that peach yields can be highly variable across years due to weather sensitivities of the fruit and that this variability is more exaggerated outside of California. However, the cost information that is available (shown in Table 2) gives some insight into general cost and yield relationships in fresh peach production. California has relatively high production costs per acre, but also has significantly higher yields than other major peach production states, resulting in a low cost per pound for fresh peaches. By contrast, production costs per acre for Texas are relatively low, but average yields are also low, resulting in higher average costs per pound. Colorado presents an interesting case. Average yields in Colorado are comparable with those of California as are production costs per acre.

While USDA defines the fresh peach marketing season as May 1 to October 31, U.S. fresh peach production and sales volumes are concentrated during the months of June to September with 83 percent of the yearly volume marketed during this period (USDA-NASS, 2004). Within season variation of fresh peach prices may be contributed in part to differing marketing seasons across regions (see Table 1). Average farm and wholesale prices tend to be higher in May and September than in June through August when most regions are actively marketing fresh peaches (USDA-NASS). Though the supply of imports and domestic production overlap at the beginning and end of the domestic marketing season, overall supply is sufficiently thin relative to demand during these periods, driving prices upward. The period of thin markets also presents market opportunities for producers who can adjust their marketing season accordingly.

Florida presents an interesting example. It is notably absent from the list of top ten peach production states. During the primary domestic marketing season (summer), Florida peach production is thwarted by persistent summer rains that create disease problems. However, Williamson, et al (2004) point out that Florida's marketing advantage lies in an early spring combined with improved cultivars possessing a short bloom to harvest period and lower winter chilling requirements. This results in early season marketing (April and May) before California, Georgia and South Carolina have peaches available. Consequently, Florida producers likely receive a higher price per pound than do producers who are unable to market product until later in the season. Some regions of Texas also hold an early marketing advantage, but most Texas peaches are consumed within the state and consistently bring a premium over non-Texas fruit throughout the harvest season (Kamas, et al).

Retail prices for fresh peaches increased by 80% from 1993 to 2003 (AMS-USDA, 2005). By contrast, farm and wholesale fresh peach prices have risen only slightly during the last decade. Farm level season average fresh peach prices from 1995 to 2004 ranged from 24.4 cents per pound to 30.7 cents per pound (NASS, 2005). An exception is 1996 when prices rose to 33.10 cents per pound due to a short peach crop. Wholesale prices have remained relatively constant as well and averaged more than double the farm gate price at 67 cents per pound during the 2003 production year.

The bimodal nature of the supply source of fresh peaches to the U.S. market begs the question of whether wholesale price relationships among regions are inconsistent across the year. It is certainly logical that the driving forces behind prices changes from the import (winter) season to the domestic (summer) season. The answer to this question may have implications at the farm level as well, given the apparently strong relationship between U.S. farm and wholesale prices.

Modeling Spatial Price Relationships

Tomek (2003) summarized the principles that underlie spatial price relationships in the following way:

1. Price differences between any two regions that trade with each other will just equal transfer cost.
2. Price differences between any regions that do not engage in trade with each other will be less than or equal to the transfer cost.

Accordingly, determination of the geographic price structure is given by three key factors: (1) the lowest-cost source determines each deficit market's prevailing price, (2) producers sell in the market that yields the highest net return, and (3) the prevailing price in each surplus-production area is the deficit-market price less the cost of transferring a unit of product to that market.

In theory, spatial price determination models suggest that if two markets are linked by trade in a free market regime, excess demand or supply shocks in one market will have an equal impact on price in both markets. In practical terms, the LOP, closely related to the Enke-Samuelson-Takayama-Judge model, can be depicted as follows:

$$P_{it} = P_{jt} + c_{ji} \tag{1}$$

where P_{it} and P_{jt} are the prices for a commodity in two spatially separated markets, and c represent transfer costs from market i to market j, which are assumed to be time-invariant. If equation (1) holds, the markets can be said to be integrated and direct price transmission exists between the markets. This is known as the strong form of the LOP. However, in the short run, this is unlikely to occur.

Rapsomanikis *et al* (2003) point out that spatial arbitrage warrants that the difference between a commodity price in two regions will be at least equal to the transfer cost. Thus, a less restrictive definition of the LOP can be written as:

$$P_{jt} - P_{it} \geq c_{ji} \; . \tag{2}$$

Equation (2) represents the weak form of LOP and denotes an equilibrium condition (Fackler and Goodwin, 2001).

Ardeni (1989) indicates that price arbitrage is likely to be imperfect; that is, a price shock in one region does not occur completely through prices in other regions that are engaged in trade, at least not in the short run. However, in the case of agricultural commodities, perfect arbitrage is considered a realistic approximation since trading is usually assumed to be in flexible-price markets as opposed to the fixed price markets for manufactured goods.

Though realistic transfer cost data are not always available, price data alone can still yield evidence of spatial price relationships. Price integration leads to greater interdependence among prices of different regions in the short run, such that every price contributes to explain the evolution of the others. It is also true that as markets become more integrated markets likely form prices based on information from other markets, i.e. bidirectional causality should be present (Rapsomanikis *et al,* 2003). VAR models can provide information on bidirectional causality as well as forecast error variance (FEV) decomposition, which is a useful tool for analyzing interdependence among markets.

We use VAR analysis to determine the nature and extent of spatial price relationships in the U.S. fresh peach wholesale market among four U.S. regions. A VAR model allows examination of all possible spatial price relationships among the regions, since variables are defined by their own lags and the lagged values of all other variables. Modeling price relationships using VAR also allows us to directly test the hypotheses of market segmentation and long run integration.

Given the bi-modal nature of the U.S. fresh peach market with respect to supply sources, the domestic supply season and the import season could be considered independent markets and thus analyzed separately. However, since we analyze wholesale level rather than farm level prices, it is also beneficial to examine the marketing year in its entirety. We therefore estimate models for three marketing seasons: (1) the full year, (2) the "summer" (domestic supply) season, defined as the third week of April through the second week of November, and (3) the "winter" (import) season, defined as the third week of November to the second week of April. Defining separate summer and winter marketing seasons creates gaps in each series. Ward (1982) details the proper use of dummy variables when data gaps exist because of seasonality. His approach is used in this study by incorporating lagged dummy variables that indicate which lags enter the model. The inclusion of these dummy variables is detailed below.

The following VAR model is used to examine spatial price relationships in the U.S. fresh peach wholesale market:

$$\mathbf{y}_t = \mathbf{B}_0 + \mathbf{D}_{s1}\mathbf{B}_1\mathbf{y}_{t-1} + \mathbf{D}_{s2}\mathbf{B}_2\mathbf{y}_{t-2} + \dots + \mathbf{D}_{sm}\mathbf{B}_m\mathbf{y}_{t-m} + \mathbf{A}_0\mathbf{Q}_t + \mathbf{A}_1\mathbf{Q}_{t-1} + \mathbf{D}_t + \mathbf{u}_t \qquad (3)$$

where $\mathbf{y}_t$ is a 4 X 1 vector of weekly (time *t*) regional wholesale prices, defined in this study as West, Midwest, East, and South; $\mathbf{y}_{t-1}$, $\mathbf{y}_{t-2}$, and $\mathbf{y}_{t-m}$ are lagged values of $\mathbf{y}_t$; $\mathbf{B}_0$ is a 4 X 1 vector of constants; the remaining **B**'s are 4 X 4 matrices of coefficients; **Q** is total fresh peach shipments (in pounds) for the U.S.; $\mathbf{A}_0$ and $\mathbf{A}_1$ are 4 X 1 coefficient vectors; $\mathbf{D}_t$ is a seasonal dummy to account for thin market periods during certain weeks in April, May, November and December; and $\mathbf{u}_t$ is a 4 X 1 vector of white noise disturbance terms. Total U.S. quantity of fresh peaches shipped is included in the VAR as an exogenous variable. This variable captures the effect of the fresh peach volume available in the U.S. market. The seasonal dummy, $\mathbf{D}_t$ captures weeks where domestic production overlaps with imports since these weeks typically have relatively low volumes traded. Since our definition of marketing seasons leaves gaps in the data, we include

Ward's dummy variables so that the first value of a current season is not made dependent on the value(s) of the previous season. For example, in equation (3), $\mathbf{D_{s1}=[0,1,1,1,\ldots]}$ and $\mathbf{D_{s2}=[0,0,1,1,\ldots]}$.

Dickey-Fuller and Philips-Perron stationarity tests are employed to determine the stochastic properties of each price series (Pindyck & Rubinfeld, 1998). Following Donovan, *et al* (1999), the optimal VAR lag length can be determined by using criteria such as Akaike's Information Criterion (AIC), Schwartz Criterion, or the sequential likelihood ratio test. Ivanov and Kilian (2005) argued that for monthly VAR models, the AIC tends to produce the most accurate structural and semi-structural impulse response. Several studies have also used the AIC in determining lag length for weekly data, including Balaban and Kunter (1996), Darrat and Zhong (2000) and Vickner and Davies (2000). We follow these studies in using the AIC for lag length determination. The resulting VAR model is then estimated for the four wholesale regions under each marketing season scenario using ordinary least squares (OLS). VAR results are then used to estimate the FEV and impulse response functions.

Market Segmentation and Integration

Following Jordan and VanSickle (1995) and Ravallion (1986), we test the spatial price relationship hypotheses of market segmentation and long run market integration. Market segmentation implies that prices received in one region do not influence prices received in another market. This is tested by:

$$H_o\text{: } \lambda_{rj} = 0 \quad \text{for j} = 0,1,2,\ldots\ l \tag{4}$$

Here, λ is the parameter of the lagged prices of region y_r and j is the lag number. If $\lambda_{rj}=0$, lagged prices do not contribute to price variation in the dependent region. That is, markets x and y_r are segmented and prices in one region do not affect prices in the other.

If long run integration is present, then a price change in one region is completely reflected over time in another region's prices. This test was performed in both directions to account for simultaneity. Long run market integration requires that:

$$H_o\text{:} \sum_{\iota=1}^{l} \beta_\iota + \sum_{j=0}^{l} \lambda_{rj} = 1 \tag{5}$$

Here, β_i are the parameters of lagged prices in region x, and λ_j, are parameters of the lagged prices for region y. Assuming long run equilibrium, prices in the long run are the same, which implies that a change in price in region x would be fully reflected in region y.

Data

Data analyzed in this study are weekly U.S. wholesale prices for fresh peaches from the first week of 1998 through the fourth week of June 2005 (Agricultural Marketing Service-USDA

2005). The series represents prices received by wholesalers at U.S. terminal wholesale markets. We construct four regional price series consisting of 390 observations. Each region's weekly price is constructed as the weighted average wholesale price of the main cities in the region. All prices are expressed in U.S. dollars per pound.

The four regions defined in this study are: West (Los Angeles, San Francisco), Midwest (Chicago, St. Louis, Detroit), East (New York, Boston, Baltimore, Philadelphia) and South (Miami, Atlanta, Dallas, Columbia). The four series contain some missing values for the second and third weeks of April and November when both domestic production and imports are thin. Daily shipment information for each market includes the number of transactions and the price for each transaction. During these thin market weeks, weekly price information is not reported and some markets have days with no transactions. Since quantity information is inconsistently reported, we estimate missing values for weekly prices by generating a simple daily average based on the number of transactions and then a simple weekly average for each market that includes only days where shipments were received. The region's weekly price is then calculated as a simple weekly average across the markets included in that region. Total weekly fresh peach shipments are also obtained from Agricultural Marketing Service of the USDA and are expressed in pounds. This series is constructed as the sum of weekly volume reported by each U.S. shipment point.

Table 3 reports descriptive statistics for the four price series. The South exhibits both the lowest general price level and the smallest price variance across all marketing seasons. Average price in the East is slightly higher than that of the South and has a higher variance, but is relatively stable across marketing seasons. The Midwest and West, in contrast, have higher average prices coupled with higher price variances across the seasons. Figure 1 plots the relationship of the price series from April 10, 2004 through June 18, 2005. The plot presents evidence that regional prices tend to track more closely together during the summer marketing season than in the winter marketing season.

Results

Dickey-Fuller and Philips-Perron tests indicate that the four regional price series are stationary in price levels. This result holds for each of the three marketing season scenarios of annual, winter, and summer, allowing a VAR model in price levels to be estimated in each case. For brevity, results are not presented here as they are auxiliary to the analysis. Additionally, AIC statistics indicate that a second-order VAR model is optimal for each of the three marketing season scenarios.

Table 4 reports coefficient results and goodness-of-fit statistics of the estimated VAR models for each marketing season. Adjusted R^2 ranges from 0.51 to 0.74 for individual equations. In each case, the past week's price of the dependent variable is a significant contributor to the value of the dependent variable. Coefficients for total shipments and lagged total shipments are significantly different from zero during summer and also when the analysis covers the entire year. However, in winter, these coefficients are not significantly different from zero. This is likely a result of the dramatically lower trading volumes during the winter season as compared to the summer season when domestic production is available.

Forecast Error Variance Decomposition

FEV decomposition as shown in Table 5 indicates that wholesale prices of the largest peach production regions, the West and South, can be considered as the most exogenous series of the VAR model. In practical terms, this means that the prices received in these regions are more likely to determine prices in other regions, while the inverse case is less likely. Since the West and South regions are the largest peach producing regions, this is not a surprising result. FEV decomposition results reveal further interesting differences among regions.

For the West region, very little of the FEV is explained by other regions, particularly in the shorter time horizons of one and four weeks. In the summer analysis, more than 80 percent of the West FEV is attributed to its own error, even after 2 months. In winter, this falls to 62 percent. This pattern is also observed in the other regions, with the exception of Midwest, where the pattern is reversed. This could be the reflection of more balanced supply during winter, since the Midwest is the only region without an import entrance. It is notable that other regions do contribute more to the West's FEV in the winter than in the summer beyond the one week time horizon. This suggests that these regional markets are perhaps more integrated in the winter when only imported fruit is available than in the summer when regional production is available.

Though the FEV for wholesale fresh peach prices in the West is barely affected by prices in other U.S. regions, West prices are primary contributors to the FEV in other regions' prices. During the summer, prices in the West are the primary factor explaining FEV of other regional prices and the relevance rises as the time horizon increases. The South is the only region where West price changes do not have any contemporaneous effect on its price FEV. This higher degree of automony in regional prices during the domestic supply season likely stems from the fact that the South is the second largest production region. Another contributing factor may be the reputation of quality that the South has built over time. That reputation likely insulates the region somewhat from fluctuations elsewhere. During winter, price changes in the West also explain a large degree of other regions' FEV, but the relevance is less than in the summer. Additionally, the impact of West prices over time differs from one region to another.

The South region's FEV is similar, though other regions do begin to have relatively more influence than on the West beyond the one week time horizon. An interesting difference is seen when the source of variance is examined more closely. The longer time horizons of four and eight weeks reveal that in the summer marketing season, the West exerts the strongest outside influence (19.7 percent and 32.6 percent, respectively) while the East also contributes a significant portion of FEV (11.3 percent and 22.7 percent). However, the relationship changes in the winter marketing season with the West and Midwest contributing nearly equally to FEV at the four week time horizon (21.2 percent and 21.3 percent, respectively) and still exerting significant influence at the eight week time horizon (28.0 percent and 12.2 percent).

Further examination of Table 5 reveals that in the summer marketing season, the FEV for regions other than the West have a notable percentage of their FEV explained by the West, which is the largest production region. In the winter marketing season, however, this relationship still holds for the Midwest, but the decomposition of the FEV for the East and the South show significant impact from the Midwest as well as from the West. Generally speaking, the FEV results suggest that wholesale price formation in the West and the South is relatively more independent than in the Midwest and the East. During the summer marketing season, the Midwest region can be considered as the more endogenous variable in the VAR model with 42 percent of FEV explained by its own error at the 8 week time horizon. For Midwest growers, assuming symmetric price transmission between wholesale and farm prices, this implies that the prices they receive are determined to a great degree by prices in other regions. This is not surprising since, though Michigan boasts two of the top 10 fresh peach producing counties in the nation, the Midwest is the smallest production region. The results of this study confirm Midwest growers' perceptions of price relationships in the market.

Market Segmentation

Market segmentation test results are presented in Table 6. In general, the West is the most segmented market. Market segmentation is rejected for W→S across all three marketing season scenarios. That is, the idea that the South does not influence prices in the West is rejected. However, results show that the East and Midwest wholesale prices do not influence wholesale prices in the West for any of the three marketing season scenarios. That is, market segmentation is not rejected.

The Midwest presents an interesting case regarding direction of price influence. Through the summer marketing season, the Midwest market is segmented only from the East, while the West and South influence Midwest wholesale prices. Thus, the two largest production regions for fresh peaches are most influential during the marketing season when Midwest has local production competing in the market. However, in the winter marketing season, the Midwest market is segmented from both the West and the East and is influenced only by the South. Thus, the South exerts influence on Midwest wholesale prices throughout the year.

Wholesale prices in the East also present interesting relationships. The West is a strong influence in the summer as is the South. Again, this is likely explained by the fact that the West is by far the largest producer of fresh peaches, followed by the South. In the winter, the West is no longer an influence while the Midwest becomes a more important contributor to the East's wholesale prices for fresh peaches. This relationship reflects the fact that the bulk of fresh peach imports enter the U.S. through eastern ports (Philadelphia, D.C.) with the residual entering through California during the winter marketing season. Thus, the East becomes the center of supply during the winter marketing season.

For the South, fresh peach wholesale prices in the West are always relevant. Market segmentation with respect to the West's influence on the South is rejected in each of the three marketing season models. In the summer, the East also becomes a relevant influence, perhaps because of their geographical nearness to the south and large demand centers which serve as markets for the South's summer production. Market segmentation is not rejected in remaining market pairs as related to the South across marketing seasons, suggesting no significant price influences in those cases.

Long Run Market Integration

Long run spatial relationships were also tested to see if a price change at one region is fully reflected over time in the other regions, i.e. whether regional markets are integrated in the long run. As shown in Table 7, long run market integration is rejected for nearly all market pairs. There are two notable exceptions, however. Price changes in the South are shown to be fully reflected in the West as well as in the East across all three marketing season scenarios. A noteworthy observation is that long run market integration is rejected for all market pairs where the West would be the change catalyst, whereas the West seems most influential in the previous analysis and tests presented here. That is, though our earlier analysis suggests that the West has significant influence over prices in other regions, the markets are not fully integrated in the long run.

Impulse Response Functions

Figure 2 illustrates the impulse response functions from the VAR analysis for each market. Impulse response functions show the reaction to a one standard deviation shock in one region, e.g. West, by that region as well as all other regions in the model. Impulse response functions are shown here only for the Summer and Winter marketing seasons, as it is the differences between these two seasons that present the most interesting contrasts. In general, the reaction to price shocks is larger and more persistent in the winter than in the summer. Price shocks in the East region present the most dramatic illustration of this. A shock in the East in the summer initially generates a moderate response in Midwest prices, with a slower response from the South. The price changes converge at about week 4 and persist through the 10 week period projected. In the winter marketing season, the initial response of other regions to a shock in East prices is similar, except that West response is larger than before. However, the magnitude of response increases more rapidly and, with the exception of the West, persists at higher levels for a longer period of time. The own price effect for the East actually falls more quickly over the time horizon and settles at a lower level than in the summer. By contrast, the impact of a shock to the South has twice the impact on own-price in the winter than in the summer, perhaps an indication of the dampening effect of local supply in the summer marketing season.

Price shocks in the East and Midwest during summer have a positive contemporaneous effect on West prices. Since the West is the largest producer, it is expected that West suppliers will react to changes in other regions. South prices are affected by these shocks in the long run, particularly by shocks in the Midwest. Price changes in the East have short run effects in the Midwest, but the opposite does not happen. During winter, East and Midwest price fluctuations also have an immediate effect on West, and the effect on the South is greater in the long run. Summer marketing season price variation does not dramatically affect prices in other regions in the short run, although this variation does have long run effects on prices in the West. Midwest prices are drastically affected by price variations in the South in the long run.

Conclusions

The seasonality of fresh peach production appears to be a main driver of the market dynamics in the fresh peach wholesale market. Overall, our results do suggest that the market dynamics in each marketing season work differently. This is not unexpected, since during the winter (import) season, domestic supply regions lose relevance. During the summer marketing season, locally available supply appears to dampen the impacts of price variations in other regions on a region's price. However, during the winter months, our analysis suggests that markets become more integrated as the supply source switches to imports rather than domestic fruit.

The spatial price relationships among regions for the U.S. fresh peach wholesale market are stronger in the winter than in the summer. Summer marketing season prices are led by the two main production regions - the West and South. During winter the leadership of these two regions is less preponderant. Though not an issue specifically addressed in this study, the influence that these two regions exhibit during winter may be due to well established distributional channels for imported peaches. In all three marketing season scenarios, short run price variation in the West and South (the major production regions) are explained to a greater degree by own price changes than by price changes in other regions.

Wholesale prices for the Midwest and the East can be considered more dependent than those of the South and West, i.e. prices in these regions are strongly influenced by changes in prices in other regions. Moreover, any price shock in the Midwest is absorbed by the West region, which reacts in the short run. Assuming symmetric price transmission between wholesale and farm prices, this may have a negative effect on Midwest farm prices. The West and, to some degree, the South are able to cover any shortage in supply, which leads to lower prices in the Midwest.

Given the strong correlation between wholesale and farm level fresh peach prices, there may be implications for those growers in the East and Midwest during the summer marketing season. Both are relatively small regions in terms of fresh peach production. It is unlikely that either region could increase production significantly, based on both climatological and population pressures. Climatological characteristics of the regions also make it unlikely that varietal changes targeting national marketing windows (e.g. Florida) would be successful. However, this study has assumed that fresh peaches are homogeneous goods, while in fact, varietal differences in taste, quality and use do exist. Efforts focused toward product differentiation through varieties that offer an improved flavor, higher quality, or unique culinary characteristics or through promotion of place of production (e.g. "buy local", Jersey Fresh, Select Michigan) may work to lessen the impact of price leadership from the two major production regions during the summer marketing season.

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Table 1. State Rank in Fresh Market Peach Production (2004), Regional Marketing Season and Corresponding Nearest Wholesale Market Region.

State	Fresh Market Peaches (Tons)	% of U.S. Fresh Peach Production	Rank	Regional Marketing Season[a]	Nearest Wholesale Region[b]
CA	305000	48.71	1	June 1 to September 30	West
SC	67500	10.78	2	May 20 to August 31	Southeast
GA	52500	8.39	3	May 20 to August 31	Southeast
NJ	32500	5.19	4	July 1 to September 30	East
PA	23000	3.67	5	July 1 to September 30	East
WA	21500	3.43	6	July 1 to September 30	West
AL	14000	2.24	7	June 1 to September 30	Southeast
CO	13000	2.08	8	June 1 to September 30	West
MI	12500	2.00	9	July 1 to September 30	Midwest
TX	12200	1.95	10	June 1 to September 30	Southeast
Other States	72410	11.57		Varied	
Total	**626110**	**100**			

Source: National Agricultural Statistics Service, USDA

[a] USDA defines the overall marketing year for fresh peaches as May 1 to October 31. Regional marketing seasons are reported here.

[b] As defined in this study.

Table 2. Production Cost Estimates for Fresh Peaches, Selected States.

State	Estimated Production Cost Per Acre[a]	Average Yield (lbs/acre)	Nearest Wholesale Region[b]	Estimated Cost/Lb (Farm Gate)
CA[c]	$11,291 (2004)	27,000	West	0.42
SC/GA	$3224 (1998)	6960	South	0.56
NJ	$3,129 (1996)	7250	East	0.53
CO	$8,410 (2005)	21,840	West	0.39
TX	$3500 (2003)	3600	South	0.97

Source: National Agricultural Statistics Service, www.ipmcenters.org, California Department of Food and Agriculture

[a] Year of published estimate is in parentheses.

[b] As defined in this study.

[c] San Joaquin Valley-South (includes Fresno County)

Table 3. Descriptive Statistics for Regional Fresh Peach Wholesale Prices for Annual, Summer, and Winter Marketing Seasons.

	West			**Midwest**			**East**			**South**		
	Annual	Summer	Winter	Annual	Summer	Winter	Annual	Summer	Winter	Annual	Summer	Winter
Average	0.87	0.76	1.02	0.84	0.77	0.94	0.82	0.80	0.85	0.75	0.71	0.81
Minimum	0.46	0.46	0.51	0.42	0.42	0.54	0.50	0.50	0.51	0.49	0.49	0.56
Maximum	2.18	1.68	2.18	3.09	1.84	3.09	1.88	1.88	1.85	1.45	1.41	2.12
Std Dev	0.31	0.23	0.34	0.30	0.24	0.35	0.25	0.25	0.24	0.17	0.16	0.17
Variance	0.10	0.05	0.12	0.09	0.06	0.12	0.06	0.06	0.06	0.03	0.02	0.03

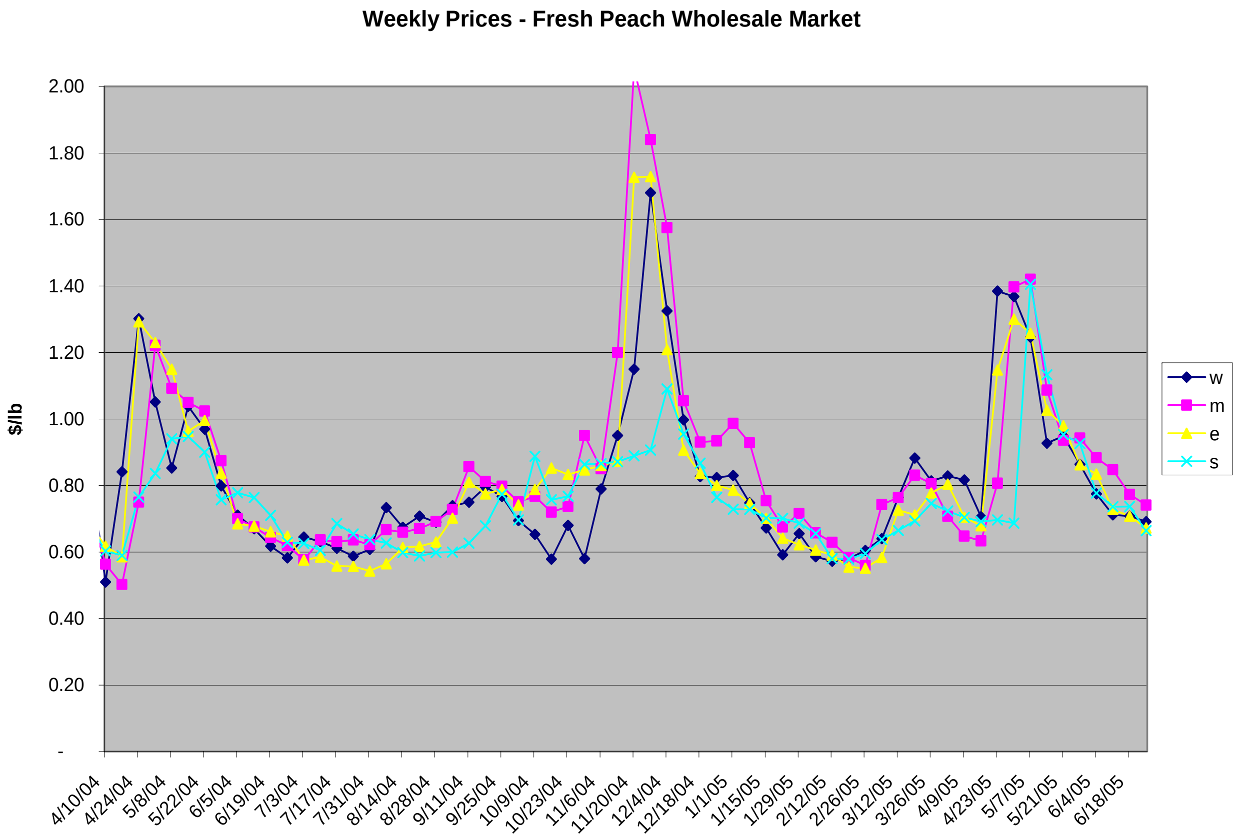

Figure 1. Weekly Regional Wholesale Prices for Fresh Peaches, April 10, 2004 through June 18, 2005.

Table 4. VAR analysis results for the three model scenarios.[a]

		Full Year		Summer		Winter	
Dependent Variable	**Independent Variable**	**Coefficient Estimate**	**p-value**	**Coefficient Estimate**	**p-value**	**Coefficient Estimate**	**p-value**
West	W(-1)	0.687	(.000)	0.7914	(.000)	0.5996	(.000)
	W(-2)	-0.100	(.081)	-0.1464	(.071)	-0.1086	(.226)
	M(-1)	0.242	(.000)	-0.0250	(.733)	0.3044	(.003)
	M(-2)	-0.137	(.026)	0.0386	(.593)	-0.2138	(.038)
	E(-1)	0.130	(.039)	0.1045	(.090)	0.2143	(.101)
	E(-2)	-0.162	(.013)	-0.0536	(.428)	-0.1897	(.116)
	S(-1)	0.055	(.598)	-0.0809	(.396)	0.2084	(.331)
	S(-2)	0.306	(.001)	0.2942	(.001)	0.2961	(.140)
	Q	-0.0001	(.013)	-0.0001	(.002)	0.00003	(.984)
	Q(-1)	0.0001	(.020)	0.0001	(.000)	-0.0001	(.523)
	DP	0.088	(.001)	0.1510	(.000)	0.0449	(.225)
R2		0.68		0.72		0.53	
Midwest	W(-1)	0.185	(.002)	0.2886	(.001)	0.1240	(.219)
	W(-2)	-0.143	(.017)	-0.1137	(.162)	-0.1808	(.056)
	M(-1)	0.684	(.000)	0.6589	(.000)	0.7291	(.000)
	M(-2)	-0.196	(.002)	-0.1516	(.037)	-0.2087	(.068)
	E(-1)	0.126	(.052)	0.1171	(.059)	0.0578	(.660)
	E(-2)	-0.028	(.683)	-0.1752	(.011)	0.1279	(.323)
	S(-1)	0.254	(.020)	0.2782	(.004)	0.1850	(.443)
	S(-2)	0.121	(.210)	0.1087	(.206)	0.2301	(.267)
	Q	-0.0001	(.030)	-0.0001	(.003)	-0.0001	(.544)
	Q(-1)	0.0001	(.037)	0.0001	(.004)	0.0000	(.998)
	DP	0.100	(.000)	0.1072	(.000)	0.0609	(.260)
R2		0.64		0.74		0.51	

Table 4 (Continued). VAR analysis results for the three model scenarios.

		Full Year		Summer		Winter	
Dependent Variable	**Independent Variable**	**Coefficient Estimate**	**p-value**	**Coefficient Estimate**	**p-value**	**Coefficient Estimate**	**p-value**
East	W(-1)	0.103	(.057)	0.1263	(.266)	0.0895	(.149)
	W(-2)	-0.092	(.087)	0.0173	(.877)	-0.1391	(.026)
	M(-1)	0.299	(.000)	0.1570	(.121)	0.4043	(.000)
	M(-2)	-0.260	(.000)	-0.1508	(.130)	-0.2250	(.002)
	E(-1)	0.489	(.000)	0.4757	(.000)	0.3806	(.000)
	E(-2)	0.078	(.204)	0.0511	(.583)	0.0985	(.236)
	S(-1)	0.031	(.754)	-0.0329	(.802)	0.0579	(.695)
	S(-2)	0.321	(.000)	0.3163	(.008)	0.3542	(.011)
	Q	-0.0001	(.006)	-0.0001	(.002)	-0.0001	(.330)
	Q(-1)	0.0001	(.003)	0.0001	(.001)	0.0000	(.964)
	DP	0.102	(.000)	0.1596	(.000)	0.0003	(.992)
R2		0.56		0.56		0.58	
South	W(-1)	0.042	(.143)	0.0312	(.594)	0.0591	(.083)
	W(-2)	0.032	(.265)	0.0893	(.121)	0.0004	(.990)
	M(-1)	0.013	(.659)	0.0480	(.357)	-0.0112	(.773)
	M(-2)	0.033	(.277)	0.0237	(.644)	0.0767	(.049)
	E(-1)	0.175	(.000)	0.1379	(.002)	0.1859	(.000)
	E(-2)	-0.054	(.096)	-0.0136	(.778)	-0.1135	(.014)
	S(-1)	0.772	(.000)	0.7077	(.000)	0.8304	(.000)
	S(-2)	-0.043	(.353)	-0.0475	(.433)	-0.0410	(.589)
	Q	-0.00001	(.001)	-0.0001	(.000)	-0.0000	(.989)
	Q(-1)	0.00001	(.001)	0.0001	(.000)	-0.0000	(.472)
	DP	-0.0041	(.755)	0.0031	(.877)	-0.0312	(.117)
R2		0.75		0.71		0.73	

Table 5. Forecast error variance (FEV) decomposition by region across marketing season.

Region	Time horizon (Weeks)	Standard Error		Summer				Winter			
		Summer	Winter	West	Midwest	East	South	West	Midwest	East	South
West	1	0.121	0.230	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0
	4	0.181	0.369	94.6	0.4	1.7	3.3	79.2	11.6	1.3	7.8
	8	0.207	0.440	82.9	2.2	4.3	10.6	61.9	16.1	2.7	19.3
Mid-West	1	0.122	0.247	15.8	84.2	0.0	0.0	24.1	75.9	0.0	0.0
	4	0.198	0.360	34.0	53.5	1.4	11.1	26.4	67.7	2.2	4.8
	8	0.232	0.428	36.8	41.5	3.4	18.3	22.5	59.7	4.0	13.7
East	1	0.167	0.158	18.1	5.1	76.8	0.0	15.5	23.6	60.9	0.0
	4	0.217	0.273	26.3	6.5	63.1	4.0	22.4	41.2	28.3	8.1
	8	0.245	0.338	30.2	6.3	54.0	9.4	20.3	38.5	21.7	19.5
South	1	0.086	0.087	0.1	1.4	1.5	96.8	0.7	3.4	0.8	95.1
	4	0.146	0.189	19.7	6.7	11.3	62.3	20.1	21.3	4.9	53.0
	8	0.188	0.274	32.6	6.9	22.7	48.3	21.8	28.4	5.4	43.5

Table 6. Testing for market segmentation between regions across marketing seasons.[a]

Prices received in region X are influenced by those received in Y X → Y	Marketing Season								
	Year			Summer			Winter		
	Between regions	All regions		Between regions	All regions		Between regions	All regions	
		Wald	F		Wald	F		Wald	F
W → M	.1037 (0.106)	**60.92** **(0.00)**	**20.31** **(0.00)**	0.014 (0.898)	**24.23** **(0.00)**	**8.08** **(0.00)**	0.091 (0.437)	**30.77** **(0.00)**	**10.26** **(0.00)**
W → E	-0.024 (0.726)			0.051 (0.489)			0.025 (0.853)		
W → S	**0.356 (0.000)**			**0.213 (0.000)**			**0504 (0.000)**		
M → W	0.046 (0.402)	**72.31** **(0.00)**	**24.11** **(0.00)**	**0.175 (0.006)**	**54.49** **(0.00)**	**18.16** **(0.00)**	-0.067 (0.503)	**21.93** **(0.00)**	**7.31** **(0.00)**
M → E	0.102 (0.155)			-0.058 (0.433)			0.190 (0.185)		
M → S	**0.373 (0.000)**			**0.386 (0.000)**			**0.416 (0.001)**		
E → W	0.014 (0.776)	**48.91** **(0.00)**	**16.33** **(0.00)**	**0.143 (0.098)**	**18.16** **(0.00)**	**6.05** **(0.00)**	-0.050 (0.440)	**42.11** **(0.00)**	**14.04** **(0.00)**
E → M	0.036 (0.554)			0.006 (0.952)			**0.179 (0.026)**		
E → S	**0.348 (0.000)**			**0.283 (0.002)**			**0.412 (0.000)**		
S → W	**0.073 (0.005)**	**76.50** **(0.00)**	**25.50** **(0.00)**	**0.121 (0.007)**	**53.31** **(0.00)**	**17.76** **(0.00)**	**0.060 (0.091)**	**30.16 (0.00)**	**10.05 (0.00)**
S → M	0.046 (0.144)			0.072 (0.183)			0.065 (0.139)		
S → E	**0.122 (0.000)**			**0.124 (0.017)**			0.072 (0.151)		

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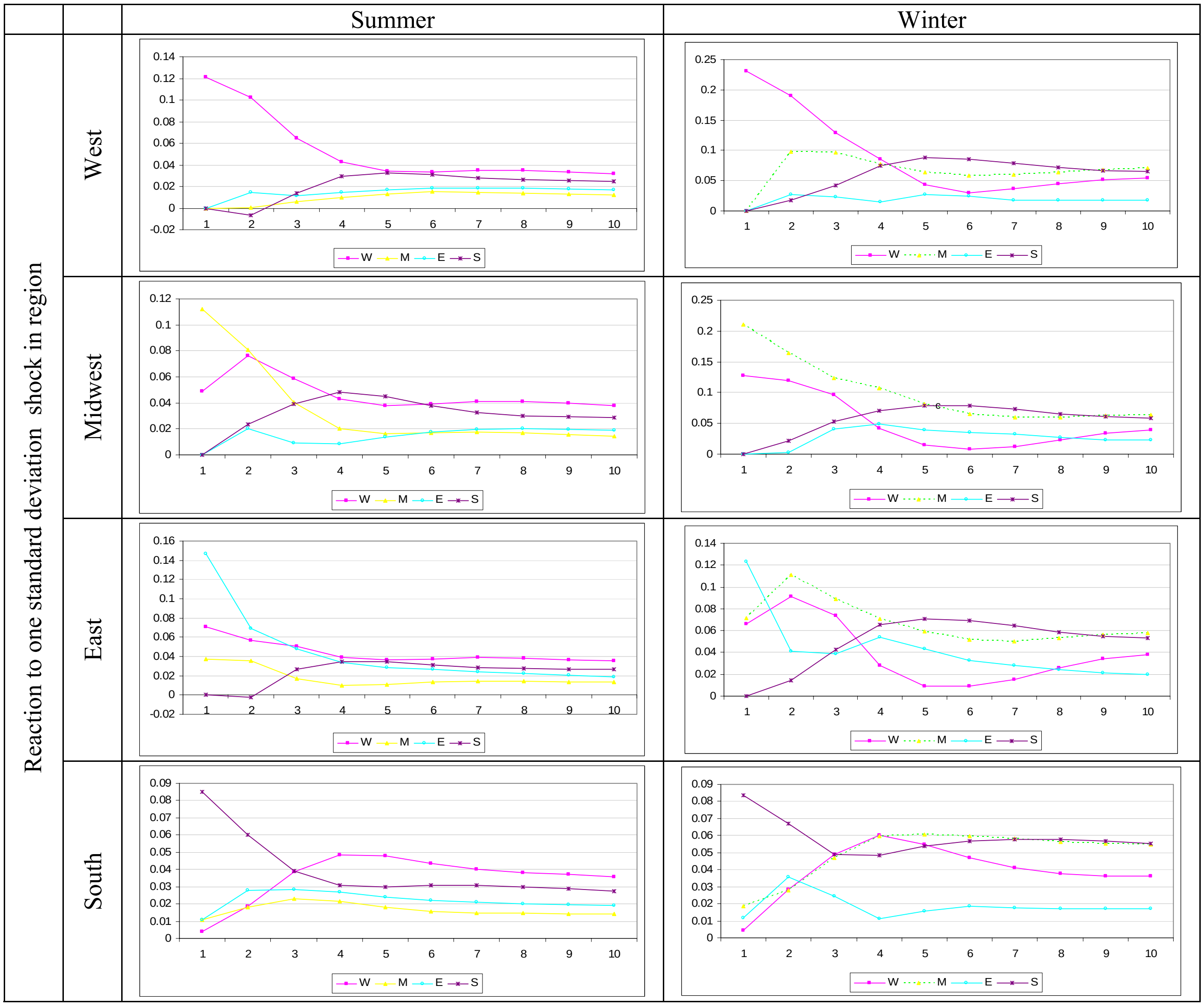
[a] H_0: Market segmentation; H_a: No market segmentation.

Table 7. Hypothesis testing for Long Run Market Integration by Marketing Season.

Prices received in region X fully reflect price changes in region Y X → Y	Marketing Season								
	Year			Summer			Winter		
	Test Coefficient	F Statistic	p-value	Test Coefficient	F Statistic	p-value	Test Coefficient	F Statistic	p-value
W → M	-0.308	25.05	0.000	-0.341	21.29	0.000	-0.421	12.55	0.000
W → E	-0.436	30.90	0.000	-0.304	13.18	0.000	-0.487	11.53	0.0007
W → S	**-0.055**	**0.62**	**0.431**	**-0.142**	**2.67**	**0.102**	**-0.007**	**0.0041**	**0.949**
M → W	-0.472	55.25	0.000	-0.318	18.26	0.000	-0.542	17.99	0.000
M → E	-0.415	31.46	0.000	-0.551	46.05	0.000	-0.286	4.756	0.029
M → S	0.855	102.83	0.000	0.894	105.61	0.000	0.940	31.72	0.000
E → W	-0.413	31.45	0.000	-0.330	8.17	0.005	-0.571	33.21	0.000
E → M	-0.391	33.76	0.000	-0.467	17.65	0.000	-0.342	16.50	0.000
E → S	**-0.079**	**1.415**	**0.234**	**-0.190**	**3.30**	**0.070**	**-0.108**	**1.223**	**0.269**
S → W	-0.198	32.86	0.000	-0.219	12.68	0.000	-0.151	11.464	0.0008
S → M	-0.225	31.413	0.000	-0.268	18.94	0.000	-0.153	6.876	0.009
S → E	-0.150	18.69	0.000	-0.215	15.98	0.000	-0.145	6.065	0.014

[a] H_0: Long Run Market Integration; H_a: No long run market integration

Figure 2. Impulse response function graphs.[a]



[a]The y axis represents the magnitude of the price shock and corresponding responses in other regions. The x axis represents the timeline of weeks of impact.