

The Rice Demand System in Japan¹

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Changes in Japanese dietary life have been observed for the past three decades as the economic growth has made the improvement in standard of living possible. Rice consumption per capita has been declining since 1962. Rice is still the staple food in Japan, but per capita consumption of rice has been about a half of its peak in recent years. Meat consumption has been increasing, instead. A wide variety of food items has become available for table use. Consumers have chosen to diversify their food consumption. The purpose of this paper is to review the recent changes in rice consumption and the structure of the demand system in Japanese households. This is an attempt to draw policy implications for what might happen in the future in rice consumption of other Asian countries as their economies grow.

Rice price policies in Japan are reviewed first. This is to understand the economic environments related to rice consumption in Japan. Next, the characteristics of rice consumption are summarized. Changes in consumer behavior are examined there. The following section deals with the estimation of price and income elasticities under the framework of an Almost Ideal Demand System (AIDS) model using aggregated time series data based on non-farm and farm household expenditure surveys. In the last section, factors influencing the future consumption of rice in Japan are discussed.

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Rice Price Policies in Japan

With the importance of rice as the staple food in the Japanese traditional dietary life, this crop has been under direct government control for the past five decades. The government influence over this crop has not been confined to regulate consumer as well as producer prices. The distribution of rice has been managed by the Food Agency of the government. Until the middle of 1995 with the strict border control, practically no rice for regular consumption in the households had been imported since the self-sufficiency was once achieved in the late 1960s with the exceptions of emergency importation in bad crop years. However, the GATT Uruguay Round negotiations have eventually resulted in partial opening of the Japanese rice market with a minimum access arrangement. In this section, the recent government rice policies are reviewed.

The Food Control Law, which was originally introduced in 1942, has been in effect for regulating distribution of rice. This Law was created to cope with the shortage of food in the war time by rationing food distribution. Most food items were governed under this law. Initially, three regulative functions existed with the Law. First, all the prices and marketing fees were ruled to be set by the government. Second, the compulsory delivery and contract purchase systems were established for producers and the rationing practice was introduced for consumers. Third, the international trade of food was launched to be under the complete control of the government.

Although the rationing over most food items was abolished when enough supply became available in the early part of the post war period, the government controls over rice and mugi (wheat, barley, etc.) on pricing, distribution (purchase and selling) , and international trade stayed in effect. Consequently, the government has been in total control of across the border trading as well as domestic trading for rice. When the shortage emerged, the Japanese Food Agency purchased the necessary amount of rice in the international market and marketed in the domestic market through the government distribution channels.

As for rice, self-sufficiency was achieved by the latter part of the

1960s and over production of rice became an every year phenomenon. Adjustment measures were introduced to limit the further expansion of rice production. A rice cultivation conversion program started in 1969. In this program, incentive payments were granted to the farmers who were willing to retire their paddies from producing rice. They had an option to grow other crops. This has been in effect until now. To cope with the excess of the rice stock which once reached more than seven million tons in 1970, old rice was liquidated for lower prices than the government purchased prices for feeding and industrial uses in the domestic market. The export of rice was also conducted using cheap credits.

Around the same time, the government regulation on distribution became little relaxed in order to lower the government's rice stock and the financial burden in the government's Food Control Special Account. In 1969, the voluntary rice (*jishu ryutsu mai*) channel was introduced to cope with these problems. Opposed to the government rice (*seifu mai*), the rice going through the traditional government channel, this was newly created. Producers were allowed to sell their rice through cooperatives to wholesalers without directly going through the government channel. This channel has gradually become popular for both producers and consumers because of higher purchasing prices for producers and better quality rice for consumers. Now almost 70 percent (or 3.9 million tons) of rice sold by farmers through the official channels goes through this channel. (There exists an illegal channel now. The explanation can be found in the section for demand elasticity estimation.) The trading prices of the voluntary rice have been negotiated by the cooperatives with wholesalers on behalf of producers. The voluntary rice has been regularly better in tastes. It has been sold for higher prices than the government rice. The government encouraged farmers to produce better quality rice by offering subsidies starting 1976 for producing the designated rice varieties which were better in tastes. As for the government rice, with the abolition of the Price Control Law in 1972, the retail rice prices became free from the government controls. Now, only the government purchasing prices and the government selling prices to

wholesalers are set by the government only for the government rice, not for the voluntary rice.

As for price policies, producer prices were set high enough to provide enough incentive for producers to increase rice production during the period when domestic rice supply did not meet the domestic rice demand. In the late 1960s and early 1970s, nominal producer prices did not increase as fast as observed in the previous period. This is a part of efforts to reduce rice production. However, with the energy crisis in 1973, the government pushed the nominal producer prices up again to secure enough stock of rice in Japan. Then, from the middle of the 1970s to the middle of the 1980s the nominal producer prices were kept almost the same. In 1987, the nominal producer prices were reduced compared to the previous years' rates for the first time.

The consumer prices had been kept lower than the producer prices until 1986. The difference had been financed from the government's Food Control Special Account. This inverse price relationship coupled with over stock of rice became a burden for the government budget. The burden was the highest in 1970 when the food control operation cost the government more than five percent of the total budget.

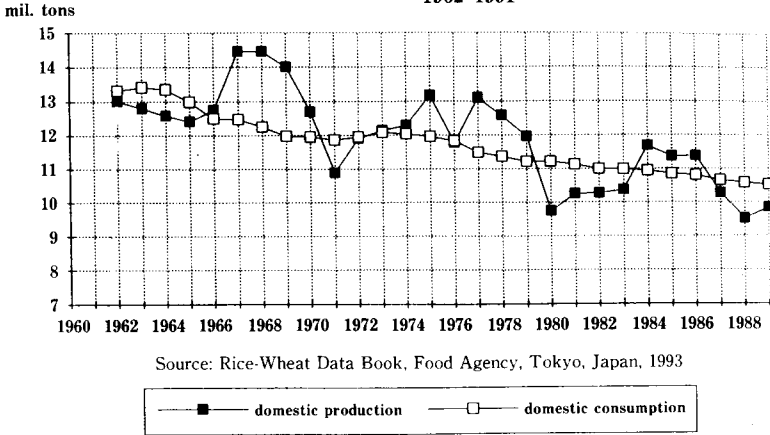
Characteristics of Rice Consumption in Japan

For the past 25 years with a few exceptions, the domestic rice supply has been exceeding the domestic rice demand. Figure 1 shows the gradual declining trend in domestic rice production and consumption over time. The negative gap between domestic production and consumption has been generally filled with carry-over rice in stock. Figure 2 depicts annual changes in the amount of rice available for domestic consumers in per capita basis. The data from the food balance sheet show that the availability of rice was the highest with per capita annual consumption of 130.4 kg in 1962. This has been reduced to 69.2 kg in 1993.

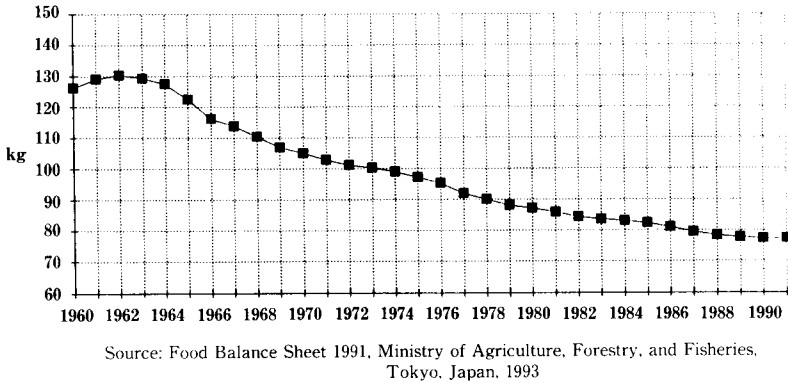
The importance of rice in daily calorie in-take has also been declining in Japan. Rice has been losing its share in the availability of

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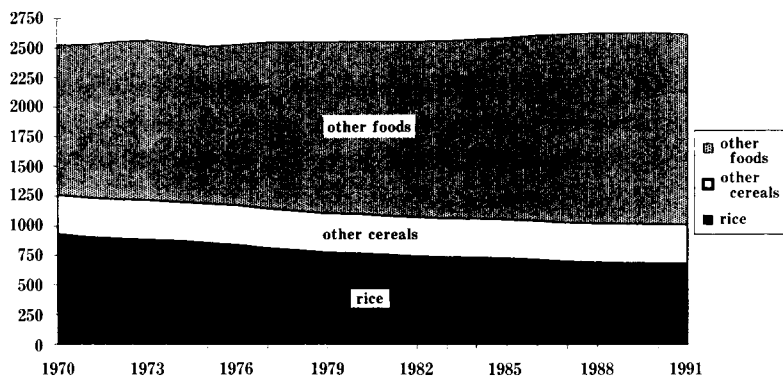
**Figure 1 Domestic Rice Production and Consumption in Japan
1962-1991**



**Figure 2 Availability of Rice for Domestic Consumers in Japan
1960-1991 (per capita annual data)**

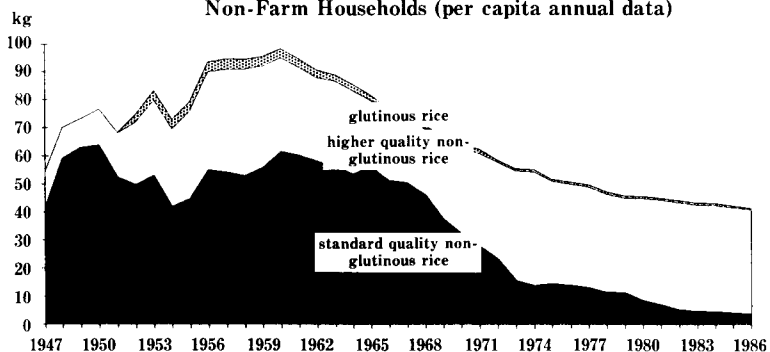


**Figure 3 Availability of Daily Nutrients in Japan, 1970-1991
(per capita in Kcal)**



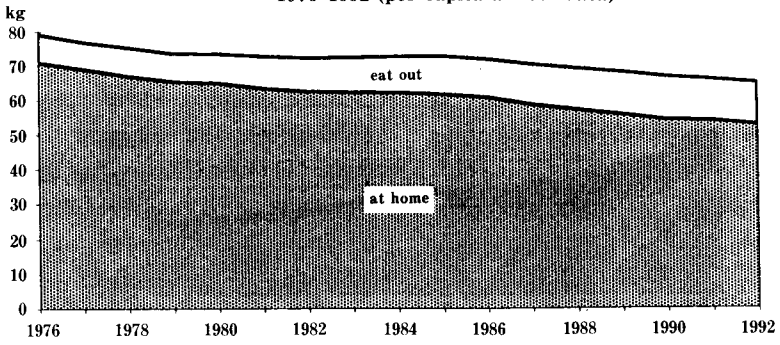
Source: Food Balance Sheet 1991, Ministry of Agriculture, Forestry, and Fisheries, Tokyo, Japan, 1993

Figure 4 Changes in Rice Consumption in Japanese Non-Farm Households (per capita annual data)



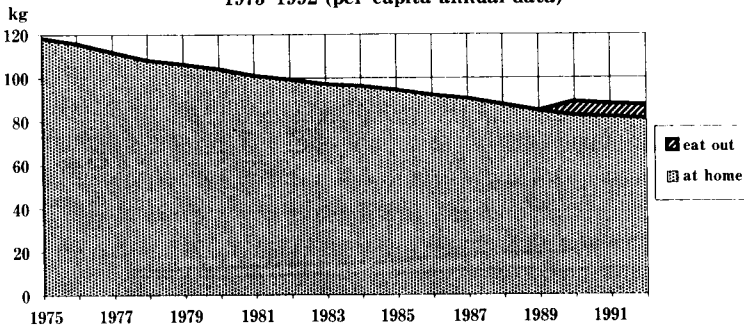
Source: Comprehensive Time Series Report on the Family Income and Expenditure Survey 1947-1986

Figure 5 Rice Consumption in Japanese Non-Rice Producing Households 1976-1992 (per capita annual data)



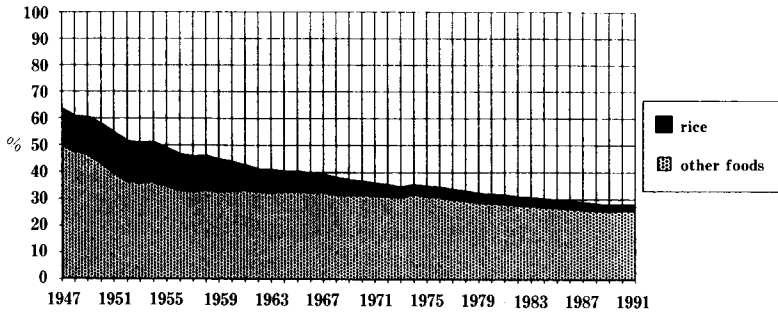
Source: Surveyed Data, Ministry of Agriculture, Forestry, and Fisheries, Tokyo, Japan

Figure 6 Rice Consumption in Japanese Rice Producing Households 1975-1992 (per capita annual data)



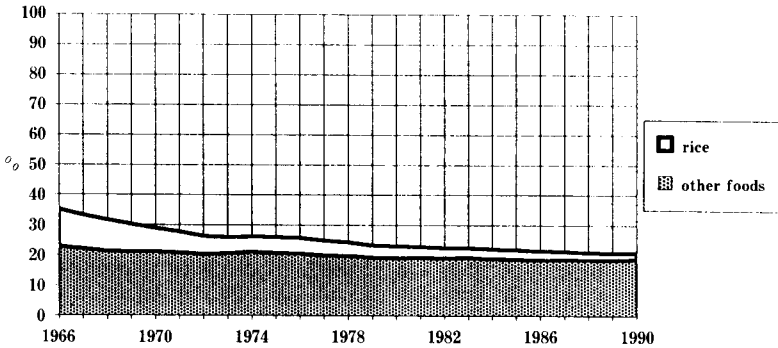
Source: Surveyed Data, Ministry of Agriculture, Forestry, and Fisheries, Tokyo, Japan
(Eat-out data available only for 1990-1992)

Figure 7 Food and Rice Shares in Total Expenditure for Japanese Non-Farm Households



Source: Annual Report on the Family Income and Expenditure Survey (various issues)

Figure 8 Food and Rice Shares in Total Expenditure for Japanese Farm Households



Source: Annual Report on the Farm Expenditure Survey (various issues)

daily nutrients. In 1970, rice had a share of 36.7 percent (Figure 3). This has been declined to 25.9 percent in 1992.

As for the differences in quality of rice, higher quality rice has been replacing standard quality rice in non-farm households' consumption as observed in Figure 4. Another noticeable change related with rice consumption in Japan is an expanding share of rice consumption away from home (Figures 5 and 6). For the surveyed non-farm households, the amount of rice consumed outside home measured in per capita basis has been increased to have a share of 23.4 percent of the total household rice consumption in 1992. The share was only 11.5 percent in 1976. For rice producing households, the share has been smaller and had a share of 7.9 percent in 1992. In the absolute term for the outside of home consumption, the rice producing households consumed about a half the rice consumed by non-farm households in 1992.

The average household share of the monthly expenditure spent on rice has been declining from 2.9 percent in 1970 to 1.6 percent in 1991. The rice share in the average household's food expenditure has been also declining from 9.2 percent in 1970 to 6.2 percent in 1991. These numbers were obtained from annual household income and expenditure sample surveys covering all types of households including the ones involving in rice producing activities. The changes in the food and rice shares in total expenditure are shown for the non-farm households in Figure 7. The food share has been declined to a half the level of the late 1940s. The rice share in the food share has also been significantly declined over time. Farm households also followed a similar path in the changing patterns of the food and rice shares over time as observed in Figure 8.

Demand Analysis of Japanese Rice using an Almost Ideal Demand System (AIDS) Model

An analysis of demand elasticities is conducted here using expenditure surveyed data for non-farm households and farm households in Japan.

(a) Basic Model

The general form of the share equations derived from the Linear Approximate Almost Ideal Demand System (LA/AIDS, Deaton and Muellbauer) is specified as

$$W_i = \alpha_i + \sum_{j=1}^n \delta_{ij} \ln P_j + \beta_i \ln \left(\frac{X}{P^*} \right) \quad (1)$$

where W_i stands for the share of expenditure on food item i ; P_j is the price of food item j ; and $\left(\frac{X}{P^*} \right)$ represents the real expenditure on the food items in question. P^* shows the level of prices which can be derived using an approximation method called Stone's geometric price index. The employment of this index makes the empirical estimation of (1) simpler because of its linearity.

$$\ln P^* = \sum_{i=1}^n W_i \ln P_i \quad (2)$$

Based on the estimated parameters, the price (η_{ij}) and expenditure (η_{ix}) elasticities are estimated using the estimated parameters. The formulae of the Marshallian price and expenditure elasticities (Chalfant) for the LA/AIDS model are

$$\eta_{ii} = -1 + \frac{\delta_{ii}}{W_i} - \beta_i \quad (3)$$

$$\eta_{ij} = \frac{\delta_{ij}}{W_i} - \beta_i \frac{W_j}{W_i} \quad (4)$$

$$\eta_{ix} = 1 + \frac{\beta_i}{W_i} \quad (5)$$

(b) Estimation and Results

For empirical estimation, equation (1) was estimated using time series data. The data were obtained from the published sources. The data on prices were obtained from various issues of *Report on Consumer Price Index* (Statistics Bureau, Management and Coordination Agency). For non-farm household expenditure survey data, *Comprehensive Time Series Report on the Family Income and Expenditure Survey 1947-1986* (Statistics Bureau, Management and Coordination Agency) became the major source of the necessary information.

The data from 1965 through 1986 were utilized. More recent data exist, but these do not include the detail figures about the consumption of different quality rice which used to be provided for the previous years. Therefore, the data from recent years were retired from this time series analysis.

For farm household expenditure survey data, various issues of *Annual Report on the Farm Expenditure Survey* (Statistics and Information Bureau, Ministry of Agriculture, Forestry, and Fisheries) were found to be a useful source of the data required for this empirical study. The data from 1970 to 1990 were used. Since a complete set of expenditure information is not available for each quality of rice from this source, a further breakdown of the demand system according to rice quality was not attempted for the analysis of this set of data.

A rice demand system was estimated in three stages for the non-farm survey data and in two stages for the farm survey data. In the first stage, consumption items were grouped into two groups. One is food and another is non-food. Then, the second stage covered rice and non-rice food items. The third stage is for the higher quality rice and the standard quality rice. The standard quality rice is mainly the government rice, and the higher quality rice is the voluntary rice and *jiyu mai* (free rice). (The government rice and the voluntary rice go through the channels under the government supervision. However, free rice does not go through the government channels and is going through private channels. Formally speaking, the marketing of free rice is illegal, but it is widely practiced. This rice is coming directly out from the farmers' own stock which is originally stored for their own consumption. The rice quality is considered better than the rice going through the government set channels. The official account for the amount of rice going through this channel is not available. However, this is believed to amount to close to 3 million tons per year now.)

Imposing the symmetry and homogeneity conditions, the estimation share equation was set to have the following form to have more degree of freedom.

$$W_i = \alpha_i + \delta_{ii} \ln \frac{P_i}{P_j} + \beta_i \ln \left(\frac{X}{p^*} \right) \quad (6)$$

Although a set of two equations was to be estimated in each stage, only a single equation was estimated for singularity reasons. Because of the existence of autocorrelation, the error term was assumed to have the first-order autoregressive form.

The estimation results are presented in Tables 1 and 2. The calculated elasticities are listed in Tables 3 and 4. R²s are generally high and the parameters are significantly different from zero with the exception of the price coefficient for the higher quality rice. All the elasticities except the cross price elasticities for higher quality rice and standard quality rice for the analysis of the non-farm households have the expected signs and reasonable magnitudes.

Table 1 Estimated Parameters for the Non-farm Households in Japan

	Parameter	Estimated Values	Standard Errors
Food Equation	α_i	-17.972	9.984
	δ_{ii}	0.036	0.012
	β_i	-0.143	0.037
			R ² 0.99
			D-W 1.78
Rice Equation	α_i	0.772	0.087
	δ_{ii}	0.077	0.008
	β_i	-0.111	0.0014
			R ² 0.99
			D-W 1.84
Higher Quality Rice Equation	α_i	-1.475	1.535
	δ_{ii}	0.213	0.538
	β_i	0.627	0.388
			R ² 0.96
			D-W 1.62

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Table 2 Estimated Parameters for the Farm Households in Japan

	Parameter	Estimated Values	Standard Errors	
Food Equation	α_1	1.193	0.127	
	δ_{11}	0.093	0.016	
	β_1	-0.122	0.016	
			R ²	0.99
			D-W	1.19
Rice Equation	α_1	1.860	0.402	
	δ_{11}	0.084	0.015	
	β_1	-0.280	0.060	
			R ²	0.99
			D-W	1.40

Table 3 Price and Expenditure Elasticities of Food and Rice Demand for the Non-farm Households in Japan

	Price/Expenditure	Marshallian Elasticities
Food	Own Price	-0.75
	Non-food Price	0.19
	Expenditure (with mean values)	0.55
	Expenditure (with recent values)	0.51
Rice	Own Price	-0.17
	Non-rice Price	0.21
	Expenditure (with mean values)	-0.04
	Expenditure (with recent values)	-0.25
Higher Quality Rice (HQR)	Own Price	-1.35
	SQR Price	-0.46
	Expenditure (with mean values)	1.81
	Expenditure (with recent values)	2.09

Standard Quality
Rice (SQR)

Own Price	-0.70
HQR Price	-2.18
Expenditure (with mean values)	2.62
Expenditure (with recent values)	5.66

Table 4 Price and Expenditure Elasticities of Food and Rice Demand for the Farm Households in Japan

	Price/Expenditure	Marshallian Elasticities
Food		
	Own Price	-0.51
	Non-food Price	-0.01
	Expenditure (with mean values)	0.51
	Expenditure (with recent values)	0.42
Rice		
	Own Price	-0.30
	Non-rice Price	0.70
	Expenditure (with mean values)	-0.40
	Expenditure (with recent values)	-1.80

All own price elasticities are negative. This implies that the consumption declines when its price increases. If the quality is the same, the consumers in the non-farm and farm households have been rationally responding to the price changes.

The total expenditure elasticities are calculated as a product of the elasticities in different aggregation levels. The total elasticities are negative for rice in two levels (aggregated and disaggregated levels). Two observations can be made with the estimated total expenditure elasticities for the non-farm households. One observation is that the standard quality rice is considered as more inferior good than the higher quality rice. The total elasticity for the standard quality rice is calculated to be -0.06, whereas the one for the higher

quality rice is calculated to be -0.04 , both using the mean values. The difference becomes larger if the most recent values are utilized for the calculation of the elasticities. The standard quality rice has the total expenditure elasticity of -0.72 with recent values and higher quality rice has -0.27 for the elasticity calculated in the same way. Another observation is the existence of a declining trend in the total expenditure elasticity over time. This decline is larger with the standard quality rice in the absolute values.

For the farm households, rice is also considered as an inferior good. The total expenditure elasticity is found to be -0.20 using the mean values and -0.76 using the most recent values. The declining trend in the expenditure elasticity is observed over time. Although per capita consumption of rice measured in the absolute values is still larger, the speed and magnitude of rice becoming an inferior good is higher with the farm households compared to the non-farm households. This can be explained by the faster reduction in per capita consumption of rice in recent years with the farm households shown in Figure 6. The recent changes in farming structure should be the major explanatory factor for this phenomenon. In response to the increasing share of part-time farmers, their consumption pattern is rapidly shifting toward the one for the non-farm urban households. The manual labor type of work has been significantly reduced in agricultural practices because of mechanization and the increasing use of other modern inputs. The daily calorie requirement has been lowered and accordingly the components of food in-take have been changed. The aging of farm operators is another explanatory factor for the rapid decline in per capita consumption of rice in farm households. A growing number of operators is in their 50s and 60s. Their rice consumption has already reached its peak in their life cycle and is declining sharply in recent years.

Factors Influencing the Future Consumption of Rice in Japan

Per capita annual consumption of rice is expected to further decline in the future years. Since the annual population growth rate is about 0.4 percent in Japan, the total amount of rice consumed

would not be expanded by population increase.

The future level of rice consumption would be rather confined by changes in dietary habit, disposable income, and relative price of rice. The dietary habit is changing and the consumers are choosing less rice over a variety of food items available in the market place. The income elasticity of demand is already negative for rice in Japan. This implies a decline in rice demand as an increase in disposable income takes place in the future.

The own price elasticity of demand is negative for rice. Dependent upon the extent of the decline in consumer prices as a result of the future policy reforms by the Japanese government in market controls and international trade practices, the rice demand can be restored to a certain extent.

In response to the Japanese government's agreement on rice trade in the GATT Uruguay Round talks, 0.4 million tons to 0.8 million tons of rice will be imported to the Japanese market annually from the period between 1995 through 2000 following the minimum access arrangement. This would result in lowering domestic consumer prices and in increasing the international prices. The speed of the decline in per capita consumption of rice would be slowed down as a result of this decrease in domestic rice prices.

The findings from this study on the Japanese rice demand system imply that per capita rice consumption would most probably decline in other Asian countries as their disposable income increases as a result of economic growth. Rice quality differences are also found to make a difference in demand responsiveness to income changes. The consumption of standard quality rice is discovered to be declining faster than higher quality rice in response to income expansion. The speed of changes in expenditure elasticities is observed to be larger in the farm sector than the non-farm sector. All these might be experienced by other Asian countries in the near future.

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