MGTC 05-02

International Agricultural Trade and Policy Center

IMPORT DEMAND FOR FRESH FRUIT IN JAPAN AND UNIFORM SUBSTITUTION FOR PRODUCTS FROM DIFFERENT SOURCES

By

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MGTC 05-02 **September 2005**

MONOGRAPH SERIES

UNIVERSITY OF FLORIDA

Institute of Food and Agricultural Sciences

INTERNATIONAL AGRICULTURAL TRADE AND POLICY CENTER

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Import Demand for Fresh Fruit in Japan and Uniform Substitution for Products from Different Sources

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1. Introduction

The total value of U.S. exports of fresh fruit increased by nearly 125 percent between 1984 and 1993. As export shares continue to increase, attention is being focused on export-expansion opportunities for fresh fruit produced in the United States. For example, roughly 50 percent of the entire budget allocated to the U.S. Market Promotion Program in 1994 was spent on the development of U.S. horticultural products overseas, 40 percent of which was allocated to industry organizations associated with fresh fruit.

Although the fresh-fruit market has become increasingly important in terms of its contribution to the total value of U.S. agricultural exports, relatively few empirical demand studies have targeted the major U.S. markets for disaggregate fresh-fruit commodities. Most literature on this subject has focused on the demand for aggregate groupings of fruit or vegetables. For example, Sarris (1981 and 1983) estimates income and price elasticities of demand for five broad categories of fruit and vegetables—fresh fruit, dried fruit, processed fruit, fresh vegetables, and processed vegetables—in the European Union. Sparks (1987) estimates a world-trade model for vegetables in which all vegetables and related products are combined into one category.[1] Hunt estimates the import demand for 36 disaggregate fruit and vegetable products from Mediterranean countries by the European Union under the assumptions that demand is a linear function of per-capita income and that market shares are constant. Two

[1]Other studies of the vegetable trade do not employ rigorous empirical estimation techniques and are based on more descriptive or institutional approaches (for example, Montegaud and Lauret; Mackintosh; Seale 1996; Seale, Davis, and Mulkey; Seale, Sparks, and Buxton; Davis and Seale; Kobayoshi (1989a and 1989b); and Fairchild et al.).

studies center on the import demand for fresh apples in the United Kingdom, but apples from the United States are not included in the analysis (Roberts and Cuthbertson; Atkin and Blanford).

Studies that estimate the demand for aggregate groupings of fresh and processed fruit and vegetables are limited in the sense that income and price responses may differ markedly among disaggregate products (e.g., apples, oranges, or orange juice). Through neither general nor specific price-substitution effects, the studies do not take into account the impact demand for one good has on the demand for other goods. Studies analyzing the domestic or import demand for fresh and processed fruit and vegetables at a disaggregate level in a system-wide approach have only recently appeared in the literature.

Four such studies address the issue of aggregate fresh-fruit demand.[2] For instance, Lee, Seale, and Jierwiriyapant analyze the relationships among major suppliers of citrus juices in Japan using a Rotterdam import-allocation model. They show that the Japanese demand for imports of fresh grapefruit from the United States is affected by banana and pineapple imports. Lee, Seale, and Jierwiriyapant also show that the Japanese import demand for U.S. citrus juice is affected by Brazilian and Israeli export competition. Seale, Sparks, and Buxton also apply a Rotterdam model to the import demand for fresh apples in Canada, Hong Kong, Singapore, and the United Kingdom. Except for the case of U.K. imports from Australia, Seale, Sparks, and Buxton show that an increase in the total expenditure on apple imports in each of the major apple-importing countries would increase apple exports in each of the major exporting markets. In addition, they show that a 1- percent increase in the expenditure on fresh apple imports in Hong Kong, Singapore, and the United Kingdom would increase imports of U.S. fresh apples by

[2] The following staff papers on this topic have also been published: Aviphant, Seale, and Lee; and Sparks, Seale, and Buxton.

more than 1 percent in each of these countries. Lee, Brown, and Seale use a nested approach to analyze Canadian fresh-fruit-import and juice-import demand for the 1960 through 1987 period. The approach draws from the Rotterdam demand specification and from an income-variant differential-demand specification developed by Keller and Driel and by Clements. Results indicate that if total expenditures on aggregate Canadian imports of fresh fruit and juices increases, expenditure shares of oranges and apples increase. Furthermore, the results indicate the oranges and grapefruit are substitutes for apples. Hence, an increase in the price of fresh apples would increase the total consumption of citrus, thereby increasing Canadian citrus imports.

Brown applies the uniform-substitutes hypothesis in a differential demand system to analyze weekly retail sales data for nine juice products. Compared to the unrestricted Rotterdam model, Brown found that the only uniform substitutes are ready-to-serve chilled orange juice made from concentrate and ready-to-serve chilled orange juice that is not made from concentrate. However, the demand system developed by Brown is not strictly conditional because it was not developed exclusively under within-group demand conditions.

This study estimates empirically the sensitivity of Japanese fresh-fruit imports to changes in import prices of these commodities from the US and from competitive country substitutes. The study also estimates the sensitivity of import demand for fresh fruits in terms of expenditure changes. Japanese fresh-fruit imports are disaggregated by type and, in some instances, by country. Japanese fresh-fruit imports are separated into seven categories: bananas, grapefruit, oranges, lemons, pineapples, berries, and grapes. Where appropriate, imports of these commodities are also aggregated by country of origin.

Section 2 of this paper provides a brief description of the U.S. fresh-fruit market, its importance relative to other agricultural commodities in the United States, and its role in the international fresh-fruit export market. Section 3 presents background information on the Japanese fresh-fruit market, identifies the major international competitors in Japan's fresh-fruit-import market, and includes a brief discussion of Japanese agricultural trade policy as it applies to fresh fruit. Section 4 describes the different import-demand specifications that are used in the analyses along with their estimation procedures. It also includes a discussion of the Frisch, Slutsky, and Cournot price-elasticity measures and their importance in the interpretation of empirical results obtained under the different specifications. Section 5 identifies various groupings of Japanese fresh-fruit import commodities and the corresponding demand specifications that are applied empirically to each set of groupings. Section 6 provides the empirical results of the analysis of Japanese banana imports by country of origin and compares and contrasts the applicability of the various demand specifications, while section 7 provides the results of the analysis of Japanese grape imports by country of origin. Conclusions are drawn in Section 8.

2. U.S. Fresh-Fruit Market

During the last two decades, fruit production in the United States increased by 27 percent, from 25.1 million tons in 1973 to 31.8 million tons in 1993. The share of fresh-fruit use with respect to total fruit utilization in the United States varied little during that time period. Fresh fruit uses accounted for 26 percent and 25 percent of total U.S. citrus production during 1970 and 1992, respectively, and for 61 percent and 60 percent of total non-citrus U.S. fruit production during 1970 and 1992, respectively. Per-capita consumption of fresh fruit in the United States increased from 101 pounds in 1970 to 123 pounds in 1989, decreased to 113 pounds in 1991, and then increased to 123 pounds in 1992. As the domestic market for fresh fruit evolves, attention turns to export markets for market-expansion opportunities.

Market development is becoming increasingly important for the U.S. fruit industry. Almost U.S. $50 million of the Market Promotion Program's budget was used to promote U.S. horticultural products overseas, which is one-half of the total budget outlay of the former Targeted Export Assistance Program. Fruit-industry organizations, including Washington Apple Commission, Sunkist, California Raisin Board, Florida Department of Citrus, California Avocado Commission, California Kiwifruit Commission, Northeast Cherry Growers, and the California Table Grape Commission were given more than U.S. $20 million.

U.S. exports of fresh fruit have become increasingly important in terms of the U.S. balance of payments and the income growth of U.S. farmers. The results of Table 1 provide an overview of the relative importance of the major aggregate commodity groups associated with U.S. agriculture in terms of total value of exports in 1984 and 1993. From 1984 to 1993, the value of U.S. exports of fresh fruit increased by 125 percent, from U.S. $.75 billion to U.S. $1.71 billion. By 1993, this category accounted for 4 percent of the total value of U.S. agricultural exports compared to 5 percent for beef, 1 percent for pork, 3 percent for poultry, and less than 2 percent for dairy. Only bulk products, such as wheat products (12 percent), feed products (12 percent), and oilseeds (17 percent), comprised a larger percentage of the total value of U.S. agricultural exports in 1993. With respect to the total value of U.S. agricultural exports, the share of fresh-fruit exports doubled during the 1984 to 1993 period while the export share for wheat products, feed products, and oilseed products decreased.

Table 1. U.S. agricultural exports, 1984 and 1993

Product	Value of exports		Percent of Total Exports		Percent of Categories	
	1984	1993	1984	1993	1984	1993
(1)	(2)	(3)	(4)	(5)	(6)	(7)
	------------U.S. $1,000-------------					
Fruit & juices	1,242,961	2,764,195	3.29	6.49	4.39	9.52
Fruit	1,023,154	2,334,565	2.71	5.48	3.61	8.04
Fresh fruit	757,981	1,707,147	2.01	4.01	2.68	5.88
Beef products	469,593	1,995,232	1.24	4.68	1.66	6.87
Pork products	113,288	484,189	0.30	1.14	0.40	1.67
Poultry meats	281,969	1,100,613	0.75	2.58	1.00	3.79
Dairy products	373,698	754,050	0.99	1.77	1.32	2.60
Wheat products	6,740,061	4,908,697	17.83	11.52	23.81	16.91
Feed products	8,204,396	5,174,141	21.70	12.14	28.98	17.82
Vegetables	1,001,542	3,277,480	2.65	7.69	3.54	11.29
Oilseeds	8,369,078	7,270,335	22.14	17.06	29.56	25.04
Tobacco	1,511,067	1,306,067	4.00	3.07	5.34	4.50
Other	9,496,745	13,573,723	25.12	31.86	33.55	46.75
Category	28,307,653	29,034,999	74.88	68.14	100.00	100.00
Total exports	37,804,398	42,608,722	100.00	100.00		

Source: USDA/ERS (1985 and 1993).

In Table 2, we show the value of U.S. fruit and total U.S. agricultural exports by country or region of destination in 1993. During 1993, exports to Asia, Western Europe, and Canada accounted for 42 percent, 17 percent, and 12 percent of total U.S. agricultural exports, respectively. Most U.S. agricultural exports to Asia went to Japan, Taiwan, and Hong Kong.

Japan accounted for more than 50 percent of the entire value of U.S. fresh-fruit exports to Asia and was the largest importer of agricultural commodities from the United States in 1993.

Table 2. U.S. fresh-fruit exports by country of destination, 1993

Region (1)	Value of exports Total agric. exports (2)	All fruit (3)	Fresh fruit (4)	Prepared fruit (5)
	---------------------------------U.S. $1,000----------------------------------			
World	42,608,722	2,334,565	1,707,147	627,418
Canada	5,271,240	728,070	609,373	118,697
Latin America	6,793,745	181,895	141,821	40,074
W. Europe	7,324,113	371,009	144,639	226,371
EC-12	6,838,706	317,397	131,360	186,037
E. Europe	431,803	d.n.a.	d.n.a.	d.n.a.
Former USSR	1,757,643	d.n.a.	d.n.a.	d.n.a.
Asia	18,074,256	1,019,583	796,412	223,171
W. Asia	1,975,862	35,551	18,876	16,675
S. Asia	207,754	d.n.a.	d.n.a.	d.n.a.
Japan	8,728,069	538,684	409,440	129,244
China	376,401	d.n.a .	d.n.a.	d.n.a.
SE Asia	1,549,503	124,269	95,959	28,310
OE Asia	4,865,618	319,656	271,294	48,362
Hong Kong	875,346	160,607	137,199	23,408
Taiwan	2,043,068	138,050	125,465	12,585
Oceania	470,657	15,384	d.n.a.	15,384
Africa	2,485,222	d.n.a.	d.n.a.	d.n.a.
Developed	22,320,115	1,669,876	1,175,539	494,337
Developing	19,897,850	664,013	531,370	132,643

d.n.a. = data not available.
Source: USDA/ERS (1993).

Canada is the largest international market importer of U.S. fresh fruit followed by Japan, Hong Kong, and Taiwan. During 1993, U.S. exports to Canada accounted for 36 percent of total U.S. fresh-fruit exports, while exports to Japan accounted for 24 percent. The combined fresh-fruit exports to Japan and other Eastern Asian countries accounted for 40 percent of total U.S. fresh-fruit exports in 1993.

3. Japanese Fresh-Fruit-Import Market

Japan, with an area of 377,801 square kilometers and a population of 126 million in 1994, has a population density of 332 people per square kilometer. Also, it and has the world’s second largest economy, with a 1992 gross domestic product of 465 trillion yen (U.S. $ 3.7 trillion). The total Japanese food expenditure in 1991 was 51,241 billion yen. In 1992, Japan’s trade surplus reached a record high of U.S. $118 billion and represented 3.2 percent of its gross national product. Many a structural rigidity (e.g., complex distributional channels) remains widespread throughout the Japanese marketing system. These rigidities either impede imports directly or impair their price competitiveness. To address some of these issues, the Japanese government has explored economic stimulus initiatives. The objectives of these initiatives have included deregulation and the transference of a portion of the import price reduction to consumers that resulted from the appreciation of the Japanese yen.

During the last few years, the Japanese government has removed most formal barriers to importing goods and services. Japan’s average industrial tariff rate is one of the lowest in the world, and the country made further reduction offers during the Uruguay Round of the General Agreement on Tariffs and Trade (GATT). The successful conclusion of the Uruguay Round negotiations further reduced formal trade barriers in a number of areas, such as agriculture, manufactured goods, and the services sector. However, formal trade barriers (e.g., tariffs and quotas) are not the major obstacles to Japanese market access. The major obstacles include government red tape, the tolerance of collusive behavior among Japanese firms, exclusionary private-business practices, an outdated and fragmented distribution system, and insular attitudes by both government officials and private businessmen (Balassa and Noland 1988, 49-62). U.S. and Japanese negotiators have concluded agreements recently designed to improve access to

Japanese markets. One example related to agricultural markets is the so-called “Work Plan” concerning U.S. fresh apples (USDA/APHIS 1994; Government of Japan 2002). The purpose of this plan is to facilitate the exportation of fresh apples to Japan.

Most Japanese agricultural imports are subject to an ad valorem duty in addition to other duties. We provide a list of the customs duties on Japanese fresh-fruit imports in 1993, in which we show the basic rate applied to each commodity (Table 3, Column 2). The general ad valorem customs rate for most fresh-fruit commodities at most times of the year was 20 percent, with the exception of bananas (30 percent) and oranges (40 percent) imported from December 1 to May 31. The general customs rate is subject to seasonal adjustment. For example, we show that bananas imported from developing countries from April 1 to September 30 were subject to a general ad valorem tariff of 10 percent, while bananas imported from developing countries from October 1 to March 31 were subject to a general ad valorem tariff of 20 percent (Table 3, Column 4). In addition, there can be certain *temporary* adjustments imposed by Japanese authorities (Table 3, Column 5). For example, the actual 1993 ad valorem tariff rate for Japanese banana imports were raised temporarily to 40 percent for products imported between April 1 and September 30 and to 50 percent for products imported otherwise. As another example, the actual duty on grapefruit was reduced temporarily to 10 percent from all sources during 1993.

We show the 1993 total value and quantity of Japanese imports of bananas, berries, grapes, grapefruit, oranges, lemons, and pineapples (Table 4). Japanese consumers spent 52.9, 23.7, 17.3, 13.9, 5.8, 2.9, and 2.1 billion yen on imports of bananas, grapefruit, oranges, lemons, pineapples, berries, and grapes, respectively. Bananas were by far the most important Japanese fresh-fruit import in 1993 and accounted for 52.9 billion yen in total value (913.3 million tons of

Table 3. Customs duties on fresh fruit entering Japan, 1993

Commodity (1)	General (2)	GATT (3)	Preferential (4)	Temporary (5)	Description (6)
	------------	percent	---------------		
Apples	20				
Bananas	(30)				
			10% free	40	If imported during the period from April 1 to September 30.
			20% free	50	If imported during the period from October 1 to March 31.
Berries	20	10			
Cherries	20	10		10	
Grapes	20				
		(13)		13	If imported during the period from November 1 to the last day of February.
Grapefruit	(20)			10	
		(12)			If imported during the period from June 1 to November 30.
		(25)			If imported during the period from December 1 to May 31.
Lemons and limes		(20)	(5%) free		
Mandarins		20			Including tangerines, satsumas, clementines, wilkings and other similar citrus hybrids.
Melons	(20)			10	
Oranges	20	(20)			If imported during the period from June 1 to November 30.
	40	(40)			If imported during the period from December 1 to May 31.
Pears and quinces	20	8			
Pineapples	20				

Note: The general rate is the basic rate. If and when no other rates are set, this rate should be applied to imports, regardless of the exporting country. The rates in parentheses are temporarily suspended. The GATT rate is reserved for GATT signatory countries. The preferential rate is for the developing countries. The temporary rate is applicable only for that tariff year (Japanese fiscal year, from April 1 to March 31).
Source: UNSO (1994).

Table 4. Japanese fresh-fruit imports, 1993

Fresh Fruit (1)	Value (2)	Quantity (3)
	-billion yen-	-million tons-
Bananas	52.9	913.3
Berries	2.9	3.9
Grapes	2.1	7.8
Grapefruit	23.7	237.5
Oranges	17.3	165.4
Lemons	13.9	89.3
Pineapples	5.8	121.0

Source: USDA/ERS (1993).

total volume); grapefruit, oranges, and lemons were the second, third, and fourth most important fresh-fruit commodities, respectively. The total 1993 value of banana imports was more than twice as high as that of any other fresh-fruit commodity.

Although more than 30 countries export fresh fruit to Japan, only a few of them, however, command significant shares of the Japanese fresh-fruit-import market. Among them, the United States is the largest exporter in terms of both value and volume, followed by the Philippines and Taiwan. We show the average U.S. export share of seven fresh-fruit commodities as a percentage of the total Japanese imports of each commodity from 1970 through 1993 (Table 5). The

Table 5. Average imports of fresh fruit into Japan, 1970 to 1993

Fruit	Total Imports		U.S. Exports		U.S. Share of Total	
	Quantity	Value	Quantity	Value	Quantity	Value
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Bananas	19,284	1,255	0	0	0	0
Grapefruit	3,836	469	3,639	445	95	95
Oranges	1,804	278	1,762	271	98	98
Lemons	2,392	406	2,374	399	99	98
Pineapples	2,421	169	1	0.1	0	0
Berries	35	34	34	32	96	95
Grapes	80	24	52	15	65	60

Note: Quantities and values are in billions of yens and millions of tons. U.S. shares should be divided by 100.
Source: USDA/ERS (1985 and 1993).

United States had more than a 95-percent share of the Japanese import market of grapefruit, oranges, lemons, and berries; they also had and a 60-percent share of Japanese grape imports during the 1970 to 1993 period. Taiwan was a major competitor with the United States for Japanese grape imports. The United States commanded no significant share of the Japanese banana or pineapple import markets during that same period. Taiwan and the Philippines were the major exporters of bananas into Japan from 1970 through 1993. Because bananas comprise the largest share of Japanese fresh-fruit imports, an analysis of the Japanese demand for grapefruit, orange, lemon, berry, and grape imports from the United States is not complete without the inclusion of banana and grape imports from competing countries as potential substitutes for U.S. imports. The next section develops the import-demand models used to construct empirical-demand estimates for Japanese fresh-fruit imports and for selected fruit by country of source.

4. Modeling Import Demand

A new methodological development by Seale (1996) is applied to the Japanese import data. Specifically, empirical demand relationships are estimated under five different econometric specifications. These specifications are developed under a system-wide approach to consumer demand with multistage budgeting. With two exceptions, the empirical analysis relies on the differential demand system developed by Barten (1964) and Theil (1965). The most popular demand system that resulted from the differential approach is known as the Rotterdam model. However, this model is only one particular parameterization adapted from the works of Theil and Barten. The Central Bureau of Statistics (CBS) model developed by Keller and van Driel and by Clements is an alternative parameterization of the differential approach based on the Working model. It assumes that the budget share allocated to each commodity group is a linear function of the logarithm of income whereas the Rotterdam model assumes constant-marginal shares.

A conditional-differential model is developed in this paper under the assumption of blockwise dependence and uniform substitutes in which the imports of a specific commodity from one country are uniformly substitutable for the imports of the same commodity from other countries. This demand representation is more parsimonious in terms of the number of required parameters than are many other specifications. In addition to the differential models, empirical estimates of Japanese fresh-fruit demand are obtained for the Almost Ideal Demand System (AIDS) developed by Deaton and Muellbauer and the AIDS income-variant National Bureau of Research (NBR) specification developed by Neves. These five demand specifications and the results of their empirical application to disaggregate Japanese fresh-fruit imports are compared and contrasted below.

In general, the two most popular demand systems used in the agricultural economics profession are the Rotterdam (Barten 1964; Theil 1965) and the AIDS (Deaton and Muellbauer) models. The Rotterdam model takes the form (with time subscripts omitted for convenience)

$$w_i d\log q_i = \theta_i d\log Q + \sum_j \pi_{ij} d\log p_j, \qquad i = 1, 2, \ldots, n, \tag{1}$$

where $w_i = \left(w_{it} + w_{i,t-1}\right)/2$ represents the average value share for commodity i with subscript t representing time; $d\log q_i = \log\left(q_{it}/q_{i,t\text{-}1}\right)$ is the log change in the consumption level for commodity i; $d\log p_i = \log\left(p_{it}/p_{i,t-1}\right)$ is the log change in the price for commodity i; and $d\log Q$ is an index number (Divisia volume index) for the change in real income and can be written as

$$d\log Q = \sum_i w_i d\log q_i. \tag{2}$$

The demand parameters θ_i and π_{ij} are given by

$$\theta_i = p_i\left(\partial q_i/\partial m\right);\ \ \pi_{\text{ij}} = \left(p_i p_j/m\right)s_{ij};\ \ \text{and } s_{ij} = \partial q_i/\partial p_j + q_j\partial q_i/\partial m, \tag{3}$$

where m is total outlay or the budget and s_{ij} is the $(i, j)^{\text{th}}$ element of the Slutsky substitution matrix. The parameter θ_i is the marginal budget share for commodity *i*, and π_{ij} is a compensated price effect. The constraints of demand theory can be applied directly to the parameters of the Rotterdam model. In particular,

$$\text{Adding-up} \qquad \sum_i \theta_i = 1, \sum_i \pi_{ij} = 0; \tag{4}$$

$$\text{Homogeneity} \qquad \sum_j \pi_{ij} = 0;\ \text{and} \tag{5}$$

$$\text{Slutsky Symmetry} \qquad \pi_{ij} = \pi_{ji}. \tag{6}$$

The Rotterdam model is a particular parameterization of a system of differential demand equations, where the demand parameters $\theta_i s$ and $\pi_{ij} s$ are assumed to be constant. However, there is no strong *a priori* reason that $\theta_i s$ and $\pi_{ij} s$ should be held constant. An alternative parameterization is based on the Working Engel model

$$w_i = \alpha_i + \beta_i \log m,\ \ i = 1, 2, \ldots, n. \tag{7}$$

As the sum of the budget shares is unity, it follows from Equation (7) that $\sum \alpha_i = 1$ and $\sum \beta_i = 0$. To derive the marginal shares implied by the Working model, one multiplies Equation (7) by *m* and then differentiates with respect to m, which results in

$$\partial\left(p_i q_i\right)/\partial m = \alpha_i + \beta_i\left(1 + \log_m\right) = w_i + \beta_i. \tag{8}$$

Hence, under the Working model, the i^{th} marginal share differs from the corresponding budget share by β_i, because the budget share is not constant with respect to income or to the associated-marginal share.

The income elasticity corresponding to Equation (8) is

$$\eta_i = 1 + \beta_i / w_i . \tag{9}$$

This expression indicates that a good with positive (negative) β_i is a luxury (necessity). As the budget share of a luxury increases with income (prices remaining constant), it follows from Equation (9) that increasing income causes the η_i for such a good to fall toward 1. The income elasticity of a necessity also declines with increasing income under Equation (9). Accordingly, as the consumer becomes more affluent, luxury and necessity goods become less luxurious under the Working model, which is a plausible outcome. If $\beta_i = 0$ the good is unitary elastic and the budget share will not change in response to income changes (again, with prices held constant).

Replacing θ_i in Equation (1) with Equation (8) and rearranging terms, one obtains

$$w_i \left(d \log q_i - d \log Q \right) = \beta_i d \log Q + \sum\nolimits_j \pi_{ij} d \log p_j , \tag{10}$$

where β_i and π_{ij} are assumed constant coefficients (Keller and van Driel; Clements). Following Keller and van Driel, Equation (10) will be referred to as the CBS model.

The AIDS model, another specification, is

$$w_i = \alpha_i + \sum\nolimits_j \gamma_{ij} \log p_j + \beta_i \log\left(m/P \right), \tag{11}$$

where P is a price index defined by

$$\log P = \alpha_0 + \sum \alpha_k \log p_k + \tfrac{1}{2} \sum\nolimits_k \sum\nolimits_1 \gamma_{k1} \log p_k \log p_1 .$$

The adding up restriction requires that

$$\sum_i \alpha_i = 1, \ \sum_i \beta_i = 0, \text{ and } \sum_i \gamma_{ij} = 0;$$

homogeneity is satisfied if and only if

$$\sum_i \gamma_{ji} = 0;$$

and symmetry is satisfied provided that

$$\gamma_{ij} = \gamma_{ji}.$$

By approximating P by Stone's price index and the logarithmic change in Stone's price index by the Divisia price index $\sum_i w_i d \log p_i$, Equation (11) can be expressed in differential form (Deaton and Muellbauer; Barten 1993)

$$dw_i = \beta_i d \log Q + \sum_j \gamma_{ij} d \log p_j. \tag{12}$$

As shown by Barten (1993)

$$\beta_i = \theta_i - w_i, \text{ and}$$

$$\gamma_{ij} = \pi_{ij} + w_i \delta_{ij} - w_i w_j,$$

where δ_{ij} is the Kronecker delta equal to unity if $i = j$ and zero otherwise. Note that the CBS system has the AIDS income coefficients $\beta_i s$ and the Rotterdam price coefficients $\pi_{ij} s$. Also, if all units of analysis face the same prices, the CBS and AIDS models collapse to the simple Working model.

Another alternative, the NBR model (Neves), can be derived by substituting $\theta_i - w_i$ for β_i in Equation (12) so that it has the Rotterdam income coefficients but uses the AIDS price coefficients. Specifically, the NBR model is

$$dw_i + w_i d \log Q = \theta_i d \log Q + \sum_j \gamma_{ij} d \log p_j, \tag{13}$$

and the NBR and the CBS models can be considered as income-response variants of the Rotterdam and AIDS models, respectively.

These four models are not nested, but a General model that nests all four models can be developed (Barten 1993). Specifically, the General model is

$$w_i d\log q_i = \left(d_i + \delta_1 w_i\right) d\log Q + \sum_j e_{ij} d\log p_j$$

$$+\delta_1 w_i d\log Q - \delta_2 w_i \left(d\log p_i - d\log P\right);\quad i = 1,2,\ldots,n, \qquad (14)$$

where δ_1 and δ_2 are two additional parameters to be estimated, and $d\log P = \sum_i w_i d\log p_i$ is the Divisia price index. Note that Equation (14) becomes the Rotterdam model when both δ_1 and δ_2 are restricted to zero; it becomes the CBS model when $\delta_1 = 1$ and $\delta_2 = 0;$ it becomes the AIDS model when $\delta_1 = 0$ and $\delta_2 = 1;$ and it becomes the NBR model when $\delta_1 = 1$ and when $\delta_2 = 1.$ The demand restrictions on Equation (14) are

Adding-up $\quad \sum_i d_i = 1 - d_i$ and $\sum_i e_{ij} = 0;$

Homogeneity $\quad \sum_j e_{ij} = 0;$ and

Symmetry $\quad e_{ij} = e_{ji}.$

Although Barten's (1993) model in Equation (14) is more flexible than the other four models, it contains the budget share w_i on the left-hand side of the equation; therefore, it is used only as a model selection tool and not as a demand system in this study.

Note that nested models, which meet either homogeneity or symmetry conditions, can be derived from Equation (3). The likelihood ratio test (LRT) for the hypotheses of homogeneity in Equation (5), symmetry in Equation (6), and for model selection is

$$\text{LRT} = -2\left[\log L\left(\theta^*\right) - \log L\left(\theta\right)\right],$$

where θ^* is the vector of parameter estimates with the restrictions imposed, θ is the vector of parameter estimates without the restrictions, and $\log L(\cdot)$ is the log value of the likelihood function. For example, under the null hypothesis of Equation (5) or Equation (6), the test statistic LRT has an asymptotic $\chi^2(q)$ distribution, where q is the number of restrictions imposed (that is, the degree of freedom equal to the difference between the number of parameters in the models without restrictions and those with restrictions).

4.1. Conditional Geographic Import Demand System

One implication of block independence between domestic and imported goods is that an importing country's utility function is additive, and domestic and imported goods are strongly separable[3]. This means that the marginal utility of an imported good depends only on the consumption of other imports. Thus, the demand for imported goods can be estimated conditionally on total import expenditure and can be estimated independently of demand for domestic goods.

Let imports consist of $g = 1,\ldots,n$ groups with each group consisting of one good bought from n_g countries. The import-allocation problem first involves allocating total expenditure E between domestic and imported goods (first stage); next, allocating total import expenditure E_m among all imported goods (second stage); and finally, allocating expenditure on each good E_g among the n_g supplying countries (third stage). Thus E_i is the expenditure spent on import g from source country

[3]It should be noted that Winters (1984) argued that manufactured import into the UK were not additively separable from domestic manufactured goods.

$(i = 1,\ldots,n_g)$. The preference structure between stages two and three can be represented by blockwise dependence (Theil 1980). This structure enables one to estimate the import demand for good *g* from the n_g countries conditional on E_g, which is the expenditure spent on imported good *g*. Estimation of the conditional-import demand for good g from source i is useful if the researcher is interested in the effects on the conditional trade shares when the consumption volume of the group S_g changes due to a change in total income or when the relative prices for good g among sources change.

Let $q_1,\ldots,q_{n_g}$ and $p_1,\ldots,p_{n_g}$ represent the quantities and prices of good g from the n_g source countries, and $W_g = E_g / E_m$ and $w_i = E_i / E_m$ represent the import shares of group S_g (that is, group g) and of good g from source i, respectively. Define θ_{ij} such that $\theta_{ij} = \left(\mu / \phi E\right) p_i u^{ij} p_j$, where μ represents the marginal utility of income; u^{ij} is the $\left(i, j\right)$th element of U^{-1}, which is the inverse of the Hessian matrix for the utility function (Theil 1980); and ϕ is the income flexibility or the reciprocal of the income elasticity of the marginal utility of income (1/ϕ = (dμ/dE)E/U). Additionally, let $\theta_i = \left(\partial p_i q_i / \partial E\right)$ represent the marginal share of good g from $i \in S_g$, and $\Theta_{gh} = \sum_{i \in S_g} \sum_{j \in S_h} \theta_{ij}$. It follows from $E_g = \sum_{i \in S_g} E_i$ that $W_g = \sum_{i \in S_g} w_i$. Following Theil, Chung, and Seale (1989: Sec. 6.6), it can be shown that the conditional differential import demand for good g from source $i \in S_g$ is

$$w_i^* d\left(\log q_i\right) = \theta_i^* \left(\log Q_g\right) + \sum_{j \in S_g} \pi_{ij}^* d\left(\log p_j\right), \tag{15}$$

where $\theta_i^* = \theta_i / \Theta_{gg}$ is the conditional-marginal-import share for good $i \in S_g$, and p_i is the price of good g from country i such that, letting x_i represent either p_i or q_i, $d\left(\log_{x_i}\right) = dx_i / x_i$. The π_{ij}^*s

are conditional Slutsky price parameters; $d\left(\log Q_g\right)=\sum_{i\in S_g} w_i^* d\left(\log q_i\right)$ is the Divisia quantity index for S_g and $w_i^*=w_i/W_g$. The adding-up condition requires $\sum_{i\in S_g}\theta_i^*=1$ while homogeneity and symmetry require that $\sum_{j\in S_g}\pi_{ij}^*=0$ and π_{ij}^*, $i, j\in S_g$, respectively. By assuming θ_i and π_{ij}^* are constants, we obtain the conditional absolute price version of the Rotterdam model:

$$\bar{w}_{it}^* d\left(\log q_{it}\right)=\theta_i^*\left(\log Q_{gt}\right)+\sum_{j\in S_g}\pi_{ij}^* d\left(\log p_{jt}\right)+\varepsilon_{it}^*, \tag{16}$$

where $\bar{w}_{it}^*=\left(w_{it}^*+w_{i,t-1}^*\right)/2$ and $Dx_{it}=\log x_{it}-\log x_{i,t-1}$, letting x represent q, p, or Q_g. To estimate the system of equations represented by Equation (16), omit one equation and estimate the system's n_g-1 equations. Parameter estimates are invariant to the equation omitted (Barten 1969), and the parameters of the omitted equation can be recovered from $\theta_{ng}^*=1-\sum_{i\neq n_g}\theta_i^*$ (the adding-up condition) and from $\pi_{in_g}=-\sum_{i\neq n_g}\pi_{ij}^*$ (the homogeneity condition). With symmetry imposed, the n_g-1 equations can be estimated jointly using an iterative seemingly unrelated regression (SUR) technique which is maximum likelihood.

4.2. Uniform Substitution and Products Differentiated by Place of Production

Import demand for the same type of good from different sources is an important concern for both importers and exporters in international agricultural markets. In the past several years, two types of import-allocation models have dominated the agricultural economics literature: Armington-type models and system-wide models, such as the Rotterdam and Deaton-Muellbauer models. Armington models were first estimated empirically in the late 1970s (e.g., Grennes, Johnson, and Thursby; Johnson, Grennes, and Thursby) and became increasingly popular in the 1980s and

1990s (e.g., Abbot and Paarlberg; Babula; Duffy, Wohlgenant, and Richardson; Figueroa and Webb; Haniotis; Penson and Babula; and Sarris, 1981 and 1983). Of the system-wide models, the Rotterdam model was first applied to import data differentiated by place of production in the late 1970s (Clements and Theil), while the Deaton-Muellbauer model was first fit to import data by source in the mid-1980s (Winters).

Of these two approaches, the Armington model has become increasingly criticized for both conceptual and empirical reasons. Alston et al. suggest that the two maintained hypotheses of homotheticity and separability of the Armington model might not be supported by import data and recommend that the restrictions be tested. Davis and Kruse (1986) criticize the Armington model more fundamentally by showing that the formulated Armington model did not actually differentiate among the same type of products from different sources; instead it treats them as perfect substitutes. Accordingly, parameter estimates of the import demand for a product differentiated by place of production are biased. However, Davis and Kruse use duality to develop an unbiased primal (empirical) Armington model, which is relatively difficult to estimate and also uses many more degrees of freedom than the traditional one. Their conclusion is that one should choose other functional forms, such as the Rotterdam or the Deaton-Muellbauer models, in lieu of the empirical Armington model.

Although the system-wide approaches do allow more general testing of theoretical restrictions and the use of more flexible functional forms than the Armington model, it is not without cost (Alston et al.). The main empirical advantage of the Armington model is its extreme parsimony with regard to degrees of freedom; only two parameters are needed to estimate the import demand for a product from any number of sources. Thus, this model can be applied to both regional and world import models.

System-wide models, such as the Deaton-Muellbauer and Rotterdam models, require many more degrees of freedom than the Armington model in order to estimate the same import demand problem. System-wide models are well-suited for estimating import demand by source in single import markets but can not be used realistically to develop regional or world models for estimation. For example, both models require $n_g\left(n_g-1\right)/2$ degrees of freedom to estimate the price terms of import demand for the same type of product from n_g countries.[4]

Separability also becomes an issue in estimating system-wide models. The Deaton-Muellbauer model is not separable globally and only becomes separable locally under extremely stringent conditions (Lee, Brown, and Seale; Moschini, Moro, and Green). This makes its use in multistage budgeting questionable. The Rotterdam model is separable globally, so separability conditions can be imposed and tested statistically. This makes it a natural candidate for use in a multistage budgeting problem.

Additionally, separability conditions can be used to restrict the number of parameters needed to estimate an import-demand system. One way to do so is to impose strong separability or preference independence (e.g., Clements and Theil; Seale, Sparks, and Buxton). Although this preference structure is well-suited for estimating consumer or import demand for broad categories of goods, it does not seem plausible that the same type of product differentiated by source of production would be preference independent.

It does, however, seem plausible and defensible that these types of goods would be uniform substitutes. This type of preference structure was introduced by Theil (1980) to describe preferences underlying the demand for similar goods, such as brand names of the same type of good. The hypothesis was applied empirically once by Brown but not for an import-allocation model or for a conditional-demand system. The advantages of this form of separability are many. First, the method recognizes the close similarity and uniform substitutability of the same type of product, such as bananas, from different sources. Further, it is extremely parsimonious in its use of parameters, much like the Armington model. However, unlike the Armington model, the differential approach is based solidly on economic and econometric theory (Winters; Alston et al.; Davis and Kruse).

The model developed by Seale (1996) differs from Theil's (1980) uniform-substitutes formulation because it allows blockwise dependence in the upper stage of the import-allocation problem. It differs from Brown's formulation because the model is an import-allocation model conditional on the total expenditure for the good from all sources. The Seale (1996) model allows estimation of import demand for the same type of good differentiated by place of origin, and it is as parsimonious in its use of degrees of freedom as is the Armington model.

In the next subsection, the methodology—first for a Rotterdam type functional form and later for a Working-type model—is developed and explained. Although these two uniform-substitution models are not nested, a General model that does nest the two models is used to choose statistically between these two competing but non-nested models.

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[4] This is the number of estimated price parameters when homogeneity and symmetry are imposed; without these restrictions, the estimation of these import demand systems would require $(n_g - 1)^2$ estimated price parameters.

4.2.1. Methodology

The restriction that goods differentiated by source are uniform substitutes can be imposed on Equation (16). Under blockwise dependence in the second stage, the conditional Slutsky price parameters are

$$\pi_{ij}^{*} = (\phi_{gg})(\theta_{ij}^{*} - \theta_{i}^{*}\theta_{j}^{*}), \tag{17}$$

where ϕ_{gg} is the Frisch own-price elasticity of the group S_g (Theil, Chung, and Lee 1989). When we impose uniform substitution within group S_g, the $n_g x n_g$ submatrix of the Hessian of the utility function multiplied by $\phi E / \mu$ is equal to

$$\frac{\phi E}{\mu}\left[\frac{\partial^2 u}{\partial(p_i q_i)\partial(p_j p_j)}\right] = \begin{bmatrix} \theta^{11} & k & \dots & k \\ k & \theta^{22} & \dots & k \\ \vdots & \vdots & & \vdots \\ k & k & \dots & n_g n_g \end{bmatrix}, \tag{18}$$

such that the off-diagonal elements $(\text{i.e., } \theta^{ij} = 1/\theta_{ij},\ i \neq j)$ are all equal to a constant and positive value k while the diagonal elements are also positive. Since $\phi E/\mu$ is negative, this type of preference structure implies that the marginal utility of a dollar spent on each good in $S_g\left(\partial u/\partial p_i q_i\right)$ is affected negatively and by the same amount $k\mu/\phi E$ when an additional dollar is spent on any other good in the group. Thus all goods in S_g are affected uniformly by the additional consumption of any other good in the group. The inverse of the expression above is equal to $\left[\theta_{ij}\right]$ and, as shown by Theil (1980),

$$\left[\theta_{ij}\right] = D - \frac{k}{1 + klDl} Dll'D, \tag{19}$$

where $\left[\theta_{ij}\right]$ is the $n_g x n_g$ matrix of $\theta_{ij}s$ for $i,\ j \in S_g$; D is a diagonal matrix with positive diagonal elements; and ι is a vector of ones. Using $\sum_{j \in S_g} \theta_{ij} = \theta_i^* \Theta_{gg}$ in the blockwise dependent case, $\theta_i^* \Theta_{gg} = d_i - \frac{(kl'Dl)d_i}{(1+kl'Dl)}$ or $d_i = (1+kl'Dl)\theta_i^* \Theta_{gg}$ is the ith diagonal element of D. Further, $\sum_{j \in S_g} d_i = l'D' = (1+kl'Dl)\theta_i^* \Theta_{gg}$ which, solving for $l'Dl$, gives us the result that $1 + k\iota' D\iota = 1 \big/ \left(1 - k\Theta_{gg}\right)$. Utilizing the above information, it can be shown that with blockwise dependence among imported groups and uniform substitutes within a group,[5]

$$
\begin{aligned}
\theta_{ij} &= \frac{\theta_i^* \Theta_{gg}\left(1 - k\theta_i^* \Theta_{gg}\right)}{1 - k\Theta_{gg}} \qquad i = j \\
&= -\frac{k\theta_i^* \Theta_{gg} \theta_j^* \Theta_{gg}}{1 - k\Theta_{gg}} \qquad i \neq j.
\end{aligned}
\tag{20}
$$

By summing over $j \in S_g$ and post-multiplying θ_{ij} by $d\left(\log p_j\right)$,

$$
\begin{aligned}
\sum_{j \in S_g} \theta_{ij} d\left(\log p_{\mathrm{j}}\right) &= \frac{\theta_i^* \Theta_{gg}}{1 - k\Theta_{gg}} \left[d\left(\log p_i\right) - k\Theta_{gg} \sum_{j \in S_g} \theta_j^* d\left(\log p_j\right) \right] \\
&= \frac{\theta_i^* \Theta_{gg}}{1 - k\Theta_{gg}} \left[d\left(\log p_i\right) \text{-k}\Theta_{\text{gg}} d\left(\log P_j'\right) \right],
\end{aligned}
\tag{21}
$$

where $d\left(\log P_g'\right) = \sum_{j \in S_g} \theta_i^* d\left(\log p_j\right)$.

Next, subtract $\sum_{j \in S_g} \theta_{ij} d\left(\log P_g'\right) = \theta_i^* \Theta_{gg} d\left(\log P_g'\right)$, yielding

---

[5] Theil (1980: 209–10) shows that, under block independence of the upper group, $\theta_{ij} = \frac{\theta_i\left(1 - k\theta_i\right)}{1 - k\Theta_g}$ for $i = j$ and $-\frac{k\theta_i\theta_j}{1 - k\Theta_g}$ for $i \neq j$.

$$\sum_{j\in S_g}\theta_{ij}d\left(\log\frac{p_j}{P_g'}\right)=\frac{\theta_i^*\Theta_{gg}}{1-k\Theta_{gg}}\Big[d\left(\log p_i\right)-\left(k\Theta_{gg}+1-k\Theta_{gg}\right)d\left(\log P_g'\right)\Big]$$
$$=\frac{\theta_i^*\Theta_{gg}}{1-k\Theta_{gg}}d\left(\log\frac{p_j}{P_g'}\right), \tag{22}$$

which can be related back to the conditional π_{ij}^* (Equation 18) such that

$$\pi_{ij}^*=\left(\frac{\phi\Theta_{gg}}{W_g\left(1-k\Theta_{gg}\right)}\right)\theta_i^*\left(1-\theta_i^*\right) \qquad i=j$$
$$=-\left(\frac{\phi\Theta_{\mathrm{gg}}}{W_g\left(1-k\Theta_{gg}\right)}\right)\theta_i^*\theta_j^* \qquad i\neq j. \tag{23}$$

Further, letting $\phi_{gg}^*=\left(\frac{\phi\Theta_{gg}}{W_g\left(1-k\Theta_{gg}\right)}\right)$, we can make the conditional-uniform substitutes, import-demand model estimatable as

$$\bar{w}_{it}^*Dq_{it}=\theta_l^*DQ_{gt}+\phi_{gg}^*\theta_i^*D\left(\frac{p_{it}}{P_{gt}'}\right)+\varepsilon_{it}^*. \tag{24}$$

One should note that preference independence is a special case of uniform substitutes when $k=0$. Since k and Θ_{gg} are both positive, goods that are uniform substitutes are more price-responsive to changes in the price of other goods in the group than under preference independence. To operationalize Equation (24), we assume that θ_i^* and ϕ_{gg}^* are constants. Because the Rotterdam model is separable globally, it is easy to test asymptotically the restrictions of uniform substitutes and those of homogeneity and symmetry using log-likelihood-ratio tests.[6]

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[6] Laitenen and Meisner show that asymptotic tests of homogeneity and symmetry are biased toward rejection in small samples, respectively; Laitenen developed an exact test for homogeneity, and Meisner suggested Monte Carlo strategies to test for symmetry.

4.2.2. A Competing Uniform Substitutes Model

Although the Rotterdam model is separable globally, it can be tested locally only for homotheticity.[7] Further, its marginal shares are constant so that, as total expenditure increases, the expenditure elasticity for normal goods increases, which is an unacceptable finding (Seale and Theil). One of the strengths of the differential approach is that an explicit functional form for estimation purposes is the last step in making the model estimatable. Although the Rotterdam model treats the marginal shares as constants, there is no *a priori* reason to do so. In fact, economists hypothesize that marginal shares tend to vary with different levels of expenditure.

One way to proceed is to assume that the marginal shares follow those of Working's model, which is

$$w_i = \alpha_i + \beta_i \log E. \tag{25}$$

The marginal share of Working's model for good i is $w_1 + \beta_i$. Consider again the general-conditional differential-demand equation with uniform substitutes imposed

$$w_i^* d\left(\log q_i\right) = \theta_i^* d\left(\log Q_g\right) + \phi_{gg}^* \theta_i^* d\left(\log \frac{p_i}{P_g'}\right). \tag{26}$$

By replacing θ_{i}^* in Equation (27) by $w_i^* + \beta_i$ we have

$$w_i^* d\left(\log q_i\right) = \left(w_i^* + \beta_i\right) d\left(\log Q_g\right) + \phi_{gg}^* \left(w_i^* + \beta_i\right)\left[\left(d \log p_i\right) - \sum_{j\in S_g} \left(w_i^* + \beta_i\right) d\left(\log p_i\right)\right]. \tag{27}$$

---

[7] One could impose homotheticity on Equation (1) by letting $\theta_{it} = w_{it}^*$ in each time period and assuming $\pi_{ij}\left(\forall_{i,j}\right)$ is constant. This, however, would no longer technically be a Rotterdam model, which assumes θ_i equals a constant; consequently, the restriction $\theta_{it}^* = w_{it}^* \forall t$ leads to a model un-nested with the Rotterdam model.

Further simplification and making Equation (28) estimatable yields

$$\bar{w}_{it}^{*}D\left(\frac{q_{it}}{Q_{gt}}\right)=\beta_{i}DQ_{gt}+\phi_{gg}^{*}\left(\beta_{i}+\bar{w}_{it}^{*}\right)\left[Dp_{it}-\sum_{j\in S_{g}}\left(\beta_{j}+\bar{w}_{jt}^{*}\right)Dp_{jt}\right]+\varepsilon_{it}^{**}. \quad (28)$$

Although the model is nonlinear, it can be estimated easily by maximum likelihood with the Aptech program or with time series (TSP). One can also impose homotheticity globally by restricting $\beta_{i}=0\forall i.$ If homotheticity cannot be rejected, the model's parameters simplify to one $\phi_{g}^{*}.$ Accordingly, with homotheticity imposed, this model is competitive with the Armington model in terms of parsimonious use of degrees of freedom. In the current formulation, however, the homothetic restriction can be tested statistically, whereas it is a maintained hypothesis in the Armington model.

Following Barten (1993), one can develop a General-uniform-substitutes model that nests the Rotterdam uniform-substitutes model and the Working-type uniform-substitutes model of Equation (28). The General model necessitates the additional use of one degree of freedom by placing the parameter δ in front of each $\bar{w}_{it}^{*}\forall_{i}$ on the right-hand side of the equation

$$\bar{w}_{it}^{*}Dq_{it}=\left(\beta_{i}+\delta\bar{w}_{it}^{*}\right)DQ_{gt}+\phi_{gg}^{*}\left(\beta_{i}+\delta\bar{w}_{it}^{*}\right)\left[Dp_{it}-\sum_{j\in S_{g}}\left(\beta_{j}+\delta\bar{w}_{jt}^{*}\right)Dp_{jt}\right]+\varepsilon_{it}^{**}. \quad (29)$$

A log-likelihood-ratio test can be used to compare the General model to both the Rotterdam uniform-substitutes model of Equation (24) and the Working-type uniform-substitutes model of Equation (28). If $\delta=0,$ the model is the Rotterdam uniform-substitutes model of Equation (24). However, if $\delta=1,$ the model is that of Equation (28).

4.3. Conditional Expenditure and Price Elasticities

Calculating conditional-expenditure and price elasticities is relatively easy for the uniform-substitutes case. Conditional-expenditure-elasticities are simply the conditional-marginal shares divided by the conditional-average shares, or $\eta_i^* = \theta_i^* / w_i^*$. Three types of conditional-price elasticities can be calculated: Frisch, Slutsky, and Cournot. The conditional Frisch own-price elasticity is

$$F_{ii}^* = \frac{\phi_{gg}^* \theta_i}{w_i^*}; \tag{30}$$

the conditional Slutsky own-price elasticity is

$$S_{ii}^* = \frac{\phi_{gg}^* \theta_i^* \left(1 - \theta_i^*\right)}{w_i^*}; \tag{31}$$

and the conditional Cournot own-price elasticity is

$$F_{ii}^* = \frac{\phi_{gg}^* \theta_i^*}{w_i^*}. \tag{32}$$

It is also possible to calculate conditional Slutsky and Cournot cross-price elasticities of import demand with uniform substitutes, however, the Frisch cross-price elasticities vanish. The conditional Slutsky cross-price elasticity is

$$S_{ij}^* = -\frac{\phi_{gg}^* \theta_i^* \theta_j^*}{w_i^*}, \tag{33}$$

and the conditional Cournot cross-price elasticity is

$$C_{ij}^* = \frac{\phi_{gg}^* \theta_i^* \left(1 - \theta_i^*\right) - \theta_j^* w_j^*}{w_i^*}.$$

For the Working-type uniform-substitutes model, conditional-expenditure elasticities can be calculated as $\eta_i^* = 1 + \beta_i^* / \bar{w}_i^*$, and conditional-price elasticities can be calculated by replacing the θ_i^* in Equation (31) to Equation (35) with $\bar{w}_i^* + \beta_i \forall i$.

5. Analyzing Fresh-Fruit Imports as a Group

In this section, we analyze Japanese import patterns for different fruit. The data are from the United Nations (1994). We present the total average values and quantities of seven groups of imported fresh fruit for Japan from 1970 to 1993 (Table 5). We aggregate these data into four groups of fruit (bananas, grapefruit, oranges, and lemons) plus others (pineapple, berries, and grapes) (Table 6). (Data for each of the seven fruit, by country of source, are presented in Appendix Tables A.1 through A.7.) We estimate the general demand system (Equation 14) unrestricted; with homogeneity imposed; with homogeneity and symmetry imposed; and with homogeneity, symmetry, and unitary-expenditure elasticities imposed. We present the log-likelihood values of these estimations; the numbers in parentheses are the number of parameters estimated for each of the above restriction conditions (Table 7, Column 2). The results show that we fail to reject either of the two economic constraints—homogeneity or symmetry—with any of the five models (i.e., General, Rotterdam, CBS, AIDS, and NBR) (Table 7, Row 1 to Row 3). We do reject unitary expenditure elasticities, homogeneity and symmetry imposed, with the General, CBS, and AIDS models $(\alpha = .05)$.[8]

We present the log-likelihood values of the Rotterdam model with homogeneity and

[8] The Rotterdam and NBR models are not homothetic globally (unitary elastic).

Table 6. Total values and quantities of fresh fruit imports for Japan.

Year (1)	Banana (2)	Grapefruit (3)	Orange (4)	Lemon (5)	Other (6)	Banana (7)	Grapefruit (8)	Orange (9)	Lemon (10)	Other (11)
	Value (millions of Yen)					Quantity (thousands of tons)				
1970	51.89	**.30**	.51	8.69	1.99	843.9	2.3	4.3	54.0	35.6
1971	49.02	1.60	.87	10.61	2.47	988.5	11.4	6.9	62.3	44.4
1972	45.48	10.28	1.41	11.67	3.16	1062.9	91.4	13.5	78.7	71.8
1973	33.42	9.78	1.85	12.93	2.55	931.1	109.7	16.4	91.3	56.7
1974	37.59	14.89	2.47	16.55	2.83	857.2	151.4	20.4	93.0	37.3
1975	48.47	17.77	3.27	14.73	4.35	894.1	146.7	22.1	64.1	55.9
1976	47.77	17.99	3.51	15.32	5.32	832.2	151.8	24.4	92.8	64.0
1977	44.50	19.65	3.10	15.39	6.15	824.9	161.2	22.5	104.7	78.7
1978	37.72	14.77	7.41	17.42	7.46	804.1	142.2	51.0	116.9	103.9
1979	42.51	19.27	9.59	22.99	9.47	790.1	159.4	54.1	100.0	111.7
1980	43.44	17.82	9.63	18.80	11.10	726.1	135.2	71.4	100.7	108.0
1981	49.25	24.49	14.16	18.95	11.62	707.9	166.9	75.5	112.5	124.7
1982	59.96	24.28	18.69	20.86	12.75	757.9	153.7	82.4	104.6	125.0
1983	54.92	24.82	14.89	20.00	11.49	575.9	177.3	89.2	119.6	104.9
1984	60.82	21.29	19.58	21.69	11.70	682.4	157.9	89.1	122.6	118.4
1985	72.13	18.78	21.79	24.07	13.80	680.0	120.8	111.6	113.9	132.6
1986	63.80	21.57	16.53	16.94	14.11	764.6	182.4	117.3	125.8	151.5
1987	53.43	21.93	17.55	17.11	14.24	774.8	204.8	123.4	128.2	152.6
1988	55.54	23.64	16.34	15.87	13.89	760.4	235.0	115.3	118.9	148.6
1989	60.71	31.86	18.55	18.34	14.43	773.7	275.4	128.4	112.3	146.1
1990	60.77	23.26	20.87	18.12	14.97	757.5	156.7	145.2	103.9	143.5
1991	62.62	33.66	18.08	20.58	13.18	803.3	260.8	82.0	89.1	149.0
1992	66.22	31.48	19.61	14.15	12.95	777.2	244.6	171.7	93.4	138.6
1993	52.89	23.73	17.33	13.92	10.88	913.3	237.5	165.4	89.3	132.7

Table 7. General model log-likelihood values and alternatives for five Japanese fresh-fruit imports, 1971 to 1993

Restriction (1)	General (2)	Rotterdam (3)	CBS (4)	AIDS (5)	NBR (6)
	Models				
Unrestricted	264.1(26)	264.1(24)	262.0(24)	258.6(24)	259.3(24)
Homogeneity	262.4(22)	262.4(20)	259.6(20)	255.9(20)	257.3(20)
Symmetry	257.8(16)	257.7(14)	254.7(14)	251.8(14)	253.2(14)
Unitary expenditure elasticities	242.7(11)	n.a.	242.4(10)	240.6(10)	n.a.

n.a. = not applicable.
Note: Number of free parameters for each model is in parentheses.

symmetry imposed and its value when uniform substitution is imposed (Table 8, Column 2). The log-likelihood values of the Rotterdam model are 257.9 (Table 8, Row 1) with homogeneity and symmetry imposed, and 238.5 (Table 8, Row 2) with uniform substitution imposed. The log-likelihood ratio for testing uniform substitution with the Rotterdam model is equal to 38.6, which is greater than its critical chi-square value of 16.9 at the 95 percent confidence level with nine degrees of freedom. Thus, we reject uniform substitution with the Rotterdam model.

We conduct the log-likelihood ratio between the General model with homogeneity and symmetry imposed, and each of the other four models with the same restrictions, which are all nested within the General model. The Rotterdam model was not rejected at the 95 percent

Table 8. Uniform substitution log-likelihood values for five Japanese fresh-fruit imports, 1971 to 1993

Restrictions (1)	General (2)	Rotterdam (3)	Working-type (4)
	Models		
Symmetry	n.a.	257.9(14)	n.a.
Uniform Substitute	240.1(6)	238.5(5)	238.9(5)
Unitary Expenditure Elasticities	225.5(2)	n.a.	225.5(1)

n.a. = not applicable.
Note: The number of estimated parameters for each model is in parentheses.

confidence level, while the CBS model was not rejected at the 90 percent confidence level. The AIDS and NBR models were both rejected at the 90 percent confidence level (the AIDS model fits the data more poorly). One may hypothesize that the AIDS price structure causes the AIDS and NBR models to fit the data more poorly than the Rotterdam and CBS models. Further, the AIDS and NBR models are not separable globally, which makes their use as conditional demand systems unattractive theoretically.

We also impose uniform substitutes on the General, Rotterdam, and Working-type models.[9] We compare the General model to the other two models using log-likelihood ratio tests. When compared to the General model with uniform substitutes, neither the Rotterdam nor the Working-type models are rejected $(a = .05)$. The unitary-expenditure-elasticities restriction is strongly rejected within the General and Working-type models.

As shown above, we reject the restrictions of unitary expenditure elasticities and uniform substitution for the conditional Japanese import demand of the five fresh-fruit varieties. This is not surprising since we do not expect these restrictions to hold for different types of fresh-fruit imports although they might hold for import demand of the same fruit from different sources. We explore this issue further in the next two sections.

The parameter estimates, under the restrictions of homogeneity and symmetry, are reported in Tables 9, 10, and 11 for the General, Rotterdam, and CBS models, respectively. In the General model, expenditure coefficients for grapefruit-other are significantly different from zero $(\alpha = .05)$ and for banana, orange, and lemon when $(\alpha = .10)$. Neither d_1 nor d_2 are significantly different from zero $(\alpha = .05)$. All own-price parameters are negative and significantly different from zero $(\alpha = .05)$,

[9] Again, the AIDS and NBR models are not separable globally.

Table 9. General model (under homogeneity and symmetry) parameter estimates for Japanese fresh-fruit imports, 1971 to 1993

Fruit	Expenditure Coefficient	Slutsky Price Coefficients						
		Banana	Grapefruit	Orange	Lemon	Other	d_1	d_2
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Bananas	.256	-.220	.177	.017	.021	.005	.066	.083
	(.215)[a]	(.074)	(.043)	(.024)	(.031)	(.015)	(.331)	(.266)
Grapefruit	.413	-.258	.049	.010	.022			
	(.073)	(.059)	(.025)	(.024)	(.013)			
Oranges	.088		-.102	.035	.002			
	(.051)		(.035)	(.018)	(.009)			
Lemons	.111			-.071	.006			
	(.068)			(.041)	(.010)			
Other	.067				-.035			
	(.025)				(.019)			

[a]Asymptotic standard errors are in parentheses.

except that of lemon, which is statistically different from zero $(\alpha = .10)$. All cross-price terms are positive with 4 of 10 different from zero at the 95 percent confidence level; one-half are different from zero at the 90 percent confidence level.

The Rotterdam results of Table 10 show that the marginal shares are all different from zero $(\alpha = .05)$ except that of orange; the orange marginal share is statistically different from zero at $(\alpha = .10)$. All own-price parameter estimates are negative, and all cross-price parameter estimates are positive. These latter results suggest that imported fruit are all Hicksian substitutes. All own-price parameters are statistically different from zero $(\alpha = .05)$. Slutsky cross-price parameters are statistically different from zero $(\alpha = .05)$ for banana-grapefruit, grapefruit-banana, grapefruit-orange, and orange-lemon. Finally, grapefruit-other is statistically different from zero $(\alpha = .10)$.

We report the results of the CBS model with homogeneity and symmetry restrictions imposed (Table 11). For the CBS model, an expenditure-parameter estimate greater than, less

Table 10. Rotterdam model (under homogeneity and symmetry) parameter estimates for Japanese fresh-fruit imports, 1971 to 1993

Fruit (1)	Marginal Shares (2)	Slutsky Price Coefficients Banana (3)	Grapefruit (4)	Orange (5)	Lemon (6)	Other (7)
Bananas	.296	-.240	.185	.020	.027	.008
	(.063)[a]	(.040)	(.037)	(.020)	(.023)	(.012)
Grapefruit	.422		-.270	.050	.013	.022
	(.063)		(.047)	(.024)	(.023)	(.013)
Oranges	.092			-.111	.037	.004
	(.048)			(.020)	(.017)	(.008)
Lemons	.120				-.083	.006
	(.045)				(.022)	(.009)
Other	.070					-.040
	(.016)					(.010)

[a]Asymptotic standard errors are in parentheses.

than, or equal to zero indicates an expenditure elasticity greater than, less than, or equal to unity. The expenditure parameter estimates for bananas are negative and different from zero $(\alpha = .05)$, while that of grapefruit is positive and different from zero $(\alpha = .05)$; the other three expenditure parameter estimates are the same as zero $(\alpha = .05)$, with that of lemon being negative and those of orange and other being positive. All own-price parameters are negative and statistically different than zero $(\alpha = .05)$. All cross-price parameters are positive, except that of orange-other.

Table 11. CBS model (under homogeneity and symmetry) parameter estimates for Japanese fresh-fruit imports, 1971 to 1993

Fruit (1)	Expenditure Coefficients (2)	Slutsky Price Coefficients Banana (3)	Grapefruit (4)	Orange (5)	Lemon (6)	Other (7)
Bananas	-.326	-.219	.159	.027	.022	.010
	(.074)[a]	(.048)	(.044)	(.022)	(.024)	(.013)
Grapefruit	.310		-.245	.051	.011	.025
	(.068)		(.054)	(.025)	(.023)	(.013)
Oranges	.040			-.117	.041	-.003
	(.048)			(.019)	(.016)	(.008)
Lemons	-.037				-.087	.012
	(.045)				(.020)	(.009)
Other	.013					-.045

[a]Asymptotic standard errors are in parentheses.

As with the Rotterdam results, cross-price parameters for banana-grapefruit, grapefruit-banana, grapefruit-orange, and orange-lemon are different from zero $(\alpha = .05)$; that of grapefruit-other is different from zero $(\alpha = .10)$.

5.1. Conditional-Import-Expenditure Elasticities

We calculate the conditional-import-expenditure elasticities at the sample mean, using the Rotterdam and CBS results and report them (with asymptotic standard errors in parentheses) in Table 12 (Columns 2 and 3), respectively. All estimates are different statistically from zero $(\alpha = .05)$.

Table 12. Estimated conditional-expenditure-elasticities, Slutsky own-price elasticities and Cournot own-price elasticities for five Japanese fresh-fruit imports calculated at sample means, 1971 to 1993

Imported Fruit	Expenditure Elasticities		Slutsky Own-Price Elasticities		Cournot Own-Price Elasticities	
(1)	Rotterdam[a] (2)	CBS[a] (3)	Rotterdam[a] (4)	CBS[a] (5)	Rotterdam[a] (6)	CBS[a] (7)
Bananas	.61 (.13)[b]	.32 (.15)	-.50 (.08)	-.45 (.10)	-.79 (.10)	-.61 (.12)
Grapefruit	2.36 (.35)	2.73 (.38)	-1.51 (.26)	-1.37 (.30)	-1.93 (.24)	-1.86 (.31)
Oranges	.95 (.50)	1.41 (.49)	-1.15 (.20)	-1.21 (.19)	-1.23 (.22)	-1.35 (.21)
Lemons	.75 (.28)	.78 (.27)	-.52 (.14)	-.54 (.13)	-.64 (.14)	-.67 (.13)
Other	.85 (.20)	1.16 (.20)	-.48 (.12)	-.55 (.13)	-.55 (.13)	-.64 (.13)

[a]Absolute price version with homogeneity and symmetry imposed.
[b]Asymptotic standard errors are in parentheses.

Both the Rotterdam and CBS estimates indicate that the conditional-import-expenditure elasticity for bananas is less than unity, and both indicate that the elasticity of grapefruit is greater than unity with point estimates above 2.0. Based on the CBS model, the point estimates of orange, lemon, and other are greater than those that are based on the Rotterdam model. For example, the CBS point estimates of orange (1.41) and other (1.16) are greater than those based on the Rotterdam model (.95 for lemon; .85 for other). Both models estimate the conditional-expenditure-elasticity for lemon to be about .8. These results indicate that a 1-percent increase in total import expenditures for the five fruit varieties would result in more than a 2-percent increase in grapefruit imports, between a .3 and a .6 percent increase in banana imports, and between a 1.0 and a 1.4 percent increase in orange imports.

This is good news for U.S. grapefruit and orange exporters to Japan since 95 to 99 percent of Japanese grapefruit and orange imports come from U.S. sources; both fruits will increase their conditional shares as expenditure for this group of fresh-fruit imports increases. Japanese lemon imports also come predominantly from U.S. sources (99 percent), and these exporters should see the share of lemon fall slightly as the expenditures for this group increases.

5.2. Slutsky and Cournot Own-Price Elasticities

Fruit exporters are also interested in the responsiveness of import demand to changes in own-price elasticities. Slutsky and Cournot own-price elasticities are calculated at the sample means based on estimates from the Rotterdam and CBS models, homogeneity and symmetry imposed. We report the Slutsky own-price elasticities (Table 12, Columns 4 and 5). We also report the Cournot elasticities (Table 12, Columns 6 and 7) for both the Rotterdam and CBS models. As expected, the Slutsky (compensated) own-price elasticities are smaller (absolute value) than the corresponding Cournot (uncompensated) ones. Pairwise, the Slutsky own-price estimates from the two models are quite close in value, and all estimates are negative. The Slutsky own-price import elasticity estimates for banana, lemon, and other are all different statistically from zero and negative, indicating that their own-price response is inelastic. Those of grapefruit and orange are statistically different from zero, and their point estimates are greater than unity in absolute value, indicating an elastic conditional own-price response. These results are important for exporters of these fruit because they indicate whether or not an own-price change would decrease or increase revenue. For example, the own-price-elasticity estimates of the Rotterdam and CBS models indicate that a 1-percent increase in own-price elasticities would decrease import demand for grapefruit 1.5 and 1.4 percent, respectively. The same increase in orange price would decrease demand for imported oranges by about 1.2 percent as indicated by both models. Accordingly, a price increase for these fruit, *ceteris paribus*, would decrease total revenue. The own-price-elasticity estimates of banana, lemon, and other suggest the opposite. Based on the two models, a 1-percent increase in the own-price elasticities of banana and lemon would also decrease their import demand by .5 percent, while the same increase in the own-price elasticities of other would decrease import demand for other between .5 and .6 percent. Thus, a small increase in price would increase total revenue for banana, lemon, and other.

The Cournot own-price elasticities are calculated by keeping nominal expenditures constant, thus the elasticities are affected by price and income effects. For each fruit, the Cournot estimates are more negative than are the corresponding Slutsky estimates. However, the responsiveness of own-price-elasticity changes is only increased slightly when accounting for expenditure effects of own-price-elasticity changes. For example, point estimates of banana, lemon, and other continue to be inelastic, while those of grapefruit and orange remain elastic but slightly more so. Cournot own-price point estimates for the two models indicate that, from a 1-percent increase in the own-price elasticity, banana imports would decrease between .6 and .8 percent; grapefruit imports would decrease 1.9 percent; orange imports would decrease between 1.2 and 1.4 percent; lemon imports would decrease between .6 and .7 percent; and other imports would decrease .6 percent.

5.3. Conditional Cross-Price Slutsky and Cournot Import Elasticities

It is also important information for fruit exporters to understand the effects on their product's demand of changes in price of other competing fruit. In Table 13, we report the Slutsky and Cournot cross-price elasticities calculated at sample mean for Rotterdam results, and in Table 14 we report the CBS cross-price-elasticity results. Positive Slutsky cross-price elasticities indicate that two products are substitutes while negative (and significant statistically) elasticities indicate complementarity. All Rotterdam-based Slutsky estimates (Table 13) are positive statistically or are zero, which indicates that these products are either substitutes or have no statistical cross- price effects. Of those different statistically from zero $(\alpha = .05)$, banana import demand would increase .4 percent from a 1-percent increase in grapefruit price; grapefruit import demand would increase 1 percent from a 1-percent increase in banana price and would increase .3 percent from a 1-percent increase in orange price; orange import demand would increase .5 percent from a 1-percent increase in grapefruit price and .4 percent from a 1-percent increase in lemon price; and lemon import demand would increase .2 percent from a 1-percent increase in orange price. All the other cross-price responses are zero statistically.

Table 13. Rotterdam model estimated conditional cross-price elasticities for five Japanese fresh-fruit imports calculated at sample means, 1971 to 1993

Imported Fruit	Slutsky Cross-price Elasticities					Cournot Cross-price Elasticities				
	Banana[a]	Grapefruit[a]	Orange[a]	Lemon[a]	Other[a]	Banana[a]	Grapefruit[a]	Orange[a]	Lemon[a]	Other[a]
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Bananas	-	.38 (.08)[b]	.04 (.04)	.06 (.05)	.02 (.03)	-	.27 (.08)	-.02 (.04)	-.04 (.05)	-.03 (.03)
Grapefruit	1.03 (.21)	-	.28 (.14)	.07 (.13)	.12 (.07)	-.10 (.26)	-	.05 (.05)	-.31 (.14)	-.07 (.08)
Oranges	.21 (.21)	.52 (.25)	-	.38 (.17)	.04 (.08)	-.25 (.31)	.35 (.26)	-	.23 (.19)	-.04 (.10)
Lemons	.17 (.14)	.08 (.14)	.23 (.11)	-	.04 (.06)	-.19 (.19)	-.05 (.15)	.16 (.11)	-	-.02 (.06)
Other	.10 (.15)	.26 (.16)	.05 (.10)	.07 (.11)	-	-.31 (.16)	.11 (.16)	-.03 (.10)	-.06 (.12)	-

Estimates are based on parameter estimates from Rotterdam absolute price version with homogeneity and symmetry imposed.
[b]Asymptotic standard errors are in parentheses.

Table 14. CBS model estimated conditional cross-price elasticities for five Japanese fresh-fruit imports calculated at sample means, 1971 to 1993

Imported Fruit	Slutsky Cross-price Elasticities					Cournot Cross-price Elasticities				
	Banana[a]	Grapefruit[a]	Orange[a]	Lemon[a]	Other[a]	Banana[a]	Grapefruit[a]	Orange[a]	Lemon[a]	Other[a]
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Bananas	-	.33	.06	.05	.02	-	.27	.03	-.01	.08
		(.09)[b]	(.05)	(.05)	(.03)		(.10)	(.05)	(.06)	(.03)
Grapefruit	.89	-	.29	.06	.14	-.43	-	.02	-.38	.09
	(.25)		(.14)	(.13)	(.07)	(.30)		(.15)	(.14)	(.08)
Oranges	.28	.53	-	.43	-.03	-.40	.28	-	.20	-.14
	(.22)	(.26)		(.16)	(.08)	(.31)	(.27)		(.18)	(.10)
Lemons	.14	.07	.26	-	.08	-.23	-.07	.18	-	.01
	(.15)	(.15)	(.10)		(.06)	(.19)	(.15)	(.11)		(.06)
Other	.12	.30	-.03	.15	-	-.43	.10	-.14	-.03	-
	(.15)	(.16)	(.10)	(.11)		(.17)	(.16)	(.10)	(.11)	

Estimates are based on parameter estimates from CBS absolute price version with homogeneity and symmetry imposed.
[b]Asymptotic standard errors are in parentheses.

Estimates based on the CBS model (Table 14) suggest that all cross-price elasticities are positive except that of orange-other, which is zero statistically. Point estimates vary, though not widely, from those based on the Rotterdam model. Based on cross-price-elasticity estimates different from zero statistically, a 1-percent increase in grapefruit price (*ceteris paribus* and keeping real expenditure constant) would increase the import demand for banana by .3 percent; for orange by .4 percent; and for other by .3 percent. Likewise, a 1-percent banana-price increase would increase grapefruit demand by .9 percent; a 1-percent orange-price increase would increase grapefruit and lemon import demands by .3 percent; a 1-percent lemon price increase would increase orange import demand by .4 percent; and a 1-percent other price increase would increase grapefruit import demand by .1 percent. All other cross-price responses are zero statistically.

A Cournot cross-price-elasticity measures both price and income effects from changes in another product's price. The expenditure effect can counteract the price-substitution effect, and a Cournot cross-price elasticity can be negative while the corresponding Slutsky cross-price elasticity can be positive. Based on Rotterdam results, this change in sign of point estimates occurred in the case of banana-orange, banana-lemon, banana-other, grapefruit-banana, grapefruit-lemon, orange-banana, orange-other, lemon-banana, lemon-grapefruit, lemon-other, other-orange, and other-lemon. However, none of these negative point estimates are different from zero statistically $\alpha = .05$, except that of grapefruit-lemon (–.3) and other-banana (–.3). Of the Cournot cross-price elasticities different from zero statistically $(\alpha = .05)$, the estimates indicate that banana-import demand would increase .3 percent from a 1-percent grapefruit-price increase; grapefruit-import demand would decrease .3 percent from a 1-percent lemon-price increase; and other import demand would decrease .3 percent from a 1-percent banana-price increase. (The expenditure effects from cross-price changes can be significant when looking at cross-price responsiveness and when keeping nominal income constant.)

Cournot cross-price-elasticity estimates based on the CBS results changed signs less frequently than did those based on the Rotterdam model (discussed above). The following estimates changed signs: banana-lemon, grapefruit-banana, grapefruit-lemon, orange-banana, grapefruit-lemon, orange-banana, lemon-banana, lemon-grapefruit, other-banana, and other-lemon. Of these, grapefruit-lemon (–.4) and other-banana (–.4) are different statistically from zero $(\alpha = .05)$. The cross-price elasticities different statistically from zero $(\alpha = .05)$ indicate (*ceteris paribus* and keeping nominal income constant) the following: a 1-percent grapefruit price increase will increase banana import demand by .3 percent; a 1-percent lemon price increase will decrease grapefruit import demand by .4 percent; and a 1-percent banana price increase will decrease Other import demand by .4 percent. All other cross-price-elasticity estimates indicate no statistical cross-price responses.

5.4. Conditional Expenditure and Own-price Elasticities Through Time

Although elasticities calculated at sample means are informative, it is often useful to see how elasticities change through time. For example, conditional-import-expenditure elasticities are calculated by dividing conditional-import-marginal shares by conditional-import-average shares. Since the Rotterdam conditional-marginal shares are constant by assumption, calculating expenditure elasticities through time that are based on the Rotterdam model can give misleading trends. The marginal-conditional-import shares from the CBS model follow that of the Working (1943) model and vary with changes in conditional-average-import shares. Accordingly, elasticities through time are calculated based on only CBS parameter results and average annual-conditional-import shares.

We report these average annual-conditional-import shares (Table 15). The conditional-import shares of banana and lemon decreased during the 1971 to 1993 period while those of grapefruit, orange, and other increased. Banana shares decreased from .8 percent in 1971 to .4 percent in 1993, and lemon shares decreased slightly from .2 percent to .1 percent during the same period. Import shares of grapefruit increased from .03 percent in 1971 to .2 percent in 1993, and orange and other increased, respectively, from .01 percent and .04 percent in 1971 to .1 percent in 1993 for both. We report the mean-conditional-import shares during the 1971 to 1993 period (Table 15, Row 24).

Table 15. Conditional-import shares of five Japanese fresh-fruit imports, 1971 to 1993

Year (1)	Banana (2)	Grapefruit (3)	Orange (4)	Lemon (5)	Other (6)
1971	.759	.025	.014	.164	.038
1972	.632	.143	.020	.162	.044
1973	.552	.161	.031	.214	.042
1974	.506	.200	.033	.223	.038
1975	.547	.201	.037	.166	.049
1976	.531	.200	.039	.170	.059
1977	.501	.221	.035	.173	.069
1978	.445	.174	.087	.206	.088
1979	.409	.186	.092	.221	.091
1980	.431	.177	.096	.186	.110
1981	.416	.207	.119	.160	.098
1982	.439	.178	.137	.153	.093
1983	.435	.197	.118	.159	.091
1984	.450	.158	.145	.161	.087
1985	.479	.125	.145	.160	.092
1986	.480	.162	.124	.127	.106
1987	.430	.176	.141	.138	.115
1988	.443	.189	.130	.127	.111
1989	.422	.221	.129	.127	.100
1990	.440	.169	.151	.131	.108
1991	.423	.227	.122	.139	.089
1992	.459	.218	.136	.098	.090
1993	.445	.200	.146	.117	.092
Mean	.482	.179	.097	.160	.083

Based on expenditure-parameter estimates from the CBS model and the conditional-import shares reported in Table 15, we report the annual conditional-import-expenditure elasticities for the five-fruit list from 1971 through 1993 (Table 16). Also, we report the mean estimates

Table 16. CBS model (homogeneity and symmetry imposed) estimates for conditional-Import-expenditure elasticities of five Japanese fresh-fruit imports, 1971 to 1993

Year (1)	Bananas (2)	Grapefruit (3)	Oranges (4)	Lemons (5)	Other (6)
1971	.571	13.491	3.984	.773	1.336
1972	.485	3.169	3.055	.770	1.294
1973	.410	2.918	2.316	.826	1.306
1974	.356	2.546	2.210	.833	1.338
1975	.405	2.544	2.092	.776	1.262
1976	.387	2.548	2.033	.781	1.218
1977	.350	2.400	2.154	.785	1.186
1978	.268	2.778	1.461	.819	1.147
1979	.204	2.669	1.436	.832	1.141
1980	.244	2.752	1.422	.800	1.117
1981	.217	2.499	1.337	.767	1.131
1982	.258	2.742	1.294	.756	1.138
1983	.252	2.574	1.341	.765	1.141
1984	.277	2.966	1.278	.768	1.149
1985	.320	3.484	1.278	.767	1.141
1986	.321	2.910	1.324	.708	1.121
1987	.243	2.755	1.285	.729	1.112
1988	.265	2.642	1.309	.706	1.116
1989	.228	2.399	1.313	.708	1.128
1990	.260	2.837	1.266	.716	1.119
1991	.230	2.363	1.330	.732	1.145
1992	.290	2.421	1.297	.620	1.144
1993	.269	2.550	1.276	.682	1.141
Mean	.324	2.732	1.416	.767	1.156

(Table 16, Row 24). These elasticities decreased during the period for all fruit, which is expected since expenditures for the group increased through time. The conditional-expenditure elasticities for banana, orange, lemon, and other decreased from .6, 4.0, .8, and 1.3, respectively, in 1971, to .3, 1.3, .7, and 1.1, respectively, in 1993. The conditional-import-expenditure elasticity of grapefruit decreased from 3.0 in 1972 to 2.6 in 1993. The conditional-expenditure-elasticity estimate of 13.5 for grapefruit in 1971 is somewhat misleading because its conditional-import share was so much lower that year (.03) than in following years (.1 in 1972; 0.2 in 1993). These 1993 point estimates again indicate that the conditional-expenditure response to an increase in the group’s expenditure for grapefruit, orange, and other is elastic, while those of banana and lemon are inelastic.

Conditional Slutsky (Table 17) and Cournot (Table 18) own-price elasticities are also calculated from 1971 to 1993 for the five Japanese-imported fruit varieties. As expected, in each year, the Cournot own-price-elasticity estimates are more negative (responsive) than are the corresponding Slutsky own-price-elasticity estimates. We first consider and discuss the Slutsky own-price-elasticity results.

The Slutsky own-price conditional elasticity of banana increased (absolutely) from –.29 in 1971 to –.49 in 1993. The conditional own-price elasticities of the other three fruit varieties decreased in responsiveness during the period from –1.72 in 1972 to –1.23 in 1993 for grapefruit; from –5.99 in 1972 to –.81 in 1993 for orange; and from −1.18 in 1971 to −.49 in 1993 for other. It is interesting to note that orange and other had elastic point estimates in 1971/72, but inelastic estimates by 1975 for other and inelastic estimates by 1981 for orange. These trend changes are not picked up by simply looking at sample mean estimates (Table 17, Row 24.)

The Cournot conditional own-price-elasticity estimates (Table 18) differ from those of Slutsky in magnitude and sometimes in trend. Conditional Cournot own-price elasticities increased instead of decreasing for banana from –.72 in 1971 to –.61 in 1993. Those of other followed a similar trend as that of the Slutsky estimates. Grapefruit conditional own-price-import elasticities decreased from –2.17 in 1972 to –1.74 in 1993; estimates for orange decreased from –6.05 in 1972 to –1.00 in 1993; estimates for other decreased from –1.23 in 1971 to –.60 in

Table 17. CBS model (homogeneity and symmetry imposed) estimates for conditional Slutsky own-price elasticities of five Japanese fresh-fruit imports, 1971 to 1993

Year (1)	Bananas (2)	Grapefruit (3)	Oranges (4)	Lemons (5)	Other (6)
1971	- .288	-9.892	-8.702	- .529	-1.177
1972	- .346	-1.718	-5.994	- .536	-1.029
1973	- .396	-1.519	-3.839	- .407	-1.071
1974	- .433	-1.224	-3.528	- .390	-1.183
1975	- .400	-1.223	-3.184	- .522	- .918
1976	- .412	-1.226	-3.012	- .510	- .763
1977	- .436	-1.109	-3.366	- .501	- .651
1978	- .492	-1.408	-1.344	- .423	- .513
1979	- .534	-1.322	-1.271	- .392	- .494
1980	- .508	-1.388	-1.230	- .466	- .409
1981	- .526	-1.187	- .983	- .543	- .459
1982	- .498	-1.380	- .858	- .569	- .483
1983	- .502	-1.247	- .996	- .548	- .495
1984	- .486	-1.557	- .810	- .541	- .521
1985	- .457	-1.967	- .812	- .544	- .492
1986	- .456	-1.512	- .945	- .682	- .425
1987	- .509	-1.390	- .832	- .631	- .393
1988	- .493	-1.300	- .901	- .686	- .406
1989	- .519	-1.108	- .911	- .682	- .449
1990	- .497	-1.455	- .777	- .662	- .415
1991	- .517	-1.080	- .962	- .625	- .506
1992	- .477	-1.125	- .865	- .886	- .503
1993	- .491	-1.228	- .805	- .741	- .492
Mean	- .454	-1.371	-1.213	- .543	- .545

Table 18. CBS model (homogeneity and symmetry imposed) estimates for conditional Cournot own-price elasticities of five Japanese fresh-fruit imports, 1971 to 1993

Year (1)	Bananas (2)	Grapefruit (3)	Oranges (4)	Lemons (5)	Other (6)
1971	- .722	-1 .227	-8.756	- .656	-1.228
1972	- .652	-2.171	-6.054	- .661	-1.086
1973	- .623	-1.990	-3.910	- .583	-1.126
1974	- .613	-1.734	-3.602	- .576	-1.234
1975	- .621	-1.733	-3.261	- .651	- .980
1976	- .617	-1.736	-3.092	- .643	- .835
1977	- .612	-1.640	-3.441	- .637	- .733
1978	- .611	-1.892	-1.472	- .591	- .614
1979	- .618	-1.817	-1.404	- .577	- .598
1980	- .613	-1.874	-1.366	- .615	- .532
1981	- .616	-1.703	-1.143	- .666	- .570
1982	- .612	-1.867	-1.035	- .684	- .589
1983	- .612	-1.753	-1.154	- .669	- .599
1984	- .610	-2.024	- .996	- .665	- .620
1985	- .610	-2.402	- .997	- .666	- .596
1986	- .610	-1.984	-1.110	- .772	- .544
1987	- .613	-1.876	-1.014	- .731	- .521
1988	- .611	-1.799	-1.072	- .775	- .530
1989	- .615	-1.639	-1.081	- .772	- .563
1990	- .611	-1.933	- .968	- .756	- .537
1991	- .615	-1.617	-1.125	- .727	- .608
1992	- .610	-1.653	-1.041	- .947	- .605
1993	- .611	-1.737	- .991	- .821	- .597
Mean	- .610	-1.860	-1.350	- .665	- .641

1993; and estimates of lemon increased from –.66 in 1971 to –.82 in 1993. Again, conditional own-price import elasticity point estimates for other changed from elastic in 1971 to inelastic in 1975, while those for orange went from elastic to, essentially, unitary. Again, these results are not indicated in the sample-mean estimates.

6. Import Demand for Bananas by Country of Source

As discussed in section 4, Japan imports 98 percent of its bananas from Taiwan, the Philippines, and Ecuador, with less than 2 percent being imported from 19 other countries. In this section, we estimate—unrestricted and under various restrictions (homogeneity; homogeneity and symmetry; and homogeneity, symmetry and unitary expenditure elasticities)—the General model and the four competing alternative models (Rotterdam, CBS, AIDS, and NBR). We use the Rotterdam model to test for uniform substitution and use the General model to test whether, with these restrictions, the Rotterdam model or the Working-type model better fits the data. We test for the further restrictions of unitary-expenditure elasticities with uniform substitution imposed. Based on the outcome of these restriction tests, we report conditional Slutsky price coefficients as well as conditional own-price and cross-price elasticities of Japanese import demand.

We report the data used to fit the models for the years 1970 through 1993 (Table 19). We also report the log-likelihood values from estimating the General model and the four alternative models under various restrictions (Table 20). Chi-square values based on log-likelihood ratio tests for all five models are all below the critical value when testing homogeneity-restricted versions against unrestricted versions. Thus, we do not reject homogeneity. Similarly, we do not reject symmetry when testing symmetry-imposed versions

Table 19. Total values, quantities, and shares of banana imports from three countries.

Year	Taiwan	Philippine	Ecuador and other countries	Total	Taiwan	Philippine	Ecuador and other countries	Total	Taiwan	Philippine	Ecuador and other countries
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Value (billions of Yen)				Quantity (millions of ton)				Share (x100)		
1970	13.08	2.90	35.90	51.89	213.69	54.75	575.44	843.89	25.21	5.59	69.19
1971	15.19	7.99	25.84	49.02	297.05	182.63	508.86	988.54	30.98	16.31	52.72
1972	10.45	12.56	22.47	45.48	215.17	334.40	513.31	1062.88	22.98	27.62	49.40
1973	8.78	14.08	10.56	33.42	223.31	442.19	265.64	931.14	26.28	42.13	31.59
1974	7.39	25.50	4.70	37.59	140.58	627.80	88.84	857.21	19.67	67.84	12.49
1975	7.33	39.11	2.03	48.47	97.43	763.28	33.40	894.11	15.11	80.69	4.20
1976	6.99	38.21	2.57	47.77	81.70	713.91	36.62	832.23	14.63	80.00	5.37
1977	8.82	35.22	0.46	44.50	119.59	696.41	8.92	824.92	19.81	79.14	1.04
1978	4.74	31.75	1.23	37.72	75.24	707.49	21.37	804.09	12.57	84.18	3.26
1979	6.63	35.53	0.35	42.51	100.48	682.11	7.50	790.09	15.60	83.58	0.82
1980	7.39	35.96	0.09	43.44	82.56	642.10	1.43	726.09	17.01	82.79	0.20
1981	6.10	42.74	0.41	49.25	58.00	644.33	5.57	707.90	12.39	86.78	0.83
1982	10.62	49.16	0.18	59.96	74.38	681.38	2.16	757.92	17.71	81.99	0.30
1983	10.29	43.72	0.91	54.92	96.85	469.00	10.04	575.90	18.73	79.61	1.65
1984	10.00	50.60	0.22	60.82	99.09	580.44	2.82	682.36	16.44	83.20	0.36
1985	10.66	59.93	1.54	72.13	98.64	559.74	21.65	680.04	14.78	83.08	2.13
1986	7.51	52.12	4.18	63.80	82.37	620.49	61.71	764.56	11.76	81.69	6.55
1987	8.99	38.36	6.07	53.43	108.02	569.98	96.85	774.84	16.83	71.80	11.37
1988	7.14	43.57	4.83	55.54	84.91	600.35	75.14	760.41	12.85	78.46	8.69
1989	6.58	46.77	7.35	60.71	61.52	620.48	91.72	773.72	10.84	77.04	12.11
1990	3.90	45.48	11.40	60.77	32.71	585.21	139.60	757.52	6.42	74.83	18.75
1991	6.65	44.47	11.51	62.62	54.07	586.85	162.42	803.34	10.61	71.01	18.38
1992	6.92	46.17	13.12	66.22	65.73	546.66	164.78	777.17	10.45	69.73	19.82
1993	6.54	37.00	9.36	52.89	65.14	668.84	179.36	913.34	12.36	69.95	17.69
Mean	8.28	36.62	7.39	52.29	109.51	565.87	128.13	803.51	16.34	69.13	14.54

Table 20. General model log-likelihood values and alternatives for Japanese banana imports, 1971 to 1993

Restriction (1)	Models General (2)	Rotterdam (3)	CBS (4)	AIDS (5)	NBR (6)
Unrestricted	71.08(10)	69.45(8)	69.77(8)	70.47(8)	70.32(8)
Homogeneity	70.32(8)	67.74(6)	67.85(6)	68.94(6)	68.98(6)
Symmetry	69.84(7)	67.42(5)	67.71(5)	68.76(5)	68.58(5)
Unitary Expenditure Elasticities	68.71(4)	n.a.	66.62(3)	67.79(3)	n.a.

n.a. = not applicable.
Note: Number of estimated parameters for each model are in parentheses.

nor do we reject the unitary-expenditure-elasticity restrictions using the General, CBS, and AIDS models.[10]

Next, we use the Rotterdam model to test for uniform substitution. We report the log-likelihood values of the Rotterdam model, with homogeneity and symmetry imposed and with uniform substitution imposed (Table 21, Column 2). The likelihood ratio test in this case is $-2(64.96-67.42)=4.92$ which is less than the critical value of 5.99 with two degrees of freedom at the 95 percent confidence level. Accordingly, we do not reject uniform substitution.

Log-likelihood values are reported when uniform substitution restrictions are imposed on the General, Rotterdam, and the Working-type models (Table 21, Row 2). Testing the Rotterdam and Working-type models with the uniform-substitution restriction against the General model with the same restrictions and using log-likelihood ratio tests, we reject the Rotterdam model $(\alpha=.05)$ but do not reject the Working-type model at the same significance level. We also impose the unitary-expenditure-elasticity restrictions to the General and Working-type models.

Table 21. General and alternative models (under uniform substitutes) log-likelihood values for Japanese banana imports, 1971 to 1993

Restriction (1)	Models General (2)	 Rotterdam (3)	 Working-type (4)
Symmetry	n.a.	67.42(5)	n.a.
Uniform Substitute	67.19(4)	64.96(3)	67.09(3)
Unitary Expenditure Elasticities	66.80(1)	n.a.	66.80(1)

n.a. = not applicable.
Note: Number of estimated parameters for each model are in parentheses.

Log-likelihood ratio tests indicate that we do not reject this further restriction. Note that the General model collapses to the Working-type model with the constraints of uniform substitution and unitary-expenditure elasticities.

Based on the above results, we choose the Working-type model with uniform substitution and unitary elasticities as the most appropriate model statistically to fit the Japanese banana import data from different countries of origin. Under these conditions, we constrain expenditure coefficients to zero and estimate the expenditure-flexibility coefficient parameter (–1.09) with an asymptotic standard error of .37. We calculate the Slutsky price coefficient using this estimate and divide it by the sample means of the conditional-average-import shares. We report these calculated estimates with asymptotic standard errors (Table 22). All estimates are significant statistically $(\alpha = .05)$, which is expected because the expenditure-flexibility parameter is different significantly from zero. All conditional-own-price parameter estimates are negative. The Slutsky cross-price parameter estimates are constrained to be positive by the uniform-substitution restrictions.

[10] The Rotterdam and NBR models are not homothetic globally (unitary elasticities).

Table 22. Working-type uniform-substitutes model (with unitary-expenditure elasticities) Slutsky price coefficients of Japanese banana imports by country of source, 1971 to 1993

	Slutsky Price Coefficients		
Country (1)	Taiwan (2)	Philippines (3)	Ecuador-Other (4)
Taiwan	-.146 [a]	.125	.021
	(.049) [b]	(.042)	(.007)
Philippines		-.220	.095
		(.074)	(.032)
Other			-.116
			(.039)

[a]Coefficient calculations based on sample means of import shares and an expenditure. flexibility estimate of -1.090 (asymptotic standard error of .366).
[b]Asymptotic standard errors are in parentheses.

6.1. Conditional-Price-Elasticity Estimates

We calculate: (1) the conditional-expenditure-flexibility estimate from the Working-type model with uniform substitution and unitary-expenditure elasticities imposed; (2) conditional Frisch, Slutsky, and Cournot own-price elasticities of Japanese import demand for banana from the three different sources; and (3) the conditional Slutsky and Cournot cross-price elasticities. Frisch cross-price-elasticity terms vanish under the restrictions of uniform substitution. We report these conditional-price elasticities (Table 23).

Conditional Frisch own-price elasticities for imported banana from the three sources are all equal to the conditional-expenditure flexibility, –1.09, with an asymptotic standard error of .37. All conditional Slutsky price-elasticity estimates are different significantly from zero; all own- price-elasticity estimates are negative; and all cross-price-elasticity estimates are positive. The conditional Slutsky own-price elasticity for Ecuador-other banana is most responsive (–.96); Philippine banana is least responsive (–.31); and Taiwan banana is (–.92). Statistically, conditional Slutsky own-price elasticities of Taiwan-other banana and Ecuador-other banana are

Table 23. Working-type uniform-substitutes model (with unitary-expenditure elasticities) estimated conditional price elasticities of Japanese import demand for bananas by country of source, calculated at sample means, 1971 to 1993

		Slutsky Price Elasticities			Cournot Price Elasticities		
Exporting Country (1)	Frisch Own-price Elasticities (2)	Taiwan (3)	Philippines (4)	Ecuador-Other (5)	Taiwan (6)	Philippines (7)	Ecuador-Other (8)
Taiwan	-1.09	-.92	.78	.13	-1.08	.06	.01
	(.37)[a]	(.31)	(.26)	(.04)	(.31)	(.26)	(.04)
Philippines	-1.09	.17	-.31	.13	.01	-1.03	.01
	(.37)	(.06)	(.10)	(.04)	(.06)	(.10)	(.04)
Ecuador	-1.09	.17	.78	-.96	.01	.06	-1.08
and Other	(.37)	(.06)	(.26)	(.32)	(.06)	(.26)	(.32)

[a]Asymptotic standard errors are in parentheses.

not different from unity, but the elasticities of Philippine banana are. Point estimates indicate that a 1-percent increase in own-price elasticities would decrease the conditional-import demand for Taiwan-other banana, Philippine-other banana, and Ecuador-other banana by .9 percent, .3 percent, and 1 percent, respectively.

Conditional Slutsky cross-price-elasticity estimates indicate that Taiwan-other banana and Ecuador-other banana are relatively responsive to price changes of Philippine banana. Thus a 1-percent increase in the Philippine banana price would increase the conditional-import demand for Taiwan-other banana and for Ecuador-other banana by .8 percent. A 1-percent price increase in Ecuador-other banana prices would increase conditional-import demand for Taiwan and Philippine banana by .1 percent, while a 1-percent increase in Taiwan banana prices would increase the conditional-import demand for Philippine and Ecuador-other banana by .2 percent.

We report the conditional Cournot-price elasticities (Table 23, Columns 6, 7, and 8) with own-price estimates along the diagonal of those columns. Unlike the Slutsky price elasticities, which are calculated while keeping real expenditure constant, Cournot price elasticities are calculated while keeping nominal income constant. Thus, Cournot elasticities include both price and income effects. The income effects reinforce the negative effects of own-price-elasticity changes and changes in complementary prices while dampening the effects of changes in substitute prices. Because of this effect, positive Slutsky cross-price estimates for a pair of goods can turn negative when calculating Cournot cross-price responses.

All conditional Cournot own-price-elasticity estimates are negative, different from zero statistically (but do not have negative unity) and are larger absolutely than their corresponding Slutsky own-price estimates. Also, all these conditional Cournot own-price estimates are close to negative unity: –1.1 for Taiwan-other banana and Ecuador-other banana; and –1.0 for Philippine banana. All the conditional Cournot cross-price-elasticity estimates are small, positive, and the same as zero statistically.

6.2. Conditional Own-price Import Elasticities through Time

The above discussion of elasticity results is based on conditional-average-import shares calculated at the sample mean. Although elasticities calculated at sample means are informative, it may be useful to see how elasticities change through time. This is particularly true of the Working-type price elasticities when uniform substitution is imposed because the Slutsky price parameters are not constant as in the Rotterdam and CBS models. The Slutsky price parameters instead vary with changes in both conditional-marginal shares and average shares.[11]

Conditional-import shares of Japanese banana imports from the three sources are reported from 1971 to 1993 (Table 24). The conditional-import share of Philippine banana rose dramatically from 16 percent in 1971 to 80 percent in 1975; it remained fairly constant at that level until 1987 when it gradually fell to 70 percent in 1993. Conditional-banana-import shares of Taiwan banana decreased gradually from 31 percent in 1971 to only 12 percent in 1993. Conditional-banana-import shares of Ecuador-other banana fell drastically from 53 percent in 1971 to only 1 percent in 1977 but gradually increased to 18 percent in 1993.

We report the conditional own-price-import elasticities of demand (Table 25). As a result of the restrictions of unitary expenditure elasticities, the conditional Frisch own-price estimates of import demand for banana from the three sources are all equal to the estimated conditional-expenditure flexibility ϕ_{gg}.

Table 24. Conditional-import shares of Japanese banana imports by country of source, 1971 to 1993

Year (1)	Taiwan (2)	Philippines (3)	Ecuador-Other (4)
1971	.310	.163	.527
1972	.230	.276	.494
1973	.263	.421	.316
1974	.197	.678	.125
1975	.151	.807	.042
1976	.146	.800	.054
1977	.198	.791	.010
1978	.126	.842	.033
1979	.156	.836	.008
1980	.170	.828	.002
1981	.124	.868	.008
1982	.177	.820	.003
1983	.187	.796	.017
1984	.164	.832	.004
1985	.148	.831	.021
1986	.118	.817	.066
1987	.168	.718	.114
1988	.129	.785	.087
1989	.108	.770	.121
1990	.064	.748	.188
1991	.106	.710	.184
1992	.104	.697	.198
1993	.124	.700	.177
Mean	.159	.719	.122

The Slutsky own-price import elasticity of Taiwan banana generally varies between –.8 and –.9 from 1971 to 1986 when it reaches approximately –1.0 and remains at that level throughout the rest of the period until 1993. The conditional Slutsky own-price-elasticity estimate for Philippine banana falls significantly from –.9 in 1971 to –.2 in 1975. For the rest of the period, it varies between –.2 and –.3. The conditional Slutsky own-price elasticities of Ecuador-other banana starts at –.5 in 1971, rises to –1.0 and –1.1 during the 1975 to 1989 period, and then drops to –.9 in 1993.

All of the conditional Cournot own-price-elasticity estimates are more responsive than those

[11] When the unitary-expenditure-elasticity restriction is imposed on the Working-type model, the marginal share of a

of the corresponding Slutsky elasticities and are between –1.0 and –1.1 throughout the period.

Table 25. Working-type uniform-substitutes model (with unitary-expenditure elasticities) conditional own-price Japanese import demand elasticities of bananas by country of source, 1971 to 1993

	Frisch Own-price Elasticities			Slutsky Own-price Elasticities			Cournot own-price elasticities		
Year (1)	Taiwan (2)	Philippines (3)	Ecuador -Other (4)	Taiwan (5)	Philippines (6)	Ecuador -Other (7)	Taiwan (8)	Philippines (9)	Ecuador -Other (10)
1971	-1.09	-1.09	-1.09	- .75	- .91	- .52	-1.06	-1.08	-1.04
1972	-1.09	-1.09	-1.09	- .84	- .79	- .55	-1.07	-1.07	-1.05
1973	-1.09	-1.09	-1.09	- .80	- .63	- .75	-1.07	-1.05	-1.06
1974	-1.09	-1.09	-1.09	- .88	- .35	- .95	-1.07	-1.03	-1.08
1975	-1.09	-1.09	-1.09	- .93	- .21	-1.04	-1.08	-1.02	-1.09
1976	-1.09	-1.09	-1.09	- .93	- .22	-1.03	-1.08	-1.02	-1.09
1977	-1.09	-1.09	-1.09	- .87	- .23	-1.08	-1.07	-1.02	-1.09
1978	-1.09	-1.09	-1.09	- .95	- .17	-1.05	-1.08	-1.01	-1.09
1979	-1.09	-1.09	-1.09	- .92	- .18	-1.08	-1.08	-1.02	-1.09
1980	-1.09	-1.09	-1.09	- .90	- .19	-1.09	-1.07	-1.02	-1.09
1981	-1.09	-1.09	-1.09	- .96	- .14	-1.08	-1.08	-1.01	-1.09
1982	-1.09	-1.09	-1.09	- .90	- .20	-1.09	-1.07	-1.02	-1.09
1983	-1.09	-1.09	-1.09	- .89	- .22	-1.07	-1.07	-1.02	-1.09
1984	-1.09	-1.09	-1.09	- .91	- .18	-1.09	-1.08	-1.02	-1.09
1985	-1.09	-1.09	-1.09	- .93	- .18	-1.07	-1.08	-1.02	-1.09
1986	-1.09	-1.09	-1.09	- .96	- .20	-1.02	-1.08	-1.02	-1.08
1987	-1.09	-1.09	-1.09	- .91	- .31	- .97	-1.07	-1.03	-1.08
1988	-1.09	-1.09	-1.09	- .95	- .24	-1.00	-1.08	-1.02	-1.08
1989	-1.09	-1.09	-1.09	- .97	- .25	- .96	-1.08	-1.02	-1.08
1990	-1.09	-1.09	-1.09	-1.02	- .27	- .89	-1.08	-1.02	-1.07
1991	-1.09	-1.09	-1.09	- .97	- .32	- .89	-1.08	-1.03	-1.07
1992	-1.09	-1.09	-1.09	- .98	- .33	- .87	-1.08	-1.03	-1.07
1993	-1.09	-1.09	-1.09	- .96	- .33	- .90	-1.08	-1.03	-1.07
Mean	-1.09	-1.09	-1.09	- .92	- .31	- .96	-1.08	-1.03	-1.08

This suggests that all the conditional Cournot own-price elasticities are essentially unitary throughout this period, which is in marked contrast with the Slutsky estimates, particularly for Philippine banana.

good equals its average share.

7. Import Demand for Grapes by Country of Source

Japan imported grapes from 11 different source countries during the 1970 to 1993 period (Appendix Table A.7). Among the 11 countries, only two (Taiwan and the United States) have significant and continuous shares from 1972 to 1993. Taiwanese grape exports to Japan went from 5.6 million yen in 1972 to 155.6 million yen in 1993, which is an increase from 6 percent of total share in 1972 to an increase of 8 percent in 1993. The United States increased its grape exports to Japan from 68 million yen in 1972 to 891 million yen in 1993, while its share decreased from 72 percent in 1972 to 42 percent in 1993. We group the data into three sets: Taiwan, the United States, and Other (Table 26).

Using the above data, we estimate the General demand system (Equation 14) and the four alternative models (Rotterdam, CBS, AIDS, and NBR) unrestricted, under homogeneity, and under homogeneity and symmetry. The data in Table 27 presents the log-likelihood values of the General model and the four alternative models. In all five cases, homogeneity is not rejected by log-likelihood ratio tests $(\alpha = .05)$, nor is symmetry rejected by any of the five models when comparing the homogeneity-restricted models to corresponding homogeneity-restricted and symmetry-restricted models.

The log-likelihood value of the General model, with homogeneity and symmetry restrictions, is 72.79 (Table 27, Row 3, Column 2), while the four alternative models (Table 27, Row 3, Columns 3 to 6) are all much smaller. The AIDS model has the largest log-likelihood value at 58.96 and the Rotterdam model has the smallest log-likelihood value at 45.56. When testing the functional forms of the four alternative models against the General model, all four models are rejected. We report all log-likelihood ratio-test values (Table 27, Rows 4 to 6, Columns 3 to 6) are all much greater than the chi-square critical value of 5.99 with two degrees of freedom at the 95 percent confidence level.

Table 26. Total values, quantities, and shares of grape imports from three countries

Year	Taiwan	USA	Chile and other countries	Total		Taiwan	USA	Chile and other countries	Total		Taiwan	USA	Chile
(1)	(2)	(3)	(4)	(5)		(6)	(7)	(8)	(9)		(10)	(11)	(12)
		Value (millions of Yen)					Quantity (thousands of ton)					Share (x100)	
1972	.0056	.0680	.0206	.0942		.0117	.2461	.2854	.5432		5.96	72.20	21.84
1973	.0014	.1599	.0570	.2183		.0024	.6219	.4099	1.0342		.64	73.27	26.09
1974	.0001	.1950	.0473	.2424		.0001	.6825	.2366	.9192		.05	80.44	19.51
1975	.0020	.3417	.0137	.3574		.0038	1.2918	.0168	1.3124		.55	95.61	3.84
1976	.0001	.4483	.0111	.4596		.0002	1.5382	.0235	1.5619		.03	97.56	2.42
1977	.0004	.2672	.0178	.2854		.0006	.9700	.0231	.9937		.15	93.61	6.24
1978	.0008	.4702	.0168	.4877		.0033	1.7840	.0084	1.7957		.15	96.41	3.44
1979	.0054	.4971	.0164	.5188		.0072	1.4913	.0156	1.5141		1.04	95.81	3.15
1980	.0219	.4787	.0558	.5565		.0275	1.2954	.0796	1.4025		3.94	86.03	10.03
1981	.0572	.4151	.0498	.5221		.1061	1.0224	.0550	1.1835		10.95	79.51	9.54
1982	.0319	.6407	.0494	.7220		.0505	1.5662	.0567	1.6734		4.41	88.74	6.85
1983	.0151	.5855	.0721	.6727		.0238	1.4693	.0714	1.5645		2.24	87.04	10.72
1984	.0610	.6584	.0908	.8102		.0951	1.7005	.0668	1.8624		7.53	81.27	11.20
1985	.0840	.6507	.1188	.8535		.1396	1.8709	.0884	2.0989		9.84	76.24	13.92
1986	.1542	1.1006	.0788	1.3336		.2722	4.5610	.0790	4.9121		11.56	82.53	5.91
1987	.1607	1.1920	.1178	1.4705		.2679	5.1342	.1231	5.5252		10.93	81.06	8.01
1988	.2882	1.2170	.5316	2.0368		.5192	5.4359	1.6736	7.6287		14.15	59.75	26.10
1989	.2348	1.0469	.7738	2.0555		.4195	4.2155	3.1056	7.7406		11.42	50.93	37.64
1990	.1577	1.2575	1.9688	3.3841		.2166	4.4985	7.3246	12.0397		4.66	37.16	58.18
1991	.3276	1.1579	1.0036	2.4891		.4705	4.1055	2.9918	7.5679		13.16	46.52	40.32
1992	.4138	.7984	1.4401	2.6524		.6259	3.0439	4.0624	7.7322		15.60	30.10	54.30
1993	.1705	.8907	1.0425	2.1038		.2602	3.2957	4.2202	7.7762		8.11	42.34	49.56
Mean	.1556	.8636	.5281	1.5473		.2496	3.0868	1.7142	5.0506		9.18	66.37	24.45

Table 27. General model log-likelihood values and ratios tests and alternatives for Japanese grape imports, 1973 to 1993

Restriction (1)	General (2)	Rotterdam (3)	CBS (4)	AIDS (5)	NBR (6)
	Log-Likelihood Values				
Unrestricted	73.43(10)[a]	46.98(8)	55.12(8)	60.19(8)	51.11(8)
Homogeneity	73.30(8)	45.57(6)	54.64(6)	58.96(6)	48.62(6)
Symmetry	72.79(7)	45.56(5)	54.22(5)	58.96(5)	48.45(5)
	Log-Likelihood Ratio Test Values				
Unrestricted		52.89	36.62	26.48	44.62
Homogeneity		55.47	37.33	28.67	49.35
Symmetry		54.45	37.13	28.66	48.68

[a]Number of estimated parameters for each model is in parentheses.

Further investigation reveals that the correlation coefficients or R values between the residuals and the regressors of $w_i d\log Q$ and $w_i\left(d\log p_{\mathrm{i}} - d\log P\right)$ are relatively large, implying that the disturbances from the General model and the four alternative models are correlated with the two regressors. This finding indicates that the estimates of the models are biased and unreliable. To compensate for this correlation, we estimate the General model by replacing the arithmetic average of the conditional-import share $w_i s$ with their lagged values. As before, we compute the R values between the residuals and regressors. The correlations between the residuals and $w_i d\log Qs$ diminish while the correlations between the residuals and $w_i\left(d\log p_{\mathrm{i}} - d\log P\right)$ increase. Thus, we consider the General model without the term $\delta_2 w_i\left(d\log p_i - d\log P\right)$, rejecting the AIDS' price structure and considering only the Rotterdam and CBS models as possible alternatives.

After omitting the term $\delta_2 w_i\left(d\log p_i - d\log\text{P}\right)$ in Equation (14), the General model becomes

$$w_i d\log q_i = \beta_i d\log Q + \sum_j \pi_{ij} d\log p_j + \delta_1\left(w_i d\log Q\right), \qquad i = 1,\ldots,n. \qquad (14.1)$$

We refer to Equation (14.1) as the sub-General model. As before, we estimate the Sub-General model unrestricted, under homogeneity, and under homogeneity and symmetry. We also estimate the model with current conditional-import shares and lagged conditional-import shares. The log-likelihood values and ratios are shown in the upper and lower parts of Table 28, respectively. We report the log- likelihood values when current import shares are used for estimation purposes (Table 28, Columns 2 to 4).

We again investigate the correlations between the disturbances and their regressors. The *R* values between the residuals and $w_i d\log Q$ are still large. We next estimate the Sub-General model (14.1) by replacing the arithmetic averages of the conditional-import share $w_i s$ with their lagged values. As before, log-likelihood-ratio tests indicate that neither homogeneity nor

Table 28. Sub-General log-likelihood values and test ratios and alternatives for Japanese grape imports, 1973 to 1993

Restriction	Using Budget Shares			Using Lagged Budget Shares		
	General	Rotterdam	CBS	General	Rotterdam	CBS
(1)	(2)	(3)	(4)	(5)	(6)	(7)
			Log-Likelihood Values			
Unrestricted	65.32(9) [a]	46.98(8)	55.12(8)	50.76(9)	45.35(8)	49.08(8)
Homogeneity	64.24(7)	45.57(6)	54.64(6)	49.33(6)	42.75(6)	46.96(6)
Symmetry	60.40(6)	45.56(5)	54.22(5)	48.75(5)	42.74(5)	46.83(5)
			Log-Likelihood Ratio Test Values			
Unrestricted		36.69	20.41		10.83	3.37
Homogeneity		37.35	19.20		13.15	4.73
Symmetry		29.67	12.35		12.01	3.84

[a]Number of estimated parameters for each model is in parentheses.

symmetry is rejected $(\alpha = .05)$. We report the log-likelihood ratio-test values when the two alternative models are compared to the Sub-General model (Table 28, Rows 4 to 6, Columns 3 and 4). Both models are rejected at the 95 percent confidence level. The smallest value, 12.35, is the test value when comparing the Sub-General model, with homogeneity and symmetry imposed, to the CBS model with the same restrictions, and it is greater than three times the critical value of 3.84.

Log-likelihood values with lagged-import shares used in estimation are reported for the sub-General, Rotterdam, and CBS models (Table 28, Columns 5 to 7). The three models reject neither homogeneity nor symmetry. We report the log-likelihood ratio-test values for comparing the Sub-General model to the two competing ones, when lagged conditional-import shares are used (Table 28, Columns 6 and 7, Rows 4 to 6). The Rotterdam model is rejected at the 25 percent confidence level, but the CBS model, unrestricted and with homogeneity and symmetry imposed, is not rejected at this confidence level; the CBS model with homogeneity imposed is not rejected at the 90 percent confidence level. We compute the *R* values between the residuals and the regressors again, and all the relevant *R* values are small. The test results in Table 28, Columns (5) to (7) are therefore reliable.

We impose-unitary expenditure elasticities on the Sub-General model and the CBS model by constraining $\beta_i = 0 \forall_i$ and $\delta_1 = 1$. We give the log-likelihood value of these estimations (Table 29, Column 4). We fail to reject the hypothesis of unitary-expenditure elasticities for Japan's grape imports from the three different sources with the CBS model. We also fail to reject the CBS model when it is compared statistically to the Sub-General model.

We present the conditional Slutsky price coefficients and associated asymptotic standard

Table 29. Sub-General and CBS Model (under homogeneity and symmetry and under homogeneity, symmetry, and unitary-expenditure-elasticity restrictions) log-likelihood values for Japanese grape imports using lagged import shares, 1973 to 1993

Restriction (1)	Sub-General Model (2)	CBS (3)	CBS, Unitary-Expenditure Elasticities (4)
Symmetry	48.75(6) [a]	46.83(5)	46.13(3)

[a]Number of estimated parameters for each model are in parentheses.

errors (in parentheses) for the CBS model with homogeneity-, symmetry-, and unitary-expenditure-elasticity restrictions imposed (Table 30). All conditional Slutsky own-price parameters are negative, and those for the U.S. and Other grapes are significantly different from zero ($\alpha = .05$). Only one of the conditional Slutsky cross-price parameters (United States-Other) is different statistically from zero at the above significance level.

We also fit the data by imposing the restrictions of uniform substitution in the Sub-General, Rotterdam, and Working-type models. We report the log-likelihood values of the homogeneity-constrained, symmetry-constrained, and uniform-substitution-constrained Rotterdam models (Table 31, Column 3). Based on a log-likelihood ratio test, we do not reject

Table 30. CBS model (under homogeneity, symmetry, and unitary-expenditure elasticities) Slutsky price parameters for Japanese grape imports, 1973 to 1993

	Slutsky Price Parameters		
Country (1)	Taiwan (2)	United States (3)	Other (4)
Taiwan	-.038	.047	-.010
	(.032)[a]	(.045)	(.022)
United States		-.254	.206
		(.076)	(.047)
Other			-.197
			(.043)

[a]Asymptotic standard errors are in parentheses.

Table 31. Uniform-substitutes model log-likelihood values for Japanese grape imports using lagged import shares, 1973 to 1993

Restriction (1)	Models General (2)	Rotterdam (3)	Working-type (4)
Symmetry	n.a.	42.74(5)	n.a.
Uniform Substitute	65.71(4)	42.67(3)	57.38(3)
Unitary Expenditure Elasticities	56.95(1)	n.a.	56.95(1)

n.a. = not applicable.
Note: Number of free parameters for each model is in parentheses.

uniform substitution with the Rotterdam model $(\alpha = .05)$. We report the log-likelihood values for the Sub-General, Rotterdam, and Working-type models when uniform-substitution restrictions are imposed (Table 31, Row 2). Based on log-likelihood ratio tests, we reject both the Rotterdam and Working-type models when tested against the Sub-General model. However, when we further impose unitary elasticities on the Sub-General and the Working-type models, we reject this restriction with the Sub-General model but not with the Working-type model; further, with this additional restriction, the Sub-General and Working-type models are identical functionally.

We calculate the conditional Slutsky price parameters based on the conditional-expenditure-flexibility estimate based on the Working-type model results with unitary-expenditure-elasticity and uniform-substitution restrictions. We report the conditional-expenditure flexibility parameter estimate, –2.10, with an asymptotic standard error of .25, and the conditional Slutsky price parameters with associated asymptotic standard errors in parentheses based on this estimate (Table 32). All conditional own-price parameters are negative and different significantly from zero when calculated at the sample mean. All conditional cross-price parameters that are constrained by uniform-substitution restrictions are positive and differ significantly from zero.

Table 32. Working-type model (with unitary-expenditure elasticities and uniform substitution) Slutsky price coefficients of Japanese grape imports by country of source using lagged import shares, 1973 to 1993

	Slutsky Price Coefficients		
Country (1)	Taiwan (2)	United States (3)	Other (4)
Taiwan	-.123 [a]	.097	.025
	(.015) [b]	(.012)	(.003)
United States		-.401	.304
		(.049)	(.037)
Other			-.329
			(.040)

[a]Coefficient calculations are based on sample means of import shares and an expenditure flexibility estimate of -2.099 (asymptotic standard error of .254).
[b]Asymptotic standard errors are in parentheses.

7.1. Conditional Price Elasticities of Import Demand

Based on the Working-type model with unitary-expenditure elasticities and uniform-substitution restrictions, we calculate and report conditional price elasticities of import demand. Because of the unitary-expenditure-elasticity restrictions, all conditional Frisch own-price elasticities are equal to –2.10 and vanish. We report the conditional Slutsky price elasticities (Table 33, Columns 3 to 5). All conditional Slutsky own-price-elasticity estimates reported along the diagonal of these columns are negative and differ statistically from zero. Those of Taiwan grape (–1.97) and Taiwan-Other grape (–1.69) are elastic statistically; U.S. grape (–.54) is inelastic statistically. This information suggests that a 1-percent increase in Taiwan grape price will decrease its conditional-import demand by almost 2 percent, while an increase in Taiwan-Other grape price will decrease conditional-import demand for this grape by 1.7 percent. The

Table 33. Working-type model (under unitary-expenditure elasticities and uniform substitution) estimated conditional-price elasticities of Japanese import demand for grapes by country of source estimated at sample means, 1972 to 1993

		Slutsky Price Elasticities			Cournot Price Elasticities		
Exporting Country (1)	Frisch Own-Price Elasticities (2)	Taiwan (3)	United States (4)	Other (5)	Taiwan (6)	United States (7)	Other (8)
Taiwan	-2.10 (.25)[a]	-1.97 (.24)	1.56 (.19)	.41 (.05)	-2.03 (.24)	.82 (.19)	.21 (.05)
United States	-2.10 (.25)[a]	.13 (.15)	-.54 (.07)	.41 (.05)	.07 (.02)	-1.28 (.07)	.21 (.05)
Other	-2.10 (.25)[a]	.13 (.02)	1.56 (.19)	-1.69 (.19)	.07 (.02)	.82 (.19)	-1.88 (.20)

[a]Asymptotic standard errors are in parentheses.

conditional own-price response to changes in U.S. grape price is less responsive. Thus a 1-percent increase in its price only decreases its import demand by .5 percent. This information isimportant for exporters of grapes to the Japanese market. For example, U.S. grape exporters to Japan can increase their total revenue, *ceteris paribus*, by slightly raising price, while grape exporters from Taiwan and Other can increase their total revenue, *ceteris paribus,* by lowering their prices slightly.

All conditional Slutsky cross-price elasticities are positive as constrained by the uniform-substitution restrictions, and all differ statistically from zero ($\alpha = .05$). The cross-price elasticities of Taiwan-U.S. grapes and Other-U.S. grapes are elastic (1.6), while the others are inelastic and range from .1 for U.S.-Taiwan and Other-Taiwan grapes to .4 for Taiwan-Other and U.S.-Other grapes. The above point estimates indicate that when real income is held constant, *ceteris paribus*, a 1-percent increase in the U.S. grape price will increase the conditional-import demand for Taiwan and Other grapes by 1.6 percent. A 1-percent increase in the Taiwan grape price will increase the conditional-import demand for U.S. and Other grapes by only .1 percent, while an increase in Other grape prices will increase conditional-import demand for Taiwan and U.S. grapes by .4 percent.

Conditional Cournot price elasticities are calculated by holding nominal income constant. Thus, there is both a price effect and an income effect. In the case of own-price changes, the income effect should increase in absolute value the own-price-point estimates when compared to the corresponding Slutsky own-price-point estimates. In the case of substitutes, the Cournot cross-price effects should be less responsive (i.e., smaller in absolute value) than comparable Slutsky cross-price effects. Indeed, Cournot cross-price elasticities may be negative while Slutsky cross-price elasticities are positive.

We report the conditional Cournot price elasticities (Table 33, Columns 6 to 8). The own-price estimates with asymptotic standard errors in parentheses are reported in the diagonal of these columns. The conditional Cournot own-price-elasticity estimate of Taiwan grapes is only slightly more responsive than are those of the Slutsky price elasticities. The conditional Cournot own-price estimate for U.S. grapes, however, increases to –1.3 as compared to –.5 for the conditional Slutsky estimate. The conditional Cournot own-price estimates of Other grape increases to –1.9, are elastic, and are greater than unity $(\alpha = .05)$ statistically. These results indicate that Japanese grape imports are highly responsive to own-price changes conditionally when nominal income is held constant and resulting income effects are taken into account, which means that these exporters must decrease their prices slightly so that total grape-exporter revenue to Japan will increase.

The conditional Cournot cross-price elasticities are all smaller than corresponding Slutsky cross-price elasticities. Like the conditional Slutsky estimates, the conditional Cournot estimates are all greater than zero $(\alpha = .05)$ statistically. The most responsive conditional Cournot cross-price elasticities are those for Taiwan-U.S. and Other-U.S. Holding nominal income constant, a 1-percent increase in U.S. grape price will increase conditional-import demand for Taiwan and Other grapes by .8 percent. The conditional cross-price elasticities are equal to .2 for Taiwan-Other grapes and U.S.-Other grapes and to .1 for U.S.-Taiwan grapes and Other-Taiwan grapes. Notice the price effect of a change in the price of grapes from one source has symmetric effects on the demand for its competition. The same is true for the conditional Slutsky estimates.

7.2. Conditional Own-Price Elasticities through Time

Although elasticities calculated at sample means are informative, it may be useful to know how elasticities evolve through time. This is particularly true for results based on the Working-type model whose marginal share follows that of the Working model (1943) such that $\theta_i^* = \beta_i + w_i^*$, in which θ_i^* is the conditional-marginal-import share of imported good *i*; β_i is the expenditure-parameter estimate of the model *i*; and w_i^* is the conditional-import share of i. When we impose unitary elasticities, $\theta_i^* = w_i^*$ and the conditional own-price estimates obviously vary whenever the conditional-import shares vary. (See Section 4.3. for a discussion on own-price-elasticity calculations.)

We report the conditional-import shares for grapes from the three-country sources for 1972 to 1993 (Table 34). We report the sample means of the conditional-import shares (Table 34, Column 4, Row 23). The conditional-import share of Taiwan grape in 1972 is 6 percent, but it decreases immediately in 1973 to only 1 percent. In 1980, its conditional share increases to 4 percent and increases to 10 percent in 1981. From 1985 to 1993, conditional-import share remains between 10 percent and 15 percent.

The conditional-import share of U.S. grape begins at 72 percent in 1972, increases to 98 percent in 1976, and decreases gradually to 81 percent in 1987. Thereafter, it decreases to 60 percent in 1988 and further decreases to 42 percent in 1993. Other-grape commanded 22 percent of the grape-import market in 1972, but its share quickly fell to 3 percent in 1978 and 1979. Thereafter, the Other-grape-import market share increased to about 10 percent until 1986 when it fell to 5 percent. It rose quickly, however, to 50 percent of the import market by 1993.

Because of the restrictions of unitary-expenditure elasticities, all conditional Frisch own-price elasticities are invariant throughout the period and are simply equal to the conditional-expenditure flexibility estimate of –2.10. We report these estimates for 1972 to 1993 (Table 35, Columns 2 to 4). We report the conditional Slutsky own-price elasticities of grape-import

Table 34. Conditional-import shares of Japanese grapes by source country, 1972 to 1993

Year	Taiwan	United States	Other
(1)	(2)	(3)	(4)
1972	.060	.722	.218
1973	.006	.733	.261
1974	.001	.804	.195
1875	.006	.956	.038
1976	.000	.976	.024
1977	.002	.936	.062
1978	.002	.964	.034
1979	.010	.958	.032
1980	.039	.860	.100
1981	.109	.795	.095
1982	.044	.887	.068
1983	.022	.870	.107
1984	.075	.813	.112
1985	.098	.762	.139
1986	.116	.825	.059
1987	.109	.811	.080
1988	.142	.598	.261
1989	.114	.509	.376
1990	.047	.372	.582
1991	.132	.465	.403
1992	.156	.301	.543
1993	.081	.423	.496
Mean	.062	.743	.195

demand from the three sources (Table 35, Columns 5 to 7). The conditional Slutsky own-price-elasticity of Taiwan grapes is elastic and equal to approximately –2.0 throughout the 1972 to 1993 period; its actual value in 1993 is –1.9. In contrast, the conditional Slutsky own-price-elasticity of import demand for U.S. grape is inelastic from 1972 (–.58) to 1988 (–.85); from 1972 to 1979, its value decreases generally to –.09 and then increases thereafter. From 1989, the point estimate for U.S. grape is elastic, and it equals –1.21 in 1993. The conditional Slutsky own-price elasticity of import demand for Other grape is elastic throughout the period except for the years 1990 (–.88) and 1992 (–.96). In 1972, its value is equal to –1.64, increases to above –2.0 in 1975, fluctuates between –2.0 and –1.8 until 1988, and then decreases in value to –1.55. The trend thereafter decreases until 1993 when it is –1.06.

Table 35. Working-type uniform-substitutes model with (unitary-expenditure elasticities) conditional own-price import elasticities of imported grapes by country of source, 1972 to 1993

	Frisch Own-price Elasticities			Slutsky Own-price Elasticities			Cournot Own-price Elasticities		
Year (1)	Taiwan (2)	United States (3)	Other (4)	Taiwan (5)	United States (6)	Other (7)	Taiwan (8)	United States (9)	Other (10)
1972	-2.10	-2.10	-2.10	-1.97	- .58	-1.64	-2.03	-1.31	-1.86
1973	-2.10	-2.10	-2.10	-2.09	- .56	-1.55	-2.09	-1.29	-1.82
1974	-2.10	-2.10	-2.10	-2.10	- .41	-1.69	-2.10	-1.22	-1.89
1975	-2.10	-2.10	-2.10	-2.09	- .09	-2.02	-2.09	-1.05	-2.06
1976	-2.10	-2.10	-2.10	-2.10	- .05	-2.05	-2.10	-1.03	-2.07
1977	-2.10	-2.10	-2.10	-2.10	- .13	-1.97	-2.10	-1.07	-2.03
1978	-2.10	-2.10	-2.10	-2.10	- .08	-2.03	-2.10	-1.04	-2.06
1979	-2.10	-2.10	-2.10	-2.08	- .09	-2.03	-2.09	-1.05	-2.06
1980	-2.10	-2.10	-2.10	-2.02	- .29	-1.89	-2.06	-1.15	-1.99
1981	-2.10	-2.10	-2.10	-1.87	- .43	-1.90	-1.98	-1.23	-1.99
1982	-2.10	-2.10	-2.10	-2.01	- .24	-1.96	-2.05	-1.12	-2.02
1983	-2.10	-2.10	-2.10	-2.05	- .27	-1.87	-2.07	-1.14	-1.98
1984	-2.10	-2.10	-2.10	-1.94	- .39	-1.86	-2.02	-1.21	-1.98
1985	-2.10	-2.10	-2.10	-1.90	- .50	-1.81	-1.99	-1.26	-1.95
1986	-2.10	-2.10	-2.10	-1.86	- .37	-1.98	-1.97	-1.19	-2.03
1987	-2.10	-2.10	-2.10	-1.87	- .40	-1.93	-1.98	-1.21	-2.01
1988	-2.10	-2.10	-2.10	-1.80	- .85	-1.55	-1.94	-1.44	-1.81
1989	-2.10	-2.10	-2.10	-1.86	-1.03	-1.31	-1.97	-1.54	-1.69
1990	-2.10	-2.10	-2.10	-2.00	-1.32	- .88	-2.05	-1.69	-1.46
1991	-2.10	-2.10	-2.10	-1.82	-1.12	-1.23	-1.95	-1.59	-1.66
1992	-2.10	-2.10	-2.10	-1.77	-1.47	- .96	-1.93	-1.77	-1.51
1993	-2.10	-2.10	-2.10	-1.93	-1.21	-1.06	-2.01	-1.63	-1.56
Mean	-2.10	-2.10	-2.10	-1.93	-1.21	-1.06	-2.01	-1.63	-1.56

When comparing the conditional Slutsky own-price elasticities calculated at the sample mean to those calculated at each annual data point from 1972 to 1993, it is clear that much information is missing from the sample-mean estimates, particularly for the U.S. grape estimate. At the sample mean, the Slutsky own-price estimate is inelastic at –.54, while in actuality, the elasticity was at about that level in 1972 but was elastic from 1990 and beyond.

We report the conditional Cournot own-price elasticities of grape-import demand from the above three sources from 1972 to 1993 (Table 35, Columns 8 to 10). The conditional Cournot own-price elasticity of import demand for Taiwan grape is only slightly more responsive than are those of the corresponding conditional Slutsky elasticities. The conditional Cournot own-price elasticity of import demand for U.S. grape differs markedly from the comparable conditional Slutsky elasticities in that the Cournot elasticities are all greater than –1.0 absolutely while the Slutsky elasticities are all less than –1.0 absolutely from 1972 to 1988. The conditional Cournot own-price elasticities of import demand for Other grapes are also greater than the corresponding Slutsky elasticities.

Similar to banana, Japan’s grape imports exhibit two features: uniform substitution among different country sources and unitary-expenditure elasticities. Uniform substitutes for grape imply that grapes imported from different countries are substitute goods that are closely related. Unitary-expenditure elasticities indicate that a 1-percent increase in expenditure on imported grapes would result in a 1-percent increase in quantity for grapes from each of the three country groups (i.e., the expenditure effects are the same for grapes imported from the different export countries).

8. Conclusions

Using Japanese import data, this study analyzes the import patterns of Japan’s five most important fresh-fruit imports and fits import-demand systems to date of the five fresh-fruit imports as a group and to data for banana and grape imports from different source countries. We find that bananas and grapes imported from different countries are uniform substitutes for each other. We also find that the expenditure effects for banana and grapes are all unitary for the different country sources of the imports. However, as we show in the study, the five different fruit imports are not uniform substitutes, and the expenditure effects are different for different fruit. In this study, we also compute the price elasticities for banana and grape imports.

The Working-type model with uniform substitution and unitary-expenditure elasticities that are based on log-likelihood-ratio tests best fits the country-source data for both banana and grape imports. From a modeling perspective, these are important results because they allow the estimation of a conditional differential import-demand system for the same type of product from different sources and with the same degrees of freedom as the Armington model. Its advantages over the Armington model are both theoretical and statistical, the latter because the differential approach allows global statistical testing of uniform-substitution restrictions, unitary-expenditure elasticities, and functional-form choices.

We also calculate and discuss conditional elasticities of import demand for the five import varieties and for banana and grape imports from different country sources. Among the five fresh fruits and based on CBS results, grapefruit and oranges are expenditure elastic. This is good news for U.S. grapefruit and orange exporters to Japan since 95 to 99 percent of Japanese grapefruit and orange imports come from U.S. sources; both fruits will increase their conditional shares as expenditure for this group of fresh-fruit imports increases. Japanese lemon imports also come predominantly from U.S. sources (99 percent), and these exporters should see the share of lemon fall slightly as the expenditures for this group increases.. Bananas and other fruits are also expenditure inelastic and their shares should decrease as Japanese spend more on imported fresh fruits.

The own-price elasticities of import demand for grapefruits, oranges, and other fruits are elastic while those for bananas and lemons are inelastic. This means that the import demand for oranges, other fruits and especially grapefruits are sensitive to price changes; a small decrease in own-price would increase quantity by a larger percentage. The opposite is true for bananas and, to an extent, lemons. An increase in price would decrease demand for these two fresh fruits but by a smaller percentage than the percent change in price. The results of cross-price effects indicate that the pairs—bananas-grapefruit, bananas-oranges, bananas-lemons, grapefruit-oranges, oranges-lemons, bananas-other, grapefruit-other, lemons-other, and lemons-grapefruit—are Hicksian substitutes. In closing, we mention that users of import elasticities include exporters and potential exporters, importers and potential importers, policy makers in US, Japan, and other countries, economic modelers, institutions such as ERS, World Bank, IFPRI and APHIS, and welfare analysts.

APPENDIX A

Table A.1. Total Values and Quantities of Banana Imports for Japan

Year	Korea	China	Taiwan	Hong Kong	Sabah	Vietnam	Thailand	Singa-pore	Malaya	Malaysia	Philip-pine	Guate-mala	Indo-nesia	Mexico	Hon-duras	Belize	Costa Rica	Panama	Colom-bia	Ecuador	Peru	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
											Value											
1970	.00	.01	13.08	.00	.00	.00	.00	.00	.00	.00	2.90	.52	.00	.00	.45	.00	5.73	.07	.00	29.12	.00	51.89
1971	.00	.00	15.19	.00	.00	.00	.00	.00	.00	.00	7.99	.00	.00	.00	.00	.00	4.12	.53	.00	21.19	.00	49.02
1972	.00	.01	10.45	.00	.00	.00	.00	.00	.00	.00	12.56	.01	.00	.00	.00	.00	1.75	.00	.00	20.69	.00	45.48
1973	.00	.00	8.78	.00	.00	.00	.00	.00	.00	.00	14.08	.00	.01	.00	.00	.00	.25	.00	.00	10.30	.00	33.42
1974	.00	.00	7.39	.00	.00	.00	.00	.00	.00	.00	25.50	.00	.00	.00	.00	.00	.57	.00	.00	4.13	.00	37.59
1975	.00	.00	7.33	.00	.00	.00	.00	.00	.00	.00	39.11	.00	.00	.00	.00	.00	.13	.00	.00	1.90	.00	48.47
1976	.00	.00	6.99	.00	.00	.00	.00	.00	.00	.00	38.21	.00	.00	.00	.00	.00	.25	.00	.00	2.32	.00	47.77
1977	.00	.00	8.82	.00	.00	.00	.00	.00	.00	.00	35.22	.00	.00	.00	.00	.00	.00	.00	.00	.46	.00	44.50
1978	.00	.00	4.74	.00	.00	.00	.00	.00	.00	.00	31.75	.00	.00	.00	.00	.00	.00	.00	.00	1.23	.00	37.72
1979	.00	.00	6.63	.00	.00	.00	.00	.00	.00	.00	35.53	.00	.00	.00	.00	.00	.00	.00	.00	.35	.00	42.51
1980	.00	.00	7.39	.00	.00	.00	.00	.00	.00	.00	35.96	.00	.00	.00	.00	.00	.00	.00	.00	.09	.00	43.44
1981	.03	.00	6.10	.00	.00	.00	.00	.00	.00	.00	42.74	.00	.00	.00	.00	.00	.00	.00	.00	.37	.00	49.25
1982	.00	.00	10.62	.00	.00	.00	.00	.00	.00	.00	49.16	.00	.00	.00	.00	.00	.00	.00	.00	.18	.00	59.96
1983	.00	.00	10.29	.00	.00	.00	.00	.00	.00	.00	43.72	.00	.00	.00	.00	.00	.43	.00	.00	.47	.00	54.92
1984	.00	.00	10.00	.00	.00	.00	.00	.00	.00	.00	50.60	.00	.00	.00	.00	.00	.00	.00	.00	.22	.00	60.82
1985	.00	.00	10.66	.00	.00	.00	.00	.00	.00	.00	59.93	.00	.00	.00	.00	.00	.00	.00	.00	1.53	.00	72.13
1986	.00	.00	7.51	.00	.00	.00	.01	.00	.00	.01	52.12	.00	.00	.00	.00	.00	.00	.00	.25	3.92	.00	63.80
1987	.00	.03	8.99	.00	.00	.00	.00	.00	.00	.02	38.36	.00	.00	.00	.00	.00	.00	.50	.44	5.08	.00	53.43
1988	.00	.03	7.14	.00	.00	.00	.00	.00	.00	.01	43.57	.00	.00	.00	.00	.00	.00	.00	.23	4.56	.00	55.54
1989	.00	.06	6.58	.00	.00	.00	.00	.00	.00	.00	46.77	.00	.00	.00	.00	.00	.00	.16	.18	6.95	.00	60.71
1990	.00	.07	3.90	.00	.00	.00	.00	.00	.00	.09	45.48	.00	.00	.00	.09	.00	.00	.61	.03	10.51	.00	60.77
1991	.00	.09	6.65	.00	.00	.00	.00	.01	.00	.09	44.47	.00	.00	.00	.38	.03	.00	.81	.00	10.05	.06	62.62
1992	.00	.05	6.92	.00	.00	.00	.01	.00	.00	.03	46.17	.00	.00	.00	.32	.00	.60	.21	.00	11.89	.00	66.22
1993	.00	.01	6.54	.00	.00	.05	.03	.00	.00	.00	37.00	.00	.60	.03	.03	.00	.04	.00	.07	8.49	.00	52.89

Source: UNSO (1994).

Table A.1. Continued

Year (1)	Korea (2)	China (3)	Taiwan (4)	Hong Kong (5)	Sabah (6)	Vietnam (7)	Thailand (8)	Singa-pore (9)	Malaya (10)	Malaysia (11)	Philip-pine (12)	Guate-mala (13)	Indo-nesia (14)	Mexico (15)	Hon-duras (16)	Belize (17)	Costa Rica (18)	Panama (19)	Colom-bia (20)	Ecuador (21)	Peru (22)	Total (23)
											Quantity											
1970	.00	.28	213.69	.05	.00	.00	.00	.00	.00	.00	54.75	7.62	.00	.00	6.63	.00	91.20	1.09	.00	468.58	.00	843.89
1971	.00	.00	297.05	.00	.00	.00	.00	.00	.00	.00	182.63	.00	.00	.00	.00	.00	74.86	9.30	.00	424.69	.00	988.54
1972	.00	.28	215.17	.00	.00	.00	.00	.00	.00	.00	334.40	.21	.00	.00	.00	.00	40.27	.00	.00	472.54	.00	#####
1973	.00	.00	223.31	.00	.00	.00	.00	.00	.00	.00	442.19	.00	.16	.00	.00	.00	6.51	.00	.00	258.97	.00	931.14
1974	.00	.00	140.58	.00	.00	.00	.00	.00	.00	.00	627.80	.00	.00	.00	.00	.00	10.67	.00	.00	78.17	.00	857.21
1975	.00	.00	97.43	.00	.00	.00	.00	.00	.00	.00	763.28	.00	.00	.00	.00	.00	1.94	.00	.00	31.46	.00	894.11
1976	.00	.00	81.70	.00	.00	.00	.00	.00	.00	.00	713.91	.00	.00	.00	.00	.00	3.17	.00	.00	33.45	.00	832.23
1977	.00	.00	119.59	.00	.00	.00	.00	.00	.00	.00	696.41	.00	.00	.00	.00	.00	.00	.00	.00	8.92	.00	824.92
1978	.00	.00	75.24	.00	.00	.00	.00	.00	.00	.00	707.49	.00	.00	.00	.00	.00	.00	.00	.00	21.37	.00	804.09
1979	.00	.00	100.48	.00	.00	.00	.00	.00	.00	.00	682.11	.00	.00	.00	.00	.00	.00	.00	.00	7.50	.00	790.09
1980	.00	.01	82.56	.00	.00	.00	.00	.00	.00	.00	642.10	.00	.00	.00	.00	.00	.00	.00	.00	1.43	.00	726.09
1981	.44	.01	58.00	.00	.00	.00	.00	.00	.00	.00	644.33	.00	.00	.00	.00	.00	.00	.00	.00	5.12	.00	707.90
1982	.00	.00	74.38	.00	.00	.00	.00	.00	.00	.00	681.38	.00	.00	.00	.00	.00	.00	.00	.00	2.16	.00	757.92
1983	.00	.00	96.85	.00	.00	.00	.00	.00	.01	.00	469.00	.00	.00	.00	.00	.00	4.30	.00	.00	5.73	.00	575.90
1984	.00	.00	99.09	.00	.00	.00	.00	.00	.00	.00	580.44	.00	.00	.00	.00	.00	.00	.00	.00	2.82	.00	682.36
1985	.00	.01	98.64	.00	.00	.00	.05	.00	.00	.00	559.74	.00	.00	.00	.00	.00	.00	.00	.00	21.59	.00	680.04
1986	.00	.02	82.37	.00	.00	.00	.06	.00	.00	.03	620.49	.00	.00	.00	.00	.00	.00	.00	4.56	57.04	.00	764.56
1987	.00	.40	108.02	.00	.00	.00	.00	.00	.00	.14	569.98	.00	.00	.00	.00	.00	.00	7.22	8.95	80.14	.00	774.84
1988	.00	.42	84.91	.00	.00	.00	.00	.00	.00	.05	600.35	.00	.00	.00	.00	.00	.00	.00	4.33	70.34	.00	760.41
1989	.00	.66	61.52	.00	.00	.00	.00	.00	.00	.00	620.48	.00	.00	.00	.00	.00	.00	2.47	3.87	84.73	.00	773.72
1990	.00	.67	32.71	.00	.00	.00	.00	.00	.00	1.03	585.21	.00	.00	.00	2.13	.00	.00	9.70	.63	125.43	.00	757.52
1991	.00	.77	54.07	.00	.00	.00	.00	.08	.00	1.07	586.85	.00	.00	.00	5.91	.54	.00	18.20	.00	135.02	.82	803.34
1992	.00	.43	65.73	.00	.00	.08	.04	.00	.00	.40	546.66	.00	.00	.05	3.74	.00	5.69	2.19	.00	152.16	.00	777.17
1993	.00	.10	65.14	.00	.00	1.40	.22	.00	.00	.05	668.84	.00	22.07	.38	.74	.00	.85	.00	1.04	152.51	.00	913.34

Source: UNSO (1994).

Table A.2. Total Values and Quantities of Grapefruit Imports for Japan

Year (1)	Israel (2)	Netherlands (3)	USA (4)	Mexico (5)	Surinam (6)	Cuba (7)	Ecuador (8)	S. Africa (9)	Tunisia (10)	Swaziland (11)	F. Ocean (12)	New Zealand (13)	Total (14)
							Value						
1970	.00	.00	.30	.00	.00	.00	.00	.00	.00	.00	.00	.00	.30
1971	.00	.00	1.55	.01	.00	.00	.01	.03	.00	.00	.00	.00	1.60
1972	.00	.00	10.03	.09	.00	.00	.11	.05	.00	.00	.00	.00	10.28
1973	.27	.00	9.39	.09	.02	.00	.00	.01	.00	.00	.00	.00	9.78
1974	.53	.00	13.96	.15	.00	.00	.00	.00	.00	.25	.00	.00	14.89
1975	1.41	.00	15.89	.28	.00	.00	.00	.00	.00	.19	.00	.00	17.77
1976	.73	.00	16.54	.28	.00	.00	.00	.00	.00	.44	.00	.00	17.99
1977	1.00	.00	17.96	.04	.00	.00	.00	.01	.00	.64	.00	.00	19.65
1978	.59	.00	13.23	.49	.00	.00	.00	.08	.00	.37	.00	.00	14.77
1979	.59	.00	17.78	.15	.00	.15	.00	.01	.00	.58	.00	.01	19.27
1980	.47	.00	16.62	.30	.00	.00	.00	.00	.00	.40	.00	.03	17.82
1981	.60	.00	22.89	.28	.00	.00	.00	.00	.00	.64	.00	.09	24.49
1982	1.38	.00	22.24	.15	.00	.00	.00	.00	.00	.52	.00	.00	24.28
1983	.77	.00	23.59	.04	.00	.42	.00	.00	.00	.00	.00	.00	24.82
1984	.49	.00	20.61	.04	.00	.15	.00	.00	.00	.00	.00	.00	21.29
1985	.93	.00	17.45	.00	.00	.19	.00	.00	.00	.21	.00	.00	18.78
1986	.43	.00	21.09	.00	.00	.06	.00	.00	.00	.00	.00	.00	21.57
1987	.40	.00	21.45	.00	.00	.08	.00	.00	.00	.00	.00	.00	21.93
1988	.20	.00	23.30	.00	.00	.14	.00	.00	.00	.00	.00	.00	23.64
1989	.26	.00	31.51	.00	.00	.09	.00	.00	.00	.00	.00	.00	31.86
1990	.58	.00	22.17	.00	.00	.08	.00	.00	.00	.43	.00	.00	23.26
1991	.17	.00	33.14	.00	.00	.00	.00	.00	.00	.35	.00	.00	33.66
1992	.48	.00	30.62	.00	.00	.00	.00	.04	.00	.35	.00	.00	31.48
1993	.87	.00	22.11	.00	.00	.00	.00	.37	.00	.37	.00	.00	23.73

Source: UNSO (1994).

Table A.2. Continued

Year (1)	Israel (2)	Netherlands (3)	USA (4)	Mexico (5)	Surinam (6)	Cuba (7)	Ecuador (8)	S. Africa (9)	Tunisia (10)	Swaziland (11)	F. Ocean (12)	New Zealand (13)	Total (14)
						Quantity							
1970	.00	.00	2.27	.00	.00	.00	.00	.00	.00	.00	.00	.00	2.27
1971	.00	.00	10.88	.09	.00	.00	.14	.24	.00	.00	.00	.00	11.35
1972	.00	.00	88.51	.50	.05	.00	1.96	.41	.00	.00	.00	.00	91.43
1973	3.57	.00	105.23	.63	.16	.00	.01	.10	.00	.00	.00	.01	109.70
1974	5.78	.00	142.89	.86	.00	.00	.00	.00	.00	1.90	.00	.00	151.44
1975	11.93	.00	131.85	1.63	.00	.00	.00	.00	.00	1.30	.00	.00	146.70
1976	6.27	.00	139.87	1.90	.00	.00	.00	.00	.00	3.72	.00	.00	151.76
1977	9.22	.00	146.96	.32	.00	.00	.00	.10	.00	4.65	.00	.00	161.24
1978	6.35	.00	129.12	3.19	.00	.05	.00	.66	.00	2.79	.00	.00	142.15
1979	5.71	.00	146.70	.82	.00	1.07	.01	.10	.00	4.94	.00	.06	159.41
1980	3.92	.00	126.48	1.65	.00	.00	.00	.00	.00	2.99	.00	.18	135.21
1981	4.20	.00	156.82	1.19	.00	.00	.00	.00	.01	4.31	.00	.41	166.93
1982	8.71	.00	140.54	.88	.00	.00	.00	.00	.00	3.57	.00	.00	153.70
1983	6.17	.00	166.63	.26	.00	4.23	.00	.00	.00	.00	.00	.00	177.29
1984	6.34	.00	149.88	.27	.00	1.40	.00	.00	.00	.00	.00	.00	157.89
1985	6.56	.00	111.00	.00	.00	1.31	.00	.00	.00	1.93	.00	.01	120.80
1986	5.01	.00	176.77	.00	.00	.64	.00	.00	.00	.00	.00	.00	182.43
1987	5.00	.00	198.78	.00	.00	.99	.00	.00	.00	.00	.00	.00	204.77
1988	2.76	.00	230.72	.00	.00	1.53	.00	.00	.00	.00	.00	.00	235.01
1989	2.68	.00	271.92	.00	.00	.75	.00	.00	.00	.00	.00	.00	275.35
1990	4.63	.00	147.47	.00	.00	.87	.00	.00	.00	3.68	.00	.00	156.66
1991	1.75	.00	255.99	.00	.00	.00	.00	.00	.00	3.04	.00	.00	260.78
1992	4.20	.00	237.12	.00	.00	.00	.00	.33	.00	2.94	.00	.00	244.58
1993	6.95	.00	224.39	.00	.00	.00	.00	3.04	.00	3.09	.00	.01	237.49

Quantities are in unit of millions of tons and values are in billions of Yen.
Source: UNSO (1994).

Table A.3. Total Values and Quantities of Orange Imports for Japan

Year	Taiwan	Thailand	Israel	Canada	Greenland	ST P MQ	Netherlands	USA	Mexico	Venezia	S. Africa	Swaziland	Australia	New Zealand	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
							Value								
1970	.00	.00	.00	.00	.00	.00	.00	.49	.00	.00	.03	.00	.00	.00	.51
1971	.00	.00	.00	.00	.00	.00	.00	.63	.00	.00	.24	.00	.00	.00	.87
1972	.00	.00	.00	.00	.00	.00	.00	1.31	.00	.00	.10	.00	.00	.00	1.41
1973	.00	.00	.02	.00	.00	.00	.00	1.74	.00	.00	.08	.01	.00	.00	1.85
1974	.00	.00	.04	.00	.00	.00	.00	2.25	.00	.00	.19	.00	.00	.00	2.47
1975	.00	.00	.10	.00	.00	.00	.00	3.01	.01	.00	.14	.00	.00	.00	3.27
1976	.00	.00	.00	.00	.00	.00	.00	3.51	.00	.00	.00	.00	.00	.00	3.51
1977	.04	.00	.00	.00	.00	.00	.00	3.07	.00	.00	.00	.00	.00	.00	3.10
1978	.02	.00	.00	.00	.00	.00	.00	7.39	.00	.00	.00	.00	.00	.00	7.41
1979	.05	.00	.01	.00	.00	.00	.00	9.47	.06	.00	.00	.00	.00	.00	9.59
1980	.02	.00	.00	.00	.00	.00	.00	9.58	.01	.00	.02	.00	.00	.00	9.63
1981	.01	.00	.01	.00	.00	.00	.00	14.11	.00	.00	.02	.00	.00	.00	14.16
1982	.01	.00	.00	.00	.00	.00	.00	18.66	.01	.00	.01	.00	.00	.00	18.69
1983	.00	.00	.01	.00	.00	.00	.00	14.86	.00	.00	.00	.01	.01	.00	14.89
1984	.00	.00	.00	.00	.00	.00	.00	19.43	.00	.00	.03	.00	.12	.00	19.58
1985	.00	.00	.06	.00	.00	.00	.00	21.56	.00	.00	.00	.00	.17	.00	21.79
1986	.00	.00	.04	.00	.00	.00	.00	16.34	.00	.00	.01	.00	.14	.00	16.53
1987	.00	.00	.01	.00	.00	.00	.00	17.35	.03	.00	.00	.00	.15	.00	17.55
1988	.00	.00	.00	.00	.00	.00	.00	16.24	.00	.00	.00	.00	.09	.00	16.34
1989	.00	.00	.02	.00	.00	.00	.00	18.13	.05	.00	.00	.00	.35	.00	18.55
1990	.00	.00	.03	.00	.00	.00	.00	20.60	.00	.00	.00	.00	.24	.00	20.87
1991	.00	.00	.02	.00	.00	.00	.00	16.66	.78	.00	.00	.04	.58	.00	18.08
1992	.00	.00	.00	.00	.00	.00	.00	18.91	.03	.00	.20	.02	.46	.00	19.61
1993	.00	.00	.00	.00	.00	.00	.00	16.11	.00	.00	.68	.00	.54	.00	17.33

Source: UNSO (1994).

Table A.3. Continued

Year	Taiwan	Thailand	Israel	Canada	Greenland	ST P MQ	Netherlands	USA	Mexico	Venezia	S. Africa	Swaziland	Australia	New Zealand	Total
								Quantity							
1970	.00	.00	.00	.00	.00	.00	.00	4.04	.00	.00	.27	.00	.00	.00	4.31
1971	.00	.00	.00	.00	.00	.00	.00	4.82	.00	.00	2.07	.00	.00	.00	6.90
1972	.00	.00	.00	.00	.00	.00	.00	12.49	.02	.00	.98	.00	.00	.00	13.48
1973	.00	.00	.24	.00	.00	.00	.00	15.26	.03	.00	.80	.09	.00	.00	16.42
1974	.00	.00	.34	.00	.00	.00	.00	18.63	.00	.00	1.46	.00	.00	.00	20.44
1975	.00	.00	.76	.00	.00	.00	.00	20.22	.07	.00	1.05	.01	.00	.00	22.12
1976	.01	.00	.00	.00	.00	.00	.00	24.39	.00	.00	.00	.00	.00	.00	24.40
1977	.21	.00	.00	.00	.00	.00	.00	22.29	.00	.00	.00	.00	.00	.00	22.50
1978	.11	.00	.00	.00	.00	.00	.00	50.90	.00	.00	.00	.00	.00	.00	51.01
1979	.23	.00	.06	.00	.00	.00	.00	53.41	.37	.00	.00	.00	.00	.00	54.07
1980	.06	.00	.02	.00	.00	.00	.00	71.15	.03	.00	.14	.00	.00	.00	71.40
1981	.06	.00	.03	.00	.00	.00	.00	75.25	.03	.00	.10	.00	.00	.00	75.47
1982	.03	.00	.00	.00	.00	.00	.00	82.28	.04	.00	.06	.00	.00	.00	82.42
1983	.01	.00	.04	.00	.00	.00	.00	89.05	.00	.00	.00	.06	.03	.00	89.19
1984	.00	.00	.00	.00	.00	.00	.00	88.47	.00	.00	.15	.00	.50	.00	89.12
1985	.00	.00	.32	.00	.01	.00	.00	110.46	.00	.00	.00	.00	.85	.00	111.64
1986	.00	.00	.29	.00	.00	.00	.00	115.97	.02	.00	.09	.00	.94	.00	117.30
1987	.00	.00	.09	.00	.00	.00	.00	122.19	.24	.00	.00	.00	.89	.01	123.42
1988	.00	.00	.04	.00	.00	.00	.00	114.81	.02	.00	.00	.00	.48	.00	115.35
1989	.00	.00	.17	.00	.00	.00	.00	125.91	.35	.00	.00	.00	1.94	.00	128.37
1990	.00	.00	.24	.00	.00	.00	.00	143.12	.00	.00	.00	.00	1.83	.00	145.19
1991	.00	.00	.16	.00	.00	.00	.00	75.16	3.24	.00	.00	.33	3.12	.01	82.02
1992	.00	.00	.00	.00	.00	.00	.00	166.40	.28	.00	1.52	.14	3.37	.00	171.70
1993	.00	.00	.00	.00	.00	.00	.00	155.73	.00	.00	5.15	.00	4.54	.00	165.42

Quantities are in unit of millions of tons and values are in billions of Yen.
Source: UNSO (1994).

Table A.4. Total Values and Quantities of Lemon Imports for Japan

Year	Nether- lands	Spain	Taiwan	Israel	Canada	USA	Mexico	Guatemala	Cuba	Colombia	Bermuda	Ecuador	S. Africa	Swaziland	Australia	New Zealand	Fiji	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
									Value									
1970	.00	.00	.00	.00	.00	8.69	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	8.69
1971	.00	.00	.00	.00	.00	10.60	.00	.00	.00	.00	.00	.00	.01	.00	.00	.01	.00	10.61
1972	.00	.00	.00	.00	.00	11.66	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	11.67
1973	.00	.00	.00	.01	.00	12.91	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	12.93
1974	.00	.00	.00	.00	.00	16.54	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	16.55
1975	.00	.00	.00	.00	.00	14.68	.00	.00	.00	.00	.00	.00	.05	.00	.00	.00	.00	14.73
1976	.00	.00	.00	.00	.00	15.32	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	15.32
1977	.00	.00	.00	.00	.00	15.38	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	15.39
1978	.00	.00	.00	.00	.00	17.41	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	17.42
1979	.00	.00	.00	.00	.00	22.95	.01	.00	.00	.00	.00	.00	.00	.00	.00	.03	.00	22.99
1980	.00	.00	.00	.00	.00	18.72	.02	.00	.00	.00	.01	.00	.00	.00	.00	.05	.00	18.80
1981	.00	.00	.00	.00	.00	18.81	.04	.00	.00	.00	.00	.00	.04	.00	.00	.06	.00	18.95
1982	.00	.00	.00	.00	.00	20.60	.07	.00	.00	.00	.00	.00	.13	.00	.00	.07	.00	20.86
1983	.00	.00	.00	.00	.00	19.58	.08	.00	.01	.00	.00	.00	.31	.00	.00	.03	.00	20.00
1984	.00	.00	.00	.00	.00	21.38	.13	.00	.00	.00	.00	.00	.14	.00	.00	.04	.00	21.69
1985	.00	.00	.00	.00	.00	23.33	.21	.00	.02	.00	.00	.00	.04	.16	.00	.30	.00	24.07
1986	.00	.00	.00	.00	.00	16.63	.23	.00	.00	.00	.00	.00	.01	.00	.00	.07	.00	16.94
1987	.00	.00	.00	.00	.00	16.76	.24	.00	.00	.00	.00	.00	.00	.00	.00	.11	.00	17.11
1988	.00	.00	.00	.00	.00	15.51	.32	.00	.00	.00	.00	.00	.00	.00	.00	.04	.00	15.87
1989	.00	.00	.00	.00	.00	17.85	.46	.00	.00	.00	.00	.00	.00	.00	.00	.02	.00	18.34
1990	.00	.01	.00	.00	.00	17.40	.67	.00	.00	.00	.00	.00	.00	.00	.00	.05	.00	18.12
1991	.00	.00	.00	.00	.00	19.66	.72	.00	.00	.00	.00	.00	.07	.00	.00	.12	.00	20.58
1992	.00	.00	.00	.00	.00	13.31	.74	.00	.00	.00	.00	.00	.04	.00	.01	.04	.00	14.15
1993	.00	.00	.00	.00	.00	13.10	.66	.00	.00	.00	.00	.00	.06	.00	.04	.06	.00	13.92

Source: UNSO (1994).

Table A.4. Continued

Year	Nether-lands	Spain	Taiwan	Israel	Canada	USA	Mexico	Guatemala	Cuba	Colombia	Bermuda	Ecuador	S. Africa	Swaziland	Australia	New Zealand	Fiji	Total
									Quantity									
1970	.00	.00	.00	.00	.00	54.04	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	54.04
1971	.00	.00	.00	.00	.00	62.18	.00	.00	.00	.00	.00	.00	.04	.00	.00	.06	.00	62.28
1972	.00	.00	.00	.00	.00	78.62	.04	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	78.66
1973	.00	.00	.00	.06	.00	91.11	.08	.00	.00	.00	.00	.00	.00	.00	.00	.02	.00	91.27
1974	.00	.00	.00	.00	.00	92.94	.00	.00	.00	.00	.00	.00	.03	.00	.00	.00	.00	92.98
1975	.00	.00	.00	.00	.00	63.81	.00	.00	.00	.00	.00	.00	.24	.00	.00	.00	.00	64.05
1976	.00	.00	.00	.00	.00	92.77	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	92.77
1977	.00	.00	.00	.00	.02	104.66	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	104.68
1978	.00	.00	.00	.00	.00	116.89	.05	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	116.94
1979	.00	.00	.00	.00	.02	99.81	.01	.00	.00	.00	.00	.02	.00	.00	.00	.14	.00	99.99
1980	.00	.00	.00	.00	.00	100.35	.04	.00	.00	.00	.05	.00	.00	.00	.00	.26	.00	100.69
1981	.00	.00	.00	.00	.00	112.08	.06	.00	.00	.00	.00	.00	.18	.00	.00	.20	.00	112.53
1982	.00	.00	.00	.00	.00	103.64	.08	.00	.00	.00	.00	.00	.66	.00	.00	.21	.00	104.60
1983	.00	.00	.00	.00	.00	118.16	.13	.00	.01	.00	.00	.00	1.15	.00	.00	.10	.00	119.55
1984	.00	.00	.00	.00	.00	121.20	.20	.00	.00	.00	.00	.00	1.10	.00	.00	.14	.00	122.64
1985	.00	.00	.00	.00	.00	111.90	.30	.00	.19	.00	.00	.00	.25	.43	.00	.86	.00	113.92
1986	.00	.00	.00	.00	.00	124.91	.43	.00	.00	.00	.00	.00	.11	.00	.00	.37	.00	125.82
1987	.00	.00	.00	.00	.00	127.22	.52	.00	.00	.00	.00	.00	.00	.00	.00	.45	.00	128.18
1988	.00	.00	.00	.00	.00	118.01	.66	.00	.00	.00	.00	.00	.00	.00	.00	.23	.00	118.91
1989	.00	.00	.00	.00	.00	111.32	.83	.00	.00	.00	.00	.00	.00	.00	.00	.15	.00	112.30
1990	.00	.04	.00	.00	.00	102.53	1.04	.00	.00	.00	.00	.00	.00	.00	.00	.27	.00	103.88
1991	.00	.00	.00	.00	.00	87.07	1.06	.00	.00	.00	.00	.00	.47	.00	.00	.48	.00	89.08
1992	.00	.00	.00	.00	.00	91.61	1.13	.00	.00	.00	.00	.00	.42	.00	.05	.20	.00	93.42
1993	.00	.00	.00	.00	.00	87.00	1.09	.00	.00	.00	.00	.00	.56	.00	.29	.34	.00	89.28

Quantities are in unit of millions of tons and values are in billions of Yen.
Source: UNSO (1994).

Table A.5. Total Values and Quantities of Pineapple Imports for Japan

Year	China	Ryukyu	Taiwan	Vietnam	Hong Kong	Thai-land	Singa-pore	Malaysia	Philippine	Indo-nesia	Sri Lanka	USA	Mexico	F. Ocean	Australia	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
								Value								
1970	.00	.02	1.75	.00	.00	.00	.00	.00	.19	.00	.00	.03	.00	.00	.00	1.99
1971	.00	.01	2.08	.00	.00	.00	.00	.00	.36	.00	.00	.01	.00	.00	.00	2.46
1972	.00	.00	2.49	.00	.00	.00	.00	.00	.55	.00	.00	.01	.00	.00	.00	3.05
1973	.00	.00	1.73	.00	.00	.00	.00	.00	.54	.00	.00	.02	.00	.00	.00	2.29
1974	.00	.00	.52	.00	.00	.00	.00	.00	1.86	.00	.00	.03	.00	.00	.00	2.40
1975	.00	.00	1.07	.00	.00	.00	.00	.00	2.71	.00	.00	.01	.00	.00	.00	3.79
1976	.00	.00	.67	.00	.00	.00	.00	.00	4.16	.00	.00	.01	.00	.00	.00	4.85
1977	.00	.00	.45	.00	.00	.00	.00	.00	5.34	.00	.00	.00	.00	.00	.00	5.80
1978	.00	.00	.51	.00	.00	.00	.00	.00	6.08	.00	.00	.01	.00	.00	.00	6.60
1979	.00	.00	.48	.00	.00	.00	.00	.00	7.74	.00	.00	.01	.00	.00	.00	8.23
1980	.00	.00	.33	.00	.00	.00	.00	.00	8.82	.00	.00	.01	.00	.00	.00	9.15
1981	.00	.00	.07	.00	.00	.00	.00	.00	10.31	.00	.00	.00	.00	.00	.00	10.39
1982	.00	.00	.05	.00	.00	.00	.00	.00	10.30	.00	.00	.01	.00	.00	.00	10.36
1983	.00	.00	.04	.00	.00	.00	.00	.00	9.14	.00	.00	.01	.00	.00	.00	9.19
1984	.00	.00	.03	.00	.00	.00	.00	.00	8.72	.00	.00	.01	.00	.00	.00	8.76
1985	.00	.00	.10	.00	.00	.00	.00	.00	10.51	.00	.00	.01	.00	.00	.00	10.63
1986	.00	.00	.54	.00	.00	.00	.00	.00	10.37	.00	.00	.01	.00	.00	.00	10.91
1987	.00	.00	1.03	.00	.00	.00	.00	.00	9.43	.00	.00	.02	.00	.00	.00	10.48
1988	.00	.00	.94	.00	.00	.01	.00	.00	8.35	.00	.00	.02	.00	.00	.00	9.34
1989	.00	.00	.64	.00	.00	.01	.00	.00	8.71	.00	.00	.01	.00	.00	.00	9.37
1990	.01	.00	.44	.00	.00	.01	.00	.00	7.82	.01	.00	.00	.00	.00	.00	8.30
1991	.00	.00	.30	.00	.00	.00	.00	.00	6.82	.00	.00	.00	.00	.00	.00	7.13
1992	.00	.00	.27	.00	.00	.00	.00	.00	6.92	.00	.00	.01	.00	.00	.00	7.21
1993	.00	.00	.15	.00	.00	.00	.00	.00	5.68	.00	.00	.01	.00	.00	.00	5.84

Source: UNSO (1994).

Table A.5. Continued

Year	China	Ryukyu	Taiwan	Vietnam	Hong Kong	Thai-land	Singa-pore	Malaysia	Philippine	Indo-nesia	Sri Lanka	USA	Mexico	F. Ocean	Australia	Total
								Quantity								
1970	.00	.24	32.54	.00	.00	.00	.00	.00	2.60	.00	.00	.22	.00	.00	.00	35.61
1971	.00	.07	39.62	.00	.00	.00	.00	.00	4.65	.00	.00	.04	.00	.00	.00	44.39
1972	.00	.00	62.41	.00	.00	.00	.00	.00	8.79	.00	.00	.04	.00	.00	.00	71.25
1973	.00	.00	44.91	.00	.00	.02	.00	.00	10.52	.00	.00	.08	.00	.00	.01	55.55
1974	.00	.00	7.24	.00	.00	.00	.00	.00	28.77	.00	.00	.09	.00	.00	.00	36.10
1975	.00	.00	14.14	.00	.00	.00	.00	.00	40.03	.00	.00	.04	.00	.00	.00	54.22
1976	.00	.00	8.49	.00	.00	.00	.00	.00	53.85	.00	.01	.03	.00	.00	.00	62.38
1977	.00	.00	6.09	.00	.00	.01	.00	.00	71.50	.00	.00	.01	.00	.00	.00	77.61
1978	.00	.00	6.93	.00	.00	.03	.00	.00	94.47	.00	.00	.04	.00	.00	.00	101.48
1979	.00	.00	6.97	.00	.00	.00	.00	.00	102.19	.00	.00	.03	.00	.00	.00	109.19
1980	.00	.00	4.06	.00	.00	.00	.00	.00	100.93	.00	.00	.02	.00	.00	.00	105.01
1981	.00	.00	.91	.00	.00	.02	.00	.00	121.89	.00	.00	.01	.00	.00	.00	122.83
1982	.00	.00	.60	.00	.00	.00	.00	.00	121.26	.00	.00	.02	.00	.00	.00	121.88
1983	.00	.00	.40	.00	.00	.01	.00	.00	101.54	.00	.00	.03	.00	.00	.00	101.99
1984	.00	.00	.32	.00	.00	.00	.00	.00	114.44	.00	.00	.03	.00	.00	.00	114.79
1985	.00	.00	.63	.00	.00	.01	.00	.00	128.25	.00	.00	.02	.00	.00	.00	128.91
1986	.00	.00	4.50	.00	.00	.03	.00	.00	140.26	.00	.00	.02	.00	.00	.00	144.81
1987	.01	.00	8.24	.00	.00	.05	.00	.00	136.33	.00	.00	.05	.00	.00	.01	144.68
1988	.02	.00	7.44	.00	.01	.26	.01	.01	130.26	.07	.00	.07	.00	.00	.00	138.16
1989	.00	.00	5.39	.00	.00	.22	.00	.00	129.68	.04	.01	.05	.00	.00	.00	135.38
1990	.09	.00	3.48	.00	.00	.12	.00	.00	124.34	.19	.01	.02	.00	.00	.00	128.25
1991	.04	.00	2.26	.02	.00	.02	.01	.00	135.41	.02	.00	.00	.00	.00	.00	137.79
1992	.00	.00	1.98	.00	.00	.01	.00	.00	125.39	.00	.00	.09	.00	.00	.00	127.47
1993	.00	.00	1.25	.00	.00	.02	.00	.00	119.60	.01	.00	.08	.00	.00	.00	120.96

Source: UNSO (1994).

Table A.6. Total Values and Quantities of Berries Imports for Japan

Year	R Korea	China	Taiwan	Thailand	USSR	Canada	USA	Mexico	Australia	New Zealand	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Value											
1970	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
1971	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
1972	.00	.00	.00	.00	.00	.00	.01	.00	.00	.00	.01
1973	.00	.00	.00	.00	.00	.00	.03	.00	.00	.00	.04
1974	.00	.00	.00	.00	.00	.00	.18	.00	.00	.00	.18
1975	.00	.00	.00	.00	.00	.00	.20	.00	.00	.00	.20
1976	.00	.00	.00	.00	.00	.00	.01	.00	.00	.00	.01
1977	.00	.00	.00	.00	.00	.00	.05	.00	.00	.01	.06
1978	.00	.00	.00	.00	.00	.00	.35	.00	.00	.02	.37
1979	.00	.00	.00	.00	.00	.00	.67	.00	.00	.05	.73
1980	.00	.00	.00	.00	.00	.00	1.35	.00	.00	.05	1.39
1981	.00	.00	.00	.00	.00	.00	.59	.00	.00	.12	.71
1982	.00	.00	.00	.00	.02	.00	1.57	.00	.00	.09	1.67
1983	.00	.00	.00	.00	.02	.00	1.52	.00	.00	.09	1.63
1984	.00	.00	.00	.00	.01	.00	2.02	.00	.00	.10	2.13
1985	.00	.00	.00	.00	.00	.00	2.19	.00	.00	.13	2.33
1986	.00	.00	.00	.00	.00	.00	1.76	.00	.00	.11	1.87
1987	.00	.00	.01	.00	.00	.00	2.17	.00	.00	.10	2.28
1988	.00	.00	.01	.00	.00	.00	2.42	.00	.00	.07	2.51
1989	.00	.00	.03	.00	.00	.00	2.87	.00	.00	.10	3.01
1990	.00	.00	.04	.00	.00	.00	3.14	.00	.00	.11	3.29
1991	.00	.00	.04	.00	.00	.00	3.39	.00	.00	.13	3.56
1992	.02	.00	.03	.00	.00	.00	2.95	.00	.00	.09	3.09
1993	.00	.00	.00	.00	.00	.00	2.87	.00	.00	.07	2.94

Source: UNSO (1994).

Table A.6. Continued

Year	R Korea	China	Taiwan	Thailand	USSR	Canada	USA	Mexico	Australia	New Zealand	Total
						Quantity					
1970	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
1971	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01
1972	.00	.00	.00	.00	.00	.00	.02	.00	.00	.00	.02
1973	.00	.00	.00	.00	.00	.00	.07	.00	.00	.00	.07
1974	.00	.00	.00	.00	.00	.00	.29	.00	.00	.00	.29
1975	.00	.00	.00	.00	.00	.00	.32	.00	.00	.00	.32
1976	.00	.00	.00	.00	.00	.00	.02	.00	.00	.00	.02
1977	.00	.00	.00	.00	.00	.00	.07	.00	.00	.01	.08
1978	.00	.01	.00	.00	.00	.00	.56	.00	.00	.02	.60
1979	.00	.01	.00	.00	.00	.00	.91	.00	.00	.04	.96
1980	.00	.00	.00	.00	.00	.00	1.53	.00	.00	.04	1.57
1981	.00	.00	.00	.00	.00	.00	.60	.00	.00	.09	.69
1982	.00	.00	.00	.00	.05	.00	1.29	.00	.00	.07	1.42
1983	.00	.00	.00	.00	.06	.00	1.26	.00	.00	.08	1.40
1984	.00	.00	.00	.00	.01	.00	1.62	.00	.00	.09	1.71
1985	.00	.00	.00	.00	.01	.00	1.50	.00	.00	.10	1.61
1986	.00	.00	.00	.00	.00	.00	1.70	.00	.00	.10	1.80
1987	.00	.00	.01	.00	.00	.00	2.31	.00	.00	.09	2.41
1988	.00	.00	.01	.00	.00	.00	2.76	.00	.00	.07	2.84
1989	.00	.00	.01	.00	.00	.00	2.90	.00	.00	.08	3.00
1990	.00	.00	.02	.00	.00	.00	3.15	.00	.00	.09	3.25
1991	.00	.00	.02	.00	.00	.00	3.54	.00	.00	.10	3.66
1992	.03	.00	.01	.00	.00	.00	3.31	.00	.00	.08	3.44
1993	.00	.00	.00	.00	.00	.00	3.87	.00	.00	.06	3.93

Quantities are in unit of millions of tons and values are in billions of Yen.
Source: UNSO (1994).

Table A.7. Total Values and Quantities of Grape Imports for Japan

Year	China	R Korea	Taiwan	Thailand	India	Indonesia	USA	Mexico	Colombia	Chile	New Zealand	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
						Value						
1970	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
1971	.00	.00	.00	.00	.00	.00	.01	.00	.00	.00	.00	.01
1972	.02	.00	.01	.00	.00	.00	.07	.00	.00	.00	.00	.09
1973	.05	.00	.00	.00	.00	.00	.16	.00	.00	.00	.00	.22
1974	.04	.00	.00	.00	.00	.00	.19	.00	.00	.00	.01	.24
1975	.00	.00	.00	.00	.00	.00	.34	.00	.00	.00	.01	.36
1976	.01	.00	.00	.00	.00	.00	.45	.00	.00	.00	.01	.46
1977	.01	.00	.00	.00	.00	.00	.27	.00	.00	.00	.01	.29
1978	.00	.00	.00	.00	.00	.00	.47	.00	.00	.00	.02	.49
1979	.00	.00	.01	.01	.00	.00	.50	.00	.00	.00	.01	.52
1980	.00	.00	.02	.03	.00	.00	.48	.01	.00	.00	.01	.56
1981	.00	.00	.06	.04	.00	.00	.42	.00	.00	.00	.01	.52
1982	.00	.00	.03	.03	.00	.00	.64	.00	.00	.00	.02	.72
1983	.00	.00	.02	.03	.00	.00	.59	.00	.00	.00	.04	.67
1984	.00	.00	.06	.02	.00	.00	.66	.00	.00	.00	.07	.81
1985	.00	.00	.08	.03	.00	.00	.65	.00	.00	.00	.09	.85
1986	.00	.00	.15	.02	.00	.00	1.10	.00	.00	.00	.06	1.33
1987	.00	.00	.16	.03	.00	.00	1.19	.00	.00	.00	.09	1.47
1988	.00	.00	.29	.01	.00	.00	1.22	.01	.00	.43	.09	2.04
1989	.01	.00	.23	.01	.00	.00	1.05	.00	.00	.69	.07	2.06
1990	.00	.00	.16	.01	.00	.00	1.26	.00	.00	1.86	.10	3.38
1991	.01	.00	.33	.00	.00	.00	1.16	.00	.00	.90	.09	2.49
1992	.00	.00	.41	.00	.00	.00	.80	.00	.00	1.37	.07	2.65
1993	.00	.00	.17	.00	.00	.00	.89	.00	.00	.95	.09	2.10

Source: UNSO (1994).

Table A.7. Continued

Year	China	R Korea	Taiwan	Thailand	India	Indonesia	USA	Mexico	Colombia	Chile	New Zealand	Total
						Quantity						
1970	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
1971	.00	.00	.00	.00	.00	.00	.03	.00	.00	.00	.00	.03
1972	.29	.00	.01	.00	.00	.00	.25	.00	.00	.00	.00	.54
1973	.41	.00	.00	.00	.00	.00	.62	.00	.00	.00	.00	1.03
1974	.23	.00	.00	.00	.00	.00	.68	.00	.00	.00	.01	.92
1975	.01	.00	.00	.00	.00	.00	1.29	.00	.00	.00	.01	1.31
1976	.02	.00	.00	.00	.00	.00	1.54	.00	.00	.00	.00	1.56
1977	.02	.00	.00	.00	.00	.00	.97	.00	.00	.00	.01	.99
1978	.00	.00	.00	.00	.00	.00	1.78	.00	.00	.00	.01	1.80
1979	.00	.00	.01	.01	.00	.00	1.49	.00	.00	.00	.01	1.51
1980	.00	.00	.03	.04	.00	.00	1.30	.03	.00	.00	.00	1.40
1981	.00	.00	.11	.05	.00	.00	1.02	.00	.00	.00	.01	1.18
1982	.00	.00	.05	.05	.00	.00	1.57	.00	.00	.00	.01	1.67
1983	.00	.00	.02	.05	.00	.00	1.47	.00	.00	.00	.02	1.56
1984	.00	.00	.10	.03	.00	.00	1.70	.00	.00	.00	.04	1.86
1985	.00	.00	.14	.04	.00	.00	1.87	.00	.00	.00	.05	2.10
1986	.00	.00	.27	.04	.00	.00	4.56	.00	.00	.00	.04	4.91
1987	.00	.00	.27	.06	.00	.00	5.13	.00	.00	.00	.06	5.53
1988	.00	.00	.52	.03	.00	.00	5.44	.01	.00	1.58	.06	7.63
1989	.05	.00	.42	.02	.00	.00	4.22	.00	.00	2.99	.05	7.74
1990	.03	.00	.22	.02	.00	.00	4.50	.00	.00	7.20	.08	12.04
1991	.04	.00	.47	.01	.00	.00	4.11	.00	.00	2.87	.07	7.57
1992	.01	.00	.63	.00	.00	.00	3.04	.00	.00	4.01	.04	7.73
1993	.00	.00	.26	.00	.00	.00	3.30	.00	.00	4.17	.05	7.78

Quantities are in unit of millions of tons and values are in billions of Yen.
Source: UNSO (1994).

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