ECONOMIC IMPLICATIONS OF A CHANGE IN THE SIZE OF TOMATO CARTON FROM 25 TO 20 POUNDS

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Abstract. **Federal Marketing Order 966 proposes quality regulations, including designation of allowable carton size, that must be approved by the U.S. Secretary of Agriculture for fresh tomatoes shipped from Florida and foreign countries during the winter and spring seasons. These quality regulations are one tool used to maintain orderly market conditions. An econometric model and budgeting were used to estimate the effects of a change in the size of carton used to market fresh mature green tomatoes. The results indicate that such a change would not be beneficial to growers, would probably benefit packer/shippers and would result in higher transportation costs.**

The State of Florida is a major producer of tomatoes in the U.S. market. During the period from October to June, Florida marketed 51 percent of the tomatoes sold in the United States in the 1989/90 season. The major source of competition in the domestic U.S. market during this period is Mexico. Mexico marketed nearly 30 percent of the tomatoes sold in the U.S. market during the 1989/90 season.

The marketing of most tomatoes grown in Florida must comply with regulations imposed under the authority of Federal Marketing Order 966. The Florida Tomato Committee, which governs the marketing order, maintains that regulations are needed to maintain orderly market conditions. Although many regulations are met with some degree of skepticism, market standardization is credited with improving grower returns and maintaining a reliable quality of tomatoes to consumers at a reasonable price. One of the tools for maintaining standardization in the market is designation of the size of cartons that are allowed for marketing fresh tomatoes from Florida.

The size of container in which tomatoes are shipped from the shipping point area to wholesale and retail markets has been changed several times in the last 30 years. Mature green tomatoes were marketed in 60 pound containers prior to a change to 40 pound containers in the 1959/60 season. Another change took place in the 1970/71 season that lowered the size from 40 to 30 pound containers. The latest change in box size occurred in the 1980/81 season when shippers began packing in 25 pound containers. Discussion still occurs as to the potential benefits of changing to a smaller 20 pound container.

Conventional wisdom leads us to believe that a change in box size will result in additional costs in the handling of tomatoes. Lowering carton size from 25 to 20 pound containers will result in 20 percent more containers being packed, transported and handled for the same weight volume.

The major benefits will result from any improvement in tomato quality and any reduction in losses as they are packed in smaller containers.

Several studies have been reported that document losses incurred in the tomato industry due to decay of product during handling. In 1965, U.S. losses in tomatoes were estimated to be $13.7 million annually (9). An estimated 9,000 tons of tomatoes are lost annually in the greater New York are alone (3). At Florida f.o.b. prices for the 1989/90 season (4), this translates into an estimated $5.23 million annually in the greater New York area alone. Jordan et al. (5) reported that damage to tomatoes is a major factor which lowers the price received by growers.

Several factors have been proposed for causing losses in tomatoes. Poor packaging techniques is one such factor that leads to damaged tomatoes which then decay from exposure to pathogenic agents. Techniques that improve the packing of tomatoes and result in less damage should result in fewer losses and more efficient marketing. The importance of packaging can be seen in the differentiation of containers for mature green and vine ripe tomatoes. Mature green tomatoes are packed in a standard 25 pound container. Vine ripe tomatoes are packed in smaller 20 pound containers because they are more susceptible to damage during packing and post packing operations.

Several agents stand to be affected by changes in container size. Tomato growers will benefit from any improvements in prices resulting from perceived improvements in quality by handlers and consumers of tomatoes. Handlers will pay more for tomatoes because of lowered handling costs resulting from reduced losses in handling. Consumers will be willing to pay more because of improvements in the eating experience of tomatoes. These increased returns will benefit growers only if they exceed any additional costs incurred from handling and shipping in smaller containers. Increased packing charges may result from more packages needing to be packed. Increased transportation costs may also result from less efficient shipping of tomatoes.

Packer/shippers will also be impacted by reducing the size of the shipping container. Smaller packing containers will imply that a packer/shipper will need to pack more boxes throughout the season to sell the same weight of tomatoes. Packers may realize more revenues because they charge growers for packing by the carton, and charge buyers for gassing and palletizing by the carton. They may incur additional charges, however, because of the need to add capital equipment and personnel if they currently operate at or near capacity.

Wholesalers and retailers will also be impacted by changes in box size. They will handle more containers which may increase handling costs. They also may pay additional costs for services provided by shippers. The major benefits to wholesalers and retailers will result if they realize decreases in losses of product and increases in the quality of product sold. Decreased losses will result in lower handling costs while increased quality may result in increased demand for the product.

Finally, consumers will also be impacted by changes in container size. They will realize the benefits from im-

proved quality which may be marketed and improvements in handling efficiency resulting from decreased losses of product during the marketing process. They will share in any increased costs resulting from lower efficiency of marketing caused by more packages being handled to sell the same volume of product.

The objective of this study is to determine the economic implications of a change in the size of carton in which tomatoes are shipped. All agents in the marketing system will be impacted, but the focus here is to measure impacts on growers and packer/shippers and to estimate the impact on transportation costs.

Materials and Methods

The procedure used to estimate the potential economic effect of changing box size from 25 to a 20 pound containers is to divide the analysis into the grower and packer/shipper sectors of the industry and then analyze impacts on transportation costs.

The impact on growers will be estimated by analyzing the impact of the change in box size from 30 to 25 pounds in the 1980/81 production season. This will involve an econometric analysis of the f.o.b. shipping point prices received for tomatoes and measuring the impact changes in size of carton had on prices received. These changes in revenues received by growers will then be compared to changes in packing and marketing costs to determine the net effect on growers. These changes will be used to estimate impacts which may be experienced from a change to 20 pound boxes.

The impact on packer/shippers will be determined by budgeting the effect a change in box size will have on revenues received by packers in the packing and marketing process. These changes in revenues will be compared to increases in costs packers may experience to expand the capacity they need to pack the additional volume of boxes. Packer/shippers will be assumed to be operating at or near capacity and need to expand their capacity in order to pack the same volume of tomatoes.

Finally, changes in the size of container in which tomatoes are packed may impact the cost of transportation. These costs will be discussed and budgeted to estimate the impact on marketing efficiency in the transportation from the packing house to the wholesaler.

Results and Discussion

Growers

A change in carton size from 25 to 20 pounds will require additional costs in packing which growers will be required to share. A change in box size of this magnitude will require 20 percent more boxes to be packed. Packing and selling fees published by Taylor and Smith (7) indicate that growers paid a range of $2.42 to $2.57 per carton in packing and selling fees in the 1989/90 season. Assuming a packing and selling fee of $2.50 per 25 pound carton, if that per carton charge remains unchanged after a change in carton size, then the packing and selling fee will increase from $0.10 to $0.125 per pound, an increase of $0.025 per pound. For growers to be equally as well off, then prices of tomatoes would need to increase at least $0.025 per pound after the change in box size, an increase of $0.625

per carton on a 25 pound equivalent basis and $0.50 per carton on a 20 pound equivalent basis.

Experience from the last change in box size from 30 to 25 pounds can be used to demonstrate the possible impact from another change in box size to 20 pounds. This involves analyzing the impact of the change in box size from 30 to 25 pound cartons on the prices received by growers and comparing those increases (if any) to increases in observed costs.

The analysis of the impact of the change in box size from 30 to 25 pounds on prices received by growers involved estimating a price dependent demand model similar to Castejon (3), VanSickle and Morris (11) and VanSickle and Alvarado (10). The price dependent demand model was specified for estimation as:

1) $PGt = f(PGt\text{-}1, Qt, Q_{t\text{-}1}, XO_t)$

where PGt is the average price of mature green tomatoes in week t, Qt is the number of 25 pound equivalent cartons (in millions) of mature green and vine ripe tomatoes marketed from Florida in week t, QOt-1 is the number of 25 pound carton equivalents of other tomatoes that were marketed in the U.S. in week t-1 and XOt is a dummy variable equal to 0 prior to a change in box size from 30 to 25 pounds in the 1980/81 season and equal to 1 after. This specification of XOt will capture the effect the change in box size had on growers returns. F.o.b. prices in Florida were hypothesized to be negatively related to shipments from Florida as related to the inverse relationship expected in most demand models between own price and quantity. Other shipments are mostly represented by Mexican shipments through Arizona and shipments from California. These tomatoes are expected to be substitutes for Florida tomatoes and therefore inversely related to f.o.b. prices. These shipments were lagged one week because of the origin of these tomatoes and the time required to reach the markets in which they compete with Florida tomatoes. Lagged price (PGt-1) was included because Brooker and Pearson (1) concluded that buying and selling brokers base their prices on many factors, including prices received in the previous week. The sign of the dummy variable could be either negative or positive. A positive sign would indicate that the change in box size improved grower returns because of improvements in quality and these increases in returns were greater than any increases in costs of packing and marketing. A negative sign would indicate that losses in the efficiency of the marketing system were greater than any increases in revenues received because of improvements in quality.

The data for the estimation were obtained from annual reports issued by the Florida Tomato Committee (4). The time period of data used in the estimation was 1978/79 to the 1982/83 seasons. This period included two and one-half seasons prior to the change in size of container and two and one-half seasons after the change in carton size. The model was estimated using ordinary least squares estimation. The error of the estimated model was checked to determine if correlation in the errors existed using the Cochrane-Orcutt iterative technique. The results of this procedure found the correlation of the error to be insignificant. The results of the model are shown in table 1. The results generally yield parameter estimates consistent with a priori expectations; that is, the signs for the quantity

Table 1. Results of regression analysis for f.o.b. prices of Florida tomatoes.

Variable	Estimate/Standard error[z]
Qt	0.471 / 0.221*
OQt-1	0.402 / 0.297**
Pt-1	0.857 / 0.049*
XOt	0.328 / 0.229**

[z]*significant at 5% level, ** significant at 10% level

variables are negative. The results are also consistent with other models in that the price flexibility estimated from this model (−0.089) is similar in magnitude to other estimates (10). The R^2 of the model was 0.79.

The result for estimating the effect of the change in box size shows it to be marginally significant in determining the f.o.b. prices for tomatoes. The estimate of 0.328 for XOt indicates that the box size change had the impact of increasing total returns to growers by $0.328 per 25 pound carton equivalent. The standard error of the estimate was 0.22, indicating that the estimate was significant at a confidence level of 90%.

The reported cost of grading and packing, the container, and selling tomatoes in the Dade County, Immokalee-Lee and Manatee-Ruskin producing areas increased by $0.397, $0.238 and $0.288 per 25 pound carton equivalent from the 1980/81 to 1981/82 production seasons (6 and 8). These increases in packing and selling charges are roughly equal to the increase in prices estimated in the regression analysis. The results indicate that growers in the Immokalee-Lee and Manatee-Ruskin production areas may have benefitted marginally from the change in box size while growers in Dade County were worse off.

Packer/Shippers

A change in box size from 25 to 20 pounds will create a need to pack 20 percent more boxes than previously packed for the same weight. This increase in boxes packed will increase the revenues received by packer/shippers since most of their services are billed on a per carton packed and shipped basis. An increase in the number of boxes packed will also create a need to expand capacity and increase the requirements for equipment and labor in their operation.

Packer/shippers charge for most of the services they provide by charging a per carton fee to growers and buyers. Growers normally pay a fee for packing and selling based on the number of cartons packed. Buyers are normally assessed a fee for gassing and palletizing based on the number of cartons purchased. If packers/shippers did not change the fee schedules for the services they provide, then they would realize an increase in revenues received by 20 percent because 20 percent more boxes would be packed if the carton size was decreased from 25 to 20 pounds.

Data from the 1980/81 and 1981/82 seasons indicates that per pound packing and selling fees increased by a range of 13.2 percent to 23.6 percent after the change in box size, meaning that packer/shipper revenues received from growers increased by that same amount. Per carton gassing and palletizing fees did not change during that period ($0.65 per carton), meaning that revenues from

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buyers for these services increased by 16.7 percent, the same amount as the increase in the number of boxes packed. Total revenues received by packer/shippers from growers and buyers increased from $2.33, $2.25 and $2.85 (25 pound equivalent basis) in Dade County, Immokalee-Lee and Manatee-Ruskin production areas to $2.72, $2.50 and $3.11, respectively. These packer/shippers increased their total revenues by 16.7, 11.1 and 9.1 percent respectively.

Packer/shippers operating at or near capacity may need to expand the capacity of their packing facility if carton size is decreased. An increase of 20 percent more boxes packed may create a need for additional equipment and personnel. Capital equipment that may be needed was identified by packer/shippers operating in the southwest Florida production area. These additional capital equipment needs were budgeted to determine the impact on costs within their operations. Capital equipment identified included set-up machines to make additional boxes, automatic fillers for packing the boxes and automatic palletizers. More personnel would also be required to run the additional equipment.

The additional costs of adding capacity to operate a packinghouse with smaller boxes were budgeted and are shown in Table 2. Equipment which was identified by the packinghouses included an additional set-up machine, 3 additional filler machines and one additional palletizer. Costs which were budgeted included depreciation, capital and added employee expense. Total added costs which would be realized by packinghouses were estimated to be $62,700. Given an average of $0.30 per carton for packing and selling fees (a rough average of the costs estimated by Taylor and Wilkowski(8)), packinghouses would need to pack an additional 209,000 boxes to break even from these additional expenses. A packinghouse currently packing 1,045,000 boxes per year would meet this added volume.

Transportation

The current configuration of the truck-load of tomatoes contains 20 pallets of tomatoes, each pallet holding 80 boxes which hold 25 pounds of tomatoes. Given this configuration, each truck carries 40,000 pounds of tomatoes. In addition to the tomatoes, the pallets weigh 50

Table 2. Expenses required to extend capacity to pack 20 percent more boxes in a tomato packinghouse.

Item/expense category	Amount
Set-up Machine—Initial outlay $30,000	
Annual depreciation (8 years)	$ 3,750
Capital cost (12% interest)	3,600
Extra labor (2,000 hours @ $6/hour)	12,000
Total set-up machine expense	$19,350
Filler Machines—Initial outlay $17,500 for 3	
Annual depreciation (8 years)	$ 6,550
Capital cost (12% interest)	6,300
Extra labor (1,000 hours @ $6/hour)	6,000
Total filler machine expenses	$18,850
Palletizer—Initial outlay $100,000	
Annual depreciation (8 years)	$12,500
Capital cost (12% interest)	12,000
Total palletizer expenses	$24,500
Total Annual Added Expenses	$62,700

pounds each, adding 1,000 pounds to the truckload. The cartons each weigh 3 pounds which adds up to 240 pounds per pallet (80 cartons per pallet at 3 pounds per carton) and 4,800 pounds per truckload (at 20 pallets per truck). Total weight on the truck equals 45,800 pounds from the pallets, cartons and tomatoes.

A change in box size would change the configuration in which tomatoes are stacked on pallets. Currently, pallets are stacked with 10 tomato cartons per layer, 8 layers high on a pallet. A change in box size to 20 pound containers would require smaller containers that were speculated by shippers to be shorter versions of the current container.

A shorter version of the same tomato carton would allow a pallet configuration of 10 cartons per layer with an additional layer stacked on each pallet, resulting in 90 cartons of tomatoes being stacked on each pallet. A truck would still be limited to 20 pallets on each truckload of tomatoes. Given this stacking and loading configuration, each truck would carry 20 pallets holding 90 boxes which hold 20 pounds of tomatoes. This would result in each truck carrying 36,000 pounds of tomatoes, 1,000 pounds of pallets and 5,400 pounds of cartons, a total of 42,400 pounds.

A smaller box which is loaded in the above described configuration would result in 11.1 percent fewer tomatoes being shipped on each truckload. This load configuration would result in added expenses in shipping tomatoes since 11.1 percent more trucks would be required to ship the same volume of tomatoes as would be required for a 25 pound carton.

Conclusions

Results from the change in box size from 30 to 25 pounds per carton indicate that growers did not benefit by any large measure. Total revenues increased by $0.328 per carton while packing and selling fees increased by $0.397 per carton in Dade County, $0.238 per carton in the Immokalee-Lee production area and $0.288 in the Manatee-Ruskin production area. These results would indicate that growers will not benefit from a change to 20 pound cartons, and in fact may lose.

Packer shippers will realize increased revenues from growers for packing additional cartons and from buyers for gassing and palletizing fees for which they charge on a per carton basis. Total revenues from these sources should increase proportionally by nearly as much as the increase in the number of boxes packed. Packers will incur additional expenses for expanding capacity to pack these additional boxes. Given an industry packout of more than 46 million cartons in the 1989/90 season, revenues should more than offset the added expenses packers may incur.

Transportation costs will also increase for the tomato industry. Changing carton size may decrease the volume of tomatoes which may be shipped on a truckload by as much as 11.1 percent, i.e., a decrease from 40,000 pounds to 36,000 pounds. This would create an additional demand for 11.1 percent more trucks to ship the same volume of tomatoes as currently shipped in 25 pound cartons.

Overall, decreasing the size of carton from 25 to 20 pounds for mature green tomatoes will add expenses in the handling of these tomatoes. The expenses will likely cost growers more than any increased revenues received from higher prices. Packers would likely increase their revenues more than their costs and transportation expenses for shipping tomatoes to the consumer would increase.

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