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A STUDY OF U.S. ORANGE JUICE IMPORTS AND EXPORTS

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Frozen concentrated orange juice (FCOJ) used to be the major type of orange juice sold in the U.S. market. Between 1980 and 2004 there were several changes occurred in the orange juice market: refrigerated OJ became the dominant type in the OJ market and the not-from-concentrate OJ (NFC OJ) became the dominant form of refrigerated OJ category. The gallon sales of refrigerated orange juice exceed the gallon sales of FCOJ in the 1985-86 season; and the gallon sales of NFC OJ exceed the gallons sales of from-concentrate OJ (Recon OJ) in the 2001-02 season.

The U.S. became a net importer of orange juice (OJ) in the 1980s when freezes reduced Florida's production from 206.7 million boxes in 1979-80 to 103.9 million boxes in 1984-84. However, Florida's orange production recovered and in recent years Florida produced an average of 230 million boxes in the past three seasons (2000-01 through 2002-03). U.S. orange juice exports increased from 44.4 million SSE gallons in 1985-86 to 181.2 million gallons in 2001-02 then decreased to 111.5 million gallons in 2002-03. U.S. imports of OJ have also decreased from 634.4 million gallons in 1984-85 to 191.4 million gallons in 2002-03. The gap between the volumes of OJ imports and exports has narrowed (Table 1).

In export markets, the U.S. has to compete against Brazil, the world's top OJ exporter. Because there are some degrees of product differentiations between the U.S. OJ and Brazilian OJ in terms of types and brands, the U.S. is able to export some OJ even though it is a net importer of OJ.

The Canadian, European, and Japanese markets account for a majority of all U.S. OJ exports (Table xx). The Canadian market accounted for approximate 32% of the U.S. OJ exports between 1993 and 2003. European OJ imports from the U.S. have grown from 42.8 million gallons in 1993 to 92.9 million gallons in 2002, then dropped to 32.5 million gallons in 2003 due to a small crop in Florida. Over the study period, OJ exports to Europe accounted for 42% of total U.S. OJ exports (Table 2).

Foreign OJ imported into the U.S. is subject to a tariff duty. The present tariff structure includes a duty drawback provision. If an importer exports a like amount and quality of OJ within a specific time period (three years), he can receive repayment for the duties initially paid on the imported OJ. This drawback provision allows importers to use imports as part of their over marketing programs. If domestic prices rise above the import price by more than the duty, then imports of foreign OJ should increase until the Florida and world prices at U.S. ports are nearly equal. Imported OJ in Florida is generally blended with Florida product and then sold in the domestic market. One of the reasons for OJ imports is that Brazilian OJ is often useful for improving the color of Florida product early in the season. Another reason for foreign OJ imports is to provide an alternative source of OJ supply and supplement Florida's OJ supply.

Bulk foreign FCOJ can be imported into areas near population centers then reprocessed into consumer packages. During the period between 1993 and 2003, about

50% and 75% of the FCOJ and Other OJ imports, respectively, were destined to non-Florida ports (Table 3).

In the context of the above discussion, the purposes of this study are to provide an analysis of the effects of imports on the demand for Florida OJ. The specific issues and problems are

1. How is the foreign demand for U.S. OJ influenced by changes in the export price?

2. What factors influence the levels of imports of FCOJ and other OJ?

3. How do such imports influence the export market?

4. How do Florida crop size, inventory, and OJ imports influence domestic OJ price and Florida OJ movement?

Import Demand

The quantity of OJ imported is influenced by the domestic price, import prices, and the amount of OJ that is available from Florida. Formally, the import demand equation can be written as

$$(1) \qquad mq_{it} = f_i(mp_{1t}, mp_{2t}, fp_t, inv_t, d_1, d_2, d_3, td), \qquad i = 1, 2$$

where subscript i and t refer to the OJ types ($i = 1$ for FCOJ and $i = 2$ for other OJ) and the tth year, respectively; mq is the quantity imported in million SSE gallons, mp_1 and mp_2, and fp are the import prices of foreign FCOJ and other OJ, and domestic OJ price, respectively; inv is the quantity of OJ available in Florida, d_1, d_2, d_3 are dummy variables for the first (January through March), second (April through June), and third quarters (July through September), and td is a time trend variable.

Export Demand

Exchange rates represent the system for international payments and transfer of funds between countries. The rate specifically establishes the value of the dollar in terms of the currency of the importing country. Changes in this rate can over time lead to adjustments in the demand for foreign goods. For example, when the value of the dollar declines, sales of U.S. goods should in general increase since the importing country can now buy more imports for the same amount of their domestic currency. In this case, a dollar devaluation is equivalent to a price decrease to the foreign importer of U.S. goods. The export demand equations employed in this study specify that the total quantity of U.S. OJ demanded by foreign countries depends on the price charged by U.S. exporters, exchange rate, the competing OJ prices, seasonal patterns, and time trend. Formally, the export demand equation can be written as

(2) $xq_{it} = f_i(xp_{1t}*ex_t, xp_{2t}*ex_t, rp_t*ex_t, d_1, d_2, d_3, td), \qquad i = 1, 2$

where subscript i and t refer to the OJ types ($i = 1$ for FCOJ and $i = 2$ for other OJ) and the tth year, respectively; xq is the quantity exported in million SSE gallons, xp_1 and xp_2, and rp are the export prices (nominal) of U.S. FCOJ and other OJ, and the Rotterdam OJ price, respectively; ex is the exchange rate (foreign currency per U.S. dollar), d_1, d_2, d_3, and t are defined as before. The U.S. export prices are considered as functions of Florida orange crop size, inventory level, OJ import price, and the Rotterdam price. The export price equation can be written as

(3) $xp_{it} = f_i(mp_{it}, crop_t, rp_t, inv_t), \qquad i = 1, 2$

Domestic OJ price formation

Florida's OJ price generally reflects the economic value of all domestic citrus supplies. Major changes in the fundamentals within the domestic market will ultimately by reflected in adjustments in this price. Similarly, Brazil's price reflects the fundamentals within that country's markets. Domestic OJ supplies include the juice in inventory and the potential or actual amount of fruit on trees. Each October, the US Department of Agriculture releases a forecast of Florida's orange juice crop size for the coming season. As the season progresses, this forecast will be revised according to weather conditions and the additional information that becomes available after the October forecast. A final crop forecast for the season is released in July and the actual crop size becomes available in September. OJ prices respond to the October and its subsequent forecasts. Generally, the USDA forecasts are relatively accurate, the revised forecasts after October do not deviate from the October forecast too much, unless freezes damage Florida's orange crop. Therefore, the October forecast is usually the most important one for OJ suppliers to adjust their prices and the subsequent forecasts, in general, have smaller impacts on OJ prices than the October forecast.

Brazil became the major OJ producer in the world in the 1980s. Brazil's OJ price plays an important role in the U.S. domestic market as well as international markets. Since Brazil is the major OJ exporter in the world and the U.S. and imported OJ can be sold in the domestic U.S. market and/or delivered for the fulfillment of futures contracts, the price of imported OJ plays an important role in what Florida processors can charge for their OJ products. This relationship can be written as

(4) $fp_t = f(mp_{1t}, crop_t, crop10_t, inv_t, d_1, d_2, d_3)$

where fp, mp, inv, and d_1-d_3 are defined as before; $crop_t$ is the USDA crop forecast in time period t, and $crop10_t$ equals the USDA October crop forecast for the month of October and equals zero during other months of the season. The quarterly dummies are included to capture the seasonal pattern in prices, if any.

Florida's orange crop has been used directly to produce FCOJ and NFC OJ in recent years. In general, the Florida FCOJ has to compete with imported FCOJ in the U.S. domestic market. The retail sales information demonstrate that there is a seasonal pattern in the demand for OJ and that there is an increasing trend in the demand for NFC OJ and a decreasing trend in the demand for FCOJ. Therefore, the demand for Florida OJ can be considered as a function of its own price, imported price for OJ imported into non-Florida states, seasonality, and time trend. This relationship can be written as

(5) $dq_{it} = f(fp_t, omp_{it}, d_1, d_2, d_3, td)$, i = FCOJ, NFC OJ

where fp, d_1, d_2, d_3, and td are defined as before, omp_{it} is the import price of the i^{th} type of OJ that was imported into non-Florida states during period t.

Equations (1) through (5) form a nine-equation system and was estimated with the three-stage least square method. Monthly data were used in the estimation of these equations. The data used in this study came from the following sources:

1. Florida Citrus Processors' Association: Florida FCOJ and NFC OJ movements;
2. U.S. Department of Commerce: FCOJ and Other OJ import/export values and quantities;
3. *Food News*: Rotterdam OJ price; and
4. New York Cotton Exchange: FCOJ futures price.

Average monthly prices are presented in Table 4. Note that the U.S. FCOJ export prices are more than twice the import prices and close to twice of futures prices. The higher export prices than import and futures prices are expected; however, the magnitude of the differences was unexpected. In equations (1) through (5), all prices were deflated by the consumers' price index for food.

The export price equations (3) were deleted from the system of equations because the parameter estimates were either statistically not different from zero or had the unexpected signs. Parameter estimates for the rest seven equations are shown in Table 5 and demand/supply elasticity estimates are presented in Table 6. As shown in Table 4, most parameter estimates have the expected signs except the own-price parameter for Florida FCOJ movement equation. The results for the two domestic Florida OJ movement equations show that OJ imports into non-Florida states are substitutes for Florida OJs. The estimated elasticities show that the substitution relationships between Florida OJ and imported OJ are relatively small. The elasticity estimates show that a one percent increase in the import prices for FCOJ and Other OJ to non-Florida states would increase Florida FCOJ and NFC OJ domestic movement by 0.14 and 0.06 percent, respectively. In addition, there are seasonal patterns in Florida's movement of FCOJ and NFC OJ and there is a negative time trend for Florida FCOJ domestic movement and a positive trend for Florida NFC OJ movement.

Results indicate that imported FCOJ price had a positive impact on futures price, for 10 cents (per pound of solids or PS) increase in the FCOJ import price futures price

would increase by 7.8 cents. The quantity of OJ inventory in Florida had a negative effect on futures price, for every million gallons increase in OJ inventory, futures price would decrease by 0.03 cents per PS. Results also show that USDA crop forecast had significant impact on futures price. A one million boxes increase in the USDA forecast, futures price would decrease by 0.082 cents per PS. In addition, October forecast had an additional impact on futures price, i.e., 0.018 cents per PS for a one million boxes change in forecast. In terms of elasticity, a one percent increase in the FCOJ import price would increase futures price by 0.65 percent, a one percent increase in the USDA forecast for Florida orange crop, the futures price would decrease by 0.30 percent, and for the October forecast, the futures price would decrease by 0.36 percent.

The coefficient estimates for the two export equations indicate that U.S. FCOJ and Other OJ exports are influenced by their own-prices, competitors' price (FCOJ price in Rotterdam). In addition, there is a seasonal pattern and a negative time trend for the exports of FCOJ, and a positive time for the exports of Other OJ. The coefficient estimates for the export prices show that for every ten cents increase in export prices, the exports for FCOJ and Other OJ would decrease by 748,000 and .420,000 gallons (per month). Coefficient estimates also show that FCOJ is a substitute of Other OJ, i.e., when the price of Other OJ is increased, exports of FCOJ would increase. The estimate shows that if Other OJ export price is increased by ten cents per gallon, FCOJ exports would increase by 984,000 gallons (per month). However, the export price of FCOJ had no significant effect on the exports of Other OJ. The coefficient estimates for the Rotterdam price show that for every penny increase in the Rotterdam price, U.S. exports of FCOJ and Other OJ would increase by 58,600 and 17,900 gallons, respectively.

The elasticity estimates show that U.S. OJ exports are price elastic. The own-price elasticity estimates for FCOJ and Other OJ exports are –2.05 and –2.30, respectively. The cross-price elasticity estimate for the Other OJ price in the FCOJ export equation is 3.60, an indication that exports of Other OJ can be easily substituted by FCOJ exports. The cross-price elasticity estimates for the Rotterdam price in the FCOJ and Other OJ export equations are 0.47 and 0.23, respectively; indicating that U.S. FCOJ and Other OJ are substitutes for OJ exports from other country and the substitution of U.S. FCOJ for OJ exported from other countries is more elastic than the substitutability of U.S. Other OJ for OJ exported from other countries.

The coefficient estimates for the two import equations show that if the import prices for FCOJ and Other OJ are increased by 10 cents per gallon, imports of FCOJ and Other OJ would decrease by 2.81 million gallons and 0.16 million gallons, respectively. The cross-price coefficient estimates for FCOJ and Other OJ imports are statistically not different from zero. The own-price elasticity estimates for imported FCOJ and Other OJ are –0.59 and –2.65, respectively; indicating that the imports of Other OJ are very price sensitive.

Inventory levels also influence the quantities of OJ imported. The estimates show that for every one million gallons increase in inventory, imports of FCOJ and Other OJ

would decrease by 15,800 and 150 gallons; however, the impacts of inventory on imports are relatively small.

Concluding Remarks

Results found in this study show that OJ exports are inversely related to export prices. For 2003, the most-favored-nation (MFN) tariff rates for frozen concentrated orange juice (FCOJ) and not-from-concentrate orange juice (NFC) are $0.297 per single-strength-equivalent gallon (or 28.89 cents per pound of solids) and $.1704 per gallon, respectively. The current duty drawback provision provides an opportunity for exporters to use the duty drawback to reduce their export prices. If the exporter takes the advantage of duty drawback provision, his FCOJ export price can be reduced by $0.294 (99% of the duty) per gallon. Based on the estimates in the FCOJ export equation, if all FCOJ exporters used duty drawback, a reduction of $0.294 per gallon in export price would increase FCOJ export by 2.2 million gallons per month or 26.4 million gallons per year.

In this study, we assumed that OJ imports had a direct relation with U.S. OJ export prices and thus had an indirect relationship with U.S. OJ exports. But the empirical results did not find any significant relationship between import price and export price.

The results in the futures price and import equations suggested that Florida crop size and inventory levels had significant negative impacts on futures price and the quantities OJ imported to the U.S. This finding and the lack of relationship between imports and exports suggest that the imports were used to augment the domestic supplies. The results in the Florida movement equations show that OJ imported into non-Florida destinations was used as a substitute for Florida OJ; however, the substitution between imported OJ into other states and Florida OJ was price inelastic.

Table 1. U.S. OJ imports and exports

Year	Exports			Imports			Balance (Exp – Imp)
	FCOJ	Other OJ	Total	FCOJ	Other OJ	Total	
	- - mil gallons - -						
1993	88.8	25.8	114.7	346.4	2.2	348.6	-234.0
1994	71.8	36.8	108.6	383.4	4.4	387.8	-279.2
1995	76.7	40.3	117.0	181.7	6.9	188.6	-71.6
1996	74.7	42.8	117.4	276.3	5.3	281.6	-164.2
1997	101.2	48.7	149.9	250.2	4.0	254.2	-104.3
1998	82.5	65.8	148.3	296.0	3.1	299.1	-150.7
1999	76.8	73.3	150.0	348.1	6.7	354.8	-204.8
2000	71.1	71.6	142.6	308.1	12.2	320.3	-177.6
2001	58.3	60.4	118.7	234.2	8.0	242.2	-123.5
2002	162.6	14.8	177.4	177.6	13.8	191.4	-14.0
2003	53.1	63.6	116.7	262.9	21.3	284.3	-167.6

Source: U.S. Department of Commerce.

Table 2. U.S. OJ exports by destination

	Canada	Europe	Japan	Total
		-- mil gallons --		
1993	37.66	42.80	10.81	114.66
1994	26.17	43.64	19.11	108.07
1995	32.71	51.46	6.80	116.27
1996	34.89	44.95	15.38	116.69
1997	40.77	78.79	13.91	148.94
1998	44.57	66.84	18.73	148.31
1999	48.29	60.78	19.03	150.03
2000	47.08	64.92	11.27	142.65
2001	49.44	42.61	12.52	118.71
2002	49.17	92.86	10.93	177.40
2003	55.71	32.49	6.22	116.55
Average	41.08	58.97	13.85	134.17
1993	32.8%	37.3%	9.4%	100.0%
1994	24.2%	40.4%	17.7%	100.0%
1995	28.1%	44.3%	5.8%	100.0%
1996	29.9%	38.5%	13.2%	100.0%
1997	27.4%	52.9%	9.3%	100.0%
1998	30.1%	45.1%	12.6%	100.0%
1999	32.2%	40.5%	12.7%	100.0%
2000	33.0%	45.5%	7.9%	100.0%
2001	41.6%	35.9%	10.5%	100.0%
2002	27.7%	52.3%	6.2%	100.0%
2003	47.8%	27.9%	5.3%	100.0%
Average	32.3%	41.9%	10.1%	100.0%

Source: U.S. Department of Commerce.

Table 3. U.S. OJ Imports

Year	Florida Ports		Non-Florida Ports		Total		Florida Share	
	mil gals	$mil	mil gals	$mil	mil gals	$mil	Gallon	Dollar
				FCOJ				
1993	184.79	133.77	161.65	99.35	346.43	233.12	53.3%	57.4%
1994	178.66	126.00	204.74	150.79	383.40	276.78	46.6%	45.5%
1995	84.83	74.49	96.89	83.89	181.72	158.39	46.7%	47.0%
1996	167.94	152.30	108.40	113.19	276.34	265.48	60.8%	57.4%
1997	146.60	98.79	103.58	84.12	250.18	182.91	58.6%	54.0%
1998	141.19	109.96	154.78	127.49	295.97	237.45	47.7%	46.3%
1999	165.17	116.12	182.96	145.95	348.13	262.08	47.4%	44.3%
2000	132.42	78.83	175.66	127.46	308.08	206.29	43.0%	38.2%
2001	113.10	66.39	121.12	96.07	234.22	162.46	48.3%	40.9%
2002	95.97	64.75	81.61	83.06	177.58	147.80	54.0%	43.8%
2003	130.11	92.69	133.18	106.16	263.29	198.85	49.4%	46.6%
Average	140.07	101.28	138.60	110.68	278.67	211.96	50.5%	47.4%
				Other OJ				
1993	0.04	0.13	2.14	4.04	2.19	4.17	1.9%	3.1%
1994	0.86	2.29	3.55	5.35	4.41	7.64	19.4%	29.9%
1995	0.13	0.38	6.80	8.89	6.93	9.28	1.8%	4.1%
1996	0.56	0.76	4.71	7.36	5.27	8.12	10.6%	9.4%
1997	0.18	0.52	3.85	6.04	4.03	6.56	4.5%	8.0%
1998	0.01	0.02	3.08	5.97	3.08	5.98	0.2%	0.3%
1999	0.86	1.03	5.85	12.00	6.70	13.03	12.8%	7.9%
2000	6.43	7.87	5.75	11.92	12.18	19.79	52.8%	39.8%
2001	3.26	4.55	4.75	8.44	8.01	12.99	40.7%	35.0%
2002	8.14	11.35	5.66	9.36	13.80	20.72	59.0%	54.8%
2003	13.07	18.05	8.18	10.68	21.24	28.73	61.5%	62.8%
Average	3.05	4.27	4.94	8.19	7.99	12.45	24.1%	23.2%

Source: U.S. Department of Commerce.

Table 4. Monthly average prices

	Import Price[a]		Export Price[a]		Futures Price[b]	Rotterdam Price[c]
	FCOJ	Other OJ	FCOJ	Other OJ		
			Cents/PS			
1993	62.83	221.89	173.37	275.10	101.91	84.82
1994	72.39	206.24	222.09	250.13	100.80	88.48
1995	88.61	167.07	230.61	261.41	107.84	110.84
1996	98.32	170.66	226.78	267.65	116.49	104.06
1997	73.63	174.36	182.67	263.73	77.14	72.97
1998	80.80	207.19	201.49	234.79	105.77	116.62
1999	75.37	217.10	182.33	232.32	89.79	127.46
2000	66.90	183.82	194.06	229.83	79.34	87.31
2001	68.71	179.06	188.33	230.54	80.55	73.12
2002	83.40	162.37	199.35	282.68	94.47	92.30
2003	74.80	133.72	204.07	272.19	80.45	85.97

[a]U.S. Department of Commerce.
[b]New York Cotton Exchange.
[c]*Food News*.

Table 5. Parameter estimates

	Domestic Movement		Futures Price	Export		Import	
	FCOJ	NFC		FCOJ	Other	FCOJ	Other
Intercept	16.2990*	31.5728*	59.5543*	-4.5573	10.6935*	46.8457*	3.5143*
	(2.7264)[a]	(4.8467)	(7.6496)	(3.6628)	(1.1015)	(7.9148)	(0.8775)
Futures Price	0.0186	-0.0366					
	(0.0397)	(0.0593)					
Non-FL Import Price							
FCOJ	3.2387*						
	(1.3176)						
Other OJ		1.3035*					
		(0.6933)					
US Export Price							
FCOJ				-7.4800*	0.0192		
				(0.8286)	(0.2487)		
Other OJ				9.8369*	-4.2004*		
				(1.3435)	(0.4029)		
US Import Price							
FCOJ			77.7731*			-28.0862*	-1.3806**
			(7.1545)			(9.2403)	(1.0245)
Other OJ						2.3965	-1.6474*
						(2.5682)	(0.2861)
Rotterdam Price				0.0586*	0.0179*		
				(0.0320	(0.0097		
Inventory			-0.0347*			-0.0158*	-0.0015**
			(0.0057)			(0.0088)	(0.0010)
Crop Size			-0.0821*				
			(0.0264)				
Crop Size October			-0.0183*				
			(0.0101)				
d_1	1.1093*	2.6036*	2.6772	1.4798**	0.2189	5.4101*	0.1910
	(0.6516)	(1.0937)	(2.3212)	(0.9567)	(0.2986)	(2.9590)	(0.3272)
d_2	-1.1349*	0.9416	4.5795**	2.0621*	0.3327	3.3694	0.5293
	(0.6772)	(1.0772)	(2.9743)	(0.9665)	(0.3014)	(4.0140)	(0.4452)
d_3	-1.1311*	-0.2473	-1.2856	1.0159	0.1618	-3.1220	0.9655*
	(0.6392)	(1.0940)	(2.0435)	(0.9599)	(0.2995)	(2.6078)	(0.2874)
Trend	-0.0187**	0.1402*		-0.0292*	0.0357*	-0.0611*	0.0050**
	(0.0118)	(0.0188)		(0.0124)	(0.0038)	(0.0312)	(0.0034)

[a]Numbers in parentheses are standard errors of parameter estimates.
*Statistically different from zero at α = .05 level.
**Statistically different from zero at α = .10 level.

Table 6. Elasticity estimates at sample means

	FL Domestic Mvmt			US Export		US Import	
	FCOJ	NFC	Futures P	FCOJ	Other OJ	FCOJ	Other OJ
Futures Price	0.0585	-0.0520					
Non-FL Import Price							
FCOJ	0.1441						
Other OJ		0.0580					
US Export Price							
FCOJ				-2.0509	0.0085		
Other OJ				3.3470	-2.3042		
US Import Price							
FCOJ			0.6465			-0.5888	-0.9580
Other OJ						0.1164	-2.6490
Rotterdam Price				0.4659	0.2301		
Inventory			-0.3829			-0.4393	-1.4178
Crop Size			-0.2976				
Crop Size October			-0.3640				