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# *Staff Paper*

**Optimal Supply Rules in the Tart Cherry Industry: Summary Report**

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## 1. Introduction

This analysis examined optimum supply formula (OSF) in the tart cherry industry. The OSF is a tool for stabilizing market prices as authorized by a federal market order (FMO). The current OSF sets free sales of tart cherries in a given harvest year, or optimum supply volume (OSV), equal to the average sales of the three prior years plus 10 percent. This report evaluates the current OSF relative to several alternative formulations. The analysis reviews data to identify sources of market stability, analyzes the demands for tart cherries and compares the current OSF with the alternatives.

## 2. Economic Setting

The analysis examined whether the current OSF may be modified to better address factors that lead to price instability in the domestic tart cherry market. Three factors contribute to price instability.

First, tart cherry production can vary greatly from year to year because of transitory weather conditions. In 2002, for instance, a late spring freeze reduced production to only 20 percent of the 2001 production level. The current OSF attempts to dampen market price of production variability by setting free sales to the average of the three prior years' sales. When one of the three prior years' sales is reduced because of extremely low production, that low production level becomes a permanent damper on future free sales, regardless of growth in either supply or demand in those future years.

The second factor is inelastic supply. Inelastic supply means that production makes only small adjustments in response to large price changes. Tart cherry orchards take years to establish, so productive acreages and production do not increase rapidly in response to higher prices. Once established, productive acreages yield tart cherries for many years more and at a relatively low variable cost. Hence, sharply lower prices do not result in sharp reductions in production.

The third factor is inelastic demand. Tart cherry demand and sales at the grower and processor levels are derived from products at the consumer level. Tart cherries are an ingredient of consumer products such as pies, baked goods, snacks and juices. A change in tart cherry prices affects the prices of consumer products by less than the percentage change in tart cherry prices. Consumer demands for food products tend to be price-inelastic, and derived demands are more elastic than demands at the retail level. Together, the three factors — weather-induced production uncertainty, inelastic supply and inelastic demand — create a market situation well recognized for price instability and its financial implications.

## 3. Analysis

The analysis used data from past years to estimate the demand relationship between average tart cherry prices and available quantities of tart cherries during a crop year. The analysis indicates that a change in quantity supplied brings about a demand price change that is about twice the size of a change in quantity and opposite in sign. This means that a 5 percent increase in marketed yield results in a 10 percent reduction in market price. A 5 percent reduction in marketed yield results in a 10 percent increase in market price. The net result is that the inelasticity of demand magnifies by about two times the market price changes that result from weather-induced variations in yield.

Alternative specifications of the optimum supply rule have a potential for reducing the negative effect of an extreme harvest shortfall on future supplies. Five alternatives were evaluated:

i. ***2y-OSV*** reduces the number of years in the OSF moving average to two years. The two-year average makes the OSF more responsive to short-term changes in sales trends but also may create greater variation in annual free percentages.

ii. ***4y-OSV*** extends the length of the past-year period from three years to four. The four-year average reduces the susceptibility of sales to year-to-year shocks in sales but is also likely to make the OSV less sensitive to changes in sales trends.

iii. ***DXS*** is the same rule as the three-year average OSF except in years with extreme shortfalls in production. *DXS* deletes extreme shortfalls from the calculation of the OSV. Historical production data from 1982 to 2010 (NASS, various years-c) indicates that such extreme events occur approximately once every 10 years.

iv. ***AdjX*** adjusts the three-year moving average OSF by 50 percent of the difference between the OSF and trend sales after an extreme production shortfall. When an extreme production shortfall occurs, market share unavoidably shrinks because sales cannot be maintained at OSV levels even with the addition of withdrawals from reserves. The loss of market share in an extreme shortfall year may make it difficult to bring sales up to the level implied by *DXS* — some of the buyers lost because of the shortfall may not return to buy tart cherries in subsequent years when product supply approaches normal levels. With a multiyear loss of buyers, *DXS* may result in sales levels too large to maintain stable prices. *AdjX* addresses this multiyear loss of buyers by adding to the OSV 50 percent of the difference between long-term trend sales and the three-year moving average OSF.

v. ***VSP*** aims at setting a sales volume that stabilizes tart cherry market prices. The rule incorporates the responsiveness of aggregate demand price to changes in the sales quantity. Responsiveness is measured by the inverse of the price elasticity of estimated aggregate demand as described in Section 2.b, above. The inverse of the price elasticity approximates the percentage change in prices that accompanies a 1 percent change in sales.

The current rule and five alternatives were evaluated using a computer simulation model. The model used historical data on prices to simulate 13-year sequences. Each year in the sequence was a random draw from the historical pattern of production. Each simulation averaged results over 1000 sequences of 13 years of random draws.

**4. Findings**

The results indicate that increasing the number of years used in calculating the optimum supply volume results in greater stability in sales and price. However, increasing the number of years used in the calculation also prolongs the negative effect on sales of extreme shortfalls in production. To gain the benefit of stability without the negative effects of extreme shortfalls, a revised optimum supply rule could extend the number of years in the average from three to four and omit extreme shortfalls whenever they occur. A second alternative is a price stabilization rule that anticipates consumption responses to price change and calculates an optimum supply for market stability. Such a rule can be established with a target price for the industry.

Specific findings can be summarized by each of the strategies incorporated into the alternative optimum supply rules:

i. Increasing the length of the moving average used in the OSF.
A longer period of averaging results in less year-to-year variation in the OSF and moderates the impact on the OSF of very good and very poor harvests. A longer period of averaging also lengthens the gradual upward adjustment of the OSV from a poor harvest year.

ii. Removing extreme production shortfalls from the OSF.
This substantially reduces the impact of supply shocks on the OSV. The average restricted percent is 10 percent less than with the current three-year average rule. The annual increase in

reserves is 10 percent less. Price and total sales effects are negligible compared with the current rule. Though annual variations in price and sales were similar to those of the current three-year average OSF, the annual variations of the calculated OSV and reserves decline under the drop-the-extreme-shortfall rule, *DXS*.

iii. Applying a 50 percent OSV trend adjustment following an extreme harvest shortfall.
This rule is a compromise between the current three-year average rule and simply dropping an extreme shortfall from the OSF. The effects on the OSV, restricted and free percentages, price and addition to reserves fall between those of the current OSV and removing-extreme-event rules. Because this rule results in an OSF that is more responsive to market changes, it tends to increase year-to-year variations in sales and the OSV.

iv. Stabilizing market price using a price elasticity rule and target price.
A rule that aims at price stabilization has the most pronounced effects on the performance measures among the rules considered. With the targeted price used in the simulations, the annual OSV and total sales are about 5 percent larger with the price stabilization rule, and the average price, restricted percent and annual contribution to reserves are lower. Because the price-stabilizing OSF is more resistant to market changes, the annual variation in sales and price is lower than that of the current three-year rule.

**5. Conclusions**

The findings indicate that market instability in the tart cherry industry is brought about by random changes in grower yields, which appear to be largely weather-related. Though bearing acres of tart cherries have seen modest declines since 1997, year-to-year variation in bearing acres is not sufficient to generate the year-to-year variation in production recorded by the USDA. In contrast to supply, demand for tart cherry products is stable over time.

Tart cherry demand is inelastic. Even though demand is relatively stable, the inelasticity of demand compounds the market effects of supply instability. Demand inelasticity means that users of tart cherries do not find it easy to substitute away from tart cherries as the tart cherry price increases. As a result, a small reduction in quantity results in a larger increase in market price. In numeric terms, the tart cherry demand elasticity is about -0.5 percent. This means that the price increase is about twice the size of the supply reduction, so a 10 percent reduction in supply results in a 20 percent increase in price.

Demand for processed tart cherries is derived from the downstream demands for food products such as frozen desserts, juice and juice drinks, and fruit and nut snacks. Aggregate demands for these food categories are relatively stable over time, but each presents potential subcategories for tart cherry sales growth by the development and sale of new products. Competition for market share in these food categories is vigorous, and maintenance of tart cherry market share requires product innovation and well-designed market strategies. Sales strategies need to be grounded in accurate information about quantities sold, prices by product line and product category, and the characteristics of buyers and consumers of tart cherry products.

The demand analysis using publicly available data shows that the various tart cherry product lines have very different characteristics and determinants. For example, demand for pie-fill is unresponsive to changes in its own price but does shift with consumer income and the prices of substitutes such as apples and sweet cherries. IQF demand readily responds to market prices but is unresponsive to changes in income and the prices of substitute fruits. These demand differences between product lines create opportunities for market strategies that differ by product line. Further research is needed to identify the types of strategies that may fit different product lines. It may also be possible to develop optimal supply rules that support distinct product line strategies.

Alternative specifications of the OSF have potential for reducing the negative effect of an extreme harvest shortfall on future supplies:

i. The simplest alternative rule is simply to delete the extreme shortfall year from the calculation of the OSV and replace it with sales from a prior year. A deletion rule increases long-free percentages by about 2 percent and reduces the buildup of reserves by about 13 percent per year.

ii. It is also possible to compromise between deleting an extreme shortfall and keeping it in the OSF. The simulation examined one such compromise rule by which the OSV was adjusted upward by an amount equal to 50 percent of the gap between the three-year average rule with and without the extreme shortfall. As one might expect, the compromise rule results lie between those of the current OSV and a simple deletion rule.

iii. A market price stabilization rule that anticipates supply requirements to meet market demand increases average free percentage and reduces restricted percentage more than the other rules considered. Though a range of price targets can be specified, targeting price as equal to the average processed tart cherry prices from 1997 to 2009 reduced average market price and average annual contribution to reserves while increasing average total sales by almost 5 percent.

A significant benefit of the FMO is the extent to which it allows growers, processors and industry stakeholders to share market information. The FMO sets up collaborative institutions for the development of the OSV, collection and distribution of market statistics, and discussion of industry issues and opportunities. The Cherry Industry Administrative Board (CIAB) compiles and publishes market statistics that give stakeholders an opportunity to study and understand market-level trends and influences. These FMO institutions and activities provide growers and processors better information about sales and investment prospects than would likely be the case without the FMO.

The analysis finds that the tart cherry industry has significant opportunities for improving its OSF and for developing market strategies that better reflect the sales and growth opportunities of various product lines and consumer demand categories. Better data is needed to take advantage of these opportunities. Better data is needed to evaluate how product line prices respond to changes in marketed quantities and whether OSFs for specific product lines would improve sales, net returns and industry growth. Existing data reveals too little information about price, quantity and quality relationships to support the high reliability needed for designing OSFs specific to the major product lines. To develop better data, the industry needs to give careful consideration to how data that is now proprietary to individual firms may be shared and analyzed at the industry level.