Staff Report

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ON THE FLORIDA LIME INDUSTRY

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AGRICULTURAL MARKET RESEARCH CENTER

FOOD AND RESOURCE ECONOMICS DEPARTMENT

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The Florida Agricultural Market Research Center is
a service of
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Abstract

Effects of Foreign Competition and Trade Policy on the Florida Lime Industry

The purpose of this paper is to estimate the effects of import competition and alternative trade policies on the Florida fresh lime industry. An econometric model of the Florida lime and U.S. trade sectors is specified and the estimated multipliers are used to measure the impact of four hypothetical U.S. trade policies. The free trade alternative would inverse imports and reduce Florida's output without affecting Florida prices. Increases in the U.S. specific tariff level would decrease imports and stimulate production in Florida, but would have only a very limited impact on prices. Finally, the imposition of a fixed import quota would provide a considerable stimulus for increasing Florida's output while, at the same time, raising Florida prices.

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Effects of Foreign Competition and Trade Policy on the Florida Lime Industry

The Florida fresh lime industry has recently faced increasing competition from imports, particularly from Mexico. Concern about increased lime imports began in the mid-1970's and has focused on their potentially adverse effect on Florida prices and production. In order to evaluate the potential threat of foreign competition on Florida's lime industry, and the trade policy alternatives, quantitative estimates are needed of the impact of imports on the industry.

The purpose of this study is to estimate the effects of import competition and alternative trade policies on the Florida lime industry.[1/] The methodology employed is to specify and estimate an econometric model of the Florida lime and U.S. trade sectors. A set of reduced form equations is derived from the simultaneous equation model; and the estimated multipliers are used to measure the impacts of alternative U.S. tariff and quota policies on lime imports, Florida lime production, and prices.

Florida's Fresh Lime Industry

Florida and California are the only two states in the United States producing limes commercially.[2/] Since the early 1970's, Florida has accounted for about 90 percent of the domestic acreage and California the remaining 10 percent. As recently as the 1972-73 season, Florida produced 90 percent of the total U.S. supply of fresh limes. California's

production, which is relatively small but stable, has typically accounted for 5 to 8 percent of the U.S. supply in recent years.

Imports have increased steadily since 1972-73 when imports constituted only 4 percent of U.S. fresh lime supplies. By 1976-77, however, imports accounted for about 15 percent. In the 1977-78 season, imports represented approximately one-third of the U.S. fresh lime supplies, and in the 1979-80 season, over 37 percent. Fresh limes are protected in the U.S. by a specific tariff (TSUS item No. 147.22) of one cent per pound. In recent years the ad valorem equivalent of this tariff has been about 7 percent.

Although a number of Caribbean countries export fresh limes to the U.S., Mexico is the dominant source. In recent years, from 95 to 97 percent of lime imports have come from Mexico. Mexico has the potential to become an even greater competitive threat to the Florida lime industry. Mexico has almost 112,000 acres of limes in production, compared with Florida's 4,600. Although a very high proportion of Mexico's acreage consists of the seeded 'Mexican' lime used for the production of essential oil, there is increasing production of 'Persian' limes, the preferred fresh market variety grown by Florida producers.

The Economic Model

The main components of the model are the foreign trade sector and the Florida market for limes. This system allows the simultaneous determination of import and export prices, import levels, and the quantity and price of Florida limes.

Following Magee and Goldstein and Khan, we specify the foreign trade sector to include the supply of lime exports from Mexico (M^S), the

U.S. demand for lime imports (M^d), and the relative price equation linking the U.S. import price (PM) with the Mexican export price for limes (PX).

In the absence of export tariffs, we specify the supply of limes from Mexico as a function of the export price (in pesos), the real income level in the exporting country (YMEX), and the lagged price of exports:

$$(1) \qquad M_t^S = f(PX_t, YMEX_t, PX_{t-1})$$

It is expected that current and lagged export prices are positively related to the level of exports. As export prices rise, production for export becomes more profitable, and allocation of the product to the export market increases. However, as domestic income rises in the exporting country, domestic demand for the product rises and, ceteris paribus, exports decline.

A key assumption of the model is that imports are perfect substitutes for domestic production. Thus, the import demand for limes is specified as follows:

$$(2) \qquad M_t^d = g(PM_t, QF_t, YUS_t, CPI_t)$$

where PM is the import price (in dollars), QF is the quantity of limes marketed by Florida producers, YUS is the U.S. income level, and CPI is the U.S. consumer price index. It is hypothesized that the U.S. demand for imported limes is negatively related to import price, and positively related to consumer income. In addition, under the assumption of perfect substitutability, Florida marketings should exert a negative influence on imports (Leamer and Stern). Equation (2) also embodies the hypothesis

that as the price of all other consumer goods (CPI) rises, ceteris paribus, the demand for imports increases.

Finally, the following identities complete the specification of the foreign trade sector:

$$(3) \qquad PM_t = \frac{1}{r_t} PX_t + T$$

and

$$(4) \qquad M_t^s = M_t^d$$

Expression (3) relates the dollar-valued import price (PM) to the peso-valued export price received by Mexican suppliers. This identity explicitly introduces the foreign exchange rate (r = pesos/dollar) and the U.S. specific tariff rate (T = $.01/lb.). Expression (4) imposes a market clearing solution on the trade side of the model.

With regard to the domestic side of the model, the specification of the Florida lime supply function is given by:

$$(5) \qquad QF_t^s = h\left(\sum_{i=1}^{n} PF_{t-i}, \sum_{i=1}^{m} PPF_{t-i}, FW_t, QF_{t-1}, TIME\right)$$

where PF is the Florida lime price, PPF represents prices paid by growers for the purchase of production inputs, FW is a variable denoting unfavorable Florida weather conditions, and TIME is an annual trend term.

The lag structures on product and input prices account for the influence of expected prices and costs on supply, due to the lag between planting and output. As measures of expected levels of profitability, prices should exert a positive impact on supply, while prices paid by farmers should

negatively affect supply. Lagged lime output was included in the specification to capture partial production adjustments and it is expected that $0 < \partial h/\partial QF_{t-1} < 1$. Finally, the time trend was added to represent the effects of omitted variables, such as technological change, that may have exerted systematic effects over time.

The quantity demanded of Florida limes is postulated to depend upon the price of Florida limes (PF), the U.S. income level (YUS), the overall price level (CPI), and the levels of current and lagged imports (M):

$$(6) \qquad QF_t^d = i(PF_t, YUS_t, CPI_t, M_t, M_{t-1})$$

Own price and consumer income are expected to enter the equation with negative and positive signs, respectively. Prices of all other commodities should be negatively related to demand. In addition to such traditional variables, the quantity of limes demanded depends on the availability of imported limes as well. Increased quantities of the imported substitute should erode demand for the domestic product. The sustained increase in lime imports, as evidence that foreign competitors are gaining market share, should further negatively influence the demand for Florida limes.

To complete the specification of the Florida lime market we require that:

$$(7) \qquad QF_t^s = QF_t^d$$

to assure a market-clearing equilibrium.

The Estimated Model

The economic model discussed in the previous section consists of a system of four behavioral equations and three identities. The parameters of the behavioral equations were estimated simultaneously via three-stage least squares (3SLS) using annual observations for the period 1957 through 1978. The estimated equations are reported in Table 1, along with their corresponding structural R^2's and measures of the degree of first-order residual autocorrelation. Table 2 presents the variable definitions.

All four equations exhibit good structural fits as evidenced by the high structural R^2's and the overall significance of the estimated parameters. In no case is the test of autocorrelation rejected, while the test is inconclusive for the import supply and Florida demand equations. Parameter signs conform closely to theoretical expectations. All variables enter the import supply equation with their expected signs at high levels of significance. In the import demand equation the variable PM exhibits the postulated sign, but is only very marginally significant. The income measure, YUS, also has the postulated sign but is not significant, perhaps due to its high degree of correlation with the CPI variable. The most important explanatory variable in the import demand equation is Florida lime production, which confirms the hypothesis of perfect substitutability between domestic and imported limes.

In the Florida supply equation, polynomial distributed lag forms were imposed on the lagged price and cost series. Prices were assumed to follow a four-period first order polynomial distributed lag, whereas production costs were allowed to follow a four-period second order distributed lag. In both cases all parameters are of the expected sign and highly significant, except for the parameter on PPF_{t-1}. The large

Table 1. 3SLS Structural Equation Estimates of Model for Limes

Estimated Equations	R^2	D.W.	h
Import supply $M_t^s = -20.13 + 38.73\ PX_t - 15.04\ YMEX_t + 71.89\ PX_{t-1}$ $(10.31)^a\ (15.67)\ \ (4.64)\ \ (17.17)$	.897	1.49	
Import demand $M_t^d = -86.67 - 4.26\ PM_t - .126\ QF_t + .0018\ YUS_t + 2.65\ CPI_t$ $(44.27)\ \ (3.34)\ \ (.022)\ \ (.0081)\ \ (1.17)$	.936	1.74	
Florida supply $QF_t^s = 1{,}044.3 + 58.15\ PF_{t-1} + 43.61\ PF_{t-2} + 29.07\ PF_{t-3}$ $(172.49)\ (11.43)\ \ (8.57)\ \ (5.72)$ $+ 14.54\ PF_{t-4} + 2.55\ PPF_{t-1} - 6.95\ PPF_{t-2}$ $(2.86)\ \ (2.36)\ \ (1.12)$ $- 10.54\ PPF_{t-3} - 8.23\ PPF_{t-4} - 80.38\ FW_t + .862\ QF_{t-1}$ $(2.32)\ \ (1.99)\ \ (25.68)\ \ (.152)$ $+ 28.12\ TIME_t$ (7.05)	.935	1.83	.54
Florida demand $QF_t^d = 224.12 - 40.90\ PF_t + .156\ YUS_t - 2.21\ CPI_t - 1.09\ M_t$ $(157.69)\ (10.16)\ \ (.029)\ \ (3.50)\ \ (.712)$ $- 2.13\ M_{t-1}$ $(.340)$	.968	1.48	

[a] Asymptotic standard errors in parentheses.

Table 2. Definition of Variables

Endogenous Variables

M_t = U.S. imports of limes at year t (million lbs.)

PX_t = Mexican lime export price at year t (pesos/lb.)

PM_t = U.S. lime import price at year t ($/lb.)

QF_t = Florida lime production at year t (million lbs.)

PF_t = Florida wholesale lime price at year t (cents/lb.)

Exogenous Variables

YMEX= Real Mexican gross domestic product (deflated by Mexican wholesale price index) (billions of pesos)

YUS = U.S. disposable personal income (billions of dollars)

CPI = U.S. consumer non-durable goods price index (1972 = 100)

PPF_t= U.S. index of prices paid by farmers at year t (1967 = 100)

FW = Florida weather dummy variable [FW = 1 for years with unfavorable weather conditions (due to freezes or hurricanes), and FW = 0 in remaining years]

TIME= Annual trend term, 1957-58 season is year 1

NOTE: Data were obtained from standard USDA, IMF and other governmental publications.

coefficient on QF_{t-1} reflects the substantial inertia which dominates the supply side of the Florida market. Finally, the Durbin h statistic provides an appropriate test for residual autocorrelation in this equation, because of the presence of a lagged dependent variable.

The estimated Florida demand equation also conforms closely to the hypothesized relation. The Florida price of limes and the domestic income level appear to influence the demand for Florida limes to a considerable extent. The estimated price and income elasticities of demand are -.0.64 and 2.00, respectively. In this equation, the CPI variable has the proper sign but is not statistically significant, due perhaps to its rather high degree of correlation with YUS. Current imports are a marginally significant determinant of Florida demand. Lagged imports, however, appear to have a very significant effect. This result supports the hypothesis that sustained increases in imports have an adverse effect on the demand for Florida fresh limes.

Model Validation

The generally good fit of the structural model and its conformity to a priori theoretical notions suggest its appropriateness as a simulation tool. The reduced form equations were derived and the model was, thus, simulated over the sample period in order to evaluate its forecasting performance. Both static and dynamic simulations were performed using the estimated or base model. Unlike the static simulation which uses actual values for lagged endogenous variables, the dynamic simulation employs, instead, previously solved values of the endogenous variables.

In order to assess the model's ability to track historically, the squared correlations between actual and simulated values of the

endogenous variables were calculated. The following results were obtained:

Simulation	Endogenuous Variable				
	M	PM	PX	FQ	PF
Static	.942	.715	.928	.935	.957
Dynamic	.947	.758	.924	.890	.857

The reduced form solution of the model under the two simulation strategies appears acceptable for all variables except the U.S. import price (PM). But because this variable has little impact on lime import levels (M) in the structural model, lime imports are simulated quite accurately.

Trade Policy Simulations

This section examines the implications of possible changes in trade policy on Florida's fresh lime industry. Imports, Florida output, and Florida prices are simulated over the 1970 to 1978 period under the current U.S. tariff policy (base value). Next, four alternative tariff and quota policies are inforporated into the model, and the simulation results for the 1970-78 period are compared to the base soluction values. The hypothetical trade policies considered in this study are: (a) a no tariff or free trade policy, requiring the elimination of the $.01/lb. specific tariff on limes; (b) the doubling of the current tariff to $.02/lb.; (c) a further increase in the tariff to a level of $.05/lb.; and (d) the imposition of a fixed import quota of 5 million pounds of limes per year.[3/] Table 3 shows the values of imports, Florida output and prices over the simulation period.

Table 3. Simulated Values for Lime Imports, Florida Production and Price under Alternative Trade Policies, 1970-1978.

Endogenous Variable	Trade Policy	Year									Mean	% Change from Base Value
		1970	1971	1972	1973	1974	1975	1976	1977	1978	1970-78	
Lime imports (million lbs.)	Base value (actual tariff)	3.35	4.47	4.03	7.18	7.27	8.99	15.3	21.2	20.5	10.25	
	No tariff	3.76	4.99	4.42	7.69	7.67	9.50	15.8	22.0	21.2	10.78	+ 5.2%
	Tariff = $.02/lb.	2.95	3.94	3.64	6.67	6.86	8.47	14.7	20.4	19.8	9.71	- 5.3%
	Tariff = $.05/lb.	1.75	2.37	2.46	5.13	5.64	6.93	13.1	17.9	17.7	8.11	-20.9%
Florida lime production (million lbs.)	Base value (actual tariff)	73.7	77.9	76.8	69.3	99.8	96.8	68.6	42.1	59.6	73.8	
	No tariff	72.2	76.4	75.5	67.9	98.4	95.3	67.2	40.5	57.3	72.3	- 2.0%
	Tariff = $.02/lb.	75.1	79.4	78.1	70.7	101.2	98.3	70.0	43.7	61.9	75.4	+ 2.2%
	Tariff = $.05/lb.	79.6	83.8	82.0	72.0	105.5	102.7	74.0	48.6	68.9	79.7	+ 8.0%
	Imports quota (M≤5 mill. lbs)	73.8	78.4	79.7	72.7	102.0	104.6	81.7	67.4	111.3	85.7	+16.1%
Florida lime price (cents/lb.)	Base value (actual tariff)	4.79	6.51	8.36	13.00	6.14	9.74	17.50	23.40	21.50	12.30	
	No tariff	4.77	6.52	8.30	13.00	6.11	9.75	17.40	23.30	21.50	12.30	0.0%
	Tariff = $.02/lb.	4.81	6.50	8.41	12.90	6.16	9.72	17.60	23.50	21.60	12.40	+ 0.8%
	Tariff = $.05/lb.	4.87	6.46	8.59	12.90	6.24	9.68	17.80	23.80	21.70	12.40	+ 0.8%
	Import quota (M≤5 mill. lbs)	5.12	6.70	8.17	12.80	7.32	10.10	19.10	26.90	21.40	13.10	+ 6.5%

The result of the free trade alternative would imply an average increase as compared to base levels in lime imports of 5.2 percent over the simulation period. Under the same policy, Florida production declines by an average of 2 percent per year with no appreciable effect on Florida prices.

Doubling the existing U.S. specific tariff results in a moderate (2.2 percent) increase in Florida's output and a more substantial decline of yearly imports. Florida prices exhibit a negligible increase of .08 percent per year. The further increase of the tariff to a rate of $.05/lb. results in a similar pattern. Both the stimulation of Florida's production and the discouragement of imports is now more pronounced than under the previous alternative. Again, no appreciable effect is found on Florida prices, which indicates the noninflationary impact of specific tariff increases in the case of Florida fresh limes.

Finally, the imposition of a fixed import quota of 5 million pounds of limes per year implies a decline of over 50 percent in imports during the 1970-78 period. This considerable decrease in imports would have increased Florida output an average of 16.1 percent per year, and prices an average of 6.5 percent annually. This later alternative is undoubtedly the most inflationary among the hypothetical policies considered. Thus, only increases in the U.S. specific tariff could benefit Florida growers without at the same time increasing the cost borne by U.S. consumers.

Conclusions

On the basis of the above results, obtained from a model of Florida's fresh lime sector and the U.S. import sector, it appears that increased import competition, particularly from Mexico, has had an adverse effect

effect on Florida's market. Simulation of the model under alternative U.S. trade policies yields some interesting results. The free trade alternative would increase imports and reduce Florida's output without affecting Florida prices. Increases in the U.S. specific tariff level would decrease imports and stimulate production in Florida, but would have only a very limited positive impact on prices. Limiting imports to pre-1973 levels, via the imposition of a fixed import quota, would provide a considerable stimulus for increasing Florida's output while, at the same time, raising Florida prices.

Footnotes

1. A number of other studies (Andrew, DeBoon and McPherson, Freebairn and Rausser, NovaKovic and Thompson, and Salathe, Dobson and Peterson) have investigated the role of imports and protection on agricultural commodity markets.

2. For a detailed description of the Florida fresh lime industry see Degner and Rooks, and Degner, Shonkwiler and Cubenas.

3. Examining the implications of a hypothetical fixed import quota policy required the exogenization of the foreign trade sector. The hypothetical import quota of 5 million lbs./year was chosen because it represents the approximate level of imports that prevailed prior to the intensification of import competition in 1973.

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