EUROPEAN DEMAND RELATIONSHIPS FOR PROCESSED CITRUS PRODUCTS EXPORTED FROM THE UNITED STATES

ROBERT H. PRISCOTT AND LEO POLOPOLUS

Agricultural Economics Department
University of Florida
Gainesville

ABSTRACT

Florida accounts for the bulk of the processed citrus products exported from the United States to European markets. Except for the past two seasons, exports to Europe have vascillated in direct relation to the size of the crop — up in big crop years and down or close to zero in small crop years. Projections of future crop supplies forthcoming from Florida groves strongly suggest that export markets will become a necessary and annual components of Florida's overall marketing program.

In order to aid industry groups, such as the Florida Citrus Commission and individual marketing firms, information is needed regarding the responsiveness of buyers in individual European countries regarding U. S. export price changes. Also important is the impact of income and advertising expenditures in Europe upon sales. The purpose of this paper is to present results of an empirical demand study, with particular emphasis upon estimated price and income elasticities for frozen concentrated orange juice, frozen concentrated grapefruit juice, hot pack concentrated orange juice, hot pack concentrated grapefruit juice, canned single strength orange juice, and canned single strength grapefruit juice. The countries included in the analysis represent the European Free Trade Association (e.g., Austria, Denmark, Norway, Sweden, Switzerland, and the United Kingdom) and the European Economic Community (e.g., Belgium, France, Italy, the Netherlands, and West Germany).

INTRODUCTION

If the present channels of marketing Florida's processed citrus products are not expanded, projected production volumes will lead to decreased prices which will have ruinous effects on producer incomes. Future orange production may average between 175 and 190 million boxes over the next fifteen years, with some estimates reaching 260 million boxes in a given year [2]. Surpluses can also be predicted. Assuming the present level of sales and marketing efforts and stable prices, a surplus of 30 million box equivalents of oranges will occur in the 1969-70 season. The average surplus of production over marketing is estimated to be 28 million box equivalents per year until the 1976-77 season [1, p. 8].

Much of the projected production will go into processing. Processing will take an average of 85 percent of the orange production over the next 10 to 12 years. With rising per capita incomes in Europe, and a rising demand for citrus products there, caused, in part, with the aid of advertising, the export market gallonage of single strength equivalent is expected to increase annually at an average rate of 25 percent [1. p. 7].

While expansion of the export market would ease some of the projected surplus production problem, world citrus producers, particularly in the Mediterranean area, are expected to offer continuous competition for the European market. FAO estimates of world production and consumption of citrus indicate sizeable surpluses may occur in other countries also. To relieve pressure on their fresh fruit market, these countries are turning more towards instituting processing facilities and processed citrus marketing channels.

World production was projected by extrapolation of past trends within the technical feasibility range. High and low estimates of utilization for 1975 were made by using different assumptions relating to rates of increase in population and in rates of gross domestic product increases. Many areas are going to be competing in the world market because of pressure on home markets. Some countries, notably Israel, are already competing effectively in the European market in the processed citrus field. Israel's surplus, or balance, is projected to be between 1,063 and 1,055 thousand tons of oranges and tangerines by 1975 — using low and high assumptions about domestic utilization, respectively [3, p. 208].

METHOD

Quantity and price observations found in an export series published by the United States Bureau of the Census were the basic data used in the study. European demand is defined only with reference to quantities of United States citrus products that are imported by Western European countries. Since the United States is a major exporter of citrus products in world trade, this definition should not limit the validity of the study. The demand relationships were fitted by least squares at the wholesale level. More specifically, the results relate to F.O.B. demand at the port of export. Since the wholesale demand relationship is a reflection of demand at the consumer level, variables affecting consumer demand are therefore also relevant at the wholesale level.

Since the prices are F.O.B. export prices, tariffs do not need to be included in the demand analysis at this stage of the marketing process. However, present tariff arrangements and factors that affect the incidence of a particular tariff may be of interest since changes in tariffs may affect F.O.B. prices. The EEC tariff on orange juice is 19 percent (ad valorem) with some product classifications being taxed at 42 percent (ad valorem)—depending on amount of sugar added, density, and other factors. Grapefruit juice has a duty of 15 percent (ad valorem). Canned grapefruit sections with sugar added have a tariff of 23 percent (ad valorem). The EFTA countries tariff rates are much lower than the EEC tariff rates. Most rates depend on product classifications and range from "free" in Denmark, Norway, and the United Kingdom to 7.35 cents per pound in Switzerland. Most countries in EFTA have a tariff of 2.0 to 3.0 cents per pound on all citrus juices and canned grapefruit sections.

A single-equation model of least squares was used for the estimation of the demand parameters. Least squares regression was used to estimate the following model in equation form:

[1] $Q = f(P, Y)$

where,

     Q = quantity of a product
     P = price of that same product
     Y = per capita national income for the country under consideration.

This model was used to estimate demand parameters of canned grapefruit, canned concentrated grapefruit juice, and frozen concentrated grapefruit juice — all on a yearly basis. A similar model was used for estimation of demand parameters for single strength grapefruit juice and canned concentrated orange juice on both a yearly and a monthly basis.

Another model was used to estimate demand relationships of frozen concentrated orange juice and single strength orange juice. The model is as follows:

[2] $Q = f(P, Y, Adv)$

where,

     Q = quantity of a product
     P = price of that same product
     Y = per capita national income for the country under consideration
     A = advertising expenditures.

This model was fitted with both yearly and monthly observations. In several countries, advertising was not applicable. For these countries, model Equation 1 was used.

The results of estimating the demand relationships will be presented in terms of elasticities. Price elasticity, for example, measures the responsiveness of a buyer to changes in U. S. export prices. A price elasticity value greater that absolute one (1.00) suggests that Florida exporters can increase total revenue from larger quantities sold abroad. Formulas for measuring mean price, income, and advertising elasticity coefficients are as follows:

$$\text{Price elasticity} = \frac{\partial Q}{\partial P} \frac{\overline{P}}{\overline{Q}}$$

$$\text{Income elasticity} = \frac{\partial Q}{\partial Y} \frac{\overline{Y}}{\overline{Q}}$$

$$\text{Advertising elasticity} = \frac{\partial Q}{\partial Adv} \frac{\overline{Adv}}{\overline{Q}}$$

where,

     ∂ = derivative symbol
     Q = quantity of a product
     $\overline{Q}$ = mean of Q
     P = price of that same product
     $\overline{P}$ = mean of P
     Y = per capita national income
     $\overline{Y}$ = mean of Y
     Adv = advertising expenditures
     $\overline{Adv}$ = mean of Adv.

If the price elasticity value is greater than absolute one (1.00), a one percent decrease in price will yield a greater than one percent increase in quantity sold to increase total revenue. Economic theory assumes that a negative sign in the price elasticity coefficient is logical. Theory assumes also that a positive income elasticity coefficient is logical, while a negative one is illogical. That is, a one percent increase in income will yield a greater than one percent increase in quantity sold (assuming the elasticity value is greater than absolute one). Advertising elasticity coefficients follow the same sign pattern as income elasticity values.

Data were used as natural numbers to estimate demand functions by a least squares regression procedure and the coefficients were tested with a t ratio test. Quantity was used as the dependent variable, while price, per capita national income, and advertising were used as independent variables. Time and income were both used as independent variables in the preliminary analysis, but because of a very high correlation between them, time was dropped in favor of income. It was reasoned that income would reflect changes in tastes and preferences better than time would. Since income in some countries did not rise continuously, it was felt that income would more realistically represent changes of this type.

The problem of statistical bias which may result from using time series data was checked with a Durbin-Watson statistic. A cursory examination of the results indicated strongly that serial correlation was not present in the models used to estimate the demand parameters.

RESULTS

Success in elasticity estimation appeared to be related to the product and the country involved. Canned grapefruit sections in Switzerland had an income elasticity of 2.25 on a yearly basis. Price and income elasticities successfully estimated for canned concentrated grapefruit juice were strongly negative and positive, respectively. Unsatisfactory results for frozen concentrated grapefruit juice was determined due to data limitations. Successful price elasticities ranged from −1.08 (Belgium) to −2.77 (United Kingdom) — both on a monthly basis — for single strength grapefruit juice. Income elasticities for single strength grapefruit juice ranged from 1.80 (France) on a yearly basis to

3.93 (Denmark) on a monthly basis. *Attempts to estimate demand parameters for hot pack concentrated orange juice were almost entirely unsuccessful.*

Estimated price elasticities ranging from Switzerland's −.84 monthly value to France's −3.22 yearly values were found for frozen concentrated orange juice (FCOJ). In the yearly studies, price elasticity coefficients having illogical positive signs were determined for FCOJ in the United Kingdom, the Netherlands, and West Germany. All the other estimates for the product were consistent in sign (Table 1).

Income elasticity estimates for frozen concentrated orange juice ranged from the Netherland's 1.72 yearly value to the United Kingdom's 9.00 monthly value. Only for West Germany was the income elasticity coefficient illogical in sign. It occurred in a study of its monthly data (Table 1).

Advertising elasticities were also estimated for frozen concentrated orange juice. Values for Sweden, the United Kingdom, and the Netherlands were analyzed. Only the United Kingdom had an illogical or negative sign — that occurring in a monthly study. Significant values included a .30 for the United Kingdom (yearly data) and a .23 for the Netherlands (yearly data). Refer to Table 1.

While many illogical signs occurred in estimating price and income elasticities for single strength orange juice, there were also many significant values with logical signs. Denmark, the Netherlands, France, and Switzerland were the most successfully estimated countries for this product. All values, except the Netherlands (monthly) estimate, were of a correct sign (positive) in estimating advertising elasticities (Table 1).

As a general overview, elasticities estimated for products exported to Denmark, the Netherlands, Belgium, and France appear to be more reliable than those estimated for other countries. The most successfully estimated product was single strength orange juice. Data for this product also tended to be more complete.

IMPLICATIONS

Generally, those price elasticities that were significantly estimated were found to be quite elastic. Some were very strongly so, particularly for Denmark, the Netherlands, Belgium, and France. These empirical demand relation-

Table 1. Frozen concentrated orange juice and single strength orange
juice estimates of price, income, and advertising elasticities
of demand. 16 yearly observations, 1952 through 1967, and 84
monthly observations, September, 1961, through August, 1968.

Country and product		Time series	Price elasticity coefficient	Income elasticity coefficient	Advertising elasticity coefficient
Sweden	FCOJ	Yearly	neg*[ab]	pos*	pos*
		Monthly	-1.76	pos*	pos*
	SSOJ	Yearly	neg*	pos*	---[c]
		Monthly	neg*	pos*	.43
Norway	SSOJ	Yearly	pos*	pos*	---
		Monthly	neg*	pos*	---
Denmark	SSOJ	Yearly	-4.96	6.30	---
		Monthly	-3.43	4.49	pos*
United Kingdom	FCOJ	Yearly	pos*	pos*	.30
		Monthly	-1.46	9.00	neg*
	SSOJ	Yearly	neg*	pos*	---
		Monthly	-4.70	neg*	---
Netherlands	FCOJ	Yearly	pos*	1.72	.23
		Monthly	neg*	3.66	pos*
	SSOJ	Yearly	-1.94	pos*	---
		Monthly	-2.55	2.05	neg
Belgium	FCOJ	Yearly	neg*	4.21	---
	SSOJ	Yearly	-1.40	pos*	---
		Monthly	neg*	pos*	.22
France	FCOJ	Yearly	-3.22	3.57	---
	SSOJ	Yearly	-7.61	8.85	---
		Monthly	neg*	8.89	pos*
West Germany	FCOJ	Yearly	pos*	pos*	---
		Monthly	-1.21	neg	---
	SSOJ	Yearly	neg*	neg*	.14
		Monthly	-2.72	pos*	.24
Austria	SSOJ	Yearly	pos*	pos*	---
Switzerland	FCOJ	Yearly	neg*	2.01	---
		Monthly	- .84	pos*	---
	SSOJ	Yearly	-3.99	4.68	---
		Monthly	neg*	7.07	.20
Italy	SSOJ	Yearly	pos	neg*	---

[a]A "neg" denotes a negative sign. A "pos" denotes a positive sign.

[b]An (*) denotes a value that is not significant at the .05 level
using the t test.

[c]The designation (---) indicates that Three-Party advertising
expenditures data were inadequate to provide an estimate,

ships that are strongly price elastic indicate that the European market has the potential to be successfully developed for citrus products. By expanding this market, production from the Florida citrus industry could be channeled abroad to relieve projected domestic surpluses. Total revenue to Florida exporters can be increased by increasing the sales volumes to these price elastic markets.

In order to obtain better estimations of demand parameters in the European market, different data sources will have to be used. Perhaps data that deal more directly with foreign retail markets would be more meaningful. A price index should also be used — to take inflation in the European countries into account. The results from the data used in this study are not conclusive enough to make any decisive observations concerning their use. Further research attempts should also include some analysis of demand in Eastern European countries. Along

with rising per capital incomes in Poland and other countries, there has been a demand for a greater variety of goods in these countries. Exports of single strength grapefruit juice to East Germany in April, 1968, exceeded the entire export of this product to either Sweden, Denmark, or Switzerland for all of 1967. An investigation into the potential of this export market should be included in further research on Western Europe's demand situation. Advertising should again be included as an independent variable, because of possible increasing effects on demand.

LITERATURE CITED

1. Florida Citrus Industry Coordinating Committee, June 24, 1969. A plan for future action by the citrus industry, Lakeland. (Unpublished report.)
2. Institute of Food and Agricultural Sciences, August 1968. Proceedings of the citrus conference, production and marketing alternatives for the Florida citrus industry, IFAS Publication No. 5.
3. United Nations, Food and Agriculture Organization, 1967. Agricultural commodities—projections for 1975 and 1985. Vols. I and II.

REVIEW OF LINE CHECK DATA SHOWING BACTERIAL CONTAMINATION IN PROCESSING FROZEN ORANGE CONCENTRATE

D. I. MURDOCK

The Coca-Cola Company Foods Division
Plymouth

Sanitation plays an important role in the processing of frozen concentrated orange juice (FCOJ). If an efficient sanitation program is not maintained, microorganisms, primarily lactic acid bacteria and yeast, take hold and produce off-flavors in the finished product (1, 3). Under favorable conditions, these organisms grow at *an* extremely rapid rate; thus it becomes imperative that sanitation be watched closely. The diacetyl test has been developed and is a very effective quality control tool in detecting insanitary conditions (5, 6). However, it is not a panacea for all microbiological problems that may develop as it only shows the presence of those organisms capable of producing diacetyl and/or acetylmethylcarbinol. In many cases it

is desirable to know the total viable population in various phases of the processing operation. This is especially true of the finished product. With the advent of the FDA Good Manufacturing Practices, it is mandatory that the processor maintain records of the total microbial population of the finished product. Generally this is referred to as making plate counts. However, when juice from various processing operations is plated, this is referred to by the citrus industry as a "line check." For an effective biological control program, the diacetyl test should be used in conjunction with line checks. This enables the processor to detect microbial buildup in his processing operation, the source of contamination and determine the efficiency of each cleanup. Our company employs both of these tools on a routine basis during its processing operations.

In 1952, Minute Maid set up a comprehensive biological control program for all of its