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Canadian Orange Juice Imports and Production Level Import Demand

Yan Liu, Richard L. Kilmer, and Jonq-Ying Lee

Import demand equations are estimated in order to identify the own-, cross-price, and volume elasticities that can be used to determine the best marketing strategy to increase U.S. orange juice gallons in the Canadian import market. This study uses the firm's version of production differential, AIDS, CBS, and NBR models. An expansion of total Canadian orange juice import gallons using advertising favors the U.S. much more than it does the other three origins investigated—Brazil, Mexico, and ROW. A 1% increase in imported gallons of orange juice due to advertising will increase U.S. imports by 1.20% and Brazil's gallons by 0.60%.

Key Words: AIDS model, CBS model, import demand, international trade, NBR model

Although U.S. citrus processors have not been advertising in Canada for the last several years, the value of U.S. orange juice sold in Canada has been increasing relative to other competitors. Since 1990, the U.S. dollar share of orange juice (OJ) imports into Canada has increased 24.8 percentage points, while Brazil's dollar share decreased 22.9 percentage points; yet, the U.S. gallon share increased only 9.1 percentage points and Brazil's decreased 7.1 percentage points (table 1). U.S. price, on the other hand, increased 23.4% (\$0.51) and Brazil's price decreased 35.9% (\$0.55). U.S. producers would like to increase their OJ exports to Canada; however, they want to know if lowering price and/or adopting advertising are the appropriate tools for use in increasing their gallon market share.

To employ the best marketing strategy for increasing U.S. gallons, import demand equations are estimated in order to identify the own-, cross-price, and volume elasticities that can be used to answer the marketing strategy question. Toward that end, this paper proceeds as follows. First, the differential input demand model and the firm's versions of the AIDS model, CBS model, NBR model, and Barten's (1993) synthetic model are described in the "Theoretical Models" section below. This is

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Table 1. Orange Juice Import Cost Shares, Gallon Shares, and Average Prices by Country of Origin

Year	U.S.	Brazil	Mexico	ROW
— Annual Cost Share —				
1990	44.3%	53.5%	0.6%	1.6%
Average	60.1% (9.0%)	38.8% (8.9%)	0.7% (1.17%)	0.4% (0.5%)
2005	69.1%	30.6%	0.1%	0.2%
— Annual Cost (Can\$) —				
Average	\$154,849,000 (\$41,249,200)	\$96,241,000 (\$15,460,000)	\$1,705,250 (\$2,756,090)	\$979,312 (\$1,051,146)
— Annual Gallon Share —				
1990	35.8%	61.7%	0.6%	1.9%
Average	42.0% (11.1%)	56.4% (11.7%)	1.0% (1.7%)	0.6% (0.7%)
2005	44.9%	54.6%	0.3%	0.2%
— Annual Gallons —				
Average	62,000,300 (20,784,600)	78,746,600 (11,355,900)	1,423,848 (2,437,237)	744,896 (805,995)
— Annual Average Price (Can\$/gallon) —				
1990	\$2.18	\$1.53	\$1.73	\$1.52
Average	\$2.94 (\$2.01)	\$1.23 (\$0.18)	\$1.37 (\$0.74)	\$1.37 (\$0.22)
2005	\$2.69	\$0.98	\$0.96	\$1.60

Source: Statistics Canada, International Trade Division.

Note: Values in parentheses are standard deviations.

followed by a discussion of the empirical models that are used to estimate these five input demand allocation models. The data used in the analysis are then presented. Next, we report the empirical results of the four models and the results of a synthetic test to establish which functional form provides the best explanation of the data. The final section highlights summary remarks, conclusions, and implications of the study.

Theoretical Models

This study uses Laitinen (1980) and Theil's (1980a,b) differential input demand model and three additional input demand models which are the firm's versions of the AIDS, CBS, and NBR on the consumer side. To the best of our knowledge, this is the first production interpretation of the AIDS, CBS, and NBR models. Ultimately,

the choice among different specifications for the input demand allocation models is made on empirical grounds. This investigation examines the empirical performance of four similar input demand allocation models in an econometric study of the import market for orange juice into Canada. Barten's (1993) synthetic model is used to compare the empirical results of these four models.

Consumer demand allocation models have been used extensively in import demand studies (e.g., Lee, Seale, and Jierwiriypant, 1990; Seale, Sparks, and Buxton, 1992; Lee, Brown, and Seale, 1992; Satyanarayana, Wilson, and Johnson, 1999). Four alternative approaches to the functional specification of the consumer demand allocation model have been derived, with well-known demand systems as an illustration. These four systems are the Rotterdam model (Barten, 1964; Theil, 1965), the Almost Ideal Demand System (AIDS) model (Deaton and Muellbauer, 1980), the Dutch Central Bureau of Statistics (CBS) model (Keller and van Driel, 1985), and the Netherlands National Bureau of Research (NBR) model (Neves, 1994). In these studies, imports are considered to be final goods that enter directly into the consumer's utility function.

Here we use production input demand models to estimate import demands. The assumption that importing decisions are made by a profit-maximizing or cost-minimizing firm is more consistent with how trade data are typically reported (Washington and Kilmer, 2002a,b). Given the nature of international trade where imported goods are used in domestic production processes or go through a number of domestic channels before reaching the consumer, a domestic value is added to imported goods before the final product reaches the consumer. Furthermore, the imported inputs are typically reported in bulk quantities and values at dockside. Consumers almost never purchase commodities in such quantities or at the port. It is appropriate to view imported goods as inputs even if no transformation takes place (Kohli, 1978; Diewert and Morrison, 1989). Therefore, the production approach to import demand analysis is used in this study.

The Differential Input Demand Model

The differential input demand model (Laitinen, 1980; Theil, 1980a,b) begins with the traditional production problem of choosing a bundle of inputs that

$$(1) \quad \begin{aligned} \text{Min } C &= \sum_i p_i x_i \\ \text{s.t.: } z &= h(\mathbf{x}), \end{aligned}$$

where C is total cost, p_i and x_i are the price and quantity for the i th input, z is output which is held constant, and \mathbf{x} is a vector of n input quantities. The first-order conditions are solved [equation (1)] for the input demand equations $x_i = x_i(p_1, \dots, p_n; z)$. The derivation of the differential input demand model is an approximation of this set of input demand equations which results in the differential input demand system and is represented by:

$$(2) \quad f_i d\ln(x_i) = \theta_i d\ln(X) + \sum_j \pi_{ij} d\ln(p_j),$$

where $f_i = p_i x_i / C$ is the share of total cost from input i , $d\ln(x_i)$ is the change in the i th input, $\theta_i = (M p_i x_i / M) / (MC / M)$ is the i th input's share of marginal cost,

$$d\ln(X) = \sum_i f_i d\ln(x_i)$$

is the Divisia volume index, and π_{ij} is the Slutsky coefficient. Equation (2) is the i th differential demand equation of the firm, which indicates that changes in the decision to purchase the i th input are dependent upon the changes in the total amount of inputs obtained and changes in input prices. Given data with sufficient variability in input prices and quantities, variables are constructed for $f_i d\ln(x_i)$, $d\ln(X)$, and $d\ln(p_j)$, and the coefficients for θ_i and π_{ij} are estimated.

The restrictions on the input demand equation (2) are:

$$\text{adding-up: } \sum_i \theta_i = 1, \sum_i \pi_{ij} = 0,$$

$$\text{homogeneity: } \sum_j \pi_{ij} = 0,$$

$$\text{Slutsky symmetry: } \pi_{ij} = \pi_{ji},$$

and the curvature condition is $(x' B x) \leq 0$. Equation (2) also results in own- and cross-compensated price elasticities

$$\eta_{cp} = \frac{d\ln(x_i)}{d\ln(p_j)} = \frac{\pi_{ij}}{f_i},$$

and the Divisia volume elasticity is

$$\eta_{xX} = \frac{d\ln(x_i)}{d\ln(X)} = \frac{\theta_i}{f_i}.$$

The Production AIDS Model

Instead of having expenditure as a function of utility and prices for a consumer, as in Deaton and Muellbauer's (1980) consumer AIDS model, the production AIDS model specifies cost as a function of output and prices of inputs for a firm as follows:

$$(3) \quad \ln(c(p, z)) = (1 + z) \ln(a(p)) + z \ln(b(p)),$$

where

$$\ln(a(p)) = \alpha_0 + \sum_j \alpha_j \ln(p_j) + \frac{1}{2} \sum_i \sum_j \gamma_{ij}^* \ln(p_i) \ln(p_j)$$

$$\text{and } \ln(b(p)) = \ln(a(p)) + \sum_j \beta_j p_j^{\beta_j}.$$

Total cost is denoted by c , \mathbf{p} is a vector of n input prices, and z is output. When there is no production, $z = 0$, and $\ln(c(\mathbf{p}, z)) = \ln(a(\mathbf{p}))$, which is the firm's fixed cost.

The consumer AIDS model in differential form (Barten, 1993) is written as the production AIDS model:

$$(4) \quad df_i = \beta_i d\ln(X) + \sum_j \gamma_{ij} d\ln(p_j).$$

This model is similar on the right-hand side to the differential input demand model [equation (2)]; however, the dependent variables are different on the left-hand side. The production AIDS model explains the change in input i 's share of total cost, while the differential input demand model is concerned with the change in input quantity.

Following Lee, Brown, and Seale's (1994) version of the consumer AIDS model, the production AIDS model is written as:

$$(5) \quad f_i d\ln(x_i) = (\beta_i + f_i) d\ln(X) + \sum_j (\gamma_{ij} + f_i \Delta_{ij} + f_i f_j) d\ln(p_j),$$

where Δ_{ij} is Kronecker's delta equal to unity if $i = j$, and zero otherwise. The AIDS model [equation (5)] and the differential input demand model [equation (2)] have the same dependent variable. This will allow the use of Barten's (1993) synthetic model to empirically test for the appropriate functional form.

The restrictions on the production AIDS model are:

$$\text{adding-up: } \sum_i \beta_i = 0, \sum_i \gamma_{ij} = 0,$$

$$\text{homogeneity: } \sum_j \gamma_{ij} = 0,$$

$$\text{Slutsky symmetry: } \gamma_{ij} = \gamma_{ji},$$

and the curvature condition is $(\mathbf{x} \mathbf{B} \mathbf{x}) \leq 0$, where the matrix \mathbf{B} is composed of the elements $\pi_{ij} = \gamma_{ij} + f_i \Delta_{ij} + f_i f_j$. Equation (5) results in the own- and cross-compensated price elasticities equaling

$$g_{xp} = \frac{d\ln(x_i)}{d\ln(p_j)} = \frac{\gamma_{ij} + f_i \Delta_{ij} + f_i f_j}{f_i},$$

and the Divisia volume elasticity is

$$g_{xX} = \frac{d\ln(x_i)}{d\ln(X)} = \frac{\beta_i + f_i}{f_i}.$$

The Production CBS Model

Keller and van Driel (1985) developed the Dutch Central Bureau of Statistics (CBS) consumer demand model. The production CBS model written in differential form is:

$$(6) \quad f_i(d\ln(x_i) + \beta_i d\ln(X) + \sum_j \pi_{ij} d\ln(p_j)).$$

Following Lee, Brown, and Seale's (1994) version of the consumer CBS model and rearranging equation (6), the production CBS model is written as:

$$(7) \quad f_i d\ln(x_i) = (\beta_i \% f_i) d\ln(X) + \sum_j \pi_{ij} d\ln(p_j),$$

which is another representation of the production CBS model, and Barten's (1993) synthetic model is used to empirically test for the appropriate functional form. This model has the production AIDS model's volume coefficients β_i [equation (5)] and the differential input demand model's price coefficients π_{ij} [equation (2)]. It shares with these two models the adding-up, homogeneity, and symmetry conditions.

The constraints on the production CBS model are:

$$\text{adding-up: } \sum_i \beta_i = 0, \sum_i \pi_{ij} = 0,$$

$$\text{homogeneity: } \sum_j \pi_{ij} = 0,$$

$$\text{Slutsky symmetry: } \pi_{ij} = \pi_{ji},$$

and the curvature condition is $(\mathbf{xNBx}) \geq 0$. Equation (7) results in the own- and cross-compensated price elasticities

$$g_{xp} = \frac{d\ln(x_i)}{d\ln(p_j)} = \frac{\pi_{ij}}{f_i},$$

and the Divisia volume elasticity is

$$g_{xX} = \frac{d\ln(x_i)}{d\ln(X)} = \frac{\beta_i \% f_i}{f_i}.$$

The Production NBR Model

Neves (1994) developed the NBR consumer allocation model. The production NBR model written in differential form is:

$$(8) \quad df_i \% f_i d\ln(X) = \theta_i d\ln(X) + \sum_j \gamma_{ij} d\ln(p_j).$$

Following Lee, Brown, and Seale's (1994) version of the consumer NBR model, the production NBR model is expressed as:

$$(9) \quad f_i d\ln(x_i) = \theta_i d\ln(X) + \sum_j (\gamma_{ij} + f_i \Delta_{ij} \% f_i f_j) d\ln(p_j).$$

This model has the differential input demand model's volume coefficient θ_i [equation (2)] and the production AIDS model's price coefficients γ_{ij} [equation (5)]. The constraints are:

$$\text{adding-up: } \sum_i \theta_i = 1, \sum_i \gamma_{ij} = 0,$$

$$\text{homogeneity: } \sum_j \gamma_{ij} = 0,$$

$$\text{Slutsky symmetry: } \gamma_{ij} = \gamma_{ji},$$

and the curvature condition is $(\mathbf{x} \mathbf{B} \mathbf{x}) \leq 0$, where the matrix \mathbf{B} is composed of the elements $\pi_{ij} = \gamma_{ij} + f_i \Delta_{ij} / f_i f_j$. Equation (9) results in the own- and cross-compensated price elasticities

$$(10) \quad g_{xp} = \frac{d \ln(x_i)}{d \ln(p_j)} = \gamma_{ij} + \frac{\Delta_{ij} f_i}{f_j},$$

and the Divisia volume elasticity is

$$(11) \quad g_{xX} = \frac{d \ln(x_i)}{d \ln(X)} = \frac{\theta_i}{f_i}.$$

The Synthetic Input Demand Model

A synthetic model containing all four input demand models was developed by Barten (1993). The synthetic system is employed to assess and compare the empirical performance of each of the four conditional demand systems. Following Lee, Brown, and Seale's (1994) version of Barten's synthetic model, Barten's synthetic production model is written as:

$$(12) \quad f_i d \ln(x_i) = (g_i + \delta_1 f_i) d \ln(X) + \sum_j (e_{ij} + \delta_2 f_i (\Delta_{ij} + f_j)) d \ln(p_j),$$

where $g_i = \delta_1 \beta_i / (1 + \delta_1) \theta_i$, and $e_{ij} = \delta_2 \gamma_{ij} / (1 + \delta_2) \pi_{ij}$. Equation (12) becomes the differential input demand model when $\delta_1 = \delta_2 = 0$; the production CBS model when $\delta_1 = 1$ and $\delta_2 = 0$; the production AIDS model when $\delta_1 = \delta_2 = 1$; and the production NBR model when $\delta_1 = 0$ and $\delta_2 = 1$. The demand restrictions on (12) are:

$$\text{adding-up: } \sum_i g_i = 1 + \delta_1, \sum_i e_{ij} = 0,$$

$$\text{homogeneity: } \sum_j e_{ij} = 0,$$

$$\text{Slutsky symmetry: } e_{ij} = e_{ji},$$

and the curvature condition is $(\mathbf{x} \mathbf{B} \mathbf{x}) \leq 0$, where the matrix \mathbf{B} is composed of the elements π_{ij} or $\pi_{ij} = \gamma_{ij} + f_i \Delta_{ij} / f_i f_j$. For application to discrete data, the specifications

are approximated by replacing f_i with $(f_{it} \% f_{it\&1})/2$, $d\ln(x_i)$ with $\log(x_{it}/x_{it\&1})$, and $d\ln(p_j)$ with $\log(p_{jt}/p_{jt\&1})$, where the subscript t indicates time.

Data

Statistics Canada provided the data used in this study. The target market is the Canadian orange juice importing market. Semi-annual import data from the first half of 1990 through the second half of 2005 provide details on the orange juice import quantities and value from different origins: the United States (U.S.), Mexico, Brazil, and rest of the world (ROW). Imported quantities from each of the three countries and ROW are in single strength equivalent (SSE) gallons (juice in drinkable form) and value is in Canadian dollars. Commodity prices are calculated by dividing the value of orange juice imported by the quantity, which results in unit cost per SSE gallon.

Table 1 shows the budget or expenditure shares and the average prices of the imports from the four origins for 1990, the sample mean, and 2005. The largest import expenditure share was for the OJ imported from the U.S. and the lowest was for imports from the ROW. The import expenditure share for the OJ from the U.S. increased from 44.3% in 1990 to 69.1% in 2005, while the import expenditure shares for Brazil, Mexico, and ROW decreased during the same period. The average prices for the OJ from Brazil and Mexico are similar. Import prices of U.S. OJ are higher than the OJ imported from other countries and increased over time, an indication that more non-concentrated OJ and consumer packaged OJ were imported from the United States.

Results

Since all four competing models and the general system satisfy the adding-up conditions, only three equations were estimated for the four-good system (the ROW equation was not included; see Barten, 1969). The parameters for the omitted equation are recovered from the estimates of the other equations using the adding-up conditions. Homogeneity, symmetry, and first-order autocorrelation (Berndt and Savin, 1975) were imposed, and the models were estimated by the iterative seemingly unrelated regression (ITSUR) procedure. This method is performed using the LSQ procedure in the Time Series Processor (Hall and Cummins, 1998).

For the four competing models and the synthetic system, the estimated first-order autocorrelation coefficient was at least two times greater than its asymptotic standard error. Log-likelihood values and corresponding test statistics for each of the systems are presented in table 2. The first numeric column of table 2 reports the log likelihoods, and the second column gives the log-likelihood ratio test statistics for model selection. The test results show that the synthetic system rejects the differential input demand, the production AIDS, and the production CBS. Only the production NBR is not rejected by the synthetic system, implying the production NBR fits the data

Table 2. Test Results for the Production Differential, AIDS, CBS, and NBR Models with First-Order Autocorrelation Imposed

Model	Log Likelihood	LLR Test Statistic $-2[L(\theta^*) - L(\theta)]^a$
Production Input Demand	233.320	17.384***
Production AIDS	236.083	11.858***
Production CBS	231.559	20.906***
Production NBR	237.600	8.824
Production Synthetic	242.012 ^b	

Note: First-order autocorrelation coefficient (Berndt and Savin, 1975) is at least twice as large as its asymptotic standard error.

^a The table value for $\chi^2_{[2]}$ is 9.21 at the $\alpha = 0.01$ level.

^b The estimates for δ_1 and δ_2 are 0.8116 and 2.7849 with standard errors 0.7624 and 0.6234, respectively.

better compared to the other three models. Accordingly, only results based on the production NBR corrected for autocorrelation are reported and discussed further in the following sections.

The NBR coefficient estimates for equation (9) are presented in panel A of table 3; estimates for the demand parameters, θ_i and π_{ij} , are presented in panel B; and the demand elasticity estimates [see equations (10) and (11)], calculated at sample mean budget shares, are presented in panel C.

The property of positive semi-definiteness is verified by inspection of the eigenvalues of the Slutsky matrix. This property is validated when all eigenvalues are positive except one, which is zero. The eigenvalues for the NBR Slutsky matrix are 6.89×10^6 , 0.0090, 0.0248, and 0.6399—indicating that the import firms behave in an optimal manner.

Divisia Elasticities

As reported in table 3 (panel C), the Divisia import elasticities for the U.S., Brazil, Mexico, and ROW are 1.2014, 0.5985, 5.6631, and 1.0765, respectively. All are significant except for ROW. Among the significant Divisia import elasticities, only those for the U.S. and Mexico exceeded unity; the Divisia import elasticity for Brazil is less than unity. These findings indicate that as total imports of orange juice into Canada increase by 1%, ceteris paribus, imports from the U.S. and Mexico would increase more than 1%, imports from Brazil would increase by less than 1%, and imports from ROW would not change.

Own-Price Elasticities

From table 3 (panel C), the respective own-price elasticities for the U.S., Brazil, Mexico, and ROW are 0.1744, 0.1774, 0.2305, and 2.6380. The own-price

Table 3. Parameter and Elasticity Estimates of the Production NBR Model

PANEL A. Coefficient Estimates					
Equation	θ_i	γ_{ij}			
		U.S.	Brazil	Mexico	ROW
U.S.	0.7246** (0.0616) ^a	! 0.1342** (0.0347)	0.1521** (0.0388)	! 0.0160 (0.0139)	! 0.0020 (0.0071)
Brazil	0.2307** (0.0704)		! 0.1685** (0.0503)	0.0213 (0.0197)	! 0.0049 (0.0065)
Mexico	0.0401* (0.0278)			! 0.0054 (0.0116)	! 0.0000 (0.0030)
ROW	0.0045 (0.0129)				0.0069 (0.0050)
PANEL B. Demand Parameter Estimates^b					
Equation	θ_i	π_{ij}			
		U.S.	Brazil	Mexico	ROW
U.S.	0.7246** (0.0616)	0.1052** (0.0347)	! 0.0805** (0.0388)	! 0.0202 (0.0139)	! 0.0045 (0.0071)
Brazil	0.2307** (0.0704)		0.0684* (0.0503)	0.0186 (0.0197)	! 0.0066 (0.0065)
Mexico	0.0401* (0.0278)			0.0016 (0.0116)	0.0000 (0.0030)
ROW	0.0045 (0.0129)				0.0110** (0.0050)
PANEL C. Demand Elasticity Estimates^{c,d}					
Equation	Divisia Elasticity	Price Elasticity			
		U.S.	Brazil	Mexico	ROW
U.S.	1.2014** (0.1021)	! 0.1744** (0.0575)	0.1334** (0.0644)	0.0335 (0.0230)	0.0074 (0.0118)
Brazil	0.5985** (0.1825)	0.2087** (0.1007)	! 0.1774* (0.1305)	! 0.0482 (0.0510)	0.0170 (0.0168)
Mexico	5.6631* (3.9181)	2.8561 (1.9619)	! 2.6246 (2.7776)	! 0.2305 (1.6317)	! 0.0010 (0.4236)
ROW	1.0765 (3.0777)	1.0722 (1.6971)	1.5675 (1.5515)	! 0.0016 (0.7175)	! 2.6380** (1.1899)

Note: Single and double asterisks (*) denote statistically different from zero at the $\alpha = 0.10$ and 0.05 levels, respectively.

^a Numbers in parentheses are asymptotic standard errors.

^b The eigenvalues for the Slutsky matrix are ! 6.89×10^6 , 0.0090, 0.0248, and 0.6399.

^c Estimated at sample mean budget shares.

^d Standard errors were estimated using the delta method.

elasticities for the U.S., Brazil, and ROW are significantly different from zero. These findings reveal that the import demands for the U.S. and Brazil are inelastic, meaning that quantity is less responsive to price changes, with the demand for U.S. orange juice being the most inelastic and the least responsive to price change. In contrast, import demand quantity for ROW orange juice is price elastic. If prices were decreased, Canadian firms would increase their purchases of ROW orange juice.

Cross-Price Elasticities

Of the six cross-price demand parameter estimates, only one was statistically different from zero—i.e., between the U.S. and Brazil (table 3). The cross-price elasticity estimates between the U.S. and Brazil are significant and positive (input substitutes). Results show that if the price of Brazilian OJ is increased by 1%, the import demand for U.S. OJ would increase by 0.13%. On the other hand, if the price of U.S. OJ is increased by 1%, the import demand for Brazilian OJ would increase by 0.21%. As shown in table 1, the import dollar shares of the OJ imported from Mexico and ROW are small—less than 1%; therefore, the influence of their prices on the demand for U.S. and Brazil OJ was insignificant.

Summary

This analysis used production input demand models to estimate import demands. Past studies have attempted this type of analysis utilizing consumer demand allocation models as a means of obtaining import demand estimates and elasticities. However, given the nature of international trade where imported goods are used in domestic production processes or go through a number of domestic channels before reaching the consumer, a domestic value is added to imported goods before the final product reaches the consumer. Furthermore, the imported inputs are typically reported in bulk quantities and values at dockside. Consequently, the production approach to import demand analysis used here is appropriate.

The consumer AIDS, CBS, and NBR demand models were adapted into the firm's versions of the AIDS, CBS, and NBR models. Barten's (1993) synthetic model was used to empirically test for the best performing model among the three, plus Laitinen (1980) and Theil's (1980a, b) differential input demand model. The functional form test showed that the production NBR model was the best model to use for estimating the Canadian orange juice import demand.

Findings reveal that the own-price elasticities for the U.S., Brazil, Mexico, and ROW are all negative. All the absolute values are less than unity except for ROW, indicating the import demands for orange juice from the U.S. and Brazil are price inelastic and relatively unresponsive to price changes. The import demand for orange juice from ROW is elastic and responsive to price changes; however, the quantities imported from ROW are minuscule. Results also show that U.S. and Brazil OJ exports to Canada are substitutes and compete with each other.

Of these four orange juice inputs, only the U.S. and Mexico Divisia import elasticities are greater than unity, and those for Brazil and ROW are less than unity. All are significant except the import elasticity for ROW. These results suggest that as total imports of orange juice into Canada increase by 1%, orange juice imported from the U.S. and Mexico would increase by more than 1%, and orange juice imported from Brazil and ROW would increase less than 1%.

The marketing strategy for the U.S. is clear. An expansion of total Canadian orange juice import gallons using advertising favors the U.S. much more than it does the other three origins (Brazil, Mexico, and ROW). A 1% increase in imported gallons of orange juice due to advertising will increase U.S. imports by 1.20% and Brazil's gallons by 0.60%, thereby increasing the gallon share of the U.S. relative to Brazil.

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