

## AN ANALYSIS OF A PERMANENT RESTRICTION ON THE SHIPMENT OF LOW QUALITY TOMATOES<sup>1</sup>

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**Abstract.** Federal Marketing Order 966 proposes quality regulations that must be approved by the U. S. Secretary of Agriculture for fresh market tomatoes shipped from Florida and Mexico during most of the winter and spring seasons. These quality regulations are one tool used by the marketing order to provide orderly market conditions. An econometric model for assessing marketing order regulations was developed and estimated for determining the effects of a permanent restriction on the shipment of small tomatoes. The results indicate that a restriction on the shipment of small tomatoes would be beneficial to Florida growers, but that most of the benefits would accrue to shippers in 2 of the 4 marketing order districts.

The marketing of most fresh tomatoes produced in Florida must comply with regulations imposed under the authority of Federal Marketing Order 966. The Florida Tomato Committee, the grower committee which governs the marketing order, maintains that regulations are needed for profitable returns in the Florida tomato industry. The Committee annually considers regulations that they believe will benefit the industry. Although many regulations are met with some degree of criticism, market standardization is credited with increasing the profits of most producers. Orderly market conditions achieved through regulation compliance also aid consumers insuring an adequate supply of good quality tomatoes at a fair market price.

Fresh tomatoes are sorted by maturity, grade, and size. There are two maturities, mature-green and vine-ripe. The 4 grades are 85% U.S. number 1, U.S. combination, U.S. number 2 and U.S. number 3. Fresh tomatoes are also currently divided into 4 size groups, ranging from small (7 x 7) to extra-large (5 x 6 and larger). At the beginning of each growing season, the Florida Tomato Committee recommends to the U.S. Secretary of Agriculture the standards the committee believes should be set for the minimum and maximum measurements for each size of tomato. The standards for the 1983-84 season are reported in Table 1.

Table 1. Size standards for the 1983-84 production season in Florida.<sup>2</sup>

Size classification	Minimum diameter	Maximum diameter
7 x 7	2 5/32	2 10/32
6 x 7	2 8/32	2 18/32
6 x 6	2 16/32	2 26/32
5 x 6 and larger	2 24/32	—

<sup>2</sup>Source: Florida Tomato Committee Regulatory Bul. No. 1, Oct. 5, 1983.

There has been a permanent restrictive regulation on shipping extra-small tomatoes (7 x 8) since the 1974-75 season. This restriction can be temporarily lifted during periods of short supply. This was done, for example, in

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1977 when Florida suffered a severe freeze, and again in 1978 when cold and wet weather caused the production of larger tomato sizes to drop significantly.

Tomato marketing order regulations apply to tomatoes shipped from the production area of the order and to tomatoes imported during the regulated season of the order. Fig. 1 shows the production area of the marketing order which is composed of Pinellas, Hillsborough, Polk, Osceola, and Brevard Counties and all Florida counties situated south thereof. The production area is divided into 4 districts, each representing a major segment of production within the production area. Each district elects representatives to serve on the Florida Tomato Committee.

Table 2 shows the total sales and shipments of tomatoes from the Florida production area and from each district within the production area for the 1979-80 to 1983-84 seasons. Districts 3 and 4 shipped the majority of the tomatoes, shipping approximately 70% of the total shipments each season, while District 1 averaged 20% and District 2 averaged slightly less than 9%.

Table 2. Total sales and shipments of 25-lb. equivalents of tomatoes from the production area of the marketing order and in each district, 1979-80 to 1983-84 seasons.<sup>2</sup>

Season	Total Florida	District			
		1	2	3	4
1979-80 sales <sup>y</sup>	228.72	— <sup>x</sup>	—	—	—
% of sales	100.00	—	—	—	—
shipments <sup>w</sup>	41.39	8.28	3.38	15.61	14.09
% of shipments	100.00	20.00	8.17	37.71	34.04
1980-81 sales <sup>y</sup>	239.54	—	—	—	—
% of sales	100.00	—	—	—	—
shipments <sup>w</sup>	40.88	7.34	3.68	14.78	15.01
% of shipments	100.00	17.95	9.00	36.15	36.72
1981-82 sales <sup>y</sup>	257.70	—	—	—	—
% of sales	100.00	—	—	—	—
shipments <sup>w</sup>	44.59	8.91	3.61	12.83	19.24
% of shipments	100.00	19.98	8.10	28.77	43.15
1982-83 sales <sup>y</sup>	344.69	74.96	31.78	119.81	118.13
% of sales	100.00	21.75	9.22	34.76	34.27
shipments <sup>w</sup>	45.70	9.19	4.06	16.02	16.42
% of shipments	100.00	20.11	8.88	35.05	35.93
1983-84 sales <sup>y</sup>	310.62	98.58	28.55	77.91	105.56
% of sales	100.00	31.74	9.19	25.08	33.98
shipments <sup>w</sup>	45.49	10.66	4.16	13.78	16.87
% of shipments	100.00	23.43	9.14	30.29	37.09

<sup>2</sup>Source: Florida Tomato Committee Annual Report, various issues.

<sup>y</sup>Expressed in millions of U.S. dollars.

<sup>x</sup>Indicates that data was not available for those years.

<sup>w</sup>Expressed in millions of 25-lb. equivalents.

The total sales of tomatoes from each district were only available for the 1982-83 and 1983-84 seasons. An interesting point may be observed in the percent of total sales in Florida for each district. The percent of total sales in the 1982-83 season is close in value to the percent of shipments for each district. In the 1983-84 season, the percent of total sales exceeded percent of total shipments for District 1 by more than 8%, while percent of total sales were lower than percent of total shipments for Districts 3 and 4 by more than 5% and 3%, respectively. These differences are explained by the freeze in December 1983, which resulted in higher prices received for tomatoes shipped in District 1.

Because production practices vary across districts and



differences exist in the market windows for each district, the effects created by marketing order regulations vary across districts. (Market windows are defined as the time period within a production season for a commodity that a producing area markets the commodity.) While the total effect of a marketing order regulation may benefit the Florida tomato industry, some question the benefits derived within particular districts of the production area or by particular growers within a district.

Table 3 shows the total and percent of shipments, total value and average price received for small tomatoes shipped from the Florida production area and from each district within the production area. Several interesting points can be observed in these numbers. First, shipment of small tomatoes represented 7.7% of total shipments of all tomatoes from Florida in the 1982-83 season and 6.6% in the 1983-84 season. The percent of total shipments from each district that was represented by small tomatoes was substantially higher in Districts 1 and 2 (10.6 and 13.9%, respectively, in 1982-83 and 10.9 and 12.1%, respectively, in 1983-84) and substantially lower in Districts 3 and 4 (5.5 and 6.8%, respectively, in 1982-83 and 2.9 and 4.1%, respectively, in 1983-84). This dichotomy can also be observed in average price received for small tomatoes. This average price was \$4.40 per 25-lb. box in 1982-83 and \$6.23 per 25-lb. box in 1983-84. Districts 1 and 2 received higher than these average values both years while Districts 3 and 4 received less than these average values in each year.

Table 3. Summary of shipments and total value of small tomatoes (7x7) for Florida and each district, 1982-83 and 1983-84 seasons.<sup>z</sup>

Season	Total Florida	District			
		1	2	3	4
<b>1982-83</b>					
Shipments <sup>y</sup>	3555.61	978.57	568.05	892.82	1116.18
Value <sup>x</sup>	15644.68	5333.21	2556.23	3571.28	4192.31
Price (\$/25-lb.)	4.40	5.45	4.50	4.00	3.76
% of area shipments	7.78	10.65	13.99	5.57	6.80
% of total shipments	100.00	27.52	15.98	25.11	31.39
% of area value	4.54	7.11	8.04	1.98	3.55
% of total value	100.00	34.09	16.34	22.83	26.80
<b>1983-84</b>					
Shipments <sup>y</sup>	3016.08	1168.96	507.45	404.03	935.64
Value <sup>x</sup>	18785.27	9720.00	3190.87	1808.33	4066.08
Price (\$/25-lb.)	6.23	8.32	6.29	4.48	4.35
% of area shipments	6.63	10.97	12.20	2.93	5.55
% of total shipments	100.00	38.76	16.82	13.40	31.02
% of area value	6.05	9.86	11.18	2.32	3.85
% of total value	100.00	51.74	16.99	9.63	21.65

<sup>z</sup>Source: Florida Tomato Committee. Unpublished reports summarized from weekly shipment reports.

<sup>y</sup>Expressed in thousands of 25-lb. equivalents.

<sup>x</sup>Expressed in thousands of U.S. dollars.

Table 4 shows the shipments and sales of small tomatoes by maturity for each district within the production area of Florida. The shipment of small mature-green tomatoes is far more important than small vine-ripe tomatoes for each district. This should be expected, however, since total mature-green shipments and sales are far greater than vine-ripe shipments and sales. The percent of area sales that small tomatoes represent for each maturity type in each district is also shown in Table 4. These figures show that Districts 1 and 2 ship a far greater proportion of small tomatoes for each maturity than do Districts 3 and 4. In

Table 4. Total and percent of all shipments and value of mature-green and vine-ripe 7x7 tomatoes for the market order area and for each district.<sup>z</sup>

Season	Total Florida	District			
		1	2	3	4
<b>1982-83</b>					
Green shipments <sup>y</sup>	3.28	0.94	0.36	0.87	1.10
Green value <sup>x</sup>	14.54	5.17	1.71	3.50	4.16
% of area green value	4.91	7.64	9.84	3.36	3.90
Ripe shipments <sup>y</sup>	0.35	0.05	0.26	0.03	0.01
Ripe value <sup>x</sup>	1.10	0.16	0.84	0.07	0.03
% of area ripe value	2.25	2.19	5.87	0.45	0.26
<b>1983-84</b>					
Green shipments <sup>y</sup>	2.86	1.15	0.40	0.39	0.93
Green value <sup>x</sup>	17.97	9.58	2.60	1.75	4.03
% of area green value	6.50	10.30	14.36	2.52	4.21
Ripe shipments <sup>y</sup>	0.20	0.03	0.14	0.02	0.01
Ripe value <sup>x</sup>	0.81	0.14	0.59	0.05	0.03
% of area ripe value	2.37	1.94	6.70	0.60	0.30

<sup>z</sup>Source: Florida Tomato Committee. Unpublished reports summarized from weekly shipment reports.

<sup>y</sup>Expressed in millions of 25-lb. equivalents.

<sup>x</sup>Expressed in millions of U.S. dollars.

addition, the mature-green maturity contains the largest proportion of small shipments in each district.

Because the proportional shipment and sales of small tomatoes are more important to Districts 1 and 2 than to Districts 3 and 4, it is important to determine the effects of a permanent restriction on the shipment of small tomatoes for each district. The purpose of this study was to determine whether a permanent restriction on the shipment of small size tomatoes (7 x 7) would increase grower revenues, and to estimate the impact of the restriction for each district and for each maturity type of tomato shipped.

Price (5) discussed the effect on revenue from restricting quantities of a product from the market. His results showed that an optimum culling rate can be defined if the elasticity of demand and the quality price response for the product not restricted are known. VanSickle and Alvarado (6) refined the Price procedure to determine whether culling a particular size group that could not be differentiated over a continuum of quality measures would be beneficial to growers.

VanSickle and Alvarado tested their procedure by determining the impact of restricting the shipment of low grade or small tomatoes on grower revenues in periods of low prices. The procedure involved estimating econometric models for the average price of tomatoes not restricted from the market (nonrestricted tomatoes) and using simulation procedures to determine the impact of the restriction on grower revenue. They concluded that restricting the shipment of U.S. grade number 3 tomatoes would not benefit growers while restricting the shipment of small tomatoes would benefit growers in periods of low prices.

## Methods

The analyses in this paper used procedures similar to VanSickle and Alvarado (6). The procedures involve estimating econometric models for the price received for tomatoes not restricted from the market. The models are then used in a simulation analysis to determine the potential effects from imposing the restriction.

The general price model used for analyzing the effects of restricting tomatoes can be shown as

$$P_{NR,t} = F(FQ_{NR,t}, FQ_{NR,t-2}, FQ_{R,t}, FQ_{R,t-2}, MQ_{NR,t-1} + MQ_{R,t-1}, OQ_{t-2}, P_{NR,t-1})$$

where

- $P_{NR,t}$  = average f.o.b. price for a 25-lb. carton of non-restricted tomatoes in time period  $t$ ,  
 $FQ_{NR,t}$  = total shipments of 1 million 25-lb. cartons of non-restricted tomatoes in time period  $t$ ,  
 $FQ_{R,t}$  = total shipments of 1 million 25-lb. cartons of restricted tomatoes in time period  $t$ ,  
 $MQ_{NR,t}$  = total imports of 1 million 25-lb. cartons of Mexican non-restricted tomatoes in time period  $t$ ,  
 $MQ_{R,t}$  = total imports of 1 million 25-lb. cartons of Mexican restricted tomatoes in time period  $t$ ,  
 $OQ_t$  = total shipments of 1 million 25-lb. cartons of tomatoes from all domestic U. S. sources other than Florida in time period  $t$ .

The f.o.b. price was hypothesized to be a function of the shipments from Florida in the current week (time period  $t$ ) and 2 weeks prior (time period  $t - 2$ ). Both quantities were considered because retailers can purchase tomatoes either directly from Florida shippers, in which case current shipments affect retail demand and f.o.b. prices, or from terminal markets, in which case shipments from 2 weeks prior affect retail demand and f.o.b. prices. A lag of 2 weeks was considered because of the lag associated with moving Florida shipments to terminal markets (1, 2). Mexican quantities were lagged 1 week because most Mexican production is of the vine-ripe maturity and must be shipped through the market channels relatively quickly to ensure quality (3). The coefficients for restricted and non-restricted Mexican tomatoes were forced to be the same. Mexico shipped tomatoes proposed for restriction for only short periods of time, restricting their shipment to the United States for all other periods. Because of this limited information, the summation of Mexican quantities of restricted and non-restricted tomatoes was considered one variable in the model estimations. Restricted tomatoes were treated separately in the simulation, however.

The shipments from other domestic sources are for total shipments of tomatoes because the marketing order has no control over domestic production outside the designated marketing order area. These shipments were lagged 2 time periods for 2 reasons. First, most of these shipments come from California, and the distance requires additional time for these shipments to impact the Florida market. Second, these shipments are mostly mature-green tomatoes, which permit slower movement through the market channel because quality will not deteriorate as fast as in vine-ripe tomatoes. Finally, the price of nonrestricted tomatoes in the previous week was included because Brooker and Pearson (2) concluded that buying and selling brokers base their prices on many factors, including the price received the previous week.

Simulation was used to estimate the change in Florida grower revenues from the restriction. The weekly change in revenues was measured in the simulation as equal to the difference between prices with and without the restriction, multiplied by the quantity of nonrestricted tomatoes, less the revenues received for restricted tomatoes. If the general price increase in nonrestricted tomatoes created by restricting small tomatoes is large enough, then the increased revenues received for nonrestricted tomatoes will more than offset the loss in revenues caused by not shipping small tomatoes. The total change in revenues received in a season is the sum of all weekly changes.

The simulation procedure was also used to estimate the impact of the restriction for each district in the market-

ing order. The price equation models were used to determine the difference in price received with and without the restriction. The quantity of nonrestricted tomatoes and revenues received for restricted tomatoes were those values measured for each district.

## Results and Conclusions

*Data.* The data used for estimating the price model were obtained from the weekly price and shipment reports issued by the Florida Tomato Committee for the 1979-80 through 1983-84 seasons.

Two separate price models were estimated to determine the impact of the restriction. The first model specified the price equation for all mature-green and vine-ripe tomatoes shipped from Florida. This model was estimated using ordinary least squares regression analysis. The second model specified separate price equations for mature-green and vine-ripe tomatoes. This model was estimated using generalized least squares regression analysis.

*F.o.b. price models.* The results of the model estimations are presented in Table 5. The results generally yield parameter estimates consistent with *a priori* expectations; that is, the signs for the significant coefficients for all quantity variables are negative. The results of the models are similar to those derived by VanSickle and Alvarado (6), with the exception of the quantity of nonrestricted tomatoes lagged 2 weeks and the current quantity of tomatoes considered for restriction. These 2 variables were insignificant in the analysis performed here and marginally significant in the analysis performed by VanSickle and Alvarado (6). One reason for the change in significance for shipments lagged 2 weeks may be a decline in the proportion of produce going through terminal markets. More produce is being shipped directly to wholesalers today than in previous years. This decline in the use of terminal markets may be causing a decline in the significance of shipments two weeks prior. The results of nonrestricted tomato shipments being significant in the current week and not lagged 2 weeks, and restricted shipments being significant when lagged 2 weeks and not sig-

Table 5. Results of the regression analysis for prices received for Florida tomatoes.<sup>z</sup>

Variable	Regression model used		
	Model 1 Combined equation	Green equation	Ripe equation
$FQ_{NR,t}$	-1.18* (-3.09)	1.28* (-3.35)	-1.09* (-3.21)
$FQ_{NR,t-2}$	-0.17 (-0.48)	-0.14 (-0.36)	-0.16 (-0.48)
$FQ_{R,t}$	2.23 (0.38)	2.96 (0.51)	1.44 (0.28)
$FQ_{R,t-2}$	-11.8* (-2.11)	-11.8* (-2.07)	-10.8* (-2.13)
$MQ_{NR,t-1} + MQ_{R,t-1}$	-1.37* (-2.75)	-1.39* (-2.76)	-1.01* (-2.27)
$OQ_{t-2}$	-2.60* (-4.25)	-2.64* (-4.23)	-2.30* (-4.14)
$P_{NR,t-1}$	0.745* (16.46)	0.730* (19.75)	0.739* (20.28)
Durbin h statistic	-1.199	-1.167	-1.159
R <sup>2</sup>	0.77	0.77	0.77

<sup>z</sup>The parameter estimates are listed above the t-values in parentheses for each variable.

\* significant at 5% level.

nificant for the current week, may also be explained in the use of terminal markets. The results suggest that buyers purchasing tomatoes directly from the shipper and not in terminal markets are purchasing larger tomatoes and that shippers are using terminal markets to sell small tomatoes. The average direct price flexibilities for nonrestricted shipments of tomatoes in the current week were  $-0.232$ ,  $-0.253$ , and  $-0.215$  for the combined, mature-green, and vine-ripe equations, respectively. These flexibilities are similar to those previously reported (4, p. 161; 6).

*Simulation of restriction.* The models estimated for the f.o.b. price received were used to simulate the effect a restriction would have had on past revenues. Because lagged price was included in the price equations, the simulation used the lagged price for each period that was created by initializing the simulation 3 periods back. This procedure was used to keep the price equations from exploding, a result which could occur with initialization at the beginning of each season.

Table 6 shows the results of a simulation for a restriction on the shipment of small tomatoes from the 1979-80 season to the 1983-84 season. The results indicate that a restriction would have benefited Florida growers in each production season. The largest change in total revenues received was in the 1979-80 season with an estimated increase of \$43.2 million, or 18%. The smallest increase would have been \$32.4 million (12.5%) in the 1981-82 season.

Table 6. Simulated changes in Florida grower revenues from restricting 7x7 tomatoes being shipped in the 1979-80 to 1983-84 seasons.

Season	Model 1	Model 2	
	Combined	Green	Ripe
1979-80 (millions U.S. \$)	43.20	32.03	6.71
(%)	18.90	16.00	23.50
1980-81 (millions U.S. \$)	34.82	25.84	5.62
(%)	14.50	13.00	13.60
1981-82 (millions U.S. \$)	32.40	23.05	6.07
(%)	12.50	10.10	19.30
1982-83 (millions U.S. \$)	43.31	29.78	8.78
(%)	12.50	10.00	17.90
1983-84 (millions U.S. \$)	37.87	26.09	7.31
(%)	12.20	9.40	21.30

The results also showed that growers of both maturities of tomatoes would benefit. Growers of mature-green tomatoes could have increased total revenues received ranging from \$23.0 million to \$32.0 million in each production season. Growers of vine-ripe tomatoes could have increased total revenues received ranging from \$5.6 million to \$8.7 million in each production season.

The effects of restricting the shipment of small tomatoes were also estimated for each district. The effects were estimated for only the 1982-83 and 1983-84 seasons because of a lack of data for prior seasons. The results of the analysis

(Table 7) show that Districts 3 and 4 would have benefited most with total revenues received increasing by as much as 16% for mature-green tomatoes and 31% for vine-ripe tomatoes. The analyses show that total revenues received would have increased for each maturity type in each district, with the exception of mature-green tomatoes in District 1, which had an estimated loss of \$1.0 million.

Table 7. Simulated changes in Florida tomato revenues for each maturity type in each production area, 1982-83 and 1983-84 seasons.

Season	Maturity	Production area gains			
		1	2	3	4
1982-83	Green (millions U.S. \$)	5.17	0.62	14.90	10.28
	(%)	7.65	3.56	14.31	9.64
	Ripe (millions U.S. \$)	1.08	1.68	3.37	2.05
	(%)	14.71	11.76	21.52	17.78
1983-84	Green (millions U.S. \$)	(1.05)	0.09	11.72	13.61
	(%)	(1.15)	0.44	16.86	14.20
	Ripe (millions U.S. \$)	1.04	1.07	2.69	2.59
	(%)	14.38	12.00	31.88	26.53

The results indicate that Florida growers could benefit by restricting the shipment of small tomatoes. However, most of these benefits would be realized by growers in Districts 3 and 4, and by growers of mature-green tomatoes. It was expected most benefits would accrue to mature-green tomato growers since most tomatoes marketed in Florida are of the mature-green maturity type.

Recent policies of the Florida Tomato Committee have increased the minimum diameter for tomatoes that can meet the small size category. The results of this analysis would indicate that these policies should be increasing the revenues received by Florida growers. Since restrictions on the shipment of small tomatoes are estimated to provide gains to Florida growers, the Florida Tomato Committee could increase revenues received even further by restricting the shipment of small tomatoes from the market. To do so the Florida Tomato Committee must first agree on the restriction and then convince the U.S. Secretary of Agriculture to accept and impose the regulation.

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