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The Japanese Market for Imported Fruit Juices

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Abstract

The objectives were to analyze the competitiveness of countries exporting fruit juices into Japan and simulate the effect of the negative Japanese population growth rate on fruit juice demand. The relative price version of the Rotterdam demand model was estimated for orange, grapefruit, other citrus, apple, pineapple and grape juices. Results indicate that most exporters can't increase market share through price reductions. Product promotion and product differentiation is a more plausible option. The growth of fruit juice demand in Japan is expected to decrease over the period 2006 through 2020 for 11 of the 18 fruit juice/country combinations because of negative population growth rate.

Keywords: competitiveness, fruit juice, Japan, Rotterdam model, population decline.

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Introduction

There has been a more rapid expansion of the global fruit market than the trade in other agricultural commodities, especially since the 1980s due to rising incomes, falling transportation costs, improved technology, and evolving international agreements (Huang 2004). As a major player in the global trade, Japan expanded its imports of fruit juices significantly after the mid-1990s when citrus and non-citrus juice import restrictions were liberalized. This has created a better opportunity for the world's largest producers of fruit juice to compete for market share.

A fundamental understanding of the competition for market share involves market structure analysis (MSA) which explains the nature and extent of competition or the extent to which products are substitutes or complements (Allenby 1989). In light of this, several studies have investigated the competition for market share of different products including fresh and processed fruits and vegetables [Lee, Seale, and Jierwiriyapant 1990; Sparks 1992; Lee, Brown, and Seale 1994; Brown 1993; Schmitz and Seale 2002]. Among these, Lee, Seale, and Jierwiriyapant (1990) and Schmitz and Seale (2002) deal with the competition for market share of fruits in the Japanese market. Lee, Seale, and Jierwiriyapant (1990) estimated Japan's import demand for citrus juice and fresh fruits. Results indicated that U.S. fresh grapefruit exports to Japan would have to compete against imports of bananas and pineapples for the Japanese import dollars, and that U.S. citrus juice exports would have to compete against juice imports from Brazil and Israel. Schmitz and Seale (2002) estimated different versions of the system-wide import demand for fresh fruits. Results indicated that exporters of grapefruit would benefit from an increase in expenditure on fresh fruit imports and a decrease in price while exporters of other fresh fruits such as bananas, oranges, lemons, and pineapple would suffer from a decrease in price of fresh fruits. Further, results indicated that oranges are substitutes for both grapefruit and lemons, and bananas and grapefruits are also substitutes.

Unlike most empirical studies including Lee, Seale, and Jierwiriyapant (1990) which have pursued the estimation of demand functions without first identifying the underlying market structure, we tested two plausible scenarios of market structure (i.e. non-uniformly competitive and uniformly competitive) and identified the underlying market structure for the Japanese fruit juice market before estimating the necessary parameters. This is consistent with Seale et al (2005) who assessed the degree of competition (i.e. market structure) among five fresh fruits at an aggregate level and two fresh fruits (banana and grapes) disaggregated by country of origin using the uniform Rotterdam model. Unlike Seale et al (2005), our study focuses on the fruit juice market (both citrus and non-citrus) disaggregated by country of origin and uses monthly data collected after the deregulation of the fruit juice market in the 1990s to avoid the possibility of biased parameter estimates due to structural changes.

Fruit juice managers can use the information from this research to assess the appropriateness of their marketing strategy. Their marketing strategy depends on the underlying market structure that describes the relationship among fruit juices within the same juice group and across different juice groups. Further, the identification of market structure is useful for assessing strategic opportunities in the fruit juice industry, for developing fruit juice marketing programs, and for assessing the market share of each fruit juice in order to evaluate performance (Vilcassim 1989).

The objectives of this article are (1) to assess the competitiveness of the world's largest exporters of fruit juice in Japan's market through the analysis of market structure and (2) to simulate the impact of changes in population growth on the growth rate of demand for fruit juices in Japan which has been undergoing a profound change as a result of its aging population. The analysis of market structure in marketing is concerned with identifying closely competing brands of the same product or competing products. To accomplish these objectives, the relative price version of the Rotterdam model was used. This model was chosen for its strong links to the economic theory of the consumer and global separability.

Global Fruit Trade

As a result of trade liberalization and technological advances in fruit transport and storage, the fruit industry is becoming more global in scope. The major players in the global trade of fruits are the European Union (E.U.), the North American Free Trade Agreement (NAFTA) countries, China and Japan.

The international trade in fruits is dominated by processed forms. Exports of fresh citrus fruits represent only 10% of total citrus fruit production (United Nations Conference on Trade and Development (UNCTAD)). Citrus fruits rank first in international fruit trade in terms of value. According to UNCTAD, international trade in citrus juice only started to increase in the 1940s, after World War II, when citrus processing technologies were invented and developed. The advent of frozen concentrated orange juice (FCOJ) after World War II provided a new impetus for the citrus industry (Spreen et al. 2006). Citrus fruit processing accounts for approximately one third of total citrus fruit production. More than 80% of citrus fruit processing is orange juice production. Orange juice is the most important of Japan's citrus juice imports. UNCTAD notes that the major feature of the world market for orange juice is the geographical concentration of production. The State of Florida in the U.S. and the State of Sao Paulo in Brazil are the two major players accounting for approximately 85 percent of the world's orange juice production. The juice is made into one of two product forms: bulk FCOJ or not-from-concentrate (NFCOJ). In order to reduce the volume, International trade in orange juice takes place in the form of FCOJ so that storage and transportation costs are lower. Nearly all of the FCOJ traded in the world is first concentrated to 65 degree or 66 degrees Brix (Spreen, et al. 2006). NFCOJ is single strength orange juice that is de-oiled with a centrifuge, then either pasteurized, chilled, and packaged or stored for future sale. Forms of Japan's imports of orange and other juices are available on http://www.customs.go.jp/english/tariff/2008_4/data/20.htm.

Most of orange juice imports by Japan come from Brazil whose exports account for over 70% of Japan's total imports of orange juice (Table 1). Brazil has a bulk orange juice storage terminal in Japan which allows it to ship juice in bulk rather than in drums and retail containers as used by U.S. producers.

The U.S. is the leading exporter of apple juice, grapefruit juice and grape juice to Japan. Thailand and Israel are the leading exporters of pineapple juice and other citrus, respectively.

Global Fruit Consumption

Higher income, urbanization, demographic shifts, improved transportation, and consumer perceptions regarding quality and safety are changing global food consumption patterns (Huang 2004). Diet diversification and increasing demand for better quality products have increased imports of high-value and processed food products in developed countries. Fruits are mainly consumed in industrialized countries, not only because consumers in these countries have high income levels but also because they have increasing concerns about healthy eating. However, the growth of per capita consumption of fruits in these countries seems to be stagnating. Over the period 1980 to 2003, the per capita consumption of citrus fruits (oranges, grapefruit and lemons and limes) in these countries grew at an average rate of one percent per annum (Food and Agriculture Organisation (FAO)). The average per capita consumption of oranges and Mandarins in industrialized countries over the period 1990 to 2003 is 29 kilograms while that of grapefruit and lemons and limes is 3.0 and 3.6 kilograms, respectively (FAO).

Table 1. Fruit juice imports to Japan by country of origin

Product	Exporter	%
Orange juice	Brazil	72.4
	U.S.	23.7
	ROW	3.9
Apple juice	U.S.	22.4
	China	18.9
	ROW	58.7
Grapefruit juice	U.S.	87.1
	Israel	9.6
	ROW	3.3
Grape juice	U.S.	46.9
	Argentina	11.7
	ROW	41.4
Pineapple juice	Thailand	42.4
	Philippines	27.6
	ROW	30.0
Other citrus juice	Israel	40.5
	Italy	21.8
	ROW	37.7

(Japan External Trade Organization (JETRO))

The average annual per capita consumption of oranges and apples in Japan over the period 1980 to 2003 is about 14 and 12 kilograms, respectively, while those of grapes and grapefruit are 2.8 and 2.5 kilograms, respectively (FAO). Japan's domestic supply of pineapples is heavily dependent on imports. In 2003, 95% of the domestic supply of pineapples came from imports (FAO). Japan is also heavily dependent on imports for its supply of lemons and limes. In terms of apples and grapes, the significance of imports has been increasing since the last decade during which the deregulation was in effect.

Materials and Methods

Theoretical framework

Consumption theory is amenable to the identification of market structure through the analysis of the change in marginal utilities of a certain product due to a change in consumption of a closely related product. The changes in marginal utilities depend on how consumers perceive a specific commodity from one country and the same commodity from another country. The decrease in marginal utility of one product with an increased consumption of another product implies that the products are substitutes and are thus in a competitive market structure. Otherwise, they are not substitutes (i.e., complements or independent) and are thus in a noncompetitive market structure. Substitute products can be uniform (close) or non-uniform (differentiated). Similarly, a competitive market structure can be uniformly competitive or non-uniformly competitive. A group of closely-related products are uniform substitutes when the cross effect of an additional dollar spent on one product on the marginal utility of another dollar spent on another product is the same for all pairs of products in the group (Brown, 1993). If two products imported from two different countries are uniform substitutes, consumers may not be influenced by the country of origin. Consequently, price will be the overriding factor in the decision of purchase. On the contrary, if two products are non-uniform substitutes, consumers may be influenced by the country of origin. They perceive the product from one country and the same product from another country as differentiated. Consequently, price will be just one factor affecting consumers' decision of purchase. Product attributes will be important criteria in consumers' decision of purchase.

In order to identify the type and degree of competition in the Japanese fruit juice market, we consider two plausible market structures.

Non-uniformly Competitive Market

This is a case where competition occurs between products such that the effect of a change in price of a given product on the demand for another product varies from product to product irrespective of their groups. In this market structure, consumers care about the country of origin of the product because the change in marginal utility of a dollar spent on product *i* caused by an extra dollar spent on product *j* is different from the change in the marginal utility of a dollar spent on product *k* caused by an extra dollar spent on product *j*. This means, for example, that the change in marginal utility of a dollar spent on Brazilian orange juice caused by an extra dollar spent on the rest of the world (ROW) orange juice is different from the change in marginal utility of a dollar spent on the U.S. orange juice caused by an extra dollar spent on the ROW orange juice. This implies that consumers may pay a different price for products of the same group since they perceive one product as differentiated from the other.

Uniformly Competitive Market

This is the case where the effect of a change in price of a product in one group on the demand for another product within the same group is the same for all pairs of products within that group. Further, the effect of a change in price of a product in one group on the demand for another

product which belongs to a different group is the same for all pairs of products in the two groups. This implies that consumers don't care about the country of origin of the product. This means, for example, that the change in marginal utility of a dollar spent on Brazilian orange juice caused by an extra dollar spent on the rest of the world (ROW) orange juice is the same as the change in marginal utility of a dollar spent on the U.S. orange juice caused by an extra dollar spent on the ROW orange juice. This suggests that consumers may not pay a different price for products of the same group since they perceive one product as homogenous to the other.

Empirical Model

In the field of demand analysis, the issue of selecting a model among competing functional forms has been addressed in a number of studies (Barten 1993; Eales et al. 1997). Economic theory does not suggest a criterion to choose ex ante between demand models. The choice of a functional form is at the interface of economic theory and the data. In other words, the functional form should satisfy the economic proprieties such as homogeneity and symmetry and fit satisfactorily to empirical data. Parsimony and flexibility are desirable properties considered in the selection of functional forms. The most common and parsimonious demand model, which dominated the import demand literature in the past, was the Armington trade model. However, the Armington trade model came to be increasingly criticized on both conceptual and empirical grounds. The hypothesis of separability and homotheticity may not be supported by import data (Alston et al. 1990). Traditional methods of implementing the Armington trade model result in theoretically and statistically inconsistent parameter estimates (Davis and Kruse 1993).

Consequently, system-wide demand models such as the Rotterdam model and the Almost Ideal Demand Systems (AIDS) have come to be popular in the contemporary import demand literature (Fabiosa and Ukhova 2000; Washington and Kilmer 2002). Barten (1993) demonstrates that the Rotterdam and AIDS models are special cases of a general demand model so that nested tests can be applied to choose either the Rotterdam or AIDS model or the hybrid of these two models (Central Statistical Bureau (CBS) and National Bureau of Research (NBR)). However, separability is an issue in estimating system-wide models (Seale 1996). The AIDS model is not globally separable and only becomes separable locally under stringent conditions (Lee et al. 1994). This will render multi-stage demand estimation difficult. We choose to use the Rotterdam model because of its global separability, its strong links with the economic theory of the consumer and its flexibility to apply it to aggregate data, which is the case in this study. Between the absolute and relative price version of the Rotterdam model, we choose the relative price version of this model because the relative price coefficients accounts for the specific price substitution effects that aid to identify specific market structures. The marginal expenditure shares and price coefficients of the Rotterdam model are assumed to be constant.

The Relative Price Version of the Rotterdam Model

Following Theil (1980), the relative price version of the Rotterdam model can be given as

$$(1) \qquad \overline{w}_{it} dq_{it} = \theta_i dQ_t + \sum_{j=1}^{N} v_{ij} \left(\frac{dp_{jt}}{dP_t} \right) + \varepsilon_{it}.$$

where $\overline{w}_{it} = \left(w_{it} + w_{i,t-12}\right)/2$ is the average expenditure share ; $dq_{it} = \log\left(q_{it}/q_{i,t-12}\right)$ is the finite change in quantity imported of product i; θ_i is the marginal expenditure share of product i; $dQ_t = \overline{w}_{1t}dq_{1t} + ... + \overline{w}_{Nt}dq_{Nt}$ is the finite change version of the Divisia price index (real income) ; v_{ij} is the relative (Frisch-deflated) price coefficients; $dp_{jt} = \log\left(p_{jt}/p_{j,t-12}\right)$ is the finite change in price of product j; $dP_t = \theta_1 dp_{1t} + ... + \theta_{1N}dp_{Nt}$ is the finite change version of the Frisch price index (the lower case p is for prices of individual products and the upper case P is for Divisia price indices); and ε_{it} is the demand disturbance.

The relative price version of the Rotterdam model is used to describe the non-uniformly competitive market structure. This model describes the nature and extent of competition between any two products irrespective of product group. Consumers treat each individual product as different from another.

Now, following Theil (1980) and Seale (2003) we impose a restriction on the relative price coefficients v_{ij} in equation (1) so that the effect of a change in price of a product in one group on the demand for another product in another group is the same for all pairs of products in the two groups. Further, we impose a similar restriction that the effect of a change in price of a product in one group on the demand for another product within the same group is the same for all pairs of products within that group. This implies that consumers will not care about the country of origin of the product when they choose between products within the same group. This model is called *block-wise dependent uniform substitute Rotterdam model* and will describe the uniformly competitive market structure. The block-wise dependent uniform substitute Rotterdam model can be given as

$$(2)\ \overline{w}_{it}dq_{it} = \theta_i dQ_t + \phi\theta_i\left(\frac{1-k_i\theta_i}{1-k_i\Theta_g}\right)\frac{dp_{it}}{dP_t} + \phi\sum_{j\neq i\in S_g}\frac{-k\theta_i\theta_j}{1-k\Theta_g}\frac{dp_{jt}}{dP_t} + \theta_i^{'}\sum_{h\neq g}V_{gh}\frac{dp_{ht}}{dP_t} + \varepsilon_{it},$$

where θ_i is the unconditional marginal expenditure share; $\theta_i^{'}$ is the conditional marginal expenditure share; V_{gh} is the group relative price coefficient defined as $V_{gh} = \sum_{i\in g}\sum_{j\in h} v_{ij}$ where $g \neq h$; Θ_g is the group marginal expenditure shares of group g defined as $\Theta_g = \sum_{i\in S_g}\theta_i$; ϕ is expenditure flexibility; k is a constant; and ε_i is the demand disturbance.

Data Sources

The sources of data for this study are the Statistics Bureau of Japan and Japan's Ministry of Finance. Monthly population data from January 1999 to December 2005 came from the web page (http://www.stat.go.jp/english/data/jinsui/2-2.htm) maintained by the Statistics Bureau of Japan's Ministry of Internal Affairs and Communications. The period 1999 through 2005 was chosen because we were interested in the effects of price and expenditure changes in the new deregulated/liberalized Japanese fruit juice market. We wanted to model the deregulated period which followed deregulation in the early 1990s. Import data came from the Trade Statistics of Japan that are published by the Ministry of Finance and the Customs under the provision of the Customs Law and the relevant international conventions. It is available on the web page

http://www.customs.go.jp. The monthly imports and expenditures on imports of orange, grapefruit, other citrus, apple, pineapple and grape juices were obtained for the period January, 1999 to December, 2005. The values of imports are on a cost, insurance and freight (CIF) basis, which include costs of the product, insurance and transportation. Unit import values, which proxy commodity prices, were obtained by dividing import values by import quantities. Fruit juices are imported into Japan in different levels of concentration and varying units of measure. In order to have a common unit, the different kinds of fruit juices were converted into single strength equivalent gallons (SSE).

Results and Discussion

Descriptive Results

Since Japan's deregulation of imports in the early 1990s, imports of fruit juices on average have increased with the exception of U.S. orange, grapefruit, apple, and grape juices (Table 2). Over the period January, 1999 to December, 2005, the imports of U.S. orange, grapefruit, apple, and grape juices has decreased on average by 22.1%, 2.4%, 21.0%, and 6.2% annually (i.e., from one month in year *t*-12 to the same month in year *t*). The highest average increase was attained by the ROW grapefruit juice (35.8%) followed by Israel grapefruit juice (26.1%), Chinese apple juice (23.6%), and ROW other juice (22.1%). The analysis of import stability as measured by the coefficient of variation shows that the import of fruit juices into Japan over the given period exhibited significant fluctuations. The fluctuation of imports varies from country to country. Imports of U.S. grapefruit juice and U.S. grape juice have experienced the highest fluctuations among U.S. fruit juices.

Table 2. Fruit juice quantity and price average log-changes, and expenditure shares, Japan, January 1999 to December 2005

Imports	**Quantity log-changes** $dq_i = \log(q_{it} / q_{i,t-12})$		**Price log-changes** $dp_i = \log(p_{it} / p_{i,t-12})$		**Expenditure shares** $(\overline{w}_i)$	
	Mean	SD	Mean	SD	Mean	SD
U.S. orange	-0.2206	0.6136	-0.0289	0.1851	0.0589	0.0318
Brazil orange	0.0667	0.8982	-0.0504	0.2038	0.2556	0.0888
ROW orange	0.1733	0.7871	0.0437	0.3829	0.0397	0.0209
U.S. grapefruit	-0.0240	0.5504	0.0548	0.3167	0.0880	0.0315
Israel grapefruit	0.2608	0.8909	0.0818	0.4276	0.0343	0.0166
ROW grapefruit	0.3579	1.1932	0.0481	0.7038	0.0169	0.0118
U.S. apple	-0.2102	1.0034	-0.0258	0.2131	0.0359	0.0274
China apple	0.2355	0.4799	-0.0730	0.2728	0.0881	0.0344
ROW apple	0.0225	0.2977	-0.0323	0.1687	0.1404	0.0275
Thailand pineapple	0.1925	0.8945	-0.0784	0.3494	0.0108	0.0066
Philippine pineapple	0.0958	1.7272	-0.0605	0.3560	0.0081	0.0041
ROW pineapple	0.1298	1.5415	-0.0546	0.5133	0.0090	0.0063
U.S. grape	-0.0615	0.4980	-0.0462	0.1842	0.0586	0.0260
Argentina grape	0.1897	1.0392	-0.0353	0.2356	0.0110	0.0075
ROW grape	0.0930	0.3860	-0.0427	0.1638	0.0755	0.0192
Israel other citrus	0.0167	0.4673	-0.0690	0.2435	0.0204	0.0055
Italy other citrus	0.1684	0.7460	-0.0687	0.2059	0.0189	0.0067
ROW other citrus	0.2206	0.5940	-0.0840	0.4184	0.0289	0.0133

Source: Study data

Over the same period, Japan's import price of all fruit juices has decreased for all juices except ROW orange juice, U.S. grapefruit juice, Israel grapefruit juice, and ROW grapefruit juice (Table 2). On average, Japan's import price of U.S. orange, apple and grape juices has decreased by 2.9%, 2.6%, and 4.6% per year (i.e., from one month in year *t*-12 to the same month in year *t*) over the period January, 1999 to December, 2005 and U.S. grapefruit juice increased 5.5%. Over the same period, other juice imported from ROW has witnessed the largest average annual price decrease (8.4%). Among U.S. products, prices of orange, grapefruit, and grape juices are the second most stable of the respective competitors' products. The price of U.S. apple juice is less stable compared to their respective rival products.

Except for Brazilian orange juice (25.6%) and the ROW apple juice (14.0%), the average expenditure share of fruit juices in Japan is below 10% (Table 2). Expenditure share of U.S. juices, expressed as a percentage of total fruit juice expenditure, ranges from 3.6% for apple juice to 8.8% for grapefruit juice.

Test for First-order Autocorrelation

A test for first order autocorrelation was carried out for equation (1) and equation (2), considering each model with and without autocorrelation as the unrestricted and restricted model, respectively. The result of the test indicates that the null hypothesis of no autocorrelation was rejected in both models, implying that the data is serially correlated. The value of ρ, which is common across equations in each system, is 0.24 for equation (1) and 0.29 for equation (2). Both are significantly different from zero at the 0.001 level.

Selection of the Model that Best Identifies the Market Structure

Having corrected for first-order autocorrelation, we conducted a likelihood ratio test to select the model that best identifies the market structure of the Japanese fruit juice market. The identification of the market structure involves a comparison between the relative price version of the Rotterdam model (equation (1)) and the block-wise uniform substitute-Rotterdam model (equation (2)). The block wise dependent uniform substitute model is a restricted model and represents the uniformly competitive market structure while the relative price version of the Rotterdam model is an unrestricted model and represents the non-uniformly competitive market structure. The log likelihood value of the unrestricted equation (equation 1) is 3744.5 while that of the restricted equation (equation 2) is 3614.8. The value of the model chi-square is 259.4 with 132 degrees of freedom which is greater than the critical chi-square value at 1% probability level.

Therefore, we reject the restricted equation (2). The competition between any two products in two different product groups or within the same product group is not the same for all pairs of products in the two groups or within the same group. This means that the change in marginal utility of a dollar spent on a product in one product group caused by an extra dollar spent on another product in another product group is not the same for all pairs of products in the two groups. Furthermore, the change in marginal utility of a dollar spent on a product caused by an extra dollar spent on another product is not the same for all pairs of products within the same group. This implies that consumers are influenced by the country of origin and thus decide to

Table 3. Parameter estimates (v_{ij}) of cross prices of fruit juices in Japan

	Estimates	SE
U.S. orange/Thailand pineapple	0.0209***	0.0056
U.S. orange/Philippine pineapple	0.0205***	0.0050
U.S. orange/Argentine grape	-0.0149***	0.0060
U.S. orange/Israel other citrus	-0.0146***	0.0056
Brazil orange/ROW orange	-0.0447*	0.0236
Brazil orange/U.S. grapefruit	-0.1147***	0.0354
Brazil orange/ROW grapefruit	-0.0473**	0.0197
Brazil orange/China apple	-0.1200***	0.0378
Brazil orange/ROW apple	-0.1074***	0.0413
Brazil orange/Thailand pineapple	-0.0225**	0.0111
Brazil orange/ROW pineapple	0.0429***	0.0159
Brazil orange/ROW grape	-0.0513*	0.0275
Brazil orange/Israel other citrus	-0.0192**	0.0095
ROW orange/ROW grapefruit	0.0097***	0.0032
ROW orange/ROW apple	0.0195**	0.0094
ROW orange/U.S. grape	0.0128*	0.0069
ROW orange/Israel other citrus	0.0049*	0.0026
ROW orange/Italy other citrus	0.0074**	0.0034
ROW orange/ROW other citrus	0.0069**	0.0034
U.S. grapefruit/ROW grapefruit	0.0124***	0.0047
U.S. grapefruit /U.S. apple	0.0217*	0.0119
U.S. grapefruit /Thailand pineapple	-0.0160***	0.0037
U.S. grapefruit /Philippine pineapple	-0.0144***	0.0033
U.S. grapefruit /Argentina grape	0.0092**	0.0039
U.S. grapefruit/ROW grape	0.0215***	0.0087
Israel grapefruit/China apple	0.0164**	0.0079
Israel grapefruit /Argentina grape	0.0070**	0.0030
Israel grapefruit /Israel other citrus	-0.0082***	0.0025
ROW grapefruit/Italy other citrus	-0.0056***	0.0020
U.S. apple/ROW pineapple	-0.0104*	0.0057
U.S. apple /Argentina grape	-0.0216***	0.0049
U.S. apple/Italy other citrus	0.0104*	0.0058
U.S. apple/ROW other citrus	0.0127**	0.0061
China apple/U.S. grape	0.0182*	0.0095
ROW apple/Thailand pineapple	-0.0181***	0.0060
ROW apple/Argentina grape	0.0201***	0.0065
Thailand pineapple/ROW grape	0.0163***	0.0051
Thailand pineapple/Israel other citrus	0.0055**	0.0024
Philippine pineapple/Argentina grape	0.0061***	0.0021
Philippine pineapple/ROW grape	0.0072*	0.0043
Philippine pineapple/ROW other citrus	0.0037**	0.0019
ROW pineapple/Argentina grape	0.0060***	0.0020
U.S. grape/Israel other citrus	0.0122***	0.0047
Argentina grape/Italy other citrus	-0.0061*	0.0034
Argentina grape/ROW other citrus	-0.0068***	0.0022
Rho	0.2443***	0.0276

Note: *** (**)* significance at 1%, 5% and 10% (*t* statistic). Only statistically significant parameter estimates presented. Number of Observations = 83; Log Likelihood = 3744.50; Schwartz B.I.C. = -3124.45.

buy a given fruit juice based on the country of origin. In other words, product attributes are factored into the decision of purchase. Therefore, based on results of the likelihood ratio test we select the relative price version of the Rotterdam model (equation (1)) (Table 3) and hence the *non-uniformly competitive* market structure as the underlying market structure of the Japanese fruit juice market. This is consistent with Seale et al (2005) who showed that the fresh market for grapefruit, oranges, lemons, pineapples, and berries are not uniform substitutes. However, in contrast to our results, Seale et al. (2005) found that bananas and grapes disaggregated by country of origin are uniform substitutes.

Expenditure Elasticities

The expenditure elasticities are calculated at the sample means of expenditure shares of the respective imported fruit juices. The estimates of the expenditure elasticities are all positive except for ROW pineapple juice and U.S. grape juice which are both negative and insignificant (Table 4). Among the 18 fruit juices, only the demand for Brazilian orange juice is expenditure elastic (3.0997). This is due to the higher expenditure share of Brazilian exports (25.6%) (Table 2). Given that Brazilian orange juice makes up the larger proportion of the total imports of fruit juices into Japan, a one percent increase in expenditure on imported fruit juices results in a far greater increase in actual imports of Brazilian orange juice. Furthermore, Brazil's orange juice market share would increase further upon the expansion of the Japanese market of imported fruit juices over time. However, under conditions in which the economy slows down (expenditure growth slows down) Brazil will be worse off because a given percentage decrease in expenditures on imported fruit juices results in a far greater decrease in actual imports. Brazil's orange juice market share would decrease further upon the contraction of the market of imported fruit juices over time because of its larger expenditure elasticity. Since recession has been more frequent in Japan over the past few years, Brazil needs to devise an effective export strategy

Table 4. Expenditure elasticity estimates of fruit juices in Japan

Product	Estimate	SE
U.S. orange	0.2939	0.2074
Brazil orange	3.0997***	0.1686
ROW orange	0.1096	0.1895
U.S. grapefruit	0.5301***	0.1358
Israel grapefruit	0.0579	0.3008
ROW grapefruit	0.7593**	0.3881
U.S. apple	0.6132	0.4104
China apple	0.4265***	0.1437
ROW apple	0.1851**	0.0939
Thailand pineapple	0.5132*	0.3176
Philippine pineapple	0.2085	0.3848
ROW pineapple	-0.6668	0.5479
U.S. grape	-0.0003	0.1716
Argentina grape	0.0737	0.3239
ROW grape	0.2553**	0.1161
Israel other citrus	0.4891***	0.1446
Italy other citrus	0.0219	0.2187
ROW other citrus	0.24589	0.1847

*** (**)* significance at 1%, 5% and 10%

which takes account of the performance of the economy. The fact that the demand for U.S. major fruit juice exports (orange, grapefruit, apple and grape juices) is expenditure inelastic or perfectly inelastic implies that a reduction in Japanese expenditures on fruit juices has a smaller effect on U.S. juice exports to Japan than on Brazilian orange juice exports to Japan.

Because of the lack of similar studies on demand for fruit juices, it is difficult to make direct comparison and contrast with our estimates which were made under different circumstances involving use of a large sample of monthly data disaggregated by country of origin while others have used aggregate data that has not taken account of the country of origin. Further, there are differences in the underlying market structure, the assumption of separability as well as the number of possible substitutes, which are all important determinants of elasticity. Given these caveats, Schmitz and Seale (2002) estimated that the expenditure elasticity of the Japanese import demand for fresh grapefruits is 2.29 and that of fresh pineapple is 1.16 while the expenditure elasticity of the Japanese import demand for fresh bananas, fresh oranges and fresh lemons is 0.58, 0.91 and 0.87, respectively. Similarly, Lee, Brown and Seale (1992) estimated that the expenditure elasticity for the Canadian import demand for fresh oranges, fresh apples, orange juice and apple juices estimated under the assumption of strong separability are 1.37, 1.11, 1.30 and 1.80, respectively. The estimates of the expenditure elasticity of the Canadian import demand for fresh grapefruit, bananas and tomato juice is perfectly expenditure inelastic.

Population Growth

The growth of population is another major factor anticipated to affect the demand for imported fruit juices in Japan as a result of its aging population. The population growth of Japan turned negative in 2006 (Statistics Bureau of Japan). With per capita income growing at 2% per annum and assuming that the growth will remain at 2% until 2020, the growth of demand for fruit juices imported into Japan is projected in Table 5 (See Appendix 1). The growth of demand for fruit juice in Japan is positive for all juices that have expenditure elasticity significantly different from zero (Table 4) except ROW apple juice which switches from a positive growth rate to a negative growth rate in 2017 because the decrease in population outweighs the positive expenditure elasticity (Table 4). Products which have statistically significant positive expenditure elasticities will continue to grow at a declining growth rate through 2020 regardless of the negative growth of population except for ROW apple juice as previously explained. Brazilian orange juice is the least affected of all the juices because its growth rate starts out at a relative high rate in 2006 (6.20%) and declines to 5.71% by 2020 despite the negative population growth. The remaining juices that have a statistically significant positive expenditure elasticity (Table 4) will decline to a 1.03% growth rate or lower by 2020. Juices with zero expenditure elasticity (i.e., statistically insignificant expenditure elasticity) have a declining negative growth rate that is identical to the declining negative growth rate of Japan's population.

These simulations were made under the assumption that the growth of per capita income will remain constant at 2% per annum over the period 2006 through 2020. The prospect of the growth of demand for fruit juices will depend on the growth of per capita income relative to the decline in growth of the population. The 2% growth of per capita income along with a statistically significant positive expenditure elasticity will offset the decrease in population growth so that the decline in the growth of demand may be slowed. If income grows at more than 2%, the decline in the growth of juice demand will be further slowed even though population growth is negative.

Own-price Elasticities

In order to assess the responsiveness of Japan's imports to changes in price, uncompensated and compensated own-price elasticities were calculated. Results indicate that uncompensated own price elasticities of demand for fruit juices in Japan are all negative and statistically different from zero (Table 6). Among the 18 fruit juices, only U.S. orange juice, ROW orange juice, Philippine pineapple juice, and Italian other citrus juice are uncompensated price elastic. Of these, the demand for Philippine pineapple juice is the most price elastic (-2.9525) followed by ROW orange juice (-1.7702), U.S. orange juice (-1.5591), and Italian other citrus juice (-1.4134). The demand for ROW grape juice (-0.9881) and ROW other citrus juice (-0.9745) can be rounded to unitary price elastic.

Table 6. Own price elasticities of fruit juices in Japan

Product	**Uncompensated own price elasticities**		**Compensated own price elasticities**	
	Estimate	SE	Estimate	SE
U.S. orange	-1.5591***	0.0122	-1.5417***	0.0244
Brazil orange	-0.7619***	0.0431	0.0303	0.9073
ROW orange	-1.7702***	0.0075	-1.7658***	0.0056
U.S. grapefruit	-0.7912***	0.0119	-0.7445***	0.0430
Israel grapefruit	-0.4533***	0.0103	-0.4513***	0.0040
ROW grapefruit	-0.8995***	0.0065	-0.8867***	0.0338
U.S. apple	-0.7941***	0.0147	-0.7721***	0.0614
China apple	-0.4717***	0.0126	-0.4341***	0.0366
ROW apple	-0.3531***	0.0132	-0.3270***	0.0165
Thailand pineapple	-0.8989***	0.0034	-0.8933***	0.0119
Philippine Pineapple	-2.9525***	0.0031	-2.9509***	0.0044
ROW pineapple	-0.6133***	0.0049	-0.6193***	0.0225
U.S. grape	-0.9010***	0.0100	-0.9010***	0.0000
Argentina grape	-0.3225***	0.0035	-0.3217***	0.0018
ROW grape	-0.9881***	0.0087	-0.9688***	0.0152
Israel other citrus	-0.4310***	0.0029	-0.4210***	0.0098
Italy other citrus	-1.4134***	0.0041	-1.4130***	0.0006
ROW other citrus	-0.9745***	0.0053	-0.9674***	0.0089

*** significance at 1%

These results indicate that exporters of U.S. orange juice, ROW orange juice, Philippine pineapple juice, and Italian other citrus juice can increase market share and increase total revenue by decreasing market prices. On the other hand, the remaining juices with inelastic price elasticity will increase market share and reduce total revenue if they increase price. Thus, different marketing strategies should be employed depending on the price elasticity of demand for a firm's juice.

Results indicate that the absolute value of the uncompensated price elasticities of most of the fruit juices is higher than those of the respective compensated price elasticities. However, the magnitude of the difference between the two elasticities is very small. An exception is the uncompensated price elasticity of Brazilian orange juice which is -0.7619 while that of compensated price elasticity is zero. This large difference is due to a large income effect. This is apparent in the large expenditure elasticity for Brazilian orange juice (3.0997).

These estimates are not directly comparable with any published studies; however, Lee, Seale, and Jierwiriyapant (1990) and Lee, Brown and Seale (1992) did look at fruit juices. Lee, Seale, and Jierwiriyapant (1990) citrus juice imports into Japan were an aggregation of orange juice, grapefruit juice and all other citrus juices. Using annual data, they found that the compensated own price elasticity for Brazil was -1.822 compared to zero for this study which used monthly data. The elasticity for the U.S. was not statistically different from zero compared to -1.5417 for this study. Lee, Brown and Seale (1992) showed that the compensated price elasticity of demand for orange juice and apple juice imported into Canada are perfectly price inelastic (i.e., not different from zero). The variation in estimates of the elasticities is due to the difference in the number of available substitutes, market structure and proportion of income spent on a good. Since we have several substitutes and imports of the same product and competing product from different countries are close substitutes, we expect our estimates to be higher than those estimated under other circumstances such as when products are assumed to be strongly separable, not disaggregated by country and only few substitutes are available.

Cross-price Elasticities

Like the case with own price elasticities, two types of cross-price elasticities, uncompensated and compensated, were calculated at the mean values of expenditure shares over the period January 1999 to December, 2005 in Tables 7 and 8 (See Appendix 2 and 3). Results indicate that more uncompensated cross price elasticities are statistically significant than compensated price elasticities for substitutes and complements which indicates that the expenditure effect on consumption is greater than zero. Also, most substitutes and complements are price inelastic. Furthermore, there are more uncompensated substitutes (54.2%) (Table 7) than uncompensated complements (40.2%) (Table 8) and 5.6% are independent.

This indicates that the fruit juice market is competitive with 54.2% or 166 of the product combinations being substitutes (Table 7). Of the uncompensated substitutes, juices within the same product group (e.g., U.S. orange juice and Brazilian orange juice) and among product groups (U.S. orange juice and Israel grapefruit juice) are substitutes for one another. This is consistent with the market structure hypothesis when the non-uniformly competitive market structure was statistically found to be the underlying market structure of the Japanese fruit juice market. Given the 166 (123) uncompensated substitute (complement) combinations, five (six) are greater than 1.0. This indicates that price changes do not make large percentage changes in the quantity or market share of substitutes or complements because most are inelastic. Furthermore, of the uncompensated substitutes (complements) that are inelastic, only 16 (11) are between the absolute value of 0.5 and unitary elasticity. This indicates that 87.3% (86.2%) of the substitutes (complements) are less than the absolute value of 0.5, very inelastic.

Substitutes

The substitutes that are elastic include Thailand pineapple (*i*)/U.S. orange juice (*j*) ($\varepsilon_{ij} = 1.9386$) ($\varepsilon_{ji} = 0.3583$), Thailand pineapple/ROW grape juice (1.5037) (0.2182), Philippine pineapple/U.S. orange juice (2.5281) (0.3484), ROW pineapple/Brazil orange juice (3.0933) (0.0758), and Argentina grape/ROW apple juice (1.8113) (0.1416). However, when the reverse is true (e.g., U.S. orange/Thailand pineapple juice), the price change brings about a smaller

percentage change in quantity which is inelastic. This indicates that the juices are not perfect substitutes and consumers prefer the inelastic product more than the elastic product. Consumers are less willing to reduce consumption of the inelastic product even though the price of the substitute product has decreased. For example, consumers decrease their consumption of U.S. orange juice (Thailand pineapple juice) by 0.3583% (1.9386%) when the price of Thailand pineapple juice (U.S. orange juice) is decreased by 1% (1%). Finally, the most volatile product is pineapple juice where four of the five elastic substitutes are pineapple juice from different countries.

Of the 16 substitutes with an elasticity between 0.5 and 1.0, five are pineapple juice, 4 are grape juice, three are other citrus juice, two are grapefruit juice, one is orange juice and one is apple juice. When this is combined with the five substitutes greater than 1.0 for a total of 21 substitutes with an elasticity greater than 0.5, nine are pineapple juice and 5 are grape juice for a total of 14 or two-thirds of the elastitites greater than 0.5. This is further evidence that pineapple juice is the most volatile product (the largest percentage quantity changes) and grape juice is next. The remaining substitutes (145 country product combinations) are inelastic and have country product *i*/country product *j* combinations similar to those already discussed plus some ε_{ij} and ε_{ji} combinations that are approximately equal.

Each country product (i.e., U.S. orange juice, U.S. grapefruit juice, etc.) has between 7 and 11 substitutes except Brazil orange juice (3) and ROW orange juice (14). Brazil orange juice (ROW orange juice) has the fewest (most) substitutes of any country juice combination. The substitutes for Brazil orange juice are Brazil orange (*i*)/U.S. orange juice (*j*) ($\varepsilon_{ij} = 0.0490$) ($\varepsilon_{ji} = 0.9300$), Brazil orange/ROW pineapple juice (0.0758) (3.0933), and Brazil orange/Italy other citrus (0.0123) (0.9531). When the substitutes change their price, the quantity of Brazil orange juice changes between 0.0123% and 0.0758%; however, when the reverse is true (e.g., U.S. orange/Brazil orange juice), a Brazil price change brings about a quantity change in the substitutes between 0.9300% and 3.0933%. This indicates that Brazil orange juice is the preferred juice among the four juices. A price decrease by substitutes decrease Brazil orange juice (the substitute's) consumption by a smaller (larger) quantity percentage.

ROW orange juice has the most substitutes (14) (Table 7). This makes the competition between ROW orange juice and 14 out of 17 other country juices the most competitive (in terms of the number of juices) in the juice market; however, the cross-price elasticities (ε_{ij} and ε_{ji}) range from 0.5562 to almost zero. Thus the quantity impacts from price changes are relatively small.

Complements

Country product combinations that are complements (123) have six complements which have cross-price elasticities that are less than -1.0 (elastic). These include Thailand pineapple (*i*)/U.S. grapefruit juice (*j*) ($\varepsilon_{ij} = -1.4462$)($\varepsilon_{ji} = -0.1779$), Thailand pineapple/ROW apple juice (-1.7002)(-0.1274), Philippine pineapple/U.S. grapefruit juice (-1.7631)(-0.1656), ROW pineapple/U.S. apple juice (-1.1774)(-0.3096), Argentina grape/U.S. orange juice (-1.3483)(-0.2558), and Argentina grape/U.S. apple juice (-1.9527)(-0.6081)(Table 8). However, when the reverse is true (e.g., U.S. grapefruit/Thailand pineapple juice), the price change brings about a smaller percentage change in quantity which is inelastic. This indicates that the juices are not

perfect complements and consumers prefer the inelastic product more than the elastic product (i.e., U.S. grapefruit juice quantity changes by a smaller percentage (0.1770) than Thailand pineapple juice quantity which changes by a larger percentage (1.4462)). Consumers want more stability in U. S. grapefruit consumption than Thailand pineapple juice consumption. Finally, the most volatile product is pineapple juice where four of the six elastic complements are pineapple juice. Grape juice is the remaining two elastic complements.

Of the 11 complements with an elasticity between -0.5 and -1.0, orange juice, grapefruit juice, apple juice, pineapple juice, and grape juice have two complements each and other citrus juice has one. When this is combined with the six elastic complements for a total of 17 complements with an elasticity less than -0.5, six are pineapple juice and four are grape juice for a total of 10 or 58.8% of the elasticites less than -0.5. This is further evidence that pineapple juice is the most volatile product (the largest percentage quantity changes) and grape juice is next. The remaining complements (106 country product combinations) are inelastic and have country product *i*/country product *j* combinations similar to those already discussed plus some ε_{ij} and ε_{ji} combinations that are approximately equal.

Each country product (i.e., U.S. orange juice, U.S. grapefruit juice, etc.) has between 4 and 8 complements except ROW orange juice (3) and Brazil orange juice (14). This is the opposite of what was found in juice substitutes as Brazil orange juice (ROW orange juice) had the fewest (most) substitutes of any country juice combination. The complements for ROW orange juice are ROW orange (*i*)/Brazil orange juice (*j*) (ε_{ij} = -0.8570) (ε_{ji} = -0.2522), ROW orange/Thailand pineapple juice (-0.0222) (-0.0976), and ROW orange/Philippine pineapple juice (-0.0698) (-0.3453). When the complements change their price, the quantity of ROW orange juice changes between 0.0222% and 0.8570%; however, when the reverse is true (e.g., U.S. orange/Brazil orange juice), a ROW price change brings about a quantity change in the complements between 0.0976% and 0.3453%. This indicates that ROW orange juice is the preferred to Philippine pineapple juice, not preferred to Brazil orange juice, and about equal with Thailand pine apple juice.

Brazil orange juice has the most complements (14) (Table 8). This makes the relationship between Brazil orange juice and 14 out of 17 other country juices a complementary relationship in the juice market. When the Brazil orange price is changed and the 14 juice prices remain constant, nine of the complements remain complements, one complement becomes an independent, and four complements become substitutes. This indicates that when the 14 juices individually change their price, consumers increase or decrease their consumption of Brazil orange juice along with the increase or decrease in the quantity of the other 14 juices. When the price of Brazil orange juice is changed however, consumers treat nine of the complements as complements, one complement becomes an independent, and four complements become substitutes. Consumers view Brazil orange juice in different ways when the price of Brazil orange juice is changed. Brazil orange juice is a preferred juice product in Japan.

Conclusions and Implications

The purpose of this study was to assess the competitiveness of the world's largest exporters of fruit juice into Japan through the analysis of market structure. The analysis of market structure in

marketing is concerned with identifying closely competing brands of the same product. To this end, we tested two plausible scenarios of market structures (i.e. non-uniformly competitive and uniformly competitive) within the context of consumer demand theory and selected the non-uniformly competitive market structure as the underlying Japanese fruit juice market structure. The identification of fruit juice market structure is useful for assessing strategic opportunities, developing marketing programs, and assessing market share to evaluate performance (Vilcassim, 1989). Further, the appropriateness of marketing strategy depends on the relationship between products within the same product group and across different product groups.

Results of the study have important implications to countries exporting fruit juices to Japan for making marketing strategies such as price reduction, product differentiation as well as an export supply plan in light of the expansion and contraction of the Japanese market for imported fruit juices because of the change in income and declining population. Given that the effectiveness of a supply plan in raising market share through export expansion depends on the estimates of expenditure and price elasticities, the country which benefits the most from the growth of income in Japan is Brazil. Brazilian orange juice has the highest expenditure elasticity and expenditure share in Japan's market. An increase in Japan's expenditure on imported fruit juices results in a far greater increase in actual imports of Brazilian orange juice than any other country.

Consequently, Brazilian expenditure share will increase upon the expansion of the Japanese market of imported fruit juices over time. However, under conditions in which expenditure growth slows, Brazil will be worse off because a decrease in expenditure on imported fruit juices results in a far greater decrease in actual imports and its market share will decrease upon the contraction of the market of imported fruit juices over time. Hence, Brazil needs to have an export strategy which takes account of the performance of Japan's economy.

In addition to expenditures, the growth of population is another major factor anticipated to affect the demand for imported fruit juices in Japan. The Japanese population growth peaked in 2005 and turned negative in 2006. The growth of fruit juice demand in Japan is expected to decrease over the period 2006 through 2020 for 11 of the 18 fruit juice/country combinations because of negative population growth rate.

Given that the demand for the U.S. orange juice, ROW orange juice, Philippines pineapple juice and Italy other citrus juice is price elastic, price discounting can be an effective tool for the U.S., ROW, Philippines, and Italy fruit juice industry in expanding their exports to Japan. Since the demand for other country juice combinations are price inelastic, export supply expansion through price-oriented marketing strategies, trade negotiations or other marketing activities that involve reduction of prices will negatively impact the other exporting countries. These other countries should reduce their cost of production, processing, and marketing so that they can stay more competitive in Japan's import market.

The degree of competition depends on the magnitude of cross price elasticities. Given that the cross price elasticities of most of the juices imported into Japan are below one, an exporter can't take market share from another exporter quickly through price reductions. A notable exception is the U.S/Brazilian orange juice. A decrease in the price of Brazilian orange juice has a significant negative impact on the demand for U.S. orange juice but not vice versa. However,

since the demand for Brazilian orange juice is price inelastic, Brazil does not have a reason to decrease price under the current market structure. Therefore, the U.S. citrus industry should pay close attention to the development of the Brazilian citrus industry. Assume, for example, that Brazil becomes more competitive through non-price competition such as product promotion. Unless there is a similar response by the U.S. citrus industry, there may be adverse effects on the demand for U.S. orange juice. Generally, because of the low cross price elasticities of fruit juices in Japan, product promotion and further product differentiation is a more plausible option for most countries to stay competitive in Japan's fruit juice market.

Fruit juice managers can use the information in this article to assess strategic opportunities in the fruit juice industry such as identifying which fruit juice/country combinations their company is competitive with and which countries they complement and are not competitive with. These results will help managers decide whether a price competitive strategy or a non-price competitive strategy is the most appropriate fruit juice marketing program. Furthermore, the results will help managers identify who their competitors are in a market in order to assess the market share of each fruit juice competitor in order to evaluate performance.

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Appendix 1.

Table 5. Projected growth estimates (%) of the demand for fruit juices in Japan.

Year	Population growth rate[a]	Orange Juice			Grapefruit juice			Apple			Pineapple juice			Grape juice			Other juice		
	Percent	U.S.	Brazil	ROW	U.S.	Israel	ROW	U.S.	China	ROW	Thailand	Philippine	ROW	U.S.	Argentina	ROW	Israel	Italy	ROW
2006	-0.01	-0.01	6.20	-0.01	1.06	-0.01	1.52	-0.01	0.85	0.37	1.03	-0.01	-0.01	-0.01	-0.01	0.51	0.98	-0.01	-0.01
2007	-0.05	-0.05	6.15	-0.05	1.01	-0.05	1.47	-0.05	0.80	0.32	0.98	-0.05	-0.05	-0.05	-0.05	0.46	0.93	-0.05	-0.05
2008	-0.10	-0.10	6.10	-0.10	0.96	-0.10	1.42	-0.10	0.75	0.27	0.93	-0.10	-0.10	-0.10	-0.10	0.41	0.88	-0.10	-0.10
2009	-0.14	-0.14	6.06	-0.14	0.92	-0.14	1.38	-0.14	0.71	0.23	0.89	-0.14	-0.14	-0.14	-0.14	0.37	0.84	-0.14	-0.14
2010	-0.17	-0.17	6.03	-0.17	0.89	-0.17	1.35	-0.17	0.68	0.20	0.86	-0.17	-0.17	-0.17	-0.17	0.34	0.81	-0.17	-0.17
2011	-0.21	-0.21	5.99	-0.21	0.85	-0.21	1.31	-0.21	0.64	0.16	0.82	-0.21	-0.21	-0.21	-0.21	0.30	0.77	-0.21	-0.21
2012	-0.24	-0.24	5.96	-0.24	0.82	-0.24	1.28	-0.24	0.61	0.13	0.79	-0.24	-0.24	-0.24	-0.24	0.27	0.74	-0.24	-0.24
2013	-0.28	-0.28	5.92	-0.28	0.78	-0.28	1.24	-0.28	0.57	0.09	0.75	-0.28	-0.28	-0.28	-0.28	0.23	0.70	-0.28	-0.28
2014	-0.31	-0.31	5.89	-0.31	0.75	-0.31	1.21	-0.31	0.54	0.06	0.72	-0.31	-0.31	-0.31	-0.31	0.20	0.67	-0.31	-0.31
2015	-0.34	-0.31	5.89	-0.31	0.75	-0.31	1.21	-0.31	0.54	0.06	0.72	-0.31	-0.31	-0.31	-0.31	0.20	0.67	-0.31	-0.31
2016	-0.37	-0.34	5.86	-0.34	0.72	-0.34	1.18	-0.34	0.51	0.03	0.69	-0.34	-0.34	-0.34	-0.34	0.17	0.64	-0.34	-0.34
2017	-0.40	-0.40	5.80	-0.40	0.66	-0.40	1.12	-0.40	0.45	-0.03	0.63	-0.40	-0.40	-0.40	-0.40	0.11	0.58	-0.40	-0.40
2018	-0.43	-0.43	5.77	-0.43	0.63	-0.43	1.09	-0.43	0.42	-0.06	0.60	-0.43	-0.43	-0.43	-0.43	0.08	0.55	-0.43	-0.43
2019	-0.46	-0.46	5.74	-0.46	0.60	-0.46	1.06	-0.46	0.39	-0.09	0.57	-0.46	-0.46	-0.46	-0.46	0.05	0.52	-0.46	-0.46
2020	-0.49	-0.49	5.71	-0.49	0.57	-0.49	1.03	-0.49	0.36	-0.12	0.54	-0.49	-0.49	-0.49	-0.49	0.02	0.49	-0.49	-0.49

[a] Source: National Institute of Population and Social Security Research, Japan Ministry of Health, Labour and Welfare, *Population Projections for Japan: 2006-2055*, January 2006 (http://www.ipss.go.jp/index-e.html). Note: The growth of demand for fruit juices for each country was calculated using the following formula: Growth of demand (%) = % growth rate of population from Table 5 + (per capita income growth rate of 2% times the expenditure elasticity from Table 4 (if significant from zero)).

Appendix 2.

Table 7. Cross-price elasticity estimates of substitutes

Products	Uncompensated cross price elasticity		Compensated cross price elasticity	
	Estimates	SE	Estimates	SE
U.S. orange/Brazil orange	0.9300***	0.0530	1.0051**	0.4144
U.S. orange/ROW orange	0.1446***	0.0082	0.1563	0.1481
U.S. orange/Israel grapefruit	0.2205***	0.0071	0.2305	0.1557
U.S. orange/ROW grapefruit	0.0287***	0.0035	0.0336	0.0924
U.S. orange/ROW apple	0.4228***	0.0291	0.4641	0.2912
U.S. orange/Thailand pineapple	0.3583***	0.0022	0.3614***	0.0965
U.S. orange/Philippine pineapple	0.3484***	0.0016	0.3508***	0.0854
U.S. orange/ROW pineapple	0.0066***	0.0018	0.0093	0.0990
U.S. orange/U.S. grape	0.1366***	0.0121	0.1539	0.2254
Brazil orange/U.S. orange	0.0490***	0.0099	0.2318**	0.0955
Brazil orange/ROW pineapple	0.0758***	0.0015	0.1040***	0.0358
Brazil orange/Italy other citrus	0.0123***	0.0032	0.0712**	0.0328
ROW orange/U.S. orange	0.2253***	0.0111	0.2317	0.2195
ROW orange/U.S. grapefruit	0.0884***	0.0166	0.0981	0.1604
ROW orange/Israel grapefruit	0.1449***	0.0065	0.1487	0.1334
ROW orange/ROW grapefruit	0.2474***	0.0032	0.2492***	0.0810
ROW orange/U.S. apple	0.2130***	0.0068	0.2170	0.2173
ROW orange/China apple	0.1789***	0.0167	0.1886	0.1662
ROW orange/ROW apple	0.4866***	0.0266	0.5021**	0.2358
ROW orange/ROW pineapple	0.0131***	0.0017	0.0141	0.0807
ROW orange/U.S. grape	0.3164***	0.0111	0.3228*	0.1758
ROW orange/Argentina grape	0.0199***	0.0021	0.0211	0.0755
ROW orange/ROW grape	0.1885***	0.0143	0.1968	0.1629
ROW orange/Israel other citrus	0.1268***	0.0038	0.1290*	0.0660
ROW orange/Italy other citrus	0.1863***	0.0036	0.1884**	0.0877
ROW orange/ROW other citrus	0.1734***	0.0054	0.1766**	0.0862
U.S. grapefruit/ROW orange	0.0232***	0.0054	0.0443	0.0724
U.S. grapefruit/Israel grapefruit	0.0201***	0.0046	0.0384	0.0838
U.S. grapefruit/ROW grapefruit	0.1550***	0.0023	0.1640***	0.0512
U.S. grapefruit/U.S. apple	0.2674***	0.0048	0.2865**	0.1304
U.S. grapefruit/China apple	0.0623***	0.0119	0.1090	0.1035
U.S. grapefruit/Argentina grape	0.1006***	0.0015	0.1065**	0.0434
U.S. grapefruit/ROW grape	0.2389***	0.0102	0.2789***	0.0950
U.S. grapefruit/Israel other citrus	0.0124***	0.0027	0.0232	0.0366
Israel grapefruit/U.S. orange	0.3923***	0.0177	0.3957	0.2672
Israel grapefruit/ROW orange	0.1698***	0.0119	0.1721	0.1545
Israel grapefruit/U.S. grapefruit	0.0933***	0.0264	0.0984	0.2150
Israel grapefruit/China apple	0.4823***	0.0265	0.4874**	0.2245
Israel grapefruit/ROW apple	0.1660***	0.0422	0.1742	0.2867
Israel grapefruit/Philippine pineapple	0.0103***	0.0024	0.0108	0.0750
Israel grapefruit/ROW pineapple	0.0894***	0.0027	0.0900	0.1053
Israel grapefruit/Argentina grape	0.2059***	0.0033	0.2065**	0.0870
Israel grapefruit/ROW grape	0.1359***	0.0227	0.1403	0.1953
Israel grapefruit/Italy other citrus	0.0870***	0.0057	0.0881	0.0995

Table 7. Cross-price elasticity estimates of substitutes-*continued*

Products	**Uncompensated cross price elasticity**		**Compensated cross price elasticity**	
	Estimates	SE	Estimates	SE
ROW grapefruit/U.S. orange	0.0726***	0.0228	0.1174	0.3225
ROW grapefruit/ROW orange	0.5562***	0.0154	0.5864***	0.1906
ROW grapefruit/U.S. grapefruit	0.7875***	0.0341	0.8544***	0.2669
ROW grapefruit/ROW apple	0.4108***	0.0545	0.5175	0.3597
ROW grapefruit/Thailand pineapple	0.0210***	0.0042	0.0292	0.0983
ROW grapefruit/Philippine pineapple	0.0375***	0.0031	0.0437	0.0911
ROW grapefruit/ROW pineapple	0.0287***	0.0035	0.0356	0.1302
ROW grapefruit/ROW grape	0.1915***	0.0293	0.2489	0.2333
U.S. apple/Brazil orange	0.3350***	0.1049	0.4918	0.7350
U.S. apple/ROW orange	0.2158***	0.0163	0.2401	0.2405
U.S. apple/U.S. grapefruit	0.6481***	0.0361	0.7021**	0.3197
U.S. apple/Thailand pineapple	0.0493***	0.0044	0.0559	0.1315
U.S. apple/Philippine pineapple	0.1294***	0.0033	0.1344	0.1197
U.S. apple/U.S. grape	0.4240***	0.0240	0.4600	0.3464
U.S. apple/ROW grape	0.1562***	0.0310	0.2025	0.3089
U.S. apple/Italy other citrus	0.2802***	0.0077	0.2919*	0.1631
U.S. apple/ROW other citrus	0.3513***	0.0118	0.3690**	0.1705
China apple/ROW orange	0.0681***	0.0057	0.0851	0.0750
China apple/U.S. grapefruit	0.0714***	0.0126	0.1089	0.1034
China apple/Israel grapefruit	0.1753***	0.0049	0.1900**	0.0875
China apple/ROW grapefruit	0.0143***	0.0024	0.0215	0.0538
China apple/Thailand pineapple	0.0508***	0.0015	0.0554	0.0410
China apple/U.S. grape	0.1816***	0.0084	0.2066*	0.1068
China apple/ROW grape	0.0381***	0.0108	0.0703	0.0966
China apple/Israel other citrus	0.0177***	0.0029	0.0264	0.0363
China apple/ROW other citrus	0.0292***	0.0041	0.0416	0.0541
ROW apple/U.S. orange	0.1838***	0.0055	0.1947	0.1222
ROW apple/ROW orange	0.1347***	0.0037	0.1421**	0.0667
ROW apple/U.S. grapefruit	0.0270***	0.0082	0.0433	0.0864
ROW apple/Israel grapefruit	0.0362***	0.0032	0.0426	0.0701
ROW apple/ROW grapefruit	0.0591***	0.0015	0.0622	0.0432
ROW apple/Philippine pineapple	0.0196***	0.0007	0.0211	0.0386
ROW apple/U.S. grape	0.1024***	0.0055	0.1133	0.1015
ROW apple/Argentina grape	0.1416***	0.0010	0.1437***	0.0463
ROW apple/ROW grape	0.0575***	0.0071	0.0715	0.0993
ROW apple/Italy other citrus	0.0450***	0.0017	0.0485	0.0538
Thailand pineapple/U.S. orange	1.9386***	0.0187	1.9689***	0.5256
Thailand pineapple/ROW grapefruit	0.0369***	0.0053	0.0456	0.1535
Thailand pineapple/U.S. apple	0.1672***	0.0114	0.1857	0.4366
Thailand pineapple/China apple	0.4061***	0.0279	0.4513	0.3346
Thailand pineapple/Argentina apple	0.3359***	0.0035	0.3416	0.2387
Thailand pineapple/ROW grape	1.5037***	0.0239	1.5425***	0.4701
Thailand pineapple/Israel other citrus	0.5214***	0.0064	0.5319**	0.2298
Thailand pineapple/Italy other citrus	0.2082***	0.0060	0.2180	0.2752
Thailand pineapple/ROW other citrus	0.0917***	0.0092	0.1065	0.1994
Philippine pineapple/U.S. orange	2.5281***	0.0226	2.5404***	0.6187
Philippine pineapple/Israel grapefruit	0.0386***	0.0132	0.0457	0.3168

Table 7. Cross-price elasticity estimates of substitutes-*continued*

Products	**Uncompensated cross price elasticity**		**Compensated cross price elasticity**	
	Estimates	SE	Estimates	SE
Philippine pineapple/ROW grapefruit	0.0873***	0.0065	0.0908	0.1893
Philippine pineapple/U.S. apple	0.5858***	0.0138	0.5933	0.5285
Philippine pineapple/ROW apple	0.3352***	0.0540	0.3645	0.6670
Philippine pineapple/U.S. grape	0.1515***	0.0225	0.1637	0.5259
Philippine pineapple/Argentina grape	0.7488***	0.0042	0.7511***	0.2673
Philippine pineapple/ROW grape	0.8922***	0.0290	0.9080*	0.5334
Philippine pineapple/Israel other citrus	0.1597***	0.0078	0.1639	0.2497
Philippine pineapple/Italy other citrus	0.1959***	0.0073	0.1998	0.3102
Philippine pineapple/ROW other citrus	0.4559***	0.0111	0.4620**	0.2351
ROW pineapple/U.S. orange	0.0996***	0.0323	0.0603	0.6422
ROW pineapple/Brazil orange	3.0933***	0.1400	2.9229***	1.0082
ROW pineapple/ROW orange	0.0885***	0.0217	0.0620	0.3532
ROW pineapple/Israel grapefruit	0.3628***	0.0188	0.3399	0.3979
ROW pineapple/ROW grapefruit	0.0775***	0.0092	0.0662	0.2421
ROW pineapple/Argentina grape	0.6693***	0.0060	0.6620***	0.2258
ROW pineapple/Israel other citrus	0.1860***	0.0111	0.1723	0.1889
U.S. grape/U.S. orange	0.1546***	0.0101	0.1546	0.2265
U.S. grape/ROW orange	0.2188***	0.0068	0.2188*	0.1192
U.S. grape/U.S. apple	0.2817***	0.0061	0.2817	0.2122
U.S. grape/China apple	0.3105***	0.0151	0.3104*	0.1605
U.S. grape/ROW apple	0.2714***	0.0241	0.2713	0.2430
U.S. grape/Philippine pineapple	0.0227***	0.0014	0.0227	0.0729
U.S. grape/Argentina grape	0.0254***	0.0019	0.0254	0.0891
U.S. grape/ROW grape	0.1891***	0.0129	0.1890	0.1877
U.S. grape/Israel other citrus	0.2093***	0.0035	0.2093***	0.0808
U.S. grape/Italy other citrus	0.0691***	0.0032	0.0691	0.1031
U.S. grape/ROW other citrus	0.0942***	0.0049	0.0942	0.0907
Argentina grape/Brazil orange	0.4364***	0.0828	0.4552	0.6331
Argentina grape/ROW orange	0.0731***	0.0128	0.0760	0.2710
Argentina grape/U.S. grapefruit	0.8403***	0.0285	0.8468**	0.3453
Argentina grape/Israel grapefruit	0.6378***	0.0111	0.6403**	0.2697
Argentina grape/ROW apple	1.8113***	0.0455	1.8217***	0.5873
Argentina grape/Thailand pineapple	0.3328***	0.0035	0.3336	0.2331
Argentina grape/Philippine pineapple	0.5512***	0.0026	0.5518***	0.1964
Argentina grape/ROW pineapple	0.5427***	0.0029	0.5434***	0.1853
Argentina grape/U.S. grape	0.1303***	0.0190	0.1347	0.4721
ROW grape/ROW orange	0.0934***	0.0046	0.1036	0.0858
ROW grape/U.S. grapefruit	0.3027***	0.0102	0.3251***	0.1107
ROW grape/Israel grapefruit	0.0550***	0.0039	0.0638	0.0888
ROW grape/ROW grapefruit	0.0513***	0.0019	0.0557	0.0522
ROW grape/U.S. apple	0.0871***	0.0041	0.0963	0.1469
ROW grape/China apple	0.0596***	0.0102	0.0821	0.1127
ROW grape/ROW apple	0.0971***	0.0163	0.1330	0.1848
ROW grape/Thailand pineapple	0.2182***	0.0012	0.2210***	0.0673
ROW grape/Philippine pineapple	0.0957***	0.0009	0.0978*	0.0574
ROW grape/U.S. grape	0.1318***	0.0068	0.1468	0.1458
ROW grape/Italy other citrus	0.0041***	0.0022	0.0089	0.0860

Table 7. Cross-price elasticity estimates of substitutes-*continued*

Products	Uncompensated cross price elasticity		Compensated cross price elasticity	
	Estimates	SE	Estimates	SE
Israel other citrus/Brazil orange	0.2479***	0.0369	0.3730	0.2839
Israel other citrus/ROW orange	0.2317***	0.0057	0.2511*	0.1286
Israel other citrus/U.S. grapefruit	0.0572***	0.0127	0.1003	0.1577
Israel other citrus/China apple	0.0709***	0.0127	0.1140	0.1567
Israel other citrus/Thailand pineapple	0.2764***	0.0015	0.2817**	0.1217
Israel other citrus/Philippine pineapple	0.0613***	0.0011	0.0653	0.0994
Israel other citrus/ROW pineapple	0.0722***	0.0013	0.0767	0.0841
Israel other citrus/U.S. grape	0.5724***	0.0084	0.6011***	0.2320
Israel other citrus/ROW other citrus	0.0334***	0.0041	0.0475	0.0993
Italy other citrus/Brazil orange	0.9531***	0.0559	0.9587**	0.4422
Italy other citrus/ROW orange	0.3938***	0.0087	0.3947**	0.1837
Italy other citrus/Israel grapefruit	0.1587***	0.0075	0.1594	0.1801
Italy other citrus/U.S. apple	0.5517***	0.0078	0.5525*	0.3088
Italy other citrus/ROW apple	0.3561***	0.0307	0.3591	0.3983
Italy other citrus/Thailand pineapple	0.1240***	0.0023	0.1243	0.1569
Italy other citrus/Philippine pineapple	0.0855***	0.0017	0.0857	0.1330
Italy other citrus/U.S. grape	0.2123***	0.0128	0.2135	0.3188
Italy other citrus/ROW grape	0.0339***	0.0165	0.0356	0.3423
Italy other citrus/ROW other citrus	0.0318***	0.0063	0.0324	0.1409
ROW other citrus/Brazil orange	0.2643***	0.0472	0.3271	0.3413
ROW other citrus/ROW orange	0.2326***	0.0073	0.2423**	0.1184
ROW other citrus/U.S. apple	0.4488***	0.0066	0.4577**	0.2114
ROW other citrus/China apple	0.1048***	0.0162	0.1265	0.1647
ROW other citrus/Thailand pineapple	0.0371***	0.0020	0.0398	0.0744
ROW other citrus/Philippine pineapple	0.1278***	0.0015	0.1298**	0.0660
ROW other citrus/U.S. grape	0.1763***	0.0108	0.1907	0.1837
ROW other citrus/Israel other citrus	0.0285***	0.0037	0.0335	0.0700
ROW other citrus/Italy other citrus	0.0165***	0.0035	0.0212	0.0923

*** (**) * significant coefficients only at 1%, 5% and 10%

Appendix 3.

Table 8. Cross-price elasticity estimates of complements

Products	Uncompensated cross price elasticity		Compensated cross price elasticity	
	Estimate	SE	Estimate	SE
U.S. orange/U.S. apple	-0.3456***	0.0074	-0.3350	0.2526
U.S. orange/China apple	-0.0715***	0.0182	-0.0456	0.1980
U.S. orange/Argentina grape	-0.2558***	0.0023	-0.2526**	0.1024
U.S. orange/ROW grape	-0.3345***	0.0156	-0.3123	0.2177
U.S. orange/Israel other citrus	-0.2437***	0.0042	-0.2377**	0.0957
U.S. orange/Italy other citrus	-0.1099***	0.0039	-0.1043	0.1195
Brazil orange/ROW orange	-0.2522***	0.0067	-0.1289**	0.0531
Brazil orange/U.S. grapefruit	-0.2305***	0.0148	0.0423	0.0817

Table 8. Cross-price elasticity estimates of complements-*continued*

Products	**Uncompensated cross price elasticity**		**Compensated cross price elasticity**	
	Estimate	SE	Estimate	SE
Brazil orange/Israel grapefruit	-0.1849***	0.0058	-0.0784	0.0686
Brazil orange/ROW grapefruit	-0.1024***	0.0028	-0.0500	0.0438
Brazil orange/U.S. apple	-0.0422***	0.0060	0.0691	0.1033
Brazil orange/China apple	-0.3473***	0.0148	-0.0741	0.0847
Brazil orange/ROW apple	-0.5820***	0.0237	-0.1465	0.0969
Brazil orange/Thailand pineapple	-0.0633***	0.0018	-0.0297	0.0265
Brazil orange/Philippine pineapple	-0.0540***	0.0013	-0.0288	0.0238
Brazil orange/U.S. grape	-0.2827***	0.0099	-0.1009	0.0747
Brazil orange/Argentina grape	-0.0146***	0.0018	0.0197	0.0274
Brazil orange/ROW grape	-0.2322***	0.0127	0.0019	0.0677
Brazil orange/Israel other citrus	-0.0335***	0.0034	0.0298	0.0227
Brazil orange/ROW other citrus	-0.0527***	0.0048	0.0370	0.0387
ROW orange/Brazil orange	-0.8570***	0.0484	-0.8289**	0.3414
ROW orange/Thailand pineapple	-0.0222***	0.0020	-0.0210	0.0703
ROW orange/Philippine pineapple	-0.0698***	0.0015	-0.0689	0.0632
U.S. grapefruit/Thailand pineapple	-0.1779***	0.0014	-0.1721***	0.0416
U.S. grapefruit/Philippine pineapple	-0.1656***	0.0011	-0.1613***	0.0372
U.S. grapefruit/ROW pineapple	-0.0066***	0.0012	-0.0018	0.0491
U.S. grapefruit/U.S. grape	-0.1730***	0.0079	-0.1419	0.1048
U.S. grapefruit/Italy other citrus	-0.0723***	0.0025	-0.0622	0.0505
U.S. grapefruit/ROW other citrus	-0.0087**	0.0039	0.0065	0.0527
Israel grapefruit/Brazil orange	-0.5981***	0.0769	-0.5833	0.5104
Israel grapefruit/ROW grapefruit	-0.0440***	0.0050	-0.0431	0.1149
Israel grapefruit/U.S. apple	-0.1360***	0.0108	-0.1339	0.2973
Israel grapefruit/Thailand pineapple	-0.0751***	0.0032	-0.0745	0.0821
Israel grapefruit/U.S. grape	-0.2423***	0.0176	-0.2389	0.2230
Israel grapefruit/Israel other citrus	-0.2392***	0.0061	-0.2380***	0.0730
Israel grapefruit/ROW other citrus	-0.1023***	0.0087	-0.1006	0.1098
ROW grapefruit/Brazil orange	-0.9501***	0.0992	-0.7560	0.6624
ROW grapefruit/Israel grapefruit	-0.1136***	0.0133	-0.0875	0.2334
ROW grapefruit/U.S. apple	-0.2623***	0.0139	-0.2350	0.3456
ROW grapefruit/U.S. grape	-0.1040***	0.0227	-0.0594	0.2629
ROW grapefruit/Argentina grape	-0.1378***	0.0043	-0.1294	0.1045
ROW grapefruit/Israel other citrus	-0.0747***	0.0079	-0.0592	0.0861
ROW grapefruit/Italy other citrus	-0.3479***	0.0073	-0.3335***	0.1198
ROW grapefruit/ROW other citrus	-0.0207*	0.0112	0.0012	0.1352
U.S. apple/U.S. orange	-0.5858***	0.0241	-0.5497	0.4145
U.S. apple/Israel grapefruit	-0.1491***	0.0141	-0.1280	0.2842
U.S. apple/ROW grapefruit	-0.1209***	0.0069	-0.1105	0.1626
U.S. apple/China apple	-0.1228***	0.0361	-0.0687	0.3372
U.S. apple/ROW apple	-0.4543***	0.0576	-0.3681	0.4504
U.S. apple/ROW pineapple	-0.3096***	0.0037	-0.3041*	0.1589
U.S. apple/Argentina grape	-0.6081***	0.0045	-0.6013***	0.1390
U.S. apple/Israel other citrus	-0.0578***	0.0083	-0.0452	0.1183
China apple/U.S. orange	-0.0556***	0.0084	-0.0305	0.1324
China apple/Brazil orange	-0.3241***	0.0367	-0.2151	0.2458
China apple/U.S. apple	-0.0433***	0.0051	-0.0280	0.1375

Table 8. Cross-price elasticity estimates of complements-*continued*

Products	**Uncompensated cross price elasticity**		**Compensated cross price elasticity**	
	Estimate	SE	Estimate	SE
China apple/ROW apple	-0.1019***	0.0201	-0.0419	0.1442
China apple/Philippine pineapple	-0.0068***	0.0011	-0.0034	0.0372
China apple/ROW pineapple	-0.0555***	0.0013	-0.0516	0.0508
China apple/Argentina grape	-0.0039**	0.0015	0.0007	0.0432
China apple/Italy other citrus	-0.0101***	0.0027	-0.0020	0.0499
ROW apple/Brazil orange	-0.3139***	0.0240	-0.2665	0.1763
ROW apple/U.S. apple	-0.1008***	0.0033	-0.0941	0.1152
ROW apple/China apple	-0.0426***	0.0082	-0.0263	0.0905
ROW apple/Thailand pineapple	-0.1274***	0.0010	-0.1254***	0.0429
ROW apple/ROW pineapple	-0.0023***	0.0008	-0.0006	0.0453
ROW apple/ROW other citrus	-0.0496***	0.0027	-0.0442	0.0495
Thailand pineapple/Brazil orange	-0.8346***	0.0811	-0.7034	0.6271
Thailand pineapple/ROW orange	-0.0976***	0.0126	-0.0772	0.2583
Thailand pineapple/U.S. grapefruit	-1.4462***	0.0279	-1.4010***	0.3384
Thailand pineapple/Israel grapefruit	-0.2541***	0.0109	-0.2365	0.2607
Thailand pineapple/ROW apple	-1.7002***	0.0446	-1.6281***	0.5575
Thailand pineapple/Philippine pineapple	-0.0207***	0.0025	-0.0165	0.1820
Thailand pineapple/ROW pineapple	-0.1465***	0.0028	-0.1418	0.1767
Thailand pineapple/U.S. grape	-0.3244***	0.0186	-0.2943	0.4502
Philippine pineapple/Brazil orange	-0.9578***	0.0983	-0.9044	0.7483
Philippine pineapple/ROW orange	-0.3453***	0.0153	-0.3370	0.3088
Philippine pineapple/U.S. grapefruit	-1.7631***	0.0338	-1.7447***	0.4032
Philippine pineapple/Thailand pineapple	-0.0243***	0.0041	-0.0220	0.2420
Philippine pineapple/ROW pineapple	-0.2894***	0.0035	-0.2875	0.2100
ROW pineapple/U.S. apple	-1.1774***	0.0196	-1.2014*	0.6278
ROW pineapple/China apple	-0.4415***	0.0482	-0.5003	0.4923
ROW pineapple/Thailand pineapple	-0.1615***	0.0059	-0.1687	0.2103
ROW pineapple/Philippine pineapple	-0.2519***	0.0044	-0.2573	0.1879
ROW pineapple/U.S. grape	-0.4901***	0.0321	-0.5292	0.5223
ROW pineapple/ROW grape	-0.4294***	0.0413	-0.4798	0.4814
ROW pineapple/Italy other citrus	-0.1612***	0.0104	-0.1739	0.2561
ROW pineapple/ROW other citrus	-0.3080***	0.0158	-0.3274	0.2601
U.S. grape/Brazil orange	-0.4395***	0.0438	-0.4396	0.3256
U.S. grape/U.S. grapefruit	-0.2129***	0.0151	-0.2129	0.1573
U.S. grape/Israel grapefruit	-0.1399***	0.0059	-0.1399	0.1305
U.S. grape/ROW grapefruit	-0.0171***	0.0029	-0.0171	0.0757
U.S. grape/Thailand pineapple	-0.0542***	0.0018	-0.0543	0.0830
U.S. grape/ROW pineapple	-0.0820***	0.0015	-0.0820	0.0809
Argentina grape/U.S. orange	-1.3483***	0.0190	-1.3439**	0.5450
Argentina grape/ROW grapefruit	-0.1987***	0.0054	-0.1975	0.1595
Argentina grape/U.S. apple	-1.9527***	0.0116	-1.9501***	0.4508
Argentina grape/ROW grape	-0.3808***	0.0244	-0.3752	0.5049
Argentina grape/Israel other citrus	-0.0501***	0.0066	-0.0486	0.2649
Argentina grape/Italy other citrus	-0.5552***	0.0061	-0.5538*	0.3068
Argentina grape/ROW other citrus	-0.6208***	0.0093	-0.6187***	0.2047
ROW grape/U.S. orange	-0.2587***	0.0068	-0.2437	0.1699
ROW grape/Brazil orange	-0.0587**	0.0296	0.0065	0.2291

Table 8. Cross-price elasticity estimates of complements-*continued*

Products	**Uncompensated cross price elasticity**		**Compensated cross price elasticity**	
	Estimate	SE	Estimate	SE
ROW grape/ROW pineapple	-0.0601***	0.0010	-0.0577	0.0579
ROW grape/Argentina grape	-0.0578***	0.0012	-0.0550	0.0747
ROW grape/Israel other citrus	-0.0303***	0.0023	-0.0250	0.0685
Israel other citrus/U.S. orange	-0.7145***	0.0085	-0.6857**	0.2761
Israel other citrus/Israel grapefruit	-0.4169***	0.0049	-0.4001***	0.1227
Israel other citrus/ROW grapefruit	-0.0572***	0.0024	-0.0489	0.0712
Israel other citrus/U.S. apple	-0.0972***	0.0052	-0.0796	0.2080
Israel other citrus/ROW apple	-0.0605***	0.0203	0.0082	0.2868
Israel other citrus/Argentina grape	-0.0318***	0.0016	-0.0264	0.1436
Israel other citrus/ROW grape	-0.1296***	0.0109	-0.0927	0.2532
Israel other citrus/Italy other citrus	-0.1739***	0.0027	-0.1646	0.1611
Italy other citrus/U.S. orange	-0.3252***	0.0128	-0.3239	0.3712
Italy other citrus/U.S. grapefruit	-0.2907***	0.0192	-0.2887	0.2343
Italy other citrus/ROW grapefruit	-0.2974***	0.0037	-0.2970***	0.1067
Italy other citrus/ROW pineapple	-0.0835***	0.0019	-0.0833	0.1227
Italy other citrus/Argentina grape	-0.3235***	0.0024	-0.3232*	0.1791
Italy other citrus/Israel other citrus	-0.1777***	0.0044	-0.1772	0.1735
ROW other citrus/Israel grapefruit	-0.1277***	0.0063	-0.1192	0.1302
ROW other citrus/ROW apple	-0.2492***	0.0259	-0.2147	0.2400
ROW other citrus/ROW pineapple	-0.1050***	0.0016	-0.1027	0.0816
ROW other citrus/Argentina grape	-0.2393***	0.0020	-0.2366***	0.0783

*** (**) * significant coefficients only at 1%, 5% and 10%.

