GLOBAL COMPETITION FOR THE JAPANESE FRUIT JUICE MARKET:A Uniform Substitute Demand Analysis

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Abstract

This study analyzes the competitiveness of countries exporting fruit juices into Japan through market structure analysis (MSA) within the context of a consumer demand theory using the relative price version of the Rotterdam model and the block-wise dependent uniform substitute Rotterdam model The models were estimated for six different kinds of fruit juices (orange, grapefruit, other citrus, apple, pineapple and grape juices imported from 18 countries) on monthly per capita data over the period December, 1995, to May, 2005, using the non-linear least squares (LSQ) in the Time Series Processor (TSP) program. Results indicate that the market structure underlying the competition for the Japanese fruit juice market is non-uniformly competitive. Consequently, an exporter can't take market share from another exporter quickly through price reductions. Product promotion and further product differentiation seems to be a more plausible option than a price reduction option for most countries to stay more competitive in Japan's fruit juice market. Nevertheless, Brazil has the most to gain from an increase in the size of the Japanese fruit juice market. The United States citrus industry and the Philippines fruit industry have a competitive advantage in the export of orange and pineapple juices, respectively.

Key words: Competitiveness, Fruit juice, Japan, Relative price version,

INTRODUCTION

Following the deregulation of imports of apple, grapefruit, and pineapple juices as of April 1990 and that of orange juice as of April 1992, the import penetration ratio (the fraction of income spent on imports or the increase in the extent of consumption of imports) of processed fruits into Japan has increased (JETRO). Furthermore, Japan is undergoing a profound change as a result of its aging population. Japan's statistical agency has measured a decline in population growth that is about to become an absolute decline, and population shrank for the first time in 2006 and will gradually fall for a number of years thereafter. The impact of this demographic change on the demand for fruit in Japan is an empirical question, since either the aging affluent consumers may increase consumption of fruits to stay healthy or demand may decrease with the absolute decrease in population size. In either case, the increase of import penetration in the face of an aging population and declining population growth will lead to an increased competition among exporters.

Given that Japan is the second largest economy in the world with a population of about 127 million, importing agricultural products worth over $30 billion each year, this study is useful and relevant to better understand the global fruit juice market. The objectives of this study are to assess the competitiveness of the world's largest exporters of fruit juice into Japan through MSA and to simulate the impact of changes in population growth on the growth rate of demand for fruit juices by country of origin. To this end, the relative price version of the Rotterdam model was estimated.

Global Fruit Trade

International trade in fruits and vegetables has expanded more rapidly than trade in other agricultural commodities, especially since the 1980s (Huang, 2004). This is attributed to rising incomes, falling transportation costs, improved technology, and evolving international agreements. Citrus fruits rank first in international fruit trade in terms of value (UNCTAD). As a result of trade liberalization and technological advances in fruit transport and storage, the citrus fruit industry is becoming more global in scope. The major players in the global trade of fruits and vegetables are the E.U, the North American Free Trade Agreement (NAFTA) countries, China and Japan.

The international trade on fruits and vegetables is dominated by processed forms. Citrus fruit processing accounts for approximately one third of total citrus fruit production. More than 80% of it is orange processing, mostly for orange juice production. The major feature of the world market for orange juice is the geographical concentration of production. There are only two main players: the State of Florida in the U.S. and the State of Sao Paulo in Brazil. Production of orange juice between these two players account for over 80% of world orange juice production (Spreen et al. 2006). The major difference between them is that Brazil exports 99 percent of its production while 90 percent of Florida's production is consumed domestically and only 10 percent is exported (UNCTAD).

The E.U. is the largest importer of orange juice, accounting for over 80% of the world orange juice imports (UNCTAD). The other major importers of orange juice are Canada and Japan. Most of imports by the E.U. and Japan come from Brazil. Brazil's exports of orange juice to Japan account for over 70% of Japan's total import of orange juice (Table 1). In North America, the U.S. and Canada consume orange juice mainly from Florida, while a small quantity of imports comes from Brazil. 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. The U.S. share of grapefruit import is significant. However, the slow growth rate of grapefruit production in U.S. implies that the U.S. is unlikely to continue as a dominant supplier of grapefruit juice. The same is true with apple juice since the apple production growth rate in U.S. is slower relative to other countries such as China. Currently, the U.S. is a dominant supplier of apple juice to the Japanese market, followed by China and Austria. With regard to grape juice, the U.S. is still the dominant supplier and is expected to dominant the market since its production has been growing while that of France and Italy, which are the world's largest producers, has been declining.

Global Fruit Consumption

Fruits are consumed mainly 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 (FAO, 2005).

Among 26 industrialized countries, the U.S. and Canada are the largest consumers of orange and mandarins followed by the EU. In fact, some E.U. countries such as Ireland, the Netherlands and Greece consume more oranges than do the U.S. and Canada on a per capita basis. 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 (Table 2).

Japan's consumption of both citrus (except grapefruit) and non-citrus fruits is small compared to other industrialized countries. 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 (Table 2).

Japan's domestic supply of pineapples is heavily dependent on imports. In 2003, 95% of the domestic supply of pineapples came from imports (FAO, 2005). 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.

Market Structure Analysis (MSA)

A fundamental understanding of the competition for market share involves MSA, which refers to the process of organizing a set of products such that their interrelationships are apparent

(Allenby, 1989) or decomposing product markets into managerially useful partitions (Russel and Bolton, 1988). MSA explains the nature and extent of competition or the extent to which products are substitutes or complements.

MSA in marketing is concerned with identifying closely competing brands of the same product (Clements and Selvanathan, 1988). The identification of market structure is useful for assessing strategic opportunities, developing marketing programs, and assessing market share to evaluate performance (Vilcassim, 1989). 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 non-competitive market structure. Substitute products can be uniform (close) or non-uniform (differentiated). Similarly, 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 are uniform substitutes, consumers are not influenced by the country of origin. They perceive a specific commodity from one country and the same commodity from another country as homogenous. Consequently, price will be the overriding factor in the decision of purchase. In this case, price reduction is recommended to increase market share.

On the contrary, if two products are non-uniform substitutes, consumers are influenced by the country of origin. They perceive a specific commodity from one country and the same commodity from another country as differentiated. Consequently, price will be just one factor affecting consumers' decision of purchase. Product attributes come into play in consumers' decision of purchase. In this case, a non-price marketing strategy (e.g., product promotion) and/or price reduction is recommended to increase market share.

In order to identify the market structure underlying the global competition for the Japanese fruit juice market, we hypothesize that the relationship between any two fruit juices in two different groups is *block wise dependent* and the relationship between any two fruit juices within the same product group is *uniform*. The null hypothesis of block wise dependent relationship states that the marginal utility of a dollar spent on the i^{th} product $(i \in S_g)$ caused by an extra dollar spent on the j^{th} product which belongs to a different group $(j \in S_h, g \neq h)$ equals some constant a_{gh} and the null hypothesis of uniform substitute relationship states that the marginal utility of a dollar spent on the i^{th} product $(i \in S_g)$ caused by an extra dollar spent on the s^{th} product which belongs to the same group $(s \in S_g)$ equals some constant α. This joint hypothesis can mathematically expressed as

(1) $$H_0 : \frac{\partial^2 u(q)}{\partial(p_i q_i)\partial(p_j q_j)} = a_{gh}; i \in S_g; j \in S_h; g \neq h; \qquad \frac{\partial^2 u(q)}{\partial(p_i q_i)\partial(p_s q_s)} = \alpha; \quad \text{for} \quad i, s \in S_G$$

$$H_A : \frac{\partial^2 u(q)}{\partial(p_i q_i)\partial(p_j q_j)} \neq a_{gh}; i \in S_g; j \in S_h; g \neq h; \qquad \frac{\partial^2 u(q)}{\partial(p_i q_i)\partial(p_s q_s)} \neq \alpha; \quad \text{for} \quad i, s \in S_G$$

where $u(q) = u\left(u_1\left(q_{11},...,q_{1n_1}\right),...,u_G\left(q_{G1},...,q_{Gn_g}\right),...,u_M\left(q_{M1},...,q_{Mn_m}\right)\right)$

The joint null hypothesis H_0 defines the uniformly competitive market structure while the alternative hypothesis H_A defines the non-uniformly competitive market structure. The non-uniformly competitive structure involves a competition 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. The uniformly competitive structure involves a competition between products such that the effect of a change in price of a given product in one product group on the demand for another product in another product group is the same to all pairs of products in the two groups. These market structures are derived based on the relationship between the changes in marginal utilities and cross price effects. The changes in marginal utilities (equation 1) are related to cross price effects as $v_{ij} = p_i u^{ij} p_j / m$ where v_{ij} is the specific relative price coefficient; p_i is the price of product i; u^{ij} is the rate of change of marginal utilities; p_j is the price of product j and m is total expenditure. The variation in cross price effects between any two products in two different product groups is explained by the variation in the rate of changes of marginal utilities. The changes in the rate of marginal utilities and hence in cross price effects between any two products in two different product groups in the uniformly competitive market structure are the same while they are different in the non-uniformly competitive market structure.

(1) Uniformly competitive market

This is the case where a product is competing with another product outside its product group such that 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. Further, 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 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 implies that consumers may not pay a different price for products of the same group since they perceive one product as homogenous to the other.

(2) 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.

MATERIALS AND METHODS

Model

The Relative Price Version of the Rotterdam Model

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

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

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

where $\overline{w}_{it} = (w_{it} + w_{i,t-12})/2$ is the average expenditure share ; $dq_{it} = \log(q_{it} / q_{i,t-12})$ is the finite change in quantity imported of product i ; θ_i is the marginal expenditure share of product i ; $dQ_t = \overline{w}_{1t} dq_{1t} + ... + \overline{w}_{18t} dq_{18t}$ is the finite change version of the Divisia price index (real income) ; v_{ij} is the relative (Frisch-deflated) price coefficients; $dp_{jt} = \log(p_{jt} / p_{j,t-12})$ is the finite change in price of product j ; $dP_t = \theta_1 dp_{1t} + ... + \theta_{18} dp_{18t}$ is the finite change version of the Frisch price index; Note that the lower case p is for prices of individual products and the upper case P is for Divisia price indices. ε_{it} is the demand disturbance.

Block-wise Dependent Uniform Substitute Rotterdam Model

The Block-wise dependent uniform substitute Rotterdam model is used to describe the uniformly competitive market structure. It is derived from the relative price version of the Rotterdam model (equation 2) by imposing the joint hypothesis of block wise dependence for products in any two different product groups and uniform substitute relationship for products within the same product group.

Following Theil (1980), the block-wise dependent Rotterdam model can be given as

(3) $$\overline{w}_i dq_i = \theta_i dQ + \sum_{j \in S_g} v_{ij} \left(\frac{dp_j}{dP} \right) + \frac{\theta_i}{\sum_{j \in S_g} \theta_i} \sum_{h \neq g}^{6} V_{gh} \left(\frac{dP_h}{dP} \right) + \varepsilon_i$$

where v_{ij} is the specific relative price coefficients of products within in a group; V_{gh} is group relative price coefficients; dP_h is the Frisch price index of a group, and ε_i is the error term.

Now, following Seale (2003), the relative price coefficients (v_{ij}) in equation (3) are given as

$$
(4) \qquad \begin{cases} v_{ij} = \phi \dfrac{\theta_i^{'}\Theta_{gg}\left(1 - k\theta_i^{'}\Theta_{gg}\right)}{1 - k\Theta_{gg}} & i = j \\[2ex] v_{ij} = -\phi \dfrac{k\theta_i^{'}\Theta_{gg}\theta_j^{'}\Theta_{gg}}{1 - k\Theta_g} & i \neq j \end{cases}
$$

where ϕ is the income flexibility; $\theta_i^{'}$ is the conditional marginal value share, k is a constant; Θ_{gg} is the group marginal value share.

Substituting equation (4) into equation (3), we obtain equation (5) which is called block-wise dependent uniform substitute Rotterdam model.

$$
(5) \qquad \overline{w}_i dq_i = \theta_i dQ + \phi\theta_i\left(\frac{1 - k_i\theta_i}{1 - k_i\Theta_g}\right)\frac{dp_i}{dP} + \phi\sum_{j \neq i \in S_g}\frac{-k_i\theta_i\theta_j}{1 - k\Theta_g}\frac{dp_j}{dP} + \theta_i^{'}\sum_{h \neq g}V_{gh}\frac{dP_h}{dP}
$$

where θ_i is the 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 $g \neq h$. $\Theta_g = \sum_{i \in g}\theta_i$ and $\Theta_h = \sum_{j \in h}\theta_j$ are the Θ_g are the group marginal expenditure shares of group g and h, respectively. ϕ is the income flexibility; k is a constant.

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 December 1995 to May 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. 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 December, 1995 to May, 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.

Analytical Methods

The method used to estimate the model is the non-linear least square (LSQ) in the Time Series Processor Program (TSP 4.5). The LSQ command computes maximum likelihood estimates if it is specified with no instruments and more than one equation (Hall and Cummins, 1999). Since the parameter estimates in this study are generated from a system of demand equations without specifying instruments, they can be taken as maximum likelihood estimates. With normally distributed disturbances (u_{it}), the ML method has all the desirable asymptotical properties of Maximum Likelihood (ML) estimators and, therefore, is asymptotically efficient among all estimators (Greene, 2000). The likelihood ratio test is used to test for autocorrelation.

RESULTS AND DISCUSSION

Descriptive Results

Since Japan's deregulation of imports in the 1990s, the imports of fruit juices have increased with the exception of U.S. apple juice (Table 3). Over the period January, 1995 to May, 2005, the imports of U.S. apple juice has decreased by 17% while that of U.S. orange, grapefruit and grape juices increased by 4%, 12% and 5%, respectively. The highest increase was attained by the ROW grapefruit juice (51%) followed by the Chinese apple juice (31%) and the Israelis grapefruit fruit juice (26%). The analysis of import stability as measured by the coefficient of variation shows that the imports of fruit juices in Japan over the given period have exhibited a significant fluctuation. The fluctuation of imports varies from country to country. U.S. orange and grape juices have experienced the highest fluctuation among U.S. fruit juices.

Over the same period, Japan's import price of all fruit juices has decreased (Table 3). On average, Japan's import price of U.S. orange, grapefruit, apple and grape juices has decreased by 12%, 10%, 7% and 6% per month over the period December, 1995 to May, 2005. Over the same period, apple juice imported from the rest of the world has witnessed the largest price decrease (13%). Among U.S. products, prices of orange and grapefruit juices are relatively more stable than those of the respective competitors' products. The prices of apples are less stable compared to their respective rival products.

Except for Brazilian orange juice (25%) and the ROW apple juice (19%), the average expenditure share of fruit juices in Japan is below 10% (Table 3). Expenditure share of U.S. juices, expressed as a percentage of total fruit juice expenditure, ranges from 6% for apple juice to 8% for grapefruit juice.

Test for First-order Autocorrelation

A test for first order autocorrelation AR (1) was carried out for equation (2) and equation (5), 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 (Table 4), implying that the data is serially correlated. The value of ρ, which is common across equations in each system, is 0.31 for (2) and 0.33 for (5). Both are significantly different from zero ($P<0.001$).

Following the correction for first-order autocorrelation, we tested the joint hypothesis of block wise dependence and uniform substitution with a view to selecting 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 (2) and the block-wise uniform substitute-Rotterdam model (5). The block wise dependent uniform substitute model is a restricted model while the relative price version of the Rotterdam model is an unrestricted model.

The likelihood value of the restricted equation (equation 2) is 4934.79 with 171 degrees of freedom while that of the unrestricted equation (equation 5) is 4813.17 with 39 degrees of freedom (Table 3). The value of the model chi-square is 243.24 which is greater than the critical chi-square value at 1% probability level. Therefore, we reject the null hypothesis, and conclude that the competition between products in different groups is not the same for all pairs of products in the two groups. That is, the relationship between goods in any two groups is not block wise dependent. Further, the relationship between goods within a group is not a uniform substitute. 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. For example, an extra dollar spent on U.S. orange juice, affects the marginal utility of another dollar spent on Thai pineapple juice differently than does it affect the marginal utility of a dollar spent on the Philippines pineapple juice. In other words, the effect of the change in price of U.S. orange juice on the demand for Thai pineapple juice is not the same as that of the effect on the demand for the Philippines pineapple juice. This implies that the country of origin of the pineapple juice is important in consumers' decision of purchase.

Furthermore, we can conclude that 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. The country of origin is important in consumers' choice of products that belong to the same product group. For example, the change in marginal utility of a dollar spent on U.S. orange juice, caused by an extra dollar spent on Brazilian orange juice is not the same as that of the change in marginal utility of a dollar spent on U.S. orange juice caused by an extra dollar spent on the ROW orange juice. This implies that consumers are influenced by the country of origin and thus decide to buy orange juice based on the country of origin.

Therefore, based on the results of the likelihood ratio test (Table 5) the relative price version of the Rotterdam model (2) is chosen. Thus, by default, the market structure of the Japanese fruit juice market is a non-uniformly competitive. This implies that individual products are competing with each other based on the country of origin in a non-uniform fashion. That is, consumers view the specific commodity from one country as differentiated from the same commodity from other countries. In summary, the country of origin is taken into account by consumers when they choose between products that belong to different product groups and also when they choose between products that belong to the same product group.

Parameter Estimates of the Selected Model

Table 6 presents the relative (Frisch-deflated) price coefficients v_{ij} and marginal value shares θ_i and the coefficient of income flexibility ϕ. The relative price coefficients measure the specific substitution effect which accounts for the n price changes on the demand for the i^{th} product, or equivalently, the effect of such a change when the marginal utility of income remains constant.

If the relative price coefficients v_{ij} and v_{ji} are both positive, it means that an increase in the relative price of either product raises the demand for the other, and thus the two products are called specific substitutes. Similarly, if v_{ij} and v_{ji} are both negative, it means that an increase in the relative price (opportunity cost) of either product reduces the demand for the other, or thus the two products are called specific complements.

Table 6 shows that most of the products are substitutes, and hence there is competition between countries exporting those products. However, contrary to expectation, the cross price effects of products that belong to the same group are not necessarily greater than the cross effects of products that belong to different product groups. For example, the cross price effect of U.S. grapefruit/ROW grapefruit juice is smaller than that of U.S. grapefruit /U.S apple juice. Furthermore, products that belong to the same product group are not necessarily substitutes. For example, U.S. apple/ROW apple that belong to the same product group are complements.

Expenditure Elasticities

The value of the expenditure elasticity of the marginal utility of income is $1/\phi$= -0.5517. This estimate is consistent with the estimates of Frisch (1959) for the richest section of the population. According to Frisch (1959), a value of $1/\phi$=-0.7 is for the better off part of the population. Since Japanese consumers are among the richest in the world, a value of $1/\phi$= -0.5517 obtained in this study is a reasonable estimate for Japan.

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 positive except for those of the Israelis grapefruit juice and the ROW pineapple juice (Table 7). However, the expenditure elasticity of Israel's grapefruit juice is statistically insignificant while that of the ROW pineapple juice is statistically significant. Thus, we can conclude that the Israelis grapefruit juice is not an inferior product while that of the ROW pineapple juice is an inferior product.

Among the 18 fruit juices, only the demand for Brazilian orange juice is expenditure elastic (2.7522). All four major fruit juices (orange, grapefruit, apple and grape juices) that the U.S. exports to Japan are expenditure inelastic, implying that there is less preference for the U.S. juices. The expenditure elasticities of U.S. exports range from 0.1302 for grape juice to 0.8252 for apple juice. The demand for these products exported by the ROW is also expenditure inelastic.

The high expenditure elasticity of Brazilian orange juice and low expenditure elasticities of U.S. and the ROW products is not surprising given that Brazil's share of the total import expenditure is very high compared to that of other countries. The average expenditure share of Brazilian orange juice is 25% while that of U.S. ranges from 5% for apple juice to 8% for grapefruit juice. The average expenditure share of fruit juices imported from the ROW is the smallest except for that of apple juice, which accounts for about 17% of the total import expenditure on imported fruit juices. The major exporting country of apple juice in the category of the ROW is Austria.

Given that Brazilian orange juice makes up the larger proportion of the total imports of fruit juices in Japan, a one percent increase in expenditure on imported fruit juices results in a far greater increase in actual imports; and, its 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 goes to recession, or expenditure growth slows down, Brazil will be worse off because, a given percentage decrease in expenditure on imported fruit juices results in a far greater decrease in actual imports; and its market share would decrease further upon the contraction of the market of imported fruit juices over time because of its larger expenditure elasticity. The fact that recession has been more frequent in Japan over the past few years requires Brazil to devise an effective export strategy which takes account of the performance of the economy.

In addition to recession, 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 has turned negative in 2006 (Statistics Bureau of Japan). With per capita income growing at 2% per annum and assuming that it will remain constant until 2020, and population growth starting to take negative rate since 2006, the growth of demand for fruit juices imported into Japan is projected (Table 8). The growth of demand for fruit juice in Japan is positive except for that of Israelis grapefruit juice over the over the period 2006 through 2014. The demand for Israelis grapefruit is negative not only due to the population growth but also negative expenditure elasticity. Products which have positive expenditure elasticity will continue to grow at a declining rate regardless of the negative growth of population except for U.S. grape juice and Israelis and Italian other citrus juices. From the result of the simulation, it appears that grape and other citrus juice will be more affected than the other juices. The demand for Brazilian orange juices declined from 5.53% in 2005 when the growth of population was 0.3% to 5.49% in 2006 when the growth of population turned negative. It will continue to shrink over the period 2006 through 2020 while the demand for U.S. orange is projected to shrink at 1.12.9 to 0.66% over the same period.

Among U.S. products, apple juice will grow at a higher rate (more than 1%) while grape juice will grow at the smallest rate (less than 0.25%). 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 increase in the growth of per capita income will offset the decrease in population growth so that the decline in the growth of demand may be checked. If income grows at more than 2%, demand may increase, though population growth slows down. 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. If both move in the same direction, the decline of the growth rate of demand for fruit juices will be greater.

Own-price Elasticities

In order to assess the responsiveness of Japan's imports to changes in prices, two types of own-price elasticities (uncompensated and compensated) were calculated. Results indicate that both uncompensated and compensated own price elasticities of the demand for fruit juices in Japan are all negative and statistically different from zero except for the ROW apple juice (Table 9). Among the 18 fruit juices, four fruit juices are price elastic and two are unitary price elastic. These are Philippine pineapple juice, U.S. orange juice, the ROW orange juice, Italian other citrus juice, Israelis other citrus juice and Brazilian orange juice. Of these, the demand for the Philippines pineapple juice is the most price elastic (-3.0543) followed by that of the U.S. orange juice (-1.5774), the ROW orange juice (-1.4521), and Italian other citrus juice (-1.1745). The demand for Brazilian orange juice (-1.0109) and Israelis other citrus juice (-1.0039) are unitary price elastic.

Although the absolute value of uncompensated price elasticities of most of the fruit juices are higher than that of the respective compensated price elasticities, the magnitude of difference between the two elasticities is very small. Some notable exceptions are Brazilian orange juice, U.S. orange juice, U.S. grapefruit juices, and U.S. apple juice. These products have a relatively larger income effect. Suffice to mention the high expenditure elasticity of the Brazilian orange juice. The uncompensated price elasticity of Brazilian orange juice is -1.01096 while that of compensated price elasticity is -.311240. This large difference is due to a large income effect. This is apparent in the large expenditure elasticity of the Brazilian orange juice (2.7522). Based on the magnitude of differences between the two elasticities, one can see which products have a relatively larger income effect.

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 December, 1995 to May, 2005. Results indicate that more compensated cross price elasticities are statistically significant than uncompensated price elasticities, and most products are substitutes. This is consistent with Hick's second law of demand.

Results indicate that Brazilian orange juice/U.S. grapefruit juice, Brazilian orange juice/U.S. apple juice, Brazilian orange juice/Thai pineapple juice, Brazilian orange juice/ROW grape juice, and Brazilian orange juice/ROW other citrus juice are gross complements and net substitutes. Normally, we expect these products to be net substitutes. However, they are also gross complements because of the strong income effect of the Brazilian orange juice. In other words, when the prices of U.S. grapefruit juice, U.S. apple juice, Thai pineapple juice, ROW grape juice and ROW other citrus juice fall, the substitution effect may be so small that the consumer purchases more of Brazilian orange juice and less of the other juices.

Products which are net substitutes and thus belong to the same market structure include U.S. orange juice/Brazilian orange juice and U.S. orange juice/Philippines pineapple juice, U.S. apple juice/Philippines pineapple juice (Table 10). Products which have complementary relationship include Israelis grapefruit juice and Thai pineapple juice (Table 11).

A decrease in the price of Brazilian orange juice has a larger negative effect on the quantity demanded of U.S. orange juice. However, the decrease in the price of U.S. orange juice has a very small negative effect on the demand for Brazilian orange juice. This is not unexpected given that Brazil has the highest market share (25%) in Japan's market. Because of its high market share, it can influence the juice market in Japan. However, since the demand for Brazilian orange juice is compensated price inelastic and less uncompensated price elastic than that of U.S. orange juice, Brazil does not have a reason to decrease the price of its orange juice. The benefit to Brazil comes mainly from the increase in the level of income because of its high expenditure elasticity.

Another important product to which U.S. orange juice is a substitute is the Philippines pineapple juice. A decrease in the price of U.S. orange juice has a larger negative effect on the quantity demanded of the Philippines pineapple juice while a decrease in the price of the Philippines pineapple juice has a very small negative effect on the demand for U.S. orange juice. This implies that the U.S. may take some market share from the Philippines pineapple juice should the price of the Philippines pineapple juice remain constant. Nonetheless, given that the demand for both U.S. orange juice and the Philippines pineapple juice are price elastic, both have reasons to decrease price to raise total sales. The move by both countries to decrease price will positively impact the demand for their respective products.

Similarly, the U.S. orange juice is also a substitute to U.S. apple juice, which, in turn, is a substitute to U.S. grapefruit juice, and vice versa. U.S. grapefruit juice is also a substitute to the ROW grapefruit juice. Since all of them are price inelastic, the change in price of one product will not have a big impact on the demand for other product.

A decrease in the price of Brazilian orange juice has a larger negative effect on the quantity demanded of the ROW pineapple juice. However, the decrease in price of the ROW pineapple juice has a very small negative effect on the demand for Brazilian orange juice.

Nonetheless, given that the demand for Brazilian orange juice is compensated price inelastic, the decrease of Brazilian orange juice is disadvantageous to both Brazil and the ROW. This is because consumers don't significantly increase the consumption of Brazilian orange juice in spite of price decrease. The best option for both countries is to increase price. This will, however, benefit the ROW more if Brazil increases the price of its orange juice.

Similarly, a decrease in the price of U.S. grape juice has a larger negative effect on the quantity demanded of Argentinean grape juice. However, the decrease in price of the Argentinean grape juice has a very small negative effect on the demand for U.S. grape juice. Nonetheless, given that the demand for grape juice from both countries is price inelastic, the move by either country to decrease the price of its grape juice is disadvantageous to both of them. This is because consumers don't significantly increase the consumption of grape juice in spite of a decrease in the price. Hence, the product option for both countries is to raise price. This will, however, benefit Argentina more if the U.S. increases the price of its grape juice.

Given that most of the imported juices are price inelastic, most exporters can't increase their market share at the expense of their rivals through reducing prices. Some notable exceptions are the Philippines pineapple juice, U.S. and ROW orange juice. In conclusion, product differentiation/promotion appears to be a better option to increase market share. Product differentiation will provide exporters with some monopolistic power over their products.

Conclusion and Implications

The main theme of the study is to assess the competition for the Japanese fruit juice market through MSA. To this end, a differential consumer demand approach has been applied. Since competitiveness is associated with the type of market structure, two market structures are considered - the non-uniformly competitive and uniformly competitive. The non-uniformly competitive structure involves a competition 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. The uniformly competitive structure involves a competition between products such that the effect of a change in price of a given product in one product group on the demand for another product in another product group is the same to all pairs of products in the two groups. The analysis of market structure in this study has involved the estimation of two different versions of the Rotterdam model. These are the relative price version of the Rotterdam model and the block-wise dependent uniform substitute-Rotterdam model. The former describes the non-uniformly competitive market structure while the latter describes the uniformly competitive market structure. The models were estimated for six fruit juices (orange, apple, grapefruit, pineapple, grape, and other citrus) imported from 18 countries on data compiled over the period January, 1995 to May, 2005.

Based on the likelihood ratio tests, the relative price version is selected, leading to the choice of the non-uniformly competitive market structure. The 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 export supply plan in light of the expansion and contraction of the Japanese market for imported fruit juices because of the change in income.

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 market 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. Consequently, Brazilian market share will increase upon the expansion of the

Japanese market of imported fruit juices over time. However, under conditions in which the economy goes to recession, or income growth slows down, 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. The fact that recession has been more frequent in Japan over the past few years requires Brazil to devise an effective export strategy which takes account of the performance of Japan's economy.

In addition to recession, the growth of population is another major factor anticipated to affect the demand for imported fruit juices in Japan. The Japanese population growth turned negative in 2006. Consequently, the growth of demand for fruit juices will be slow in the years to come.

Given that the demand for the U.S. orange juice and the Philippines pineapple juice is price elastic, price discounting can be an effective tool for the U.S. citrus industry and the Philippines fruit industry in expanding their exports to Japan. Since the demand for other juices from other countries including Brazil and U.S. (grapefruit, apple, grape juices) 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 exporting country of the respective product. These 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. Some notable exceptions are the U.S/Brazilian orange juice and U.S. apple/Philippines pineapple 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. Nonetheless, if the current market structure changes to other market structures, Brazil may a have a reason to decrease its price if the demand for its product under that structure becomes price elastic. 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 by introducing new technologies that reduce costs. 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.

Similarly, the Philippines fruit industry should pay close attention to the development of the U.S. orange and apple sector. In particular, further reductions in the cost of production, processing or marketing activities of the U.S. orange and apple juices, if not matched by decreases in the Philippines pineapple juice can have adverse effects on the demand for the Philippines pineapple juice. Generally, because of the low cross price elasticities of fruit juices in Japan, product promotion and further product differentiation seems to be a more plausible option than a price reduction option for most countries to stay more competitive in Japan's fruit juice market.

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Table 1 Fruit juice imports to Japan by country of origin

product	Exporter	%
Orange juice	Brazil	72.4
	U.S.	23.7
	Australia	1.4
Apple juice	U.S.	22.4
	China	18.9
	Austria	18.6
Grapefruit juice	U.S.	87.1
	Israel	9.6
	Australia	2.4
Grape juice	U.S.	46.9
	Brazil	14.1
	Argentina	11.7
Pineapple juice	Thailand	42.4
	USA	28.6
	The Philippines	27.6
Other citrus juice	Israel	40.5
	Italy	21.8
	Argentina	13.9

Table 2 Per capita consumption of fruits in industrialized and developing countries

Fruits	Developing countries	Industrialized Countries	E.U.	Canada	Japan	U.S.
Orange and mandarins	8.00	29.23	27.52	46.28	13.80	39.87
Grapefruit	0.32	2.91	2.17	4.05	2.49	4.12
Lemons and limes	1.25	3.59	3.78	2.60	0.84	5.26
Apples	4.67	20.3	24.82	18.82	11.58	21.02
Grapes	2.20	7.60	8.67	10.19	2.79	8.18
Pineapples	2.01	3.61	1.97	2.61	1.43	7.01

(Source: FAO, 2005)

Table 3 Fruit juice quantity and price log-changes, and expenditure shares, Japan, December 1995 to May 2005

Imports	Quantity log-changes $dq_i = \log(q_{it}/q_{i,t-1})$		Price log-changes $dp_i = \log(p_{it}/p_{i,t-1})$		Expenditure shares $(\overline{w}_i)$	
	Mean	SD	Mean	SD	Mean	SD
U.S. oranges	0.0410	0.6701	-0.1155	0.2803	0.0724	0.0335
Brazilian. oranges	0.0982	0.9847	-0.1033	0.2683	0.2542	0.0895
ROW oranges	0.0959	0.8876	-0.0083	0.4210	0.0324	0.0205
U.S. grapefruits	0.1200	0.4909	-0.0979	0.2907	0.0808	0.0302
Israelis grapefruits	0.2617	1.0503	-0.0720	0.5821	0.0259	0.0168
ROW grapefruits	0.5078	1.3739	-0.1149	0.8360	0.0111	0.0104
U.S. apples	-0.1694	0.9249	-0.0690	0.2847	0.0567	0.0422
Chinese apples	0.3176	0.6891	-0.1405	0.2798	0.0727	0.0372
ROW apples	0.0760	0.4059	-0.0946	0.1958	0.1652	0.0510
Thai pineapples	0.1549	1.0317	-0.0572	0.3934	0.0109	0.0058
Philippines pineapples	0.1578	1.7814	-0.0606	0.3713	0.0075	0.0037
ROW pineapples	0.1109	1.5452	-0.0414	0.5171	0.0089	0.0062
U.S. grapes	0.0529	0.5942	-0.0647	0.2890	0.0621	0.0249
Argentinean grapes	0.2792	1.1260	-0.0969	0.3346	0.0091	0.0058
ROW grapes	0.1717	0.4728	-0.0802	0.2584	0.0648	0.0235
Israelis other citrus	0.0861	0.6349	-0.0924	0.3138	0.0220	0.0064
Italian other citrus	0.1756	0.7744	-0.0902	0.2412	0.0172	0.0069
ROW other citrus	0.2032	0.8238	-0.1031	0.5923	0.0250	0.0118

(**Source**: Study data)

Table 4: Test for first-order autocorrelation

Model	Coefficient	Log Likelihood value	$2\left(L(\hat{\theta}) - L(\tilde{\theta})\right)$[a]
Equation (2)	Rho = 0.00	4892.99	83.60***
	Rho = 0.31	4934.79	
Equation (5)	Rho = 0.00	4748.99	128.36***
	Rho = 0.33	4813.17	

Table 5 Model selection

Model	Log likelihood value	Free parameters	$2\left(L(\hat{\theta}) - L(\tilde{\theta})\right)$[a]
Equation (2)	4934.79	171	
Equation (5)	4813.17	39	243.24***

[a] Twice the difference between the log likelihood value for the unconstrained model, $L(\hat{\theta})$, and the log likelihood value for the constrained model, $L(\tilde{\theta})$.

[***] The chi-square critical value is at the 1% significance level.

Table 6 Parameter estimates of cross prices of fruit juices in Japan

Products	Relative price coefficients		Slutsky coefficients	
	Estimates	SE	Estimates	SE
U.S. orange/Brazilian orange	0.0395	0.0296	0.0822***	0.0259
U.S. orange/ROW grapefruit	-0.0089**	0.0040	-0.0086**	0.0040
U.S. orange/U.S. apple	0.0309**	0.0126	0.0338***	0.0128
U.S. orange/Philippines pineapple	0.0087**	0.0044	0.0088**	0.0044
U.S. orange/Israelis citrus	-0.0158**	0.0062	-0.0155**	0.0062
U.S. orange/ROW citrus	-0.0107**	0.0052	-0.0103**	0.0052
Brazilian. orange/Chinese apple	-0.0701***	0.0236	-0.0101	0.0207
Brazilian orange/ROW apple	-0.1769***	0.0402	-0.0754**	0.0354
Brazilian orange/ROW p. apple	0.0304***	0.0099	0.0211**	0.0085
Brazilian orange/Israelis citrus	0.0076	0.9335	0.0134*	0.0080
ROW orange/U.S apple	0.0129**	0.6936	0.0132*	0.0069
ROW orange/ROW apple	0.0216**	0.0103	0.0221**	0.0102
ROW orange/Argentinean grape	0.0036*	0.0022	0.0036*	0.0022
U.S. grapefruit/ROW grapefruit	0.0102***	0.0030	0.0106***	0.0030
U.S. grapefruit/U.S. apple	0.0230**	0.0096	0.0267***	0.0096
U.S. grapefruit/Thai. pineapple	-0.0188***	0.0035	-0.0185***	0.0035
U.S. grapefruit/Philippines pineapple	-0.0146***	0.0034	-0.0144***	0.0034
U.S. grapefruit/U.S. grape	-0.0161*	0.0091	-0.0155*	0.0091
U.S. grapefruit/ROW grape	0.0194**	0.0095	0.0209**	0.0095
Israelis grapefruit/Italian citrus	0.00467**	0.0020	0.0046**	0.0020
ROW grapefruit/Italian citrus	-0.0043***	0.0013	-0.0043***	0.0013
U.S. apple/ROW apple	-0.0445**	0.0178	-0.0377**	0.0176
U.S. apple/Philippines pineapple	0.00649**	0.0031	0.0066**	0.0031
U.S. apple/ROW pineapple	-0.0143***	0.0046	-0.0149***	0.0046
U.S. apple/Argentinean grape	-0.0177***	0.0035	-0.0176***	0.0035
U.S. apple/Israelis citrus	-0.0127***	0.0045	-0.0123***	0.0045
U.S. apple/ROW citrus	0.0097**	0.0047	0.0103**	0.0047
Chinese apple/ROW pineapple	-0.0066	0.0043	-0.0072*	0.0042
Chinese apple/U.S. grape	0.0211**	0.0087	0.0218**	0.0087
ROW apple/Israelis citrus	0.0127*	0.0080	0.0133*	0.0079
Philipp. pineapple/Argentinean grape	0.0050***	0.0019	0.0050***	0.0019
Philipp. pineapple/ROW grape	0.0069*	0.0039	0.0070*	0.0039
Philipp. pineapple/Israelis citrus	0.00477**	0.0021	0.0047**	0.0021
ROW pineapple/Argentinean grape	0.0055***	0.0017	0.0054***	0.0017
U.S. grape/Argentinean grape	0.0108**	0.0043	0.0108**	0.0043
U.S. grape/ROW citrus	0.0085**	0.0039	0.0086**	0.0039

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

Table 7 Expenditure elasticity estimates of fruit juices in Japan

Product	Estimate	SE
US orange	0.4654***	0.1390
Brazil orange	2.7525***	0.1467
ROW orange	0.1047	0.1789
US grapefruit	0.5463***	0.0967
Israel grapefruit	-0.0630	0.2300
ROW grapefruit	0.4603	0.3115
US apple	0.8252***	0.2189
Chinese apple	0.6504***	0.1267
ROW apple	0.4842***	0.0963
Thailand pineapple	0.4048*	0.2158
Philippines pineapple	0.3212	0.2954
ROW pineapple	-0.8262**	0.4060
US grape	0.1301	0.1226
Argentina grape	0.1921	0.2670
ROW grape	0.2912***	0.1031
Israel other citrus	0.2065	0.1491
Italy other citrus	0.1153	0.1582
ROW other citrus	0.2578	0.1649

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

Table 8 Projected growth estimates (%) of the demand for fruit juices in Japan

Year	Population growth rate	U.S. oranges	Brazilian Oranges	U.S. grape fruits	Israelis grape-fruit	U.S. apples	Chinese apples	Thai pine apple	Philipp. p. apples	U.S grapes	Argenti-nean grapes	Israelis citrus	Italian citrus
2005	0.03	0.96	5.53	1.12	-0.09	1.68	1.33	0.83	0.67	0.29	0.41	0.44	0.26
2006	-0.01	0.92	5.49	1.08	-0.13	1.64	1.29	0.79	0.63	0.25	0.37	0.4	0.22
2007	-0.04	0.89	5.46	1.05	-0.16	1.61	1.26	0.76	0.6	0.22	0.34	0.37	0.19
2008	-0.07	0.86	5.43	1.02	-0.19	1.58	1.23	0.73	0.57	0.19	0.31	0.34	0.16
2009	-0.10	0.83	5.40	0.99	-0.22	1.55	1.20	0.7	0.54	0.16	0.28	0.31	0.13
2010	-0.13	0.80	5.37	0.96	-0.25	1.52	1.17	0.67	0.51	0.13	0.25	0.28	0.10
2011	-0.16	0.77	5.34	0.93	-0.28	1.49	1.14	0.64	0.48	0.10	0.22	0.25	0.07
2012	-0.19	0.74	5.31	0.90	-0.31	1.46	1.11	0.61	0.45	0.07	0.19	0.22	0.04
2013	-0.22	0.71	5.28	0.87	-0.34	1.43	1.08	0.58	0.42	0.04	0.16	0.19	0.01
2014	-0.25	0.68	5.25	0.84	-0.37	1.40	1.05	0.55	0.39	0.01	0.13	0.16	-0.01
2015	-0.28	0.65	5.22	0.81	-0.40	1.37	1.02	0.52	0.36	-0.01	0.10	0.13	-0.04
2016	-0.31	0.62	5.19	0.78	-0.43	1.34	0.99	0.49	0.33	-0.04	0.07	0.10	-0.07
2017	-0.35	0.58	5.15	0.74	-0.47	1.30	0.95	0.45	0.29	-0.08	0.03	0.06	-0.11
2018	-0.38	0.55	5.12	0.71	-0.50	1.27	0.92	0.42	0.26	-0.11	0.00	0.03	-0.14
2019	-0.4	0.53	5.10	0.69	-0.52	1.25	0.90	0.40	0.24	-0.13	-0.01	0.01	-0.16
2020	-0.43	0.50	5.07	0.66	-0.55	1.22	0.87	0.37	0.21	-0.16	-0.04	-0.01	-0.19

Table 9 Own price elasticities of fruit juices in Japan

Product	Uncompensated own price elasticities		Compensated own price elasticities	
	Estimate	SE	Estimate	SE
US orange	-1.577***	0.3080	-1.5437***	0.3100
Brazil orange	-1.010***	0.3404	-0.3112	0.3387
ROW orange	-1.452***	0.1649	-1.4487***	0.1648
US grapefruit	-0.5835***	0.1625	-0.5394***	0.1624
Israel grapefruit	-0.5453***	0.1771	-0.5469***	0.1762
ROW grapefruit	-0.7108***	0.1429	-0.7056***	0.1435
US apple	-0.5191*	0.3150	-0.4722	0.3171
Chinese apple	-0.5948***	0.1848	-0.5474***	0.1842
ROW apple	0.0609	0.2284	0.1410	0.2247
Thailand pineapple	-0.8758***	0.1945	-0.8714***	0.1946
Philippines P. Apple	-3.054***	0.2731	-3.051***	0.2730
ROW pineapple	-0.6296**	0.3100	-0.6370**	0.3103
US grape	-0.8484***	0.2029	-0.8404***	0.2029
Argentina grape	-0.6447	0.4223	-0.6430	0.4226
ROW grape	-0.6403***	0.2301	-0.6215***	0.2303
Israel other citrus	-1.003***	0.1928	-0.9994***	0.1925
Italy other citrus	-1.1745***	0.2567	-1.1725***	0.2562
ROW other citrus	*-0.9584****	*0.1061*	-0.9520***	0.1060

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

Table 10 Cross-price elasticity estimates of substitutes

Products	Uncompensated cross price elasticity		Compensated cross price elasticity	
	Estimate	SE	Estimate	SE
US orange/Brazilian orange	1.0173***	0.3634	1.1356***	0.3581
US orange/U.S. apple	0.4404***	0.1756	0.4668***	0.1768
US orange/Philipp. pineapple	0.1186**	0.0612	0.1221**	0.0612
Brazilian orange/U.S. oranges	0.1242	0.1021	0.3236***	0.1020
Brazilian orange/ROW pineapple	0.0583*	0.0334	0.0830**	0.0334
ROW orange/U.S. apple	0.4038*	0.2144	0.4097*	0.2157
ROW orange/ROW apple	0.6669**	0.3216	0.6842**	0.3160
ROW orange/Argent. grape	0.1121*	0.0696	0.1131*	0.0696
U.S. grapefruit/ROW grapefruit	0.1254***	0.0380	0.1315***	0.0382
U.S. grapefruit/U.S. apple	0.3001***	0.1184	0.3311***	0.1191
U.S. grapefruit/ROW grapes	0.2235*	0.1183	0.2589**	0.1184
Israelis g. fruit/Italian citrus	0.1808**	0.0779	0.1797**	0.0776
ROW grapefruit/U.S. grapefruit	0.9143***	0.2781	0.9515***	0.2769
U.S. apples/U.S. oranges	0.5358**	0.2246	0.5955***	0.2256
U.S. apples/ROW. orange	0.2070*	0.1235	0.2338*	0.1231
U.S. apples/U.S. grapefruit	0.4047**	0.1706	0.4714***	0.1695
U.S. apples/Philippines pineapple	0.1116**	0.0558	0.1179**	0.0557
U.S. apples/ROW citrus	0.1614*	0.0847	0.1821**	0.0844
Chinese apple/U.S. grape	0.2601**	0.1198	0.3005**	0.1195
ROW apple/ROW orange	0.1184*	0.0619	0.1341**	0.0619
ROW apple/Israelis other citrus	0.0703	0.0480	0.0810*	0.0479
Philippines pineapple /U.S. orange	1.1434**	0.5806	0.0810*	0.0479
Philippines pineapple /U.S. apple	0.8645**	0.4145	1.166**	0.5846
Philippines pineapple/Argentinean grape	0.6659***	0.2540	0.8828**	0.4171
Philippines pineapple/ROW grape	0.9049*	0.5209	0.6688***	0.2541
Philippines pineapple/Israelis citrus	0.6247**	0.2798	0.9257*	0.5210
ROW pineapple/Brazilian orange	2.5687***	0.9605	2.3586**	0.9501
ROW pineapple/Argentinean grape	0.6218**	0.1958	0.6143***	0.1959
U.S. grape/Chinese apple	0.3425**	0.1406	0.3520**	0.1400
U.S. grape/Argentinean grape	0.1731**	0.0696	0.1743**	0.0696
U.S. grape/ROW citrus	0.1362**	0.0636	0.1395**	0.0636
Argentinean grape/ROW orange	0.3934*	0.2461	0.3996*	0.2461
Argentinean grape/Philipp. pineapple	0.5516***	0.2103	0.5531***	0.2102
Argent. grape/ROW pineapple	0.5975***	0.1909	0.5992***	0.1911
Argent. grape/U.S. grape	1.1695**	0.4713	1.1815**	0.4718
ROW grape/U.S. grapefruit	0.2995**	0.1479	0.3231**	0.1478
ROW grape/Philipp. pineapple	0.1061**	0.0610	0.1083*	0.0609
Israelis other citrus /Brazilian orange	0.5567	0.3710	0.6092*	0.3666
Israelis other citrus /ROW apple	0.5721	0.3642	0.6062*	0.3585
Israelis other citrus /Philipp. pineapple	0.2154**	0.0960	0.2169**	0.0959
Italian other citrus /Israelis grapefruit	0.2672**	0.1171	0.2702**	0.1167
ROW other citrus /U.S. apple	0.3982**	0.1902	0.4129**	0.1914
ROW other citrus /U.S. grape	0.3300**	0.1583	0.3460**	0.1579

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

Table 11 Cross-price elasticity estimates of complements

Products	Uncompensated cross price elasticity		Compensated cross price elasticity	
	Estimates	SE	Estimates	SE
U.S. orange/ROW grapefruit	-0.1246**	0.0560	-0.1194**	0.0563
U.S. orange/Israelis citrus	-0.2249***	0.0865	-0.2146**	0.0862
U.S. orange/ROW citrus	-0.1548**	0.0730	-0.1431**	0.0729
Brazilian orange/ROW orange	-0.1598***	0.0506	-0.0706	0.0503
Brazilian orange/Chinese apple	-0.2401***	0.0823	-0.0398	0.0815
Brazilian orange/ROW apple	-0.7516***	0.1433	-0.2968**	0.1395
Brazilian orange/U.S. grape	-0.2100***	0.0720	-0.0389	0.0712
Brazilian orange/ROW citrus	-0.0835**	0.0360	-0.0145	0.0358
U.S. grapefruit/Thai pineapple	-0.2349***	0.0436	-0.2289***	0.0437
U.S. grapefruit/Philippines pineapple	-0.1826***	0.0430	-0.1785**	0.0430
U.S. grapefruit/U.S. grape	-0.2259**	0.1127	-0.1920*	0.1126
ROW. grapefruit/U.S. orange	-0.8079**	0.3634	-0.7745**	0.3652
ROW. grapefruit/Italian citrus	-0.3978***	0.1204	-0.3898***	0.1200
U.S. apple/ROW apple	-0.8014**	0.3183	-0.6650**	0.3111
U.S. apple/ROW pineapple	-0.2705***	0.0821	-0.2631***	0.0822
U.S. apple/Argentinean grape	-0.3180***	0.0629	-0.3105***	0.0629
U.S. apple/Israelis citrus	-0.2350***	0.0803	-0.2168***	0.0799
Chinese. apple/ROW p. apple	-0.1052*	0.0588	-0.0994*	0.0588
Chinese. apple/ROW grape	-0.2106*	0.1205	-0.1684	0.1206
ROW apple/Brazilian orange	-0.5797***	0.2162	-0.4566**	0.2146
ROW apple/U.S. apple	-0.2560**	0.1061	-0.2285**	0.1069
Thai pineapple/U.S. grapefruit	-1.7249***	0.3230	-1.6922***	0.3229
Philippines pineapple/U.S. grapefruit	-1.9287***	0.4587	-1.9027***	0.4587
ROW pineapple/U.S. apple	-1.6233***	0.5187	-1.6702***	0.5219
ROW pineapple/Chinese apple	-0.7491*	0.4808	-0.8093*	0.4788
U.S. grape/U.S. grapefruit	-0.2603*	0.1468	-0.2497*	0.1465
Argentinean grape/U.S. apple	-1.9336***	0.3870	-1.9227***	0.3894
Israelis other citrus/U.S. orange	-0.7189**	0.2810	-0.7040**	0.2829
Israelis other citrus/U.S. apple	-0.5692***	0.2041	-0.5575***	0.2054
Italian other citrus/ROW grapefruit	-0.2533***	0.0771	-0.2521***	0.0776
ROW other citrus/U.S. orange	-0.4326**	0.2100	-0.4139**	0.2110

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