Derived Demand for Disaggregated Cheese Products Imported Into Japan

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ABSTRACT

The objective of this article is to estimate the derived demand for imported cheese products into Japan when cheese import data are disaggregated by specific cheese group and by source country of production. We provide empirical measures of the sensitivity of demand to changes in total imports, own-price, and cross-prices among exporting countries for four market segments of the cheese category. Derived demands for U.S. fresh, grated, and processed cheese products are perfectly inelastic, and it is thus suggested that competition in these segments be based upon differences in product characteristics. However, the derived demand for "other" cheese is elastic, and competition can be price driven. Hence, an advantage of this paper's approach is that disaggregating import data for a product category helps identify specific marketing strategies for market segments within the category. [EconLit citations: Q110, Q130, Q170.] © 2005 Wiley Periodicals, Inc.

1. INTRODUCTION

Changes in domestic and international policies to liberalize world agricultural trade is forcing the US dairy industry to seek new markets. Specifically, dairy price supports offered by the United States Department of Agriculture (USDA) may be phased out in the future which may reduce input costs for U.S. dairy products and make them more

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competitive in international markets. With the General Agreement on Tariffs and Trade (GATT), both the amount of agricultural products exported with subsidy and budget expenditures for export subsidies must be reduced by 21 and 36%, respectively. This will have a major effect on EU exports, but a minor effect on U.S. exports since U.S. subsidized cheese exports traditionally have been quite small.

These changes have increased the interest in developing export markets for US dairy firms and led to the creation of the United States Dairy Export Council (USDEC) in 1995. USDEC was established as a nonprofit organization to support US dairy exporters and to search for new markets. Given that exports have been a small share of total production (Table 1) and that the United States has maintained a relatively small share of the cheese traded in world markets, there is little import demand information by country and by specific cheese category. There is a need for a quantitative analysis of import demand for different countries in order to assist U.S. manufacturers of cheese products to become successful international suppliers.

The objective of this study is to estimate the derived demand for imported cheese into Japan when cheese import data are disaggregated by specific cheese groups and by source country of production, and derived demand is estimated with a differential factor demand model. Burgess (1974a, 1974b), Kohli (1978), Diewert and Morrison (1989), Truett and Truett (1998), Washington (2000), and Washington and Kilmer (2001a, 2001b, 2002) are some of the past studies that have estimated demand for imported products using the production theory approach to international trade. However, these studies do not disaggregate the demand for specific segments within a product category. Utilizing the empirically estimated import demand parameters, we provide empirical measures of the sensitivity of demand to changes in total imports, own-price, and cross-prices among exporting countries for four market segments within the cheese category. This will help U.S. cheese exporters to assess types of competition and their competitiveness in four major segments of the Japanese cheese market.

TABLE 1. U.S. Cheese Exports as Percent of U.S. Cheese Production, 1990–2000

Years	Exports (Metric Tons)	Production (Metric Tons)	Exports as Percent of Production
1990	13,048	3,126,100	0.4
1991	13,856	3,118,000	0.4
1992	17,467	3,299,900	0.5
1993	18,522	3,301,000	0.6
1994	24,761	3,385,600	0.7
1995	31,990	3,493,450	0.9
1996	35,845	3,626,820	1.0
1997	40,157	3,645,000	1.1
1998	40,592	3,728,500	1.1
1999	43,121	3,930,950	1.1
2000	49,865	4,079,450	1.2
2001	45,070	4,083,700	1.1
2002	55,620	4,239,200	1.3

Source: FAO Statistics (2004)

2. CHEESE EXPORTS AND IMPORTS

Even though the United States is one of the principal cheese producers in the world, it has a very small share of world cheese exports, which was about 1.5% in 2000. In the period 1990–2000, average U.S. cheese exports were about 1.1% of total world cheese exports (FAO-Statistics, 2002). In 2002, total U.S. cheese exports were 55,620 metric tons (Table 1) and were valued at US$167 million. U.S. cheese exports, as a percent of cheese production, increased throughout the 1990–2002 period, except for 2001 (Table 1). U.S. cheese exports increased more than 326% in that period. The percent of total U.S. cheese production being exported also increased (Table 1).

Japan is the focus of this research because USDEC has identified Japan as one of the target countries that will increase its share of world imports of dairy products in the future. Japan is a vital trade partner of the United States and has the second most powerful national economy in the world. The dairy industry is quite new in Japan, and dairy products only became well known to Japanese consumers after World War II (Japan Dairy Council, 2000). Between the years 1993 and 1998, cheese consumption increased by 21.5%, almost a five% annual growth rate. In terms of volume, cheese consumption in Japan is low, but the cheese market shows significant room for expansion and great potential in the future (JETRO, 2002). Japanese cheese imports have been steadily increasing every year, exceeding the 200,000-ton barrier in 2000. The principal cheese exporters in the Japanese market are Australia, New Zealand, the European Union, and the United States with shares of 43.8, 24.3, 26.6, and 2.3%, respectively (FAO-Statistics, 2002).[1]

3. METHODOLOGY

The differential production approach, used to examine imported cheese demand into Japan, is derived from the differential approach to the theory of the multiproduct firm (Laitinen, 1980). Using the methodology of Laitinen and Theil (1978), Laitinen (1980), and Theil (1980), the econometric model used in this project was the differential factor allocation model (DFAM), which is written as

$$\bar{f}_{it}\,\Delta x_{it} = \eta_i + \theta_i\,\Delta X_t + \pi_{ij}\sum_{j=1}^{n}\Delta w_{jt} + \varepsilon_{it} \tag{1}$$

where f_i is the ith country's factor share of total cost calculated as $\bar{f}_{it} = (f_{it} + f_{it-4})/2$ where the data were fourth differenced (four quarters in a year) to eliminate seasonality; x_i represents the ith country's quantity; w_j represents the jth country's price; $\Delta x_{it} = \log(x_{it}/x_{it-4})$ and $\Delta w_{jt} = \log(w_{jt}/w_{jt-4})$ are the log of change in quantity and change in price, respectively, from source country i, and the data are fourth differenced to eliminate seasonality; $\Delta X_t = \sum_{i=1}^{n}\bar{f}_{it}\,\Delta x_{it}$, where ΔX_t is the finite version of the Divisia input index; η_i is the intercept; θ_i is the ith country's marginal share of marginal cost; π_{ij}s are the price parameters to be estimated; n is the number of countries; and ε_{it} is the disturbance term.

[1]An anonymous reviewer pointed out that export promotion programs from each country could affect a country's market share; however, data are not readily available. So, the promotion variable is not included in the model. The Divisia input index will account for any effect of a promotion program plus other factors that influence input demand.

The differential factor demand model can be tested for homogeneity and symmetry. After testing is completed, the model has three constraints imposed on its parameters in order to ensure that the model is consistent with theory:

$$\sum_j \pi_{ij} = 0 \text{ (homogeneity)}, \tag{2}$$

$$\pi_{ij} = \pi_{ji} \text{ (symmetry)} \tag{3}$$

and

$$\sum_i \theta_i = 1. \tag{4}$$

After homogeneity and symmetry restrictions are imposed on Equation (1), it becomes

$$\bar{f}_{it}\,\Delta x_{it} = \eta_i + \theta_i\,\Delta X_t + \sum_{j=1}^{n-1} \pi_{ij}(\Delta w_{jt} - \Delta w_{nt}) + \varepsilon_{it}. \tag{5}$$

Equation (5) is used to estimate the system of derived demand equations where i represents a country and all i countries export the same type of cheese to Japan.

Elasticities will be calculated utilizing the constrained parameters in the previous equation obtained from the estimation procedure. The following are the own/cross price elasticities and the Divisia volume input elasticity, respectively:

$$\varepsilon_{xw} = \frac{d(\log x_i)}{d(\log w_j)} = \frac{\pi_{ij}}{\bar{f}_i} \tag{6}$$

$$\varepsilon_{xX} = \frac{d(\log x_i)}{d(\log X)} = \frac{\theta_i}{\bar{f}_i}. \tag{7}$$

4. DATA AND ESTIMATION

The data were gathered from the Trade Statistics section of the web page maintained by the Ministry of Finance of Japan. The data are quarterly for different periods of time depending on the type of cheese. Fresh and grated cheeses have quarterly data from 1991 through 2001, processed cheese from 1995 through 2001, and other cheeses from 1991 through 2001. For the importing country, quantities (in kilograms) and value (in yen) were collected for imports from all exporting countries for each of the cheese categories. In the following section, the derived demand for four imported cheese categories into Japan will be calculated individually. The system of equations varies for all cheese estimations (i.e., each system of equations represents one cheese type imported into Japan from different countries). Also, the rest of the world (ROW) quantities and values are obtained by subtracting the total quantity and value imported from all the primary importing countries from the overall total imported quantity and value. Commodity prices will be calculated by dividing the value of the commodity imported by the quantity.

The Least Squares (LSQ) procedure in the Times Series Processor (TSP) computer software is used to estimate the system of equations; each equation in the system is rep-

TABLE 2. Likelihood Ratio Test Results for Autocorrelation

Product	Model	Log-likelihood Value	LR*	$P[\chi^2_{(j)} \leq \text{LR*}] = 0.95$
Fresh Cheese	AR (1)	507.541		
	No-AR (1)	505.170	4.742*	3.84(1)[a]
Grated Cheese	AR (1)	110.865		
	No-AR (1)	108.430	4.87*	3.84(1)
Processed Cheese	AR (1)	321.164		
	No-AR (1)	321.068	0.192	3.84(1)
Other Cheese	AR (1)	1101.32		
	No-AR (1)	1096.88	8.88*	3.84(1)

[a]The number of restrictions are in parentheses
*Statistically significant

resented by equation (5). The LSQ procedure in TSP provides parameter estimates, standard errors, probability values, and the log-likelihood function value for the system. One equation is deleted from the system (i.e., the ROW equation), and the coefficients of the deleted equation can be recovered by using the coefficients from the estimated system. The recovery of the deleted equation's coefficients is ensured by the constraints (equations 2, 3, and 4) imposed within and across the estimated system of equations.

The test for a first order autoregressive disturbance [AR (1)] in the differential factor demand model is by applying the likelihood ratio (LR) test. Utilizing full maximum likelihood estimation, the autocorrelation parameter ρ is estimated where ρ will be common across equations (Washington, 2000). Also, the test for autocorrelation will be accomplished using the LR test where the model will be estimated with and without AR (1) disturbances. Then, the LR test will be used to test the null hypothesis that $\rho = 0$ (Table 2). If autocorrelation cannot be rejected, then the autocorrelated differential factor demand model will be used to estimate the empirical results. The validity of homogeneity and symmetry can be determined using constrained maximum likelihood estimation and the LR test (Table 3). If homogeneity is rejected, Laitinen's test (1978) is used because it is a more accurate test. All estimated models have the homogeneity and symmetry conditions imposed even if the LR test does not reject these properties.

5. EMPIRICAL RESULTS

This section reports the derived demand elasticities for imported cheeses into Japan. The competitiveness of U.S. cheeses was assessed by looking at the percentage change of quantities imported to such factors as total imports, own-prices, and cross-prices among exporting countries shipping to Japan. Descriptive statistics of the raw data (un-logged and un-differenced data) is included to help the reader better understand the magnitude of the quantity and price changes based on the elasticities (Table 4).

5.1 Imported Fresh Cheese

In this market the dominant exporting countries are the United States, Norway, the European Union, New Zealand, Australia, and the rest of the world (ROW). The time period

TABLE 3. Likelihood Ratio Test Results for Economic Constraints and Laitinen's Test for Homogeneity

Product	Model	Log-likelihood Value	LR*	$P[\chi^2_{(j)} \leq \text{LR*}] = .95$
Fresh Cheese	AR1	507.541		
	Homogeneity	500.959	13.164*	11.07(5)[a]
	Symmetry	480.674	40.570*	11.07(5)
Grated Cheese	AR (1)	110.865		
	Homogeneity	109.248	3.234	5.99(2)
	Symmetry	108.787	0.922	5.99(2)
Processed Cheese	No-AR (1)	321.068		
	Homogeneity	314.508	13.120*	11.07(5)
	Symmetry	311.492	6.032	11.07(5)
Other Cheese	AR (1)	1101.32		
	Homogeneity	1092.27	18.100*	14.06(7)
	Symmetry	1082.19	20.160*	14.06(7)

		Laitinen's Test (1978)	
		W^{*b}	$P\,[T^2 \leq W^*] = .95^c$
Fresh Cheese	Homogeneity	35.089*	14.183
Processed Cheese	Homogeneity	11.888	19.937
Other Cheese	Homogeneity	26.410*	19.937

[a]The number of restrictions are in parentheses
[b]W^* is the Wald statistic for the homogeneity constraint
[c]T^2 is the Hotelling's T^2 statistic
*Statistically significant

of the data set is from 1991:1 to 2001:4. The Divisia index elasticities are 0.778, 0.367, 1.301, 0.505, 1.117, and 0.824 for the United States, Norway, the European Union, New Zealand, Australia, and ROW, respectively (Table 5). The Divisia index elasticity shows the percentage change in imports from the exporting countries when the total imports change. The EU elasticity is the largest, which means that as the total imports of fresh cheese into Japan increase by 1.0%, EU fresh cheese imports will increase by 1.301%.

The conditional own-price elasticities of imported fresh cheese into Japan are −0.014, −0.366, −0.474, 0.056, 0.056, and −0.078 for the United States, Norway, the European Union, New Zealand, Australia, and ROW, respectively (Table 5). However, only the conditional own-price elasticities of imports from Norway and the European Union are statistically significant at a 0.05 or lower significance level. The New Zealand and Australian own-price elasticities are positive, but statistically insignificant (Table 5).

Cross-price elasticities show substitution relationships between the imports from the different sources. The conditional cross-price elasticity of the derived demand for imported fresh cheese into Japan that stands out is New Zealand/EU (0.802), which means that when EU fresh cheese price increases by 1.0%, the New Zealand fresh cheese demanded will increase by 0.802% (Table 5). Also, the US/EU (0.641) and the Norway/EU (0.663) elasticities indicate that when the price of EU cheese rises by 1.0%, imports from the United States and Norway will increase by 0.641 and 0.663%, respectively. Other significant elasticities that show little substitution are Norway/Australia (0.192), EU/United

TABLE 4. Average Quarterly Quantity (kg), Market Share, and Price (yen/kg) for Each Country

Exporting Countries	Fresh Cheese		Grated Cheese		Processed Cheese		Other Cheese	
	Quantity	Price	Quantity	Price	Quantity	Price	Quantity	Price
Australia	4,983,745 (0.525)[a]	0.30	—	—	—	—	9,857,851 (0.326)	0.28
Canada	—	—	—	—	—	—	697,413 (0.023)	0.27
European Union	1,699,130 (0.179)	0.53	253,580 (0.417)	0.59	853,046 (0.869)	0.55	8,153,631 (0.269)	0.39
New Zealand	1,346,267 (0.142)	0.21	—	—	—	—	10,030,000 (0.331)	0.28
Norway	711,177 (0.075)	0.23	—	—	—	—	1,338,761 (0.044)	0.28
Oceania[b]	—	—	—	—	44,836 (0.046)	0.44	—	—
ROW	409,384 (0.043)	0.34	40,695 (0.067)	0.71	60,549 (0.062)	0.54	50,997 (0.002)	0.45
Switzerland	–	—	—	—	7,674 (0.008)	0.74	88,094 (0.003)	0.79
United States	341,796 (0.036)	0.46	314,348 (0.516)	1.21	15,144 (0.015)	0.56	55,581 (0.002)	0.54

Source: Ministry of Finance
[a]Market share
[b]Australia and New Zealand

States (0.066), EU/Norway (0.270), EU/New Zealand (0.205), New Zealand/ROW (0.154), Australia/Norway (0.075), and ROW/New Zealand (0.434).

The most noteworthy negative cross-price elasticity is New Zealand/Norway (−0.717), which shows a complementary relationship. The latter means that when Norway's fresh cheese price increases by 1.0%, imports from New Zealand will decrease by 0.717%. Furthermore, the following cross-price elasticities indicate a smaller complementary relationship: Norway/New Zealand (−0.451), United States/New Zealand (−0.309), United States/Australia (−0.226), New Zealand/United States (−0.125), New Zealand/Australia (−0.170), Australia/ United States (−0.022), and Australia/New Zealand (−.041) [Table 5].

5.2 Imported Grated Cheese

The exporting countries considered for this estimation (1991:1 to 2001:4) are the United States, the European Union, and ROW. The Divisia index elasticities are significant at a 0.05 or lower significance level. The Divisia index elasticities indicate that when total imports of grated cheese in Japan increase by 1.0%, imports from the United States, the European Union, and ROW will increase by 0.848, 0.431, and 5.926%, respectively (Table 6). Imports from ROW increase more than that of other countries when total imports into Japan increase.

TABLE 5. Conditional Divisia and Price Elasticities of the Derived Demand for Imported Fresh Cheese

	Elasticities							
			Conditional Cross-Price					
Exporting Countries	Divisia Index	Conditional Own-Price	United States	Norway	EU	New Zealand	Australia	ROW[a]
United States	0.778***	−0.014		−0.129	0.641***	−0.309***	−0.226***	0.038
	(0.223)[b]	(0.091)		(0.123)	(0.200)	(0.090)	(0.071)	(0.091)
Norway	0.367***	−0.366**	−0.033		0.663***	−0.451***	0.192***	−0.006
	(0.126)	(0.170)	(0.031)		(0.194)	(0.113)	(0.025)	(0.035)
European Union	1.301***	−0.474***	0.066***	0.270***		0.205***	−.052	−.016
	(0.133)	(0.131)	(0.021)	(0.079)		(0.058)	(0.041)	(0.027)
New Zealand	0.505***	0.056	−0.125***	−0.717***	0.802***		−0.170***	0.154***
	(0.172)	(0.202)	(0.036)	(0.180)	(0.228)		(0.030)	(0.041)
Australia	1.117***	0.056	−0.022***	0.075***	−0.050	−0.041***		−0.017
	(0.099)	(0.035)	(0.007)	(0.010)	(0.039)	(0.007)		(0.011)
ROW	0.824**	−0.078	0.043	−0.025	−0.173	0.434***	−0.201	
	(0.399)	(0.171)	(0.103)	(0.156)	(0.297)	(0.116)	(0.131)	

[a]ROW = rest of the world
[b]The ANALYZ routine in TSP was used to calculate the asymptotic standard errors in parentheses.
***Significance level = .01
**Significance level = .05
*Significance level = .10

TABLE 6. Conditional Divisia and Price Elasticities of Derived Demand for Imported Grated Cheese

	Elasticities				
			Conditional Cross-Price		
Exporting Country	Divisia Index	Conditional Own-Price	United States	EU	ROW[a]
United States	0.848***	−0.056		0.051	0.005
	(0.114)[b]	(0.078)		(0.073)	(0.019)
European Union	0.431**	−0.167	0.187		−0.020
	(0.203)	(0.258)	(0.267)		(0.033)
ROW	5.926***	0.007	0.081	−0.088	
	(1.550)	(0.262)	(0.308)	(0.146)	

[a]ROW = rest of the world.
[b]ANALYZ routine in TSP was used to calculate asymptotic standard errors in parentheses
***Significance level = .01
**Significance level = .05
*Significance level = .10

The conditional own-price elasticities of imported grated cheese into Japan were −0.056, −0.167, and 0.007 for the United States, the European Union, and ROW, respectively. However, none of them are statistically significant. Furthermore, no cross-price elasticity is significantly different from zero, meaning that there is no competition among grated cheese imported from different exporting sources (Table 6).

5.3 Imported Processed Cheese

The major exporting sources considered for the estimation of the derived demand for imported processed cheese into Japan are the United States, the European Union, Oceania, Switzerland, and ROW. The time period of this dataset is from 1995:1 to 2001:4. The Divisia index elasticities for the United States (−4.383), the European Union (0.982), and ROW (3.425) are significant at a 0.05 or lower significance level (Table 7). When total imports of processed cheese into Japan increase, the ROW imports will grow by 3.425% and the EU imports will grow 0.982%. The ROW elasticity is the largest of all Divisia index elasticities meaning that other countries in the market gain significantly. In this case, the U.S. Divisia index elasticity is negative, which means that the U.S. imports decrease when the total imports in Japan increase. Looking at the data, U.S. processed cheese exports decreased from 1997:2 to 2001:4 compared to total imports of processed cheese in Japan, which were increasing steadily during the period of 1995:1 to 2001:4. Theoretically, U.S. processed cheese is an inferior good (i.e., the production process reduces the use of U.S. processed cheese as an input as the output from the production process increases). However, this negative effect is likely associated with an intentional downward trend of U.S. exports while total imports in Japan increased. This could have been caused by an agreement between U.S. cheese exporters and Japanese cheese importers not to trade with one another. While this strategy is not a result of the production process, it may be a conscious action of not trading. Further research is needed to determine the exact source of the negative Divisia index elasticity.

TABLE 7. Conditional Divisia and Price Elasticities of Derived Demand for Imported Processed Cheese

	Elasticities						
			Conditional Cross-Price				
Exporting Countries	Divisia Index	Conditional Own-Price	United States	EU	Oceania[a]	Switzerland	ROW[b]
United States	−4.383**	−0.013		−0.989**	0.183	0.004	0.815
	(1.889)[c]	(0.233)		(0.492)	(0.190)	(0.046)	(0.542)
European Union	0.982***	−0.209***	−0.015**		(0.021)	(0.015)*	0.187***
	(0.058)	(0.063)	(0.008)		(0.029)	(0.009)	(0.053)
Oceania	0.842	−0.406	0.063	0.475		−0.094	−0.037
	(0.550)	(0.493)	(0.065)	(0.656)		(0.105)	(0.428)
Switzerland	−0.011	−0.772	0.005	1.157*	−0.327		−0.063
	(0.466)	(0.738)	(0.054)	(0.667)	(0.363)		(0.466)
ROW	3.425***	−3.957***	0.250	3.756***	−0.033	−0.016	
	(1.227)	(1.095)	(0.167)	(1.069)	(0.385)	(0.121)	

[a]Australia and New Zealand aggregation
[b]ROW = rest of the world
[c]ANALYZ routine in TSP was used to calculate asymptotic standard errors in parentheses
***Significance level = .01
**Significance level = .05
*Significance level = .10

EU and ROW own-price elasticities are −0.209 and −3.957, respectively, which are the only significant own-price elasticities (Table 7). Hence, the derived demands for EU and ROW processed cheese are inelastic and elastic, respectively (i.e., when the EU and the ROW prices change by 1.0%, EU and ROW imports change by 0.209% and 3.957%, respectively). This indicates that the European Union has few competitors and ROW has many. The other own-price elasticities are not significantly different from zero, indicating that price is not a deciding factor when cheese from these countries is purchased. The Switzerland/EU cross-price elasticity indicates a competitive relationship between the two countries (1.157). EU processed cheese is also a substitute for the Switzerland processed cheese but to a smaller degree (0.015). Also, EU/ROW (0.187) and ROW/EU (3.756) cross-price elasticities show that the imports from these sources are substitutes. The cross-price elasticities of EU/US (−0.015) and US/EU (−0.989) indicate that imports from these countries are complements. All other cross-price elasticities were not statistically different from zero, which means no competition among these countries (Table 7).

5.4 Other Imported Cheese

The United States, Norway, the European Union, New Zealand, Australia, Switzerland, Canada, and ROW are the dominant exporting countries in this market. The time period of the data set is from 1991:1 to 2001:4. The Divisia index elasticities of the demand for other imported cheese are 0.342, 0.962, 0.934, 1.033, 1.001, 1.655, 1.155, and 5.483 for the United States, Norway, the European Union, New Zealand, Australia, Switzerland, Canada, and ROW, respectively (Table 8). However, only the Divisia index elasticities of Norway, the European Union, New Zealand, Australia, and Switzerland were significant at least at a 0.1 or lower significance level. Imports from Switzerland will increase by a larger percent than imports from other exporting sources. Imports from Norway, the European Union, New Zealand, and Australia grow by almost the same percentage as total imports. The Divisia index elasticity for the United States is the smallest (and statistically insignificant) compared to other exporting sources (Table 8).

The own-price elasticities that are significantly different from zero are for the United States (−1.940), the European Union (−0.587), New Zealand (−0.916), and Canada (0.543). The U.S. elasticity is elastic, indicating that other cheese imported into Japan from the United States is very responsive to price changes. The EU, New Zealand, and Canada elasticities are inelastic, indicating that imports from these sources are less responsive to price changes (Table 8).

The most noteworthy conditional cross-price elasticity that shows a large degree of competitiveness between two countries is the ROW/EU elasticity (5.727). This means that if the price of EU other cheese increases by 1.0%, imports demanded from ROW will increase by 5.727%. The Norway/EU elasticity indicates a significant competitive relationship between the two sources (1.108) as well. Also, the United States/Switzerland elasticity shows that when the price of Switzerland's other cheese increases by 1.0%, imports demanded from the United States will increase by 0.904%. The following are cross-price elasticities that indicate substitutability to a lesser extent: Switzerland/United States (0.391), EU/Norway (0.127), Canada/Norway (0.223), New Zealand/EU (0.471), EU/New Zealand (0.400), Norway/Canada (0.104), and EU/ROW (0.032). Furthermore, the conditional cross-price elasticities that indicate a major complementary relationship are ROW/Australia (−7.076) and Canada/New Zealand (−0.820). Also, the Australia/ROW (−0.047) and New Zealand/Canada (−0.052) cross-price elasticities show

TABLE 8. Conditional Divisia and Price Elasticities of the Derived Demand for Imported Other Cheese

	Elasticities									
			Conditional Cross-Price							
Exporting Countries	Divisia Index	Conditional Own-Price	United States	Norway	EU	New Zealand	Australia	Switzerland	Canada	ROW[a]
United States	0.342	−1.934***		1.251	−1.999	2.236	−0.375	0.904**	−0.158	0.081
	(1.443)[b]	(0.447)		(1.647)	(1.618)	(3.175)	(3.111)	(0.406)	(0.159)	(0.131)
Norway	0.962*	−0.131	0.100		1.108*	−0.392	−0.799	0.049	0.104*	−0.039
	(0.494)	(1.093)	(0.132)		(0.636)	(1.307)	(1.173)	(0.221)	(0.054)	(0.045)
European Union	0.934***	−0.587***	−0.018	0.127*		0.400***	0.075	−0.003	−0.026	0.032***
	(0.166)	(0.169)	(0.015)	(0.073)		(0.164)	(0.192)	(0.017)	(0.018)	(0.012)
New Zealand	1.033***	−0.916*	0.024	−0.053	0.471**		0.484	0.025	−0.052***	(0.016)
	(0.184)	(0.487)	(0.034)	(0.176)	(0.192)		(0.434)	(0.041)	(0.020)	(0.016)
Australia	1.001***	−0.424	−0.004	−0.111	(0.091)	0.501		−0.041	0.036	−0.047**
	(0.252)	(0.502)	(0.035)	(0.164)	(0.234)	(0.449)		(0.040)	(0.027)	(0.020)
Switzerland	1.655***	−0.011	0.391**	0.266	−0.127	1.001	−1.586		0.093	−0.029
	(0.597)	(0.624)	(0.176)	(1.193)	(0.806)	(1.640)	(1.537)		(0.066)	(0.055)
Canada	1.155	0.543***	−0.027	0.223*	−0.479	−0.820***	0.547	0.037		−0.024
	(1.485)	(0.161)	(0.027)	(0.116)	(0.329)	(0.319)	(0.412)	(0.026)		(0.040)
ROW	5.483	−0.108	0.135	−0.810	5.727***	2.471	−7.076**	−0.110	−0.229	
	(3.775)	(0.335)	(0.219)	(0.937)	(2.201)	(2.537)	(3.052)	(0.212)	(0.392)	

[a]ROW = rest of the world
[b]ANALYZ routine in TSP was used to calculate asymptotic standard errors in parentheses
***Significance level = .01
**Significance level = .05
*Significance level = .10

a complementary relationship to a smaller degree. All other cross-price elasticities are not significantly different from zero (Table 8).

5.5 U.S. Cheeses

Japan's imports of U.S. cheese categories include fresh, grated, processed, and other cheese. Japanese imports of U.S. fresh, processed, and other cheeses account for less than 4.0%, and U.S. grated cheese accounts for over 50% of Japan's cheese imports by type of cheese (Table 9). The Divisia index elasticities of U.S. fresh and grated cheese are inelastic while that of US processed cheese is elastic and negative (Table 9). The conditional own price elasticities of US fresh, grated, and processed cheeses are perfectly inelastic and not significantly different from zero while that of US other cheese is elastic and statistically significant.

As far as Japanese demand for U.S. cheese is concerned, only a few studies have been conducted so far. A study was done by Washington (2000); however, cheese was not disaggregated into different categories and annual data were used, thus making it difficult to make a direct comparison with our findings. Nevertheless, Washington found that the Divisia index elasticity for U.S. cheese imports into Japan is inelastic (0.855), which is consistent with our findings for U.S. fresh (0.778) and grated cheeses (0.848), but is inconsistent with U.S. processed cheese (−4.383) and US other cheese (0.342), which is not statistically different from zero (Table 9). Furthermore, Washington found that the own-price elasticity for U.S. cheese imports into Japan is −0.867, which is different from the own-price elasticities reported in this article (Table 9).

6. CONCLUSIONS AND IMPLICATIONS

Given the attempts of domestic and international policy makers to reduce trade barriers, U.S. manufacturers of cheese products have a growing interest in becoming successful in international markets. Since the U.S. dairy industry needs to know how U.S. cheese prod-

TABLE 9. Japan's Import Demand Elasticities for U.S. Cheeses

	Elasticities		
Cheese Category	Divisia Index	Conditional Own-Price	U.S. Import Share
Fresh	0.778***	−0.014	0.036
	(0.223)	(0.091)	
Grated	0.848***	−0.056	0.516
	(0.114)	(0.078)	
Processed	−4.383**	−0.013	0.015
	(1.889)	(0.233)	
Other	0.342	−1.934***	0.002
	(1.443)	(0.447)	

***Significance level = 0.01
**Significance level = 0.05
*Significance level = 0.10

ucts are competing overseas, this study's intention is to provide the U.S. dairy industry with empirical estimates of Japan's derived demand for various imported cheese products, differentiated by country of production. Conclusions about the competitiveness of U.S. cheese products are based on estimates of the percentage change of quantities imported in relation to changes in factors such as total imports, own-prices, and cross-prices among exporting countries in Japan.

In conclusion, this study finds that the United States competes only with the European Union in the fresh cheese market and with Switzerland in the "other cheeses" market. The demand for all U.S. cheese products, excluding these two relationships, compared to the demand for cheese products from other exporting countries, is either independent or complementary. Thus, in most market settings, a price decrease by another exporting country does not decrease the quantity of U.S. cheese demanded. This is most likely a combined result of continuing growth in Japanese demand for cheese and the relatively high degree of differentiation of cheese products.

Also, this study finds that the United States has a complementary relationship with New Zealand and Australia in the fresh cheese market and has a complementary relationship with the European Union in the processed cheese market. Here, too, a continually growing market like the Japanese cheese market would demonstrate these types of complementarities, especially since this model treats imports as inputs into a production process.

A key finding is that the overall competition varies among the cheese market segments. For example, the fresh cheese market is not a price competitive market, given that all own-price elasticities are inelastic or insignificant. Also, in the fresh cheese market, competition among exporting countries is very limited since all cross-price elasticities are inelastic. In the grated cheese market, own-price and cross-price elasticities are insignificant. Therefore, the grated cheese market is not a price competitive market and competition among exporting sources is restrained, indicating that exporting countries are in different markets, separated by product characteristics. Only the EU and ROW own-price elasticities of the demand for imported processed cheese are statistically significant. The EU own-price elasticity is less than unity (−0.209) while that of ROW is elastic (−3.957). Also, in the processed cheese market, competition rarely exists since all cross-price elasticities, except Switzerland/EU (1.157) and ROW/EU (3.756), are inelastic or not different from zero. In the other cheese market, only the U.S. imports are elastic and are thus sensitive to price changes; the rest of the own-price elasticities indicate that this market is not a price competitive market since they are all inelastic. The majority of the cross-price elasticities are inelastic or insignificant, meaning that competition among countries is limited. The elastic cross price elasticities are Norway/EU (1.108), ROW/EU (5.727), and ROW/Australia (−7.076).

Since U.S. cheese manufacturers are willing to compete in international markets, the implication is that in most market segments the U.S. dairy industry should compete on the basis of product characteristics. For instance, when Japan's derived demand for a U.S. cheese product is perfectly inelastic, as is the case for fresh cheese, grated cheese and processed cheese, the United States should compete through non-price competition (e.g., specific taste, texture, and other characteristics of the cheese that is sold). On the other hand, when Japan's derived demand for a U.S. cheese product is elastic (i.e., other cheeses), the United States should use price competition and should decrease their price to achieve a larger market share and larger revenues.

A caveat is in order as the authors recognize that these suggested strategies are not without risks. In those markets where non-price competitive strategies are recommended, U.S. exporters may need to forego maximum short-run total revenues (i.e., not raise prices when faced with inelastic demand) to increase market share. Also, there are no guarantees that a given product characteristic will be valued by Japanese importers. Alternatively, in those market segments where demand is elastic, U.S. exporters competing on price may find themselves in a price war and with lower profits in the short-run. However, as long as U.S. exporters believe they can be low-cost producers in certain market segments of cheese products, they may ultimately benefit from price-based competition once high-cost producers from other countries have exited the Japanese market.

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