A TWO-PRICING SYSTEM FOR EXPORTING FROZEN CONCENTRATED ORANGE JUICE*

Ronald W. Ward

The Florida citrus industry is in the unique position of being both importer and exporter of frozen concentrated orange juice. On one hand, exports provide the industry with an additional outlet for concentrate. On the other, imports being brought into the U.S. market creates considerable controversy as to whether this imported juice is economically desirable for the industry.

Two basic issues have evolved from these international trading activities. First, Florida exports concentrate on both Canadian and European markets. The former differs little from the domestic market [1, 3]. In contrast, the European market is expected to differ substantially from the U.S. market. Florida faces a number of competing suppliers in Europe. Often, the price of foreign concentrate exported to Europe is priced lower than Florida's export price. Recognizing that competition exists in the European market, how then should Florida price its product relative to the world price? Similarly, should the Florida export price be discounted to the domestic?[1]

Many Florida processors have argued that a two-pricing system between domestic and exported juice is desirable. However, an equally important issue revolves around how a two-pricing system can be established. Presently, Florida processors import cheaper foreign concentrate into the U.S., using this juice to average down the price of their exports. In essence, imports provide one way of achieving a two-pricing system for Florida's exports.

A second basic question relates to whether or not this type of international transaction is desirable for the citrus industry.

Two aspects of international markets allow the above programs to become operational. First, Florida's domestic price has consistently been at a premium relative to the world price. Second, U.S. tariff controls allow 99 percent of all duties on concentrate imports to be regained, once an equivalent quantity of concentrate is exported. The latter policy is known as the "duty drawback" provision. Thus, imports can be brought into the domestic market if an equivalent quantity is exported within three years. Under these arrangements, the differential between Florida and world prices can be used by exporters to average down their European export price.

In this paper, the basic economic usefulness of imports and exports to the Florida citrus industry is evaluated. A European demand model is estimated and then used to evaluate effects of maintaining a two-pricing system, using foreign imports.

EUROPEAN DEMAND

European demand for Florida concentrate can be explained in part by levels of both Florida's export

Dr. Ward is an Associate Professor in the Food and Resources Economics Department, University of Florida.

*Florida Agricultural Experiment Stations Journal Series No. 9081.

[1]Pricing policies are generally established by each Florida processor; however, considerable price leadership by larger processors is evident. A policy of establishing a two-pricing system by one processor may, then, lead to similar adjustments by others. A similar leadership role can also follow in using imports as means for supporting a two-pricing system.

While the industry does not have direct control over pricing, there are a number of indirect programs and proposals designed to influence domestic and foreign marketing of citrus. Foreign and branded advertising tax subsidities, adjustable tariffs, quality and product labeling restrictions, import bands, and industry reserve concentrate pools are but a few programs that can indirectly influence processors' pricing strategies [3].

Hence, having an empirical measure of the effect from various price changes is essential for development and/or implementation of structure changes and marketing policies.

price and world price. Adjustments in European demand for Florida concentrate, in response to changes in world price, give a good indication of the degree of competition Florida faces. Similarly, direct response to changes in Florida's export price gives guidelines for desirable price adjustments. Finally, demand most probably shifts over time, resulting directly from market development and shifts according to seasonal consumption patterns.

A quarterly export demand model is defined below:

$$QXU_t = [QPU_t]^{\epsilon_{XP}} [QPI_t]^{\epsilon_{XC}} [e^{(\Pi_0 + \Pi_1 t + \Pi_2 S_1 + \Pi_3 S_2 + \Pi_4 S_3 + \upsilon)}] \quad (1)$$

where

QXU = Florida's quarterly exports of FCOJ to Europe (thousands of gallons 45° brix)
QPU = Florida's quarterly FOB export price to Europe ($/gallon)
QPI = world or international concentrate price approximated by Brazil's export price for 45° brix concentrate ($/gallon)
t = quarterly time periods with 1=first quarter 1968; 2=second quarter 1968; 3=third quarter 1968; .... 28=fourth quarter 1974
S_i = 1 if i^{th} quarter, i=1, 2, or 3; 0 otherwise
ϵ_{XP} = direct price elasticity for export demand
ϵ_{XC} = cross price elasticity for export demand, and
Π_j = trend and seasonal parameters.

Equation (1) is one of a seven-equation simultaneous model developed by this author but not reported completely here.[2] Details of the full model are not essential to this paper; therefore, equation (1) for interpretation purposes can be treated as a single equation model, although the parameters shown below were estimated using two stage least squares:

$$\begin{aligned} \text{Log}(QXU) = &-2.259\ \text{Log}(QPU) + .966\ \text{Log}(QPI) \\ &\ \ (1.26) \qquad\qquad\quad (.920) \\ &+6.676 + .078\ t + .479\ S_1 + .748\ S_2 \\ &\ (1.04)\ \ (.012)\ \ (.171)\ \ (.175) \\ &+.477\ S_3 \quad R^2 = .804 \\ &\ (.170) \end{aligned} \quad (2)$$

Standard errors are reported in parentheses and a comparison of actual and estimated values of exports are given in Figure 1. Standard errors and related statistics are subject to the limited interpretation associated with the use of TSLS.

A TWO-PRICING SYSTEM

As indicated initially, a two-pricing system has been assumed desirable but has not been empirically shown so. Equation (2), along with results shown in footnote 2, suggest that a price differential between Florida's domestic and export price is, in fact, desirable.

The direct export elasticity is elastic while the domestic demand is inelastic, as shown where: ϵ_{XP}=−2.259 and ϵ_{DP}=−.52. Note that both elasticities are measured at the FOB level at Florida ports. Hence both domestic and export prices are per-unit values for the same product as sold in two distinct markets.

A comparison of these elasticities clearly shows the desirability of a two-pricing system. Gross revenues to the industry can be increased by reducing export price and increasing domestic price, since marginal revenues are:[3]

$$MR_D = QPD\left[1 + \frac{1}{\epsilon_{XD}}\right] = QPD[-.92] < 0 \quad (3)$$

and

[2] Ward has estimated a complete simultaneous model relating factors influencing level of imports, derivation of prices demanded by Canadian and European export and domestic demand [3]. A number of structural forms for the complete simultaneous system were estimated. However, demand equation (1) gave the best set of alternative specifications. While the final form is restrictive in that elasticities are fixed, a linear model is likewise restrictive in that slopes are fixed. The final demand form was not selected according to prior restrictions. Rather, it was determined from empirical results for the model's alternative specifications.

In addition to European demand, the simultaneous model shows domestic price elasticity of demand (ϵ_{DP}) to be −.52 at the Florida FOB level, using a domestic demand equation where: $QD = QPD^{-.52}$ ADJ, QD=Florida's domestic concentrate sales (thousand gallons), QPD=Florida's FOB price ($/gallon), and ADJ=seasonal adjustments.

[3] Although the model suggests that a two-pricing system is desirable (and economic theory indicates that optimal pricing occurs where MR_X=MR_D), pragmatically, such an allocation may be impossible. A derived optimal allocation could lead to price levels beyond the range of present data. Estimated elasticities may not be valid when prices are extended too far beyond data for which they were based.

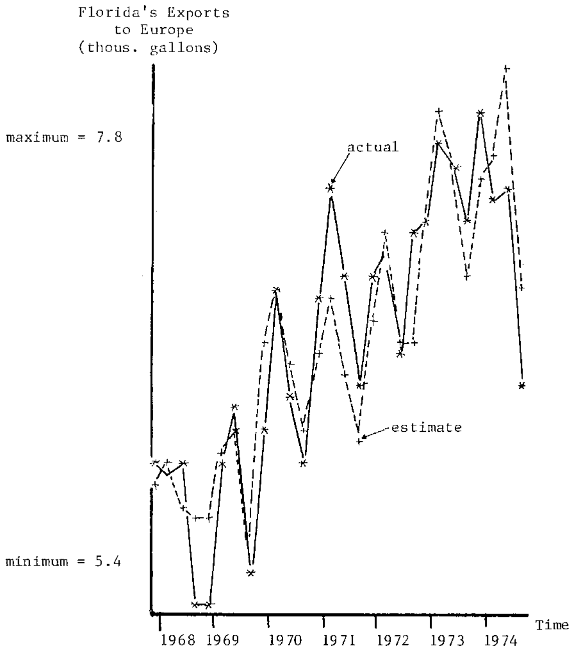

FIGURE 1. ESTIMATED AND ACTUAL GALLONS OF FLORIDA FROZEN CONCENTRATED ORANGE JUICE EXPORTED TO EUROPE EACH QUARTER [SEE EQUATION (2)]

$$MR_X = QPU\left[1+\frac{1}{\epsilon_{XP}}\right] = QPU[.56]>0 \qquad (4)$$

PRICING WITH IMPORTS

As the European export market develops, the Florida citrus industry has two basic pricing alternatives. First, export price can be equated to domestic price and exports estimated accordingly. Secondly, export price can be discounted to the domestic market. As shown above, this is an economically desirable alternative. However, the major problem arises with the implementation of a two-pricing system.

The industry now uses imports as a means for discounting its export price relative to the domestic, since the world (or Brazilian) concentrate price is generally lower than Florida's domestic one. Given that imports are brought into Florida and equivalent quantities eventually exported, does this benefit the Florida citrus industry? The demand model estimated in equation (2) addresses this question.

Florida's European export demand indicates that exports at level QXU^D could be expected if export price equals domestic—assuming other prices fixed—in a given time period. In contrast, exports should increase to QXU if export price were discounted relative to domestic by a factor of $1-\beta$, where $0\leq\beta<1$. These two levels of exports are illustrated in Figure 2 and derived below:

$$QXU^D = [QPD]^{\epsilon_{XP}}\,[QPI]^{\epsilon_{XC}}\,A \qquad (5)$$

$$QXU = [QPU]^{\epsilon_{XP}}\,[QPI]^{\epsilon_{XC}}\,A \qquad (6)$$

where

QPD = Florida's domestic price (\$/gallon)
QPI = world of international price (\$/gallon)
A = seasonal and trend adjustments in equation (2).

Initially, the difference in (6) and (5) is gain in gallons of concentrate exported due to a price reduction. However, if imports were necessary to achieve the price discount $(1-\beta)$, then net Florida concentrate exports are some level less than QXU, defined to be QXU*. The difference between QXU and QXU* is the level of imports needed. A basic question to the citrus industry is whether $QXU^* \gtrless QXU^D$ as seen in Figure 2. If $QXU^*=QXU^D$ then the industry is indifferent to the use of imports. If $QXU^*<QXU^D$ the industry would most likely oppose the use of imports, since additional concentrate would be forced into domestic markets.

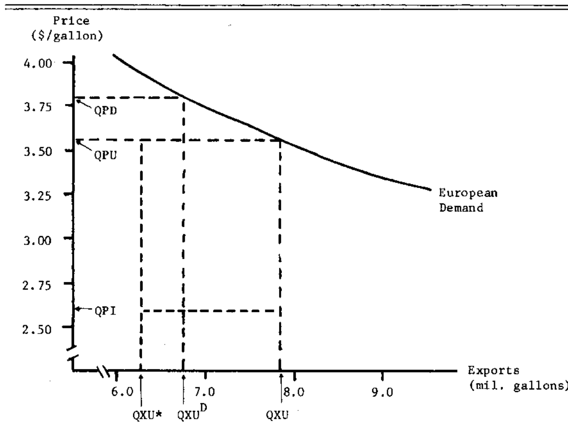

FIGURE 2. EUROPEAN DEMAND FOR FLORIDA FROZEN CONCENTRATED ORANGE JUICE [EXAMPLE IS BASED ON ANNUAL SALES FOR 1975 USING AN AGGREGATE OF EQUATION (2)]

A level of imports (QXU−QXU*) necessary to reduce the export price (QPU) to β[QPD] is derived using results for calculating Florida export price below:

$$QPU = \left[\frac{(QXU-QXU^*)QPI+(QXU^*)QPD}{QXU}\right] \quad (7)$$

then

$$QXU^* = QXU\left[\frac{\beta QPD-QPI}{QPD-QPI}\right] \quad (8)$$

Further, from equations (6) and (8) it immediately follows that:

$$QXU^* = \left[\frac{\beta QPD-QPI}{QPD-QPI}\right][QPD]^{\epsilon_{XP}}$$

$$[QPI]^{\epsilon_{XC}} \beta^{\epsilon_{XP}} A \quad (9)$$

Equation (9) shows the resulting net exports of Florida concentrate after necessary imports (for averaging down Florida's export price to βQPD) have been subtracted from total exports QXU. Hence, a comparison of QXU* from (9) to QXU^D in equation (5) shows relative gallons gained (or lost) from using imports. The ratio of QXU* to QXU^D provides an index of such gains or losses:

$$\frac{QXU^*}{QXU^D} = \left[\frac{\beta QPD-QPI}{QPD-QPI}\right]\beta^{\epsilon_{XP}} \quad (10)$$

where

$$\frac{QXU^*}{QXU^D}\begin{cases} >1 & \text{net export gains to Florida} \\ =1 & \text{no change} \\ <1 & \text{net export losses to Florida}\end{cases}$$

The solution from (10) shows that net results of imports to Florida depend on relative prices, amount of export price discount, and elasticity of demand. Letting the right-hand side of (10) be $\gtrless 1$, it follows that:

$$QPD\left[\beta^{1+\epsilon_{XP}}-1\right] - QPI\left[\beta^{\epsilon_{XP}}-1\right] \gtrless 0 \quad (11)$$

or

$$\frac{QPD}{QPI} \gtrless \left[\frac{\beta^{\epsilon_{XP}}-1}{\beta^{1+\epsilon_{XP}}-1}\right] \quad (12)$$

Equation (12) then establishes conditions where imports may or may not be beneficial, in terms of increased movements of Florida concentrate. Table 1 gives empirical results for the right-hand side of (12). From this, values indicate that, at a minimum, domestic price must be nearly twice that of world price before imports are beneficial to the industry.

Historically, relative prices shown in the left side of (12) have averaged 1.43 with the minimum of 1.14 and a maximum of 1.68. Based on these past prices, results from (12) indicate that $QXU^*<QXU^D$ (or, intuitively, total export gains achieved through averaging down export price with imports) are not sufficient to result in net export gains for Florida.

Referring to Figure 2, above results indicate that QXU* will generally lie to the left of QXU^D. Hence, using imports to maintain a two-pricing system will result in more concentrate added to the domestic market, rather than expanding foreign sales of Florida concentrate.[4] In Figure 2, this addition to domestic supplies is determined to be QXU^D-QXU^*.

As a final note, usefulness of imports and gains from exports depend on the elasticity of exports. Greater export levels would be expected for a change in export price if that market were more elastic. For a more elastic market, it follows that the ratio of domestic to world prices [shown in equation (12)] can be less, while imports are still economically useful

TABLE 1. EMPIRICAL RESULTS FOR EQUATION (12)[a]

β	$\frac{\beta^{\epsilon_{XP}}-1}{\beta^{1+\epsilon_{XP}}-1}$
.9	1.89
.8	2.02
.7	2.18
.6	2.40
.5	2.71
.4	3.19
.3	3.99

[a]Based on ϵ_{XP}=-2.26 from equation (12).

[4]While the present paper is limited to an analysis of gains or losses for Florida concentrate, net of imports, additional studies include a measure of full revenue resulting from two-pricing alternatives. Additions to domestic supplies from imports have an especially negative effect on the domestic market, this market being inelastic. Revenue gains (or losses) are addressed by Ward [3]. However, it is easy to show that gains or losses from export markets are directly proportional to relative movement in (10). Define $RQXU^D$ to be revenue without a two-pricing system. RQXU is that using imports to support a two-pricing system. Then: $RQXU^D$=(QPD)(QXU^D), RQXU=(βQPD)(QXU)—(QPI)(QXU—QXU*). From equation (8) it then follows that: RQXU=(QPD)(QXU*). Hence, the revenues differ by QPD (QXU^D—QXU*).

to the Florida citrus industry. This is demonstrated mathematically, since the right-hand side of equation (12) declines as $|\epsilon_{XP}|$ increases from that shown in (2). From equation (12), define:

$$R = \left[\beta^{-|\epsilon_{XP}|} - 1\right] \left[\beta^{1-|\epsilon_{XP}|} - 1\right]^{-1}$$

then

$$\frac{\alpha R}{\alpha|\epsilon|} = \frac{\beta^{-|\epsilon_{XP}|} \operatorname{Log}(\beta)(1-\beta)}{\left(\beta^{1-|\epsilon_{XP}|} - 1\right)^2} < 0 \qquad (13)$$

since $0 \leq \beta < 1$. Equation (13) illustrates an interesting phenomenon about the citrus industry. As Florida attempts to further differentiate its concentrate in the world market, its export demand should become less elastic—thus making imports for pricing purposes even less useful. In contrast, market development and growth in foreign competition may lead to a more elastic market. Then, imports may become more useful to the industry.

CONCLUSION

European exports of frozen orange concentrate can be expected to increase over time as derived in the export demand. In contrast to the domestic market, such exports are highly elastic. Gains can be realized from maintaining a two-pricing system, with Florida export price discounted to the domestic.

A Florida two-pricing system has been maintained by bringing in cheaper foreign imports, using these gallons to average down concentrate export price from the state. Results, however, show that under most circumstances this use of foreign concentrate does not result in net increases in exports to Florida concentrate producers.

Results presented have been limited to a study of gallons moved only. Additional research has addressed the full impact on revenues to Florida [3].

REFERENCES

[1] Chern, Wen S. "Econometric Analysis of the Consumer Demand for Orange Juices in Canada," ERD Report 73-2, Economic Research Department, Florida Department of Citrus, November 1973.

[2] Ward, Ronald W., and James A. Niles. An Economic Analysis of FCOJ Imports and Exports, *Florida State Horticultural Society Journal*, Proceedings, November 1975.

[3] Ward, Ronald W. "The Economics of Florida's Importing and Exporting of Frozen Concentrated Orange Juice: An Econometric Analysis," Economic Research Department, Florida Department of Citrus, 1976.