ANALYSIS OF FOOD CONSUMPTION BEHAVIOR BY JAPANESE HOUSEHOLDS

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Abstract

The objective of this research is to analyze the food consumption patterns and to conduct econometric analysis of food demand structure in Japan. In this study, we pay special attention to the questions on whether or not rice is an inferior good as previous researchers have so claimed and to what extent Japanese food consumption pattern has been westernized. We use the cross-sectional household data, *Annual Report on the Family Income and Expenditure Survey* (FIES) in 1997 compiled by the Statistics Bureau, Management and Coordination Agency in Japan. For major 11 food items, the total number of observations used for estimation is 95,223. Food items are non-glutinous rice, bread, noodle, fresh fish, and shellfish, fresh meat, milk, eggs, fresh vegetables, fresh fruits, fats and oil, and food away from home. For meat items, the total number of observations used for estimation is 94,200, and items in interest are beef, pork, poultry, ground meat, ham, sausage, and bacon.

In order to deal with the zero-consumption problem associated with household-level microdata, we apply various single equation models: Working-Leser model estimated by OLS, Heckman's sample selection model, and Tobit mode. For a complete demand system analysis, we apply the linearly approximated almost ideal demand system (LA/AIDS). Additionally, we apply the nonlinear almost ideal demand (AIDS) system.

Empirical results from the major 11 food items show that the expenditure elasticity of rice is positive and close to one. This proves that rice consumed in Japan is a normal good, contrary to the results from preceding studies. Marshallian uncompensated and Hicksian compensated own-price elasticities for rice are highly elastic in all models; on the other hand, the own price elasticity for meat is relatively price inelastic. Fresh meats and rice are mild complements in all models; however, fresh fish and rice show the mixed results with repect to their substitution pattern.

Results from meat items show that the expenditure elasticity of beef is greater than unity, while other meat products are inelastic. Additionally, the expenditure and price elasticities look very similar to that of Western nations. This study shows that the Japanese meat consumption pattern has become westernized.

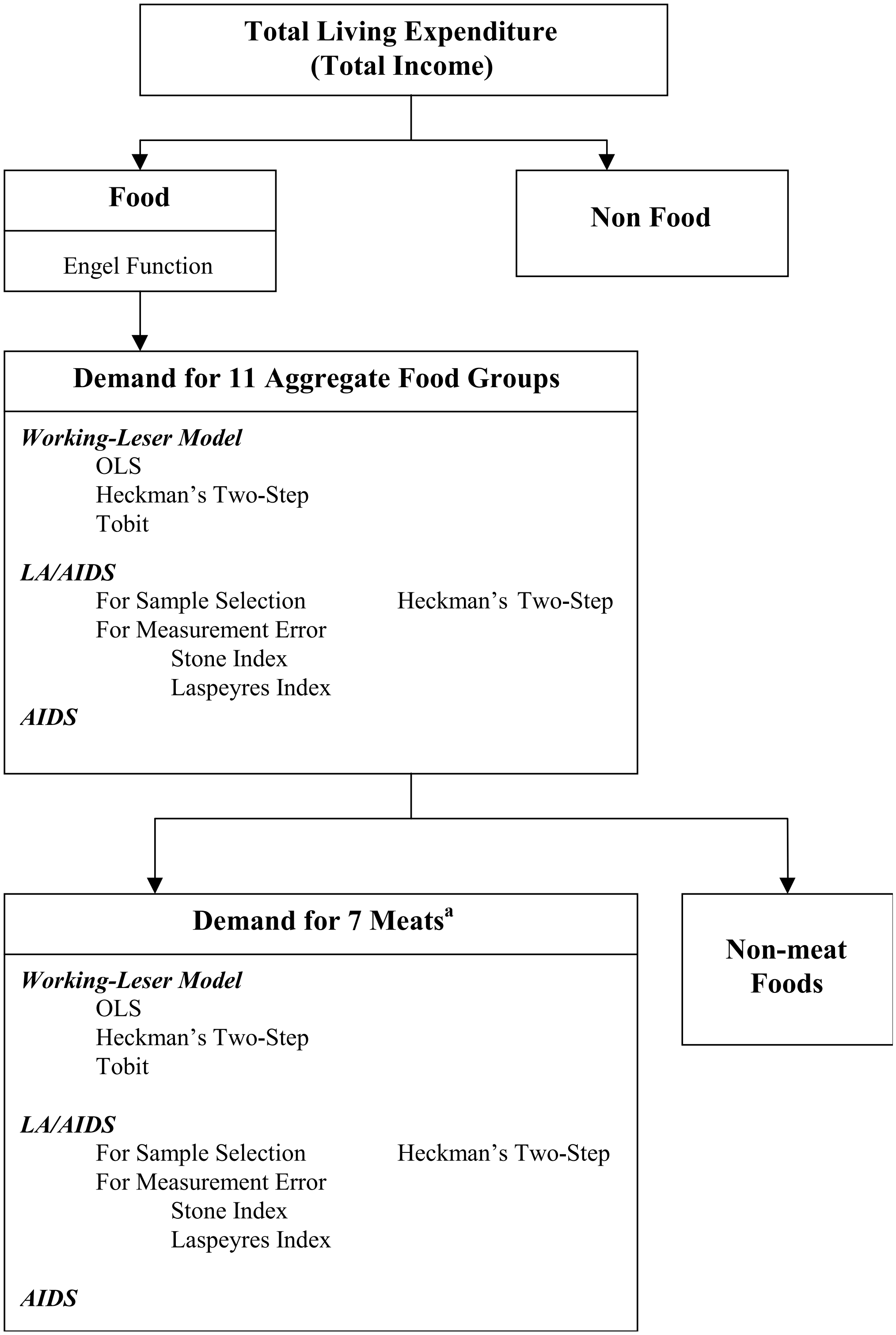
1. INTRODUCTION

Japanese food consumption pattern has been undergoing dramatic changes over the last 30 years. There have been increasing consumption of meats, particularly beef, and dairy products, and decreasing consumption of rice, fish, fresh fruits, as well as fresh and processed vegetables in Japan. Many economists have attributed these changes to such factors as higher household income, aging population, and more Westernization in lifestyle. Undoubtedly, many factors have influenced Japanese food consumption pattern. Understanding of these factors is very important for market assessment of agricultural products in Japan. Since Japan is one of the largest agricultural importing countries, its changing food consumption pattern would directly affect the world agricultural trade. The question such as whether rice is an inferior good is important for evaluating the significance of Japanese domestic rice policy in the forthcoming WTO negotiation. This study attempts to provide econometric evidence for answering such questions, using a cross-sectional data analysis.

The objectives of this study are to analyze the food consumption patterns and to conduct econometric analyses of food demand structure in Japan. Specifically, we use the household data from the Family Income and Expenditure Survey (FIES) of 1997 obtained from the Statistics Bureau, Management and Coordination Agency under the collaboration with the National Research Institute of Agricultural Economics (NRIAE) in Tokyo. This study is relatively unique because it is based on household level data while most of the literature on food demand analysis in Japan used aggregate data at the national level or by aggregate demographic groups. The use of household data enables us to analyze the impacts of important demographic variables affecting food consumption patterns in Japan. The large number of households in the FIES provides higher degrees of freedom in econometric estimation than many previous studies using time-series data. This is particularly important for estimating income elasticities of such important staple foods as rice. The household data should be able to shed more light on such issues, as whether or not rice is an inferior good or whether food demand changes with age in Japan.

Two specific food demand studies are undertaken in this study: (1) demand for eleven aggregate food groups including rice and (2) demand for seven meats. **Figure 1.1** gives an overview of the two food demand subsystems and various econometric models estimated and presented in this report. These models are to be discussed in detail in a later section. For the remainder of this report, descriptive statistics describing the food consumption patterns in Japan, the survey, the models used, econometric estimation results, estimated demand elasticities and their implications will be presented.

Figure 1.1: Modeling Food Demand in Japan Modeling Food Demand in Japan



2. FAMILY INCOME AND EXPENDITURE SURVEY 1997

2.1 Survey Description

The Family Income and Expenditure Survey (FIES, "*Kakei Chosa Nenpo*"), conducted by the Statistics Bureau, Management and Coordination Agency, is one of the two comprehensive consumer expenditure surveys in Japan[1]. The purpose of the survey is to create the consumer price indices and to collect the information on income and expenditure of households for various policy planning purposes.

The survey covers households designated as appropriate households by the Statistics Bureau. The appropriate households include all households except those engaged in agriculture, forestry and fishery, and one-person households[2]. In the 1990 population census, there were about 29 million appropriate households (71.3% of total 40.67 million households). From these 29 million households, sample households were chosen by a stratified three-stage sampling method.

In the FIES, about 8,000 households are surveyed each month. Each household participates in the survey for six consecutive months and one sixth of the participating households are replaced by the new ones each month. Unlike the Consumer Expenditure Survey (CES) in the U.S., the Statistics Bureau does not release household identification numbers; therefore, it is not possible to tract the same household through survey periods. At the beginning of the survey period, data on household characteristics such as household composition, total annual household income and housing tenure are collected. Then in the following sixth months, households are asked to report expenditure and amount purchased on each commodities twice a month.

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[1] The other survey is called National Survey of Family Income and Expenditure (NSFIE, "*Zenkoku Shohi Jittai Chosa*"), collected by the same agency every five years. The sample size is 60,000 taken from all households, including single-person households. It covers ten aggregate expenditure categories but not detailed food categories.

[2] The number of one-person households increased by 19.7% from 1990 to 1995 and is still increasing. They accounted for 11.24 million, 25.6% of all households in the 1995 Census. This increase was caused by both increases in households of young single population, who used to stay at home with their parents until their marriage, and households of old population who used to be included by their children household as an extended family. Thus, the distribution of one-person households is V shaped. Responding to this increase, Statistics Bureau, Management and Coordination Agency started to conduct a survey called "The Income and Expenditure Survey for one-person households (IES)" every month since January 1995. Several characteristics of one-person household can be noted. Following numbers were taken from the 1998 wave of IES. The average age of reference person was younger (48.6) than those in FIES. About half of the sample was female, of those 50 % were more than 60 years old. Male sample was biased to younger generation. About 60 % of households were worker's households. Only the average income for worker's households was obtained and it was 283,443 yen per month. Saving rate was slightly higher (29.2%) than those of FIES. The only expenditure which one-person household exceeded expenditure in the nominal level by average household from FIES was housing expense. It was reported that quite different consumption structures were observed for different sex and age group of one-person households, especially the large impact of one-person households on food away from home and prepared food consumption, since they are the major consumers of those goods.

Table 2.1: Change in quantity purchased: 1970-1995

Decrease		Neutral	Increase	
Cereal		Oil/Fats	**Meat**	6%
Non-glutinous Rice	-50%		Beef	41%
Fish	-24%		Pork	-13%
Fresh vegetables	-24%		Poultry	8%
Fresh fruits	-45%		Ground beef	19%
Proc vegetables			**Dairy**	
Dried mushroom	-60%		Milk	20%
Bean curd	-10%		**Nonalcoholic Beverages**	
Pickled radishes	-46%		Black Tea	13%
Nonalcoholic Beverages			Coffee	143%
Green tea	-33%			

Source: FIES (various issues)

One of the recent trends in the food consumption pattern of Japanese households is the Westernization. **Table 2.1** shows the changes in quantity purchased for major food commodities in Japan from 1975 to 1997. It is observed that the goods with a decrease in quantity purchased during the last 30 years tend to be traditional Japanese foods while the goods with an increase in quantity increased are the goods, which are not traditionally consumed.

The characteristics of the food expenditure pattern of the Japanese household are compared with that of the United States, which may be considered as a representative western country. The statistics and graphs shown here are created from following tables: Table 17 in the 1997 annual report for FIES published by the Statistics Bureau and the tables on Pages 71 and 72 in the 1997 codebook for CES provided by the Bureau of Labor Statistics[3]. It is important to note that the sample in FIES does not contain one-person households.

Household characteristics in FIES seem to reflect the rapidly aging population in Japan. Comparing to U.S. households, the age of reference person in Japan in 1997 was older (51.6 years old for Japan and 47.7 for the U.S.), and the percentage of households with children under 18 was higher (0.78% and 0.69%, respectively). On the other hand, the percentage of households with member(s) over 65 year old was higher (0.47% vs. 0.31 %). The household size in Japan (3.34 in 1997) was larger than the U.S. (2.54). Note that this comparison is somewhat distorted because the U.S. data (CES) include one-person households while the Japanese data (FIES) do not. Number of wage earners in the household in Japan was 1.54 as compared to 1.41 for U.S. Households with housing tenure accounted for 72.4% in Japan and 61.4% for the U.S. Average disposable income in Japan was 497,036 yen per month in 1997, and for the U.S. it was 37,920.11 dollars. Saving rate was 28% for Japan, and 6.9% in the U.S.

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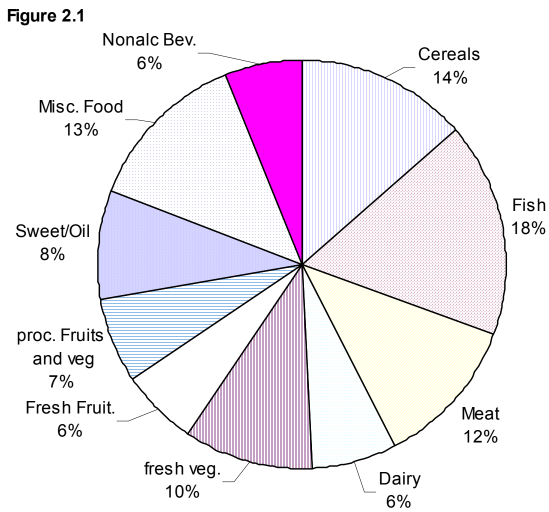
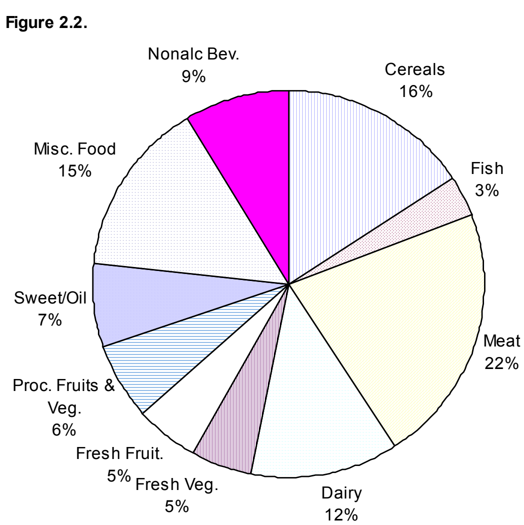
[3] The Consumer Expenditure Survey (CES), conducted by Bureau of Labor Statistics, is a representative consumer survey in the U.S. The survey consists of tow independent surveys. One is the CES Diary Survey; it has characteristics similar to FIES. The other is CES Interview Survey, which is more like NSFIE. In this study we used the data from the Diary Survey. Note that the CES includes one-person households.

Figure 2.1: Food expenditure shares in Japan in 1997



Source: FIES (1997)

Figure 2.2: Food expenditure shares in USA in 1997



Source: CES (1997)

Figures 2.1 and 2.2 show the food expenditure shares for ten aggregate food groups for at-home consumption in Japan and the U.S, respectively. The expenditure share for cereals was almost the same between the two countries. Although about 50% of the cereal expenditure was for rice in Japan, the rice expenditure in the U.S was negligible. Total expenditure shares of meat and fish were about the same in both countries; however the ratios of meat to fish expenditures were significantly different. Fish and vegetables shares in Japan were significantly higher, while the shares of fresh fruits were almost the same. Expenditure shares on the processed fruits and vegetables combined were about the same, but 95% of this combined expenditure share was for processed vegetables in Japan, while only 40% was processed vegetables in the U.S. Dairy product share was significantly lower in Japan. Other products, such as miscellaneous foods and non-alcoholic beverages had almost the same share levels in both countries. Combining these results, we can offer the following general observations regarding the food consumption patterns in the two countries:

- Foods with a significantly higher expenditure share in Japan as compared to the U.S. have decreased their shares over time in Japan, and

- Foods with a lower share in Japan as compared with the U.S. have increased their shares over time in Japan.

As a result, the differences in expenditure shares for some foods between the two countries have been narrowed in recent years.

In summary, although the Westernization of Japanese food consumption pattern has been observed, there still seems a wide gap in the expenditure pattern between Japanese and U.S. households. However, it is worth noting that the differences in expenditure share reflect the differences in relative food prices as well as the differences in the quantities consumed. Therefore, the actual food demand structures in Japan and U.S. may not be as different as they look from the observed expenditure share patterns, especially for fish and meat, which are relatively expensive food groups. Another significant difference is the expenditure share for food away from home (excluding alcoholic beverages). It was 18.7% for Japan and 29.9% for the U.S. in 1997.

There are some other important characteristics for the survey data we will use in this study. First is about the seasonality. With monthly data, it is observed that December is irregular in terms of both expenditures and income. Especially, food expenditure in December is significantly higher than in other months, apparently due to the preparation for New Year's feast. Second is that there exist regional differences. Total household income and expenditures tend to be higher in Kanto and lower in Hokkaido and Okinawa. More on these characteristics will be discussed in later sections.

Although the original survey covers all the detailed commodities that each household purchased, the data used in this study is limited to the data on more aggregate food categories and household characteristics. Other data on detailed food categories except Food Away From Home (FAFH) includes expenditures and quantity purchased. For FAFH and other non-food categories, quantities purchased are not available.

2.2 Descriptive Statistics

The FIES data set for 1997 includes the total sample of 95,223 households. As noted previously, these households had at least two persons. In order to fully understand the food consumption patterns in Japan, it is necessary to study the differences among demographic groups. Among the most important demographic variables are age, household size, and the number of wage earners. Income is often used as a demographic variable in descriptive analysis. Based on these demographic variables, the distributions of the sample and mean statistics are shown in **Appendixes A (Table A.1), B (Table B.1) and C (Table C.1)**.

Appendixes A, B, and C present the descriptive statistics of daily consumption of various foods or food groups by income, age, household size, and number of wage earners. The focus of the descriptive analysis is on the income-consumption relationships. There are also many tables showing the comparison of average prices paid by households in different demographic groups.

There are several important findings from these descriptive statistics. As shown in **Table A.7**, per household consumption of rice shows a strong positive relationship with income for all age groups, especially for the middle age (35-44) and older age (older than 65) groups. For the highest income group households, there are some declines in per household consumption of rice. Overall, the per household daily consumption of rice increased from 258.19 grams for the lowest income group to 309.34 grams for the highest income group in 1997.

Table A.9 shows per capita rice consumption by age and income. The relationships of per capita rice consumption and income are much less clear cut than per household rice consumption. Except for the older household group, the per capita rice consumption tends to fluctuate over various income levels. This pattern is not unreasonable, because there are many other factors affecting the per capita rice consumption. This can be further examined by looking at the per capita rice consumption by income and household size in **Table B.7**. For a household with four persons, the per capita consumption of rice steadily increase over income levels, from 66.57 grams/day for the lowest income group to 81.94 for the highest income group. These descriptive statistics show that there are definite evidences that rice is not an inferior good in Japan. Of course, even if the descriptive data show strong negative relationships between rice consumption and income, one cannot assert that rice is an inferior good. For example, in the United States, per capita beef consumption was steadily declining during the 1980s and 1990s, but no economists have claimed that beef is an inferior good in the U.S.

Another important finding from the descriptive statistics is that there exist strong positive relationships between price and income for many foods in Japan. **Table A.16** shows these relationships by age groups. As one can see, higher income households paid higher price for rice than lower income households did. Furthermore, the oldest household group also paid higher prices for rice in every income level. Therefore, it may be a reasonable assumption that higher income and older households tend to buy high quality rice than lower income and younger household groups. Even though the survey did not provide information on the quality of rice purchased by households, we may be able to investigate the demand for different quality rice by estimating the demand function for separate income and/or age household groups.

The analysis of the price data for beef also shows a very similar pattern of positive relationship between price and income. As shown in **Table A.18**, higher income households paid higher prices for beef than lower income households did. Interestingly, the oldest household group also paid much higher prices for beef in every income level. These statistics provide a basis for modeling the demands for different quality beef by separating the whole sample into the subgroups by income and age.

2.3 Households with Zero Consumption and Missing Price Data

One of the major econometric problems in modeling demand using household data is that many households did not purchase various foods during the survey period. **Tables 2.2 and 2.3** show the percentages of households with zero consumption.

Table 2.2: Percentage of Households with Zero Consumption Major 11 Commodities

Food Variables	%
Non-glutinous Rice	43.75%
Bread	4.15%
Noodle	6.14%
Fresh Fish and Shell Fish	2.45%
Fresh Meat	1.92%
Milk	8.36%
Eggs	5.51%
Fresh Vegetables	0.24%
Fresh Fruits	5.50%
Fats and Oil	42.12%
Food Away From Home	12.65%

Source: FIES 1997

Table 2.3: Percentage of Households with Zero Consumption 7 Meat Products

Food Variables	%
Beef	20.63%
Pork	9.50%
Poultry	19.67%
Ground Meat	70.37%
Ham	39.29%
Sausage	33.39%
Bacon	59.21%

Source: FIES 1997

Related to zero consumption is the problem of missing price data. Since the households with zero consumption have no information on either expenditures or quantities, no unit values (prices) can be derived for these households. The price used for estimation in this study is obtained by dividing expenditure by the quantity purchased. This zero consumption problem poses a serious estimation flaw, as there is no price data for households with zero consumption. In order to obtain price data for these households, we make the assumption that each household is facing the mean price of each commodity depending on region, month and income. There are ten regions, five income levels, and twelve months. Hence, totally we have six hundred average prices from the sample. For the households with missing price data, we assume that they face the average prices according to their income level, region and the month of the survey. Amongst eleven food items, food away from home (FAFH) does not have a quantity unit. We use the Consumer Price Index (CPI) from *Annual Report on the Consumer Price Index*, published by Statistics Bureau, Management and Coordination Agency, for FAFH. The CPI for FAFH has only monthly variations. Thus, within each month, all households have the same CPI for FAFH.

3. ECONOMETRIC MODELS FOR CONSUMPTION ANALYSIS

3.1 Introduction

The application of the theory of the household requires a specific model. In general, econometric studies on demand include both single equations and systems of demand equations. The demand functions can be generalized for a consumer or a household buying n goods as:

$$q_i = q_i(p_1, p_2, \ldots p_j, \ldots p_n, I), \qquad i = 1, 2, \ldots, n. \tag{3.1}$$

where q_i is quantity demanded, p is the price, the subscript i denotes the commodities, and I is income. These n equations can be estimated by single equations or by systems of equations. In this study, Equation (3.1) is estimated in a budget share form. Extending the demand function for individual consumers to the one for a group of consumers in most empirical applications induces the need to include demographic variables beside prices and income. In this section, we describe the econometric models for 11 food items. The methodology applies to the model for seven meats.

3.2 Single Equation Model

The first empirical model applied in this study is the Working-Leser model. Original form of Working-Leser was discussed by Working (1943) and Leser (1963). Intriligator et al. (1996) and Deaton and Muellbauer (1980a) provide a more detailed discussion of this functional form. In the Working-Leser model, each share of the food item is simply a linear function of the log of prices and of the total expenditure on all food items in question. The Working-Leser food demand function can be expressed as:

$$w_i = \alpha_0 + \alpha_i \log x + \sum_j \beta_{ij} \log p_j + \sum_k \gamma_{ik} H_k + \varepsilon_i \tag{3.2}$$

where $(i, j) \in$ eleven food items,

w_i = expenditure share of food i among eleven food items,

p_j = price of food j, and

x = total expenditure of all food items included in the model.

H_k includes dummy variables where $k \in$ 25:

AGE = log age of household head,

SIZE = log of household size,

WE = number of wage earners,

BABY = number of children aged 5 or under,

PRIM = number of children aged between 6 and 12,

HIGH = number of children aged between 13 and 18,

M = dummy variables for month ($M_1, \ldots, M_{10}$)[4], and

REG = dummy variables for region ($REG_1, \ldots, REG_9$).

ε_i's are random disturbances assumed with zero mean and constant variance. This model for each food item can be estimated by the ordinary least squares (OLS).

3.2.1 Demand Elasticity Formulas for Working-Leser Model

It is easy to show the elasticity formulas for the Working-Leser model. The expenditure elasticity (e_i) can be expressed as:

$$e_i = 1 + \left(\frac{\alpha_i}{w_i} \right). \qquad (3.3)$$

Taking a derivative of Equation (3.2) with respect to $\log(p_j)$ yields uncompensated own ($j=i$) and cross ($j \neq i$) price elasticities, e_{ij}, are as follows:

$$e_{ij} = -\delta_{ij} + \left(\frac{\beta_{ij}}{w_i} \right) \qquad \forall i, j = 1, \ldots, n \qquad (3.4)$$

where δ_{ij} is the Kronecker delta that is unity if $i = j$ and zero otherwise. In this study, expenditure, own-price, and cross-price elasticities are evaluated at sample means.

3.2.2 Income Elasticity in Working-Leser Model

Since the Working-Leser model uses total expenditures for the group of food items included in the model, it does not provide a direct estimate of income elasticity. In order to estimate income elasticity, we estimate the following Engel function:

$$\log x = \alpha_0 + \alpha_1 \log X + \beta \log P + \sum_k \gamma_k H_k + \varepsilon \qquad (3.5)$$

where x = Total expenditures of the food included in the model,

X = Total expenditures of food and non-food consumer goods and services,

P = Laspeyres price index for the eleven foods, and

other demographic and dummy variables are the same as previously defined. Remaining variables are the same as Equation (3.2). From Equation (3.2) and Equation (3.5), income elasticity can be estimated. From Equation (3.2), we can estimate expenditure elasticity,

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[4] Only ten monthly dummies are included in the model, because CPI data for food away from home is obtained on a monthly basis.

$e_i = \frac{\partial q_i}{\partial x}\frac{x}{q_i}$. From Equation (3.5), we can derive the responsiveness of expenditure on food items by income change, $s = \frac{\partial x}{\partial X}\frac{X}{x}$. Hence, income elasticity is estimated as follows:

$$e_{i(income)} = e_i s = \left(\frac{\partial q_i}{\partial x}\frac{x}{q_i}\right)\left(\frac{\partial x}{\partial X}\frac{X}{x}\right) = \frac{\partial q_i}{\partial X}\frac{X}{q_i}. \qquad (3.6)$$

3.3 Tobit and Heckman's Two-step Estimator

In order to estimate income elasticities, household-level micro data are preferable, since one can avoid the aggregation problem by using them. With the use of household micro data for detailed commodities; however, we encounter an econometric problem with some households having zero consumption, as stated before. This problem stems from the fact that some households do not consume some of the items considered. This zero consumption problem is particularly severe for the case of rice, oil and fats, and food away from home in FIES amongst major 11 food commodities, and ground meat and bacon in the seven meats model.

It is known that using only observed positive purchase data to estimate consumption behavior by OLS regression produces inconsistent estimates of coefficients. The dependent variables, which are the budget shares for the food items specified, are zero if a household does not purchase the food item and positive if one does. Zero shares are censored by an unobservable latent variable. In this study, we apply two different models to correct zero consumption: Heckman's two-step model and standard Tobit estimator. The derivation of elasticity measure for each model is shown. Each model is based on different assumptions on zero consumption. The observation of zero consumption is no purchase of the particular item in the month-long survey period. If we assume zero consumption is due to sample selection, Heckman's two-step is the appropriate model. Tobit model simply captures the corner solutions for utility maximization. We compare the results from the three estimators including OLS.

3.3.1 Tobit Estimator and Demand Elasticities

This section describes the Tobit estimator and elasticity calculation. There are many studies cited on this topic. Notation mainly follows Amemiya (1985) and Maddala (1983).

The Tobit estimator is defined as follows;

$$\begin{cases} y_i = y^* = s_i\beta + u_i \text{ if } \quad y_i^* > 0 \quad y^* \sim N(0,\sigma^2) \\ y_i = 0 \text{ otherwise} \end{cases} \qquad (3.7)$$

β is a $k \times 1$ vector of unknown parameters; s_i is a $k \times 1$ vector of known constants; u_i are residuals that are independently and normally distributed, with mean zero and a common variance σ^2; y^* is an unobservable latent variable.

McDonald and Moffitt (1980) describes that total change in y can be disaggregated into two parts: the change in y above the threshold, weighted by the probability of being above the threshold; and the change in the probability of being above the threshold, weighted by the expected value of y. Unconditional elasticity describes the elasticity of y from the mean of all observed y's. Conditional elasticity is the elasticity measure conditional on the consumer's choice of non-zero quantity purchased of the good.

Considering the model given above and the non-zero observations y_i, we get

$$E[y_i \mid y_i > 0] = s_i\beta + E[u_i \mid u_i > -s_i\beta] = s_i\beta + \sigma\frac{\phi_i}{\Phi_i} \tag{3.8}$$

where ϕ_i and Φ_i are the density function and cumulative distribution function of the standard normal evaluated at $\frac{s_i\beta}{\sigma}$. Define z as $z_i \equiv \frac{s_i\beta}{\sigma}$ for notational convenience.

In order to obtain predicted values using all the observations, we have:

$$\begin{aligned} E[y_i] &= P(y_i > 0)E[y_i \mid y_i > 0] + P(y_i = 0)E[y_i \mid y_i = 0] \\ &= \Phi_i(s_i\beta + \sigma\frac{\phi_i}{\Phi_i}) + (1-\Phi_i)0 \\ &= \Phi_i s_i\beta + \sigma\phi_i \end{aligned} \tag{3.9}$$

Unconditional and conditional elasticity in a general form can be obtained as follows:

Unconditional elasticity $$e_{i,unconditional} = \frac{\partial E[y_i]}{\partial s}\frac{s}{E[y_i]} \tag{3.10}$$

Conditional elasticity $$e_{i,conditional} = \frac{\partial E[y_i \mid y_i > 0]}{\partial s}\frac{s}{E[y_i \mid y_i > 0]} \tag{3.11}$$

The prediction of y_i, given s_i, can be obtained from the different expectation functions: unconditional and conditional expectations. We follow Maddala (1983) and McDonald and Moffitt (1980). In order to obtain unconditional expectation, we take derivative of (Equation (3.9). We drop subscript *i*, which denotes observation.

$$\frac{\partial E[y]}{\partial s} = \beta\Phi(z) \tag{3.12}$$

From Equation (3.12), (3.8) partial derivative calculates:

$$\frac{\partial E[y \mid y^* > 0]}{\partial s} = \beta\left[1 - z\frac{\phi(z)}{\Phi(z)} - \left(\frac{\phi(z)}{\Phi(z)}\right)^2\right] \tag{3.13}$$

See McDonald and Moffitt (1980) for the detailed derivation.

From these general formulas for elasticity estimation, we can derive the elasticity formulas for the Leser-Working model. In our study, Working-Leser Model is denoted as follows:

$$w_i^* = \alpha_0 + \alpha_i \log x + \sum_j \beta_{ij} \log p + \sum_k \gamma_{ik} H_k + \varepsilon_i \qquad i \in 1,\ldots,n \tag{3.14}$$

$$\begin{cases} w_i = w_i^* & if \quad w_i > 0 \\ w_i = 0 & if \quad w_i \le 0 \end{cases} \text{ and } \varepsilon_i \sim N(0,\sigma^2)$$

where subscript i denotes a good in question. x denotes total expenditure on eleven commodities. p_i and q_i denote price and quantity for *ith* commodity, respectively. w_i denotes budget share of *ith* good, $w_i = \frac{p_i q_i}{x}$.

Expenditure elasticity is obtained in a following way:

$$E[w_i] = \frac{p_i E[q_i]}{x}$$

$$E[q_i] = \frac{E[w_i]x}{p_i}$$

$$\frac{\partial E[q_i]}{\partial x}\frac{x}{E[q_i]} = \frac{E[w_i]}{p_i}\frac{x}{E[q_i]} + \frac{\frac{\partial E[w_i]}{\partial x}x}{p_i}\frac{x}{E[q_i]}$$

$$= 1 + \frac{\frac{\partial E[w_i]}{\partial \log x}}{E[w_i]} \tag{3.15}$$

Since the numerator of Equation (3.15) is the coefficient of Equation (3.14), we can apply this formula for Equation (3.14) evaluated at the sample mean and ϕ and Φ are the density function and cumulative density function of the standard normal evaluated at z_i, respectively. Hence, unconditional expenditure elasticity is:

$$\hat{e}_{i,unconditional} = \frac{\partial E[q_i]}{\partial x}\frac{x}{E[q_i]} = 1 + \frac{\Phi(\hat{z}_i)\hat{\alpha}_i}{\Phi(\hat{z}_i)\bar{x}\hat{\beta}_i + \hat{\sigma}_i \phi(\hat{z}_i)} \tag{3.16}$$

where upper bar denotes sample mean.

Conditional expenditure elasticity is

$$\hat{e}_i = \frac{\partial E[q_i \mid q^*_i > 0]}{\partial x}\frac{x}{E[q_i \mid q^*_i > 0]} = 1 + \frac{\hat{\alpha}_i\left[1 - \hat{z}_i \frac{\phi(\hat{z}_i)}{\Phi(\hat{z}_i)} - \left(\frac{\phi(\hat{z}_i)}{\Phi(\hat{z}_i)}\right)^2\right]}{\bar{x}\hat{\beta}_i + \hat{\sigma}_i \frac{\phi(\hat{z}_i)}{\Phi(\hat{z}_i)}} \tag{3.17}$$

Own-price elasticity becomes as follows:

$$\frac{\partial E[q_i]}{\partial p_i} = \frac{\frac{\partial E[w_i]}{\partial p_i} x - E[w_i] x}{p_i^2}$$

$$\frac{\partial E[q_i]}{\partial p_i} \frac{p_i}{q_i} = \frac{p_i}{q_i} \frac{\frac{\partial E[w_i]}{\partial p_i} x - E[w_i] x}{p_i^2} = -1 + \frac{\frac{\partial E[w_i]}{\partial \log p_i}}{E[w_i]} \tag{3.18}$$

Unconditional own-price elasticity is:

$$\hat{e}_{ii,unconditional} = -1 + \frac{\Phi(\hat{z}_i)\hat{\beta}_{ii}}{\Phi(\hat{z}_i)\overline{x}\hat{\beta}_i + \hat{\sigma}_i \phi(\hat{z}_i)} \tag{3.19}$$

Conditional own-price elasticity is:

$$\hat{e}_{ii,conditional} = -1 + \frac{\hat{\beta}_{ii}\left[1 - \hat{z}_i \frac{\phi(\hat{z}_i)}{\Phi(\hat{z}_i)} - \left(\frac{\phi(\hat{z}_i)}{\Phi(\hat{z}_i)}\right)^2\right]}{\overline{x}\hat{\beta}_i + \hat{\sigma}_i \frac{\phi(\hat{z}_i)}{\Phi(\hat{z}_i)}} \tag{3.20}$$

In the same format, cross-price elasticity can be obtained as follows:

$$\frac{\partial E[q_i]}{\partial p_j} = \frac{\frac{\partial E[w_i]}{\partial p_j} x}{p_j}$$

$$\frac{\partial E[q_i]}{\partial p_j} \frac{p_j}{q_i} = \frac{p_j}{q_i} \frac{\frac{\partial E[w_i]}{\partial p_j} x}{p_j} = \frac{\frac{\partial E[w_i]}{\partial \log p_i}}{E[w_i]} \tag{3.21}$$

Unconditional cross-price elasticity is:

$$\hat{e}_{ij,unconditional} = \frac{\Phi(\hat{z}_i)\hat{\beta}_{ij}}{\Phi(\hat{z}_i)\overline{x}\hat{\beta}_i + \hat{\sigma}_i \phi(\hat{z}_i)} \tag{3.22}$$

Conditional own-price elasticity is:

$$\hat{e}_{ij,conditional} = \frac{\hat{\beta}_{ij}\left[1 - \hat{z}_i \frac{\phi(\hat{z}_i)}{\Phi(\hat{z}_i)} - \left(\frac{\phi(\hat{z}_i)}{\Phi(\hat{z}_i)}\right)^2\right]}{\overline{x}\hat{\beta}_i + \hat{\sigma}_i \frac{\phi(\hat{z}_i)}{\Phi(\hat{z}_i)}} \tag{3.23}$$

3.3.2 Heckman's Two-step (Sample Selection) Estimator

In order to correct for the sample bias problem on rice consumption, we applied Heckman's two-step estimation (Heckit) procedure suggested by Heckman (1978). In the first stage, a probit regression is computed in order to estimate the probability that a given household consumes the food item in question. This regression is used to estimate the inverse Mills ratio (λ) for each household, which is used as an instrument in the second regression. In the second stage, the initial Working-Leser model (Equation (3.2)) with the inverse Mills ratio is estimated.

In the first stage, the decision for the household is modeled as a dichotomous choice problem;

$$I_i = \alpha_0 + \alpha_i \log x + \sum_j \beta_{ij} \log p_j + \sum_k \gamma_{ik} H_k + \varepsilon_i \qquad (3.24)$$

where I_i is one if a household consumes *i*th food item (i.e., $w_i > 0$), and zero otherwise. Other variables were defined previously. From Equation (3.24), the inverse Mills ratio (λ) for every household can be computed as:

$$\lambda_i = \frac{\phi_i(P,x,d)}{\Phi_i(P,x,d)} \qquad (3.25)$$

where P, x, d are the vector of prices, expenditures, and the vector of demographic variables for the household, respectively. ϕ_i is the density probability function, and Φ_i is the cumulative probability function. For notational convenience, we set as follows:

$$\lambda_i = \frac{\phi_i(\Gamma_i\omega)}{\Phi_i(\Gamma_i\omega)} \qquad (3.25')$$

where Γ_i is a vector of regressors explaining the binary choice in the first stage, and ω is the conformable parameter vector.

In the second step, the following Working-Leser demand function incorporating the computed inverse Mills ratio, λ_i, as an instrument variable is estimated:

$$w_i = \alpha_0 + \alpha_i \log x + \sum_j \beta_{ij} \log p_j + \sum_k \gamma_{ik} H_k + \theta_i \lambda_i + \varepsilon_i \qquad (3.26)$$

where θ_i is the parameter associated with the inverse Mills ratio. Importantly, only the non-zero observations on w_i are used in the second-stage estimation in order to estimate the conditional elasticity[5]. We use the whole sample to estimate the unconditional elasticity.

It is important to note that there has to be at least one explanatory variable at the first equation, which is not included at the second step for identification, according to Maddala (1983) Amemiya (1985), and Johnston and DiNardo (1997). We add the city size dummy variables based on the population in the first step: cities are divided into major cities

[5] For the system of equations case with inverse Mills ratio, the convention is to use the whole sample.

(population of one million or more), mid-size cities (150,000 to 1,000,000), small cities A (50,000 to 150,000), and small cities B (less than 50,000).

3.3.3 Demand Elasticities for Heckman's Two-step estimator

Even though Heckman's two-step estimator is fairly common in empirical studies, there is little literature on its elasticity estimation. Byrne, Capps, and Saha (1996) explicitly shows its elasticity estimates of Heckman's two-step estimator for a single equation case. Later, Saha, Capps, and Byrne (1997) generalized the method from a single equation to a system of equations. We adapt the methodology developed by Byrne, Capps, and Saha (1996) and Saha, Capps, and Byrne (1997), and applied it to the Working-Leser model.

At the first stage, the inverse Mills ratio is estimated by the dichotomous-choice probit model. In a general form, the estimated inverse Mills ratio, $\hat{\lambda}_i$, is described in Equation (3.25'). In the second stage equation, we can calculate the conditional expectation of the dependent variable in a general form as follows:

$$E\left[Y_i \mid Y_i > 0\right] = x_i\beta + \varphi_i\,\hat{\lambda}_i \text{ and } \hat{\lambda}_i = \frac{\phi_i(\Gamma_i\omega)}{\Phi_i(\Gamma_i\omega)} \qquad (3.27)$$

where x_i is the vector of regressors explaining the magnitude of Y_i in the second stage equation, and β is associated parameter vector. φ_i is a parameter corresponding to the estimated inverse Mills ratio, which is estimated at the first stage. In order to derive conditional elasticity, we only use the non-zero observation of Y_i for the second stage Heckman's two-step estimator.

Taking partial derivative with respect to x_i:

$$\frac{\partial E\left[Y_i \mid Y_i > 0\right]}{\partial x_i} = \beta + \varphi_i \frac{\partial \hat{\lambda}_i}{\partial x_i} \qquad (3.28)$$

According to Saha, Cappas, and Byrne (1997), this can be simplified as follows:

$$\frac{\partial E\left[Y_i \mid Y_i > 0\right]}{\partial x_i} = \beta - \varphi_i\,\omega_i\left\{\Gamma_i\omega\hat{\lambda}_i + \hat{\lambda}_i^2\right\} \qquad (3.29)$$

where β and φ_i are parameters corresponding to x_i and the inverse Mills ratio at the second stage equation, respectively. ω_i is a parameter associated with x_i at the first stage, Γ_i is the vector of regressors explaining the binary choice in the first stage, and ω is the comfortable parameter vector, as defined before. Marginal effects are evaluated at the sample mean. The average of the inverse Mills ratio can be estimated by summing up for each observation, which is divided by the number of observations.

In order to estimate unconditional elasticity, we need to use the whole sample for the second stage in order to take into account of zero-consumption households. In the second stage estimation, the expectation of the dependent variables becomes as follows:

$$E\left[Y_i \mid Y_i > 0\right] = x_i\beta + \varphi_i \frac{\phi_i(\Gamma_i\omega)}{\Phi_i(\Gamma_i\omega)} \tag{3.30}$$

$$E\left[Y_i \mid Y_i = 0\right] = x_i\beta + \varphi_i \frac{\phi_i(\Gamma_i\omega)}{1-\Phi_i(\Gamma_i\omega)} \tag{3.31}$$

We can take a partial derivative with respect to x_i, and it becomes as follows:

$$\frac{\partial E\left[Y_i \mid Y_i > 0\right]}{\partial x_i} = \beta - \varphi_i\,\omega_i \left\{ \Gamma_i\omega \frac{\phi_i(\Gamma_i\omega)}{\Phi_i(\Gamma_i\omega)} + \left(\frac{\phi_i(\Gamma_i\omega)}{\Phi_i(\Gamma_i\omega)} \right)^2 \right\} \tag{3.32}$$

$$\frac{\partial E\left[Y_i \mid Y_i = 0\right]}{\partial x_i} = \beta - \varphi_i\,\omega_i \left\{ \Gamma_i\omega \frac{\phi_i(\Gamma_i\omega)}{1-\Phi_i(\Gamma_i\omega)} + \left(\frac{\phi_i(\Gamma_i\omega)}{1-\Phi_i(\Gamma_i\omega)} \right)^2 \right\} \tag{3.33}$$

Denoting θ as the proportion of observations for which $Y_i > 0$, hence $0 < \theta < 1$, Saha Capps, and Byrne (1997) suggests to take a weighted average of these two biases as follows:

$$\frac{\partial E\left[Y_i\right]}{\partial x_i} = \beta - \varphi_i\,\omega_i \left[\theta \left\{ \Gamma_i\omega \frac{\phi_i(\Gamma_i\omega)}{\Phi_i(\Gamma_i\omega)} + \left(\frac{\phi_i(\Gamma_i\omega)}{\Phi_i(\Gamma_i\omega)} \right)^2 \right\} + (1-\theta) \left\{ \Gamma_i\omega \frac{\phi_i(\Gamma_i\omega)}{1-\Phi_i(\Gamma_i\omega)} + \left(\frac{\phi_i(\Gamma_i\omega)}{1-\Phi_i(\Gamma_i\omega)} \right)^2 \right\} \right] \tag{3.34}$$

The sample mean for the bias term is calculated as before: the bias term is summed up for each observation, which is then divided by the number of observations.

In order to apply these computations for the Working-Leser model, we further need to adjust the marginal value following the elasticity formula. We can calculate conditional price, conditional expenditure, unconditional price, and unconditional expenditure elasticity, respectively, as follows:

$$e_i \Big|_{\substack{\text{conditional}\\ \text{expenditure}\\ \text{elasticity}}} = 1 + \left(\frac{\dfrac{\partial E\left[Y_i \mid Y_i > 0\right]}{\partial \alpha_i} \Big|_{\text{at sample mean}}}{\overline{w}_i} \right) \tag{3.35}$$

$$e_{ij} \Big|_{\substack{\text{conditional}\\ \text{price}\\ \text{elasticity}}} = -\delta_{ij} + \left(\frac{\dfrac{\partial E\left[Y_i \mid Y_i > 0\right]}{\partial \beta_{ij}} \Big|_{\text{at sample mean}}}{\overline{w}_i} \right) \tag{3.36}$$

$$e_i \mid_{\substack{\text{unconditional}\\ \text{expenditure}\\ \text{elasticity}}} = 1 + \left(\frac{\frac{\partial E[Y_i]}{\partial \alpha_i} \mid_{\text{at sample mean}}}{\overline{w}_i} \right) \tag{3.37}$$

$$e_{ij} \mid_{\substack{\text{unconditional}\\ \text{price}\\ \text{elasticity}}} = -\delta_{ij} + \left(\frac{\frac{\partial E[Y_i]}{\partial x_i} \mid_{\text{at sample mean}}}{\overline{w}_i} \right) \tag{3.38}$$

3.4 A Complete Demand System

Deaton and Muellbauer (1980a, 1980b) developed a flexible demand system called the Almost Ideal Demand System (AIDS). The concept of a flexible demand system is extremely useful for estimating a demand system with many desirable properties. As Moschini (1998) pointed out, the AIDS model automatically satisfies the adding-up restriction, and with simple parametric restrictions, homogeneity and symmetry can be imposed. In addition, the non-linear Engel curves of the AIDS model imply that an increase in income will decrease the share of income allocated on a particular commodity as well as the income elasticity of that good if the income elasticity of the good is less than one. However, the AIDS model may be difficult to estimate because the price index is not linear in parameters estimated. Due to the simplicity, the linear approximate almost ideal demand system (LA/AIDS) is popular amongst empirical studies. Therefore, both LA/AIDS and AIDS models are applied in this study.

The AIDS model for the 11 food commodities can be estimated as follows:

$$w_i = \alpha_i + \sum_j \gamma_{ij} \ln(p_j) + \beta_i \ln(\frac{x}{P}) + \mu_i \qquad \text{i = 1, …, 11} \tag{3.41}$$

where w_i is the budget share of good i, p_j is the price of good j, x is the total expenditure of the goods in question, μ_i's are random disturbances assumed with zero mean and constant variance, and P is a translog price index defined by:

$$\log P = \alpha_0 + \sum_k \alpha_k \ln p_k + \frac{1}{2} \sum_k \sum_l \gamma^*_{kl} \ln p_k \ln p_l \tag{3.42}$$

k = 1, …, 11 l = 1, …, 11

and the parameters γ_{ij}'s are defined under symmetry as follows:

$$\gamma_{ij} = \frac{1}{2}(\gamma^*_{ij} + \gamma^*_{ji}) = \gamma_{ji} \qquad \text{j = 1, …, 11} \tag{3.43}$$

The model defined by the Equations (3.41) to (3.43) is called the AIDS model.

It is easy to check that the adding-up restriction is satisfied with given $\sum_i w_i = 1$ for all j;

$$\sum_i \alpha_i = 1,\ \sum_i \beta_i = 0,\ \text{and}\ \sum_k \gamma_{kj} = 0 \qquad (3.44)$$

The homogeneity restriction is satisfied for the AIDS model if and only if, for all j;

$$\sum_k \gamma_{jk} = 0 \qquad (3.45)$$

The symmetry is satisfied by:

$$\gamma_{ij} = \gamma_{ji} \qquad (3.46)$$

Using the price index in Equation (3.42) raises the estimation difficulties due to non-linearity in parameters. In addition, the theory of the household does not provide any empirically plausible value for α_0.

As Asche and Wessells (1997) pointed out, the Stone index is widely used for LA/AIDS estimation.

$$\ln(P^*) = \sum_i w_i \ln(p_i) \qquad i = 1, \ldots, 11 \qquad (3.47)$$

where w is budget share among eleven commodities. The Stone index is an approximation proportional to the translog, i.e., P = φ P* where E(ln(φ)) = α_0. The LA/AIDS model with the Stone index can be seen as follows:

$$w_i = \alpha_i^* + \sum_j \gamma_{ij} \ln(p_j) + \beta_i \ln\left(\frac{x}{P^*}\right) + \mu_i^* \qquad (3.48)$$

where $\alpha_i^* = \alpha_i - \beta_i \alpha_i$ and $\mu_i^* = \mu_i - \beta_i(\ln(\varphi) - E(\ln(\varphi)))$.

Since prices will never be perfectly collinear, it is widely cited that applying the Stone index will introduce the units of measurement error. (See Alston, Foster, and Green (1994), Asche and Wessells (1997), and Moschini (1995).) The Stone index does not satisfy the fundamental property of index numbers, because the Stone index is variant to changes in the units of measurement of prices. One of the solutions to correct the units of measurement error is that prices are scaled by their sample mean. Following Moschini's suggestion (1995) we use a Laspeyres price index in order to overcome this measurement error. Specifically, the log-linear analogue of the Laspeyres price index is obtained by replacing w_i in Equation (3.47) with $\overline{w}_i$, which is a mean budget share. Hence, the Laspeyres price index becomes a geometrically weighted average of prices:

$$\ln(P^L) = \sum_i \overline{w}_i \ln(P_i) \qquad (3.49)$$

Substitution of (3.49) into (3.48) yields a LA/AIDS model with the Laspeyres price index as follows:

$$w_i = \alpha_i^{**} + \sum_j \gamma_{ij} \ln(p_j) + \beta_i (\ln(x) - \sum_j \overline{w}_j \ln(p_j)) + \mu_i^{**} \tag{3.50}$$

where $\alpha_i^{**} = \alpha_i - \beta_i(\alpha_0 - \sum_j \overline{w}_j \ln(\overline{p}_j))$.

Following Pollak and Wales (1978, 1981), we apply linear demographic translating, $D^i(\eta) = \sum_{r=1}^{N} \delta_{ir}\eta_r$, where δ's and η's are associated parameters and the demographic variables, respectively. In this study, the linear demographic translating replaces Equation (3.41) as follows:

$$w_i = \alpha_i^{***} + \sum_k \delta_{ik}\eta_k + \sum_j \gamma_{ij} \ln(p_j) + \beta_i (\ln(x) - \sum_j \overline{w}_j \ln(p_j)) + \mu_i^{***} \tag{3.51}$$

where $\alpha_i^{***} = \alpha_i^{**} - \sum_k \delta_{ik}\eta_k$. Demographic and dummy variables used in the complete demand system are the same as the ones used in single equation models.

The adding-up restriction requires

$$\sum_i \alpha^{***} = 1, \text{ and } \sum_i \delta_{ik} = 0, \qquad k = 1, \ldots, m \tag{3.52}$$

where m is the number of demographic and other dummy variables.

In order to correct for the zero consumption problem, we apply the generalized Amemiya's two-stage estimators to a simultaneous-equation model. (See Amemiya (1974), Lee and Pitt (1986), and Heinen and Wessels (1990).) In the first stage, the probit model with dichotomous choices is estimated. From the regression results, we derive the inverse Mills ratio. For the LA/AIDS model, we only use the inverse Mills ratios of rice, fats and oil, and food away from home. These three inverse Mills ratios are used as instruments in the second stage. Similar arguments are adopted from the Heckman's two-step estimator discussed earlier.

3.5 Demand Elasticities for the AIDS model

The elasticity derivations for the AIDS and LA/AIDS models are widely investigated and well documented. Following Bues (1994) and Green and Alston (1990), taking the derivative of Equation (3.48) with respect to ln(x), we can obtain the expenditure elasticity e_i as follows:

$$e_i = 1 + \left(\frac{1}{w_i}\right)\left(\frac{\partial w_i}{\partial \ln(x)}\right) = 1 + \left(\frac{\beta_i}{w_i}\right). \tag{3.53}$$

Taking the derivative with respect to $\ln(p_j)$, uncompensated own ($j=i$) and cross ($j \neq i$) price elasticities, $e_{ij}^{LA/AIDS}$, become as follows:

$$e_{ij}^{LA/AIDS} = -\delta_{ij} + \left(\frac{1}{w_i}\right)\left(\frac{\partial w_i}{\partial \ln\left(p_j\right)}\right)$$
$$= -\delta_{ij} + \left(\frac{\gamma_{ij}}{\overline{w}_i}\right) - \left(\frac{\beta_i}{\overline{w}_i}\right)\overline{w}_j \qquad \forall i, j = 1, \dots, n, \tag{3.54}$$

where δ_{ij} is the Kronecker delta that is unity if $i = j$ and zero otherwise. In this study, we use the sample mean for the point of normalization.

We can derive the Hicksian compensated price elasticities for the AIDS and the LA/AIDS model. The compensated price elasticities $s_{ij}^{LA/AIDS}$ at the point of normalization becomes as follows:

$$s_{ij}^{LA/AIDS} = e_{ij} + e_i w_j$$
$$= -\delta_{ij} + \left(\frac{\gamma_{ij}}{\overline{w}_j}\right) + \overline{w}_j \qquad \forall i, j = 1, \dots, n. \tag{3.55}$$

For AIDS model, following Bues (1994), we apply Equation (3.53) for expenditure elasticity. Following Green and Alston (1990), uncompensated own (*j*=*i*) and cross (*j*≠*i*) price elasticities, e_{ij}^{AIDS}, become as follows:

$$e_{ij}^{AIDS} = -\delta_{ij} + \frac{\gamma_{ij}}{\overline{w}_i} - \frac{\beta_i}{\overline{w}_i}\left(\alpha_j + \sum_{k=1}^{n} \gamma_{kj} \ln \overline{P}_k\right). \tag{3.56}$$

Compensated own (*j*=*i*) and cross (*j*≠*i*) price elasticities, s_{ij}^{AIDS}, become as follows:

$$s_{ij}^{AIDS} = -\delta_{ij} + \frac{\gamma_{ij}}{\overline{w}_i} + \overline{w}_j - \frac{\beta_i}{\overline{w}_i}\left(\alpha_j + \sum_{k=1}^{n} \gamma_{kj} \ln \overline{P}_k - \overline{w}_j\right). \tag{3.57}$$

4. RICE DEMAND ANALYSIS

4.1 Introduction

The 1994 Marrakech agreements of the General Agreement on Tariff and Trade (GATT) Uruguay Round started a process of agricultural market liberalization. The new round of World Trade Organization (WTO) negotiations launched in 2000 are expected to bring this process further. The world rice market is a thin market. Ninety percent of production and consumption occurs in Asia. The GATT/WTO decisions will design a new structure of the world agricultural markets, and it is important to understand how this will influence the rice market in the near future.

Japan reached high economic growth earlier than other Asian nations. Recently, the Newly Industrialized Economies (NIEs) of South Korea, Taiwan, and Singapore have been rapidly catching up and attaining higher per capita income. Many Asian nations may eventually reach the economic standards of Japan, Europe, and the U.S.. Japanese consumption behavior is a key indicator to forecast the future consumption patterns of Asian nations. For example, South Korea accepted the same minimum access import requirements in the GATT negotiations, and Taiwan has a very similar agricultural sector to Japan. By investigating Japanese consumption behavior as being representative of high-income consumers, this study will shed some light on the future direction of Asian and world rice demand.

In addition to a general concern about Japanese consumption behavior, it is of great interest to ascertain whether rice is a normal or inferior good, i.e. as the income increases, whether per capita rice consumption goes up or down. Since rice is a very important food staple in Asian countries, many domestic agricultural as well as international trade policies are centered on rice. Such important agricultural policies would be misdirected if they were based on the belief that rice is an inferior good, without a rigorous and robust estimation of that characteristic.

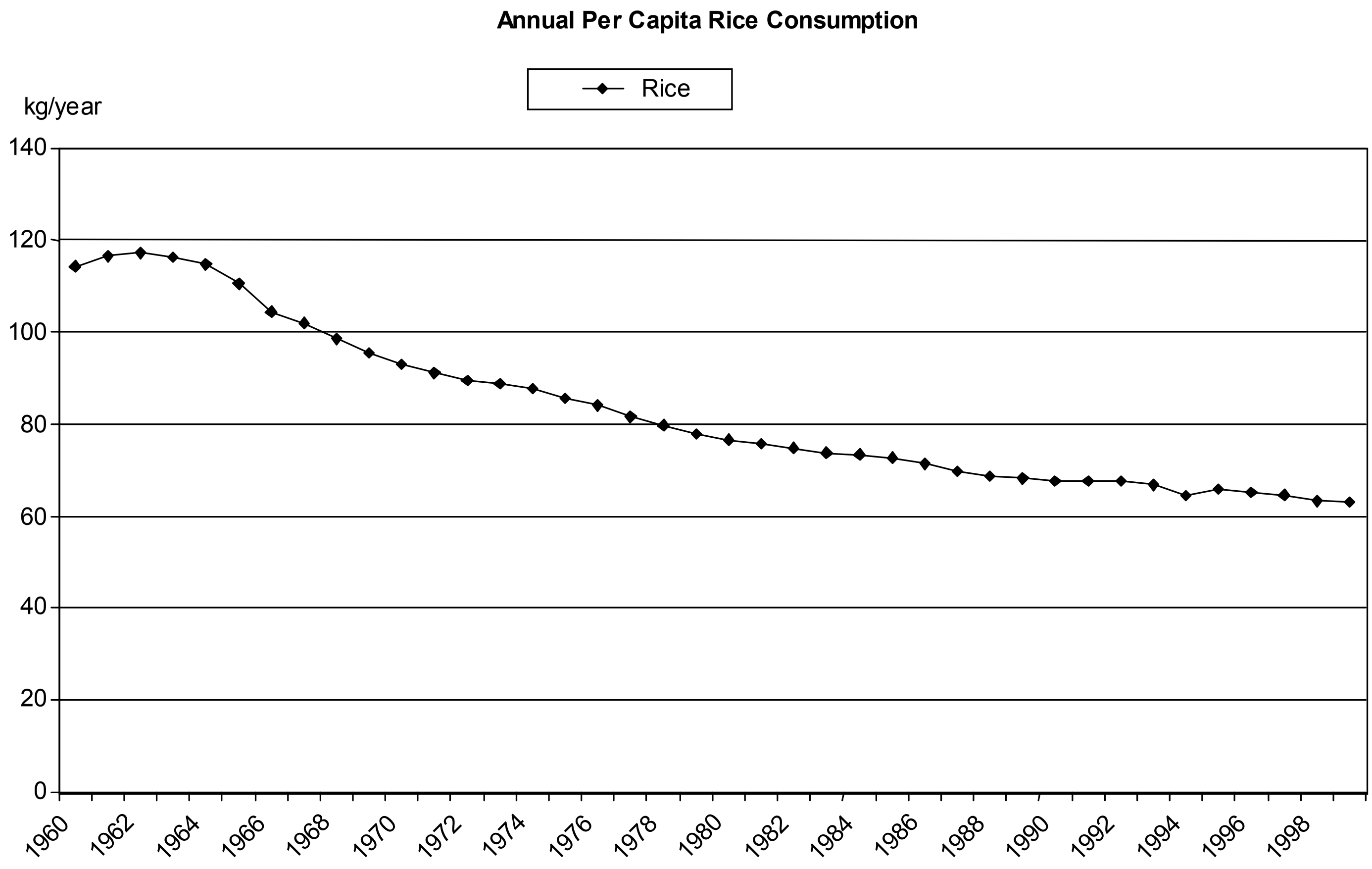
When assessing food balances, the literature on the rice market is mainly concerned with supply side factors (Oniki (1996) and Fujiki (1993, 1998, 1999)). Considering the uncertain environment of the rice market in the future, one cannot neglect the demand side. In order to obtain an accurate forecast of the impact of Japanese rice market liberalization, precisely estimated demand elasticities are necessary.

4.2 Background

Japan reached high per capita income much earlier than other Asian nations. As per capita income grew, the food consumption pattern changed. Many studies have reported that the Japanese diet has become more westernized; calorie intake is less from rice and more from animal meat, and the fat content of food has increased. Because of geographical reasons and preferences, calorie intake from fish has a larger share than from meat in a Japanese diet.

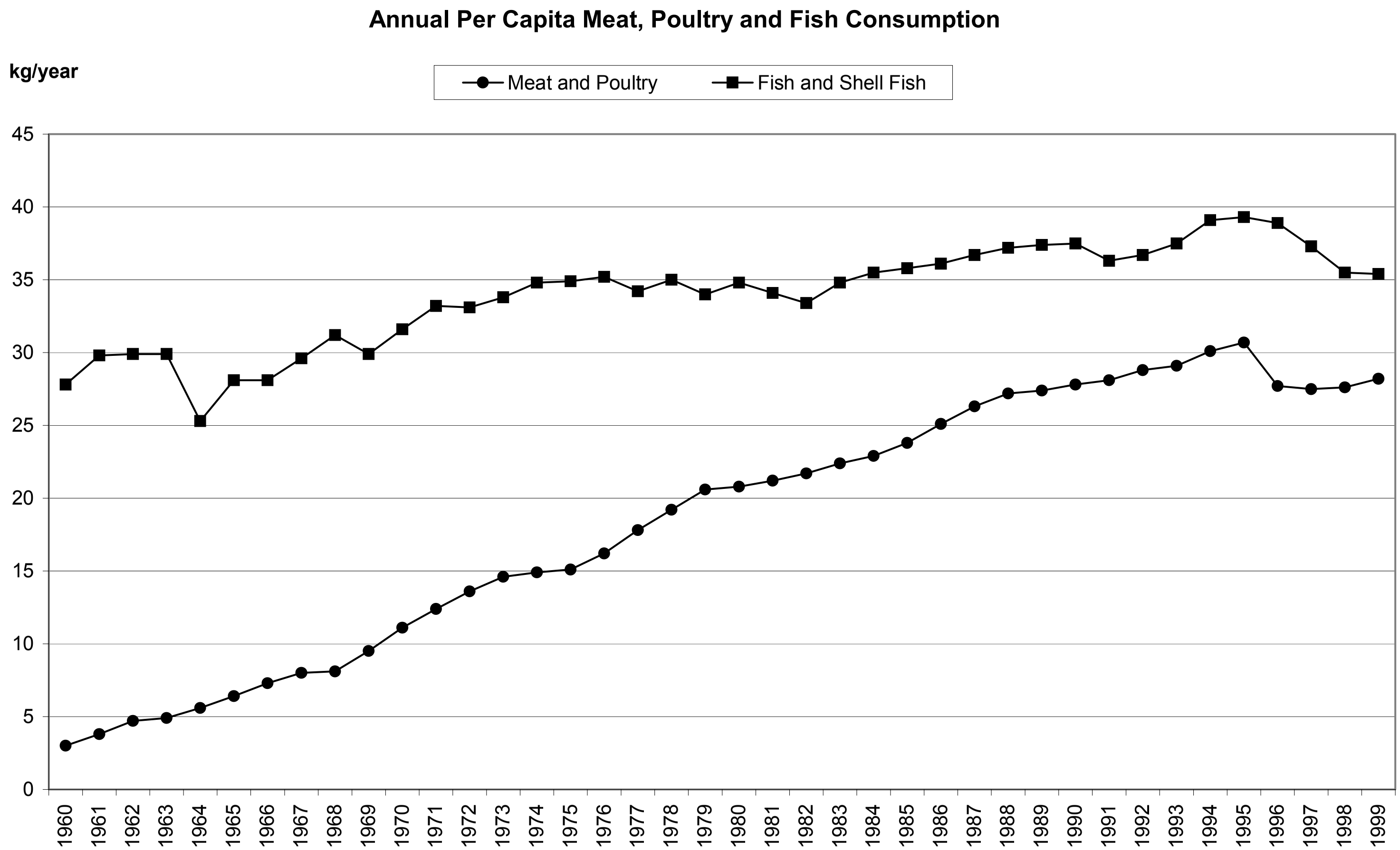
In this section, we have an overview of time trend of rice consumption patterns. **Figures 4.1 to 4.3** show descriptive consumption patterns in Japan. All data are taken from the *Food Balance Sheet* published by Japan's Ministry of Agriculture, Forestry, and Fisheries (1997). This is supply side data; data are summed up on how much food items are delivered to

Figure 4.1: Annual per Capita Consumption of Rice, 1960 - 1999



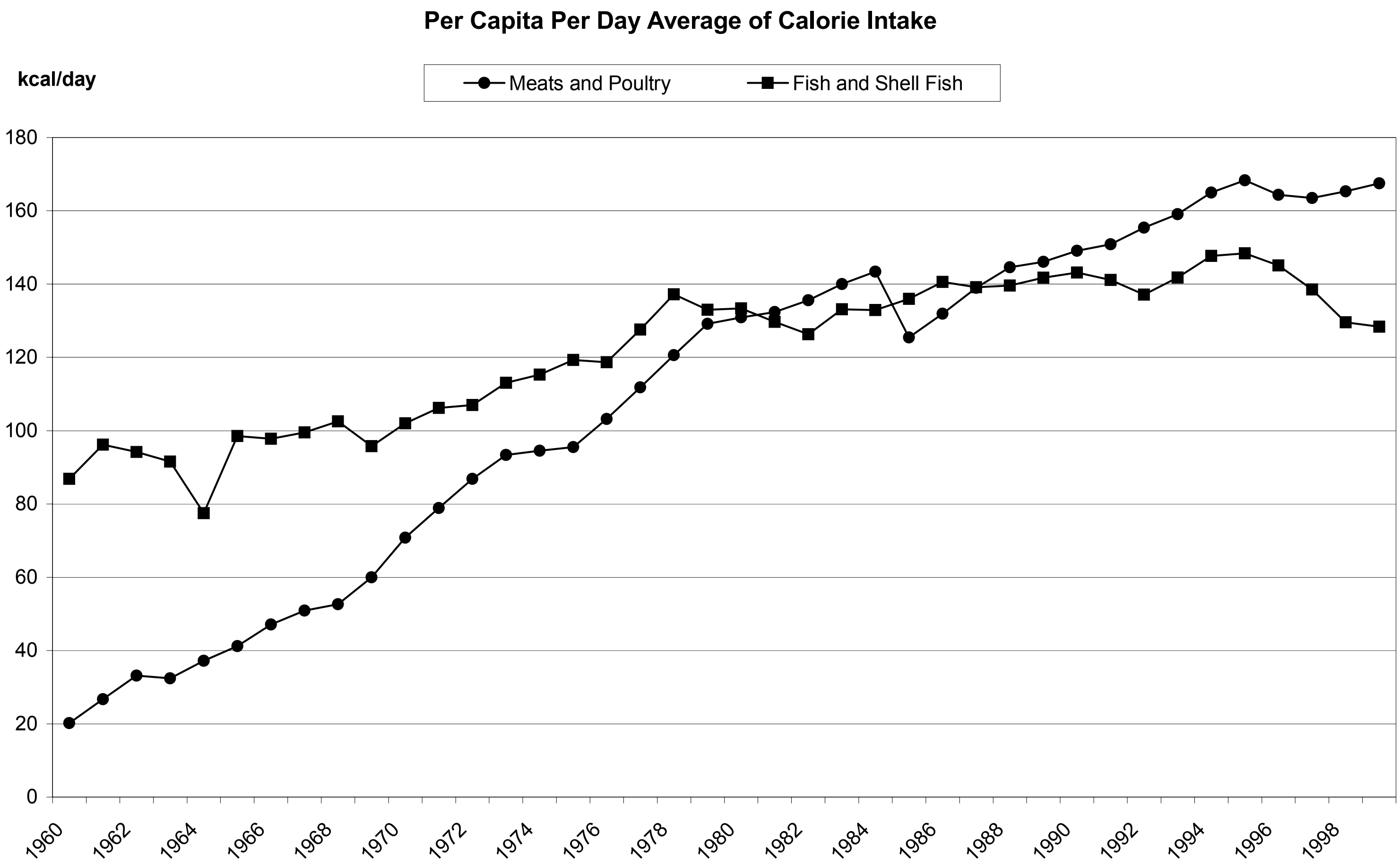
Source: Food Balance Sheet (MAFF, 2001)

Figure 4.2: Annual per Capita Meat, Poultry and Fish Consumption, 1960 - 1999



Source: Food Balance Sheet (MAFF, 2001)

Figure 4.3: Per Capita Per Day Average of Calorie Intake, 1960 - 1999



Source: Food Balance Sheet (MAFF, 2001)

consumers[6]. **Figure 4.1** plots the annual per capita rice consumption in Japan. It is a well-known fact that aggregate rice consumption in Japan has been declining over the years, which is common amongst high-income countries. The peak of the per capita consumption of rice occurred in 1962. It is almost halved by the end of the 1990s. **Figure 4.2** shows annual per capita consumptions of meat (beef and pork), poultry, and fish. In kilogram terms, Japanese consume more fish than meat and poultry. This is one of unique features of the Japanese food consumption pattern. **Figure 4.3** plots the average per capita daily calorie intake from meat, poultry, and fish and shellfish. Since 1980, meat and poultry have become a larger source of calories compared to fish. In sum, Japanese consume more fish in kilogram terms; while in nutrition terms, Japanese intake more calories from meat and poultry.

Two considerations should be noted for these figures. First, they provide little information about price and income elasticities of each commodity. Calorie intake is purely a behavioral variable, and it does not reveal any clear price information. In addition, many authors cite that there are many reasons why calorie elasticity and price and income elasticity are different (Deaton, 1997). Second, the food balance sheet provides macro data; it may not accurately capture individual household consumption patterns. That is, there may be an aggregation problem. For estimating income elasticities, household survey data should provide a better picture of individual household consumption patterns.

In this study, we estimate the income elasticity from cross-sectional survey data to shed some light on some important questions. We investigate two important questions on Japanese rice consumption: whether rice is an inferior good or not in Japan and rice is complement or substitute for meat, fish, and other food items.

4.2.1 Is Rice an Inferior Good in Japan?

Rice is a staple food in Japan, and its great importance in the Japanese diet is well known. In 1995 10,748,000 metric tons of rice were produced domestically, and 10,485,000 metric tons were consumed. Rice is used by a variety of sectors, but mostly by the household. According to the 1995 input-output table (Management and Coordination Agency, 1999), 93.21% of rough rice was purchased by the milling sector, and 74.38% of milled rice was consumed directly by households. (See **Table 4.1**.)

Table 4.1: Industry Output

Unit: Million Yen

Purchased Sector	Output of Rough Rice		Purchased Sector	Output of Milled Rice	
Milling	¥3,232,103	93.21%	Household Consumption	¥2,604,991	74.38%
Rice Wine	¥195,609	5.64%	Restaurants and Hotels	¥553,485	15.80%
Rough Rice	¥28,612	0.83%	School and Hospital Lunch	¥118,625	3.39%
Agricultural Services	¥6,690	0.19%	Rice Powder and Snacks	¥94,771	2.71%
Live Stock	¥3,869	0.11%	Alcohol Beverages	¥67,076	1.92%
Other Food Stuff	¥727	0.02%	Prepared Instant Food	¥63,038	1.80%
			Other (non-food use)	¥499	0.01%
Total	¥3,467,610		Total	¥3,502,485	

Source: 1995 Input-Output Table (Management and Coordination Agency, Government of Japan, 1999)

[6] It is noted that this data is different from household survey data, which is utilized in econometric analysis in this study.

It is important to understand whether rice is a normal or inferior good. Japan has one of the highest per capita GDP in the world. If rice were an inferior good, by definition, rice consumption would keep falling with per capita GDP growth. If that were the case, and if Japan could be considered as the leading case for other Asian countries, we could project lower world rice demand in the future as Asian nations' income increases.

It has been considered as the stylized fact among researchers that income elasticities for rice and other food staples decline as per capita income increases. Researchers believe that rice in developed countries such as Japan became an inferior good a few decades ago.

There is conflicting evidence on whether rice is an inferior good. One of the most influential studies on rice consumption in Asia is an empirical study conducted by Ito, Peterson, and Grant (IPG) (1989). Utilizing aggregate national level data, Ito and colleagues concluded that rice was an inferior good in high-income Asian countries, and they estimated income elasticity of rice in Japan to be -0.091 in 1964 and -0.708 in 1984. Kako, Gemma, and Ito (1997) projected Japanese rice demand applying a log linear function estimated by OLS using the time series data of the period 1970-1991. Authors supported IPG results; they found evidence that rice was an inferior good and meat products were substitutes for rice. Estimated own price elasticity was -0.130, and expenditure elasticity was -0.308. In a recent study, Price and Gislason (2001) investigated the habit formation of Japanese consumption, utilizing time-series survey data from 1963-1991. Authors found that expenditure elasticity of cereal was -0.01 in short run and -0.015 in long run. This result indicates that the cereal, which includes all kinds of rice and noodles, is indeed an inferior good.

Sawada (1980) studied Japanese food demand system using the Rotterdam model. Monthly survey data covered from 1956 to 1975. The food items included cereal, fish, meat, egg, vegetable, fruits, food away from home, other food, and non-food. Expenditure elasticity for rice (-0.395) was negative, and rice was only the item, which showed a negative expenditure elasticity. Own-price elasticities for rice, fish, meat, and food away from home were -0.17, -0.545, -0.799, and -0.353, respectively. Utilizing monthly time-series survey data from 1964 to 1979, Sawada (1983) estimated price and expenditure elasticities with AIDS model in Japan. Results indicated that own-price elasticities for staple food, fish, meat, and food away from home were -0.903, -1.125, -0.981, and -1.522, respectively. Own-price elasticity was particularly high for staple food, and it was similar to meat. In another study, Sawada (1984) used a two-level Food Demand System to estimate own-price and cross-price elasticities for seventeen products in Japan. Data were taken from Family Income and Expenditure Survey, and they were monthly time-series from 1963 to 1981. Rice own-price elasticity was -0.26, and its expenditure elasticity was –0.73. It is noteworthy that only rice expenditure elasticity is negative amongst seventeen products. Results indicated that the magnitude of price elasticity was similar to expenditure elasticity in absolute term, i.e. if a good is price elastic, then it tends to be expenditure elastic as well. It is interesting to see that expenditure elasticity for beef (1.93) was the highest amongst seventeen goods, and expenditure elasticity for food away from home was the second highest (1.82). Sawada (1986) later estimated income elasticities of cereal and related goods using survey data from 1976 to 1984 by means of generalized Houthakker's method. The author concluded that demand was largely influenced by income, the number of household members, and the household head's age. Price elasticities for food were small compared to income elasticities, and this tendency was particularly strong with respect to the number of household members.

Bouis (1991) objected to the study of IPG; the author claimed that time-series estimates of grain consumption have a downward bias due to the urban-rural migration pattern and decreasing importance of rice production. From their estimated calorie-income elasticities, Bouis and Haddad (1992) and Bouis (1994) claimed that cross-sectional data estimates of income elasticity are upwardly biased due to leakage from actual consumption, such as meals for guests and animal feeding in developing countries. As Chern (2000) and Huang and Bouis (1986) pointed out, plotting aggregate consumption against per capita income simply showed the correlation between two variables. It did not necessarily reveal the true consumption behavior. Accurate income elasticity can be obtained from cross-sectional data, and we will estimate income elasticities among various income classes.

4.2.2 Is Rice Complement or Substitute for Meat, Fish, and Other Food Items?

Many time-series studies show that people consume more meat and poultry as per capita income increases. Japan is not an exception: the consumption of meats and poultry has been increasing, while the consumption of rice has been decreasing since the 1960s. At the same time, consumers start to have more variety of diets. Regarding to the history of calorie intake in Japan, Morishima, Aita, and Nakagawa (1993) have a succinct historical view from the early 1920s. Authors compare the budget share of 12 food items in 1970, 1980, and 1989. The budget share of grains decreases (from 16.9% in 1970 to 12.1% in 1989), while the budget share of food away from home (FAFH) increases substantially (from 9.3% in 1970 to 15.6% in 1989). This observation indicates that the consumption patterns are shifting from starchy food to non-starchy food and from consumption at home to FAFH.

Tokoyama and Egaitsu (1994) investigate the trends in Japanese food consumption patterns in the period of 1963-1991. They classify per capita consumption patterns into varieties of ways to see the trends of goods. They conclude that saturation and stability characterize Japanese dietary patterns; the trends of foods demanded have been stabilized for a while. Recently, the preference for the higher quality food is replaced by the diversification and health concern in food consumption. In addition, due to the rise in the opportunity cost of labor for household work, the demand for convenient food rises.

As these studies show, the variety and nature of Japanese dietary patterns have shifted substantially over years, and it is important to understand the relationship of rice amongst other major food items. We estimate demand relationships among rice, meats, poultry, fish, and other products in order to investigate the substitution and complementary patterns.

4.3 A Cross-sectional Analysis

One of main objectives of this study is to analyze food consumption patterns and to conduct econometric analysis of food demand structure in Japan. We use the cross-sectional household data from the *Family Income and Expenditure Survey 1997* (FIES), conducted by the Statistics Bureau, Management and Coordination Agency in Japan. FIES provides household data on a monthly basis. As noted earlier, amongst all households in Japan, farm, one-person, and non-citizen households are excluded. Participants are asked to keep a Household Schedule, Family Account Book, and a Yearly Income Schedule. Participants join in the survey for six months. Every month one sixth of all households are replaced by new households.

The total number of observations used for estimation is 95,223. Food items are non-glutinous rice, bread, noodle, fresh fish and shellfish, fresh meat, milk, eggs, fresh vegetables, fresh fruits, fats and oil, and food away from home (FAFH). This research is unique in the sense that income elasticities of rice and other related foods are estimated with immense degrees of freedom. This kind of cross-sectional study is virtually non-existent in regard to Japanese consumption patterns. To our knowledge, these survey data have never been used for estimating a food demand system. Therefore, the results produced in this study are potentially intriguing to demand analysts and policy makers. In order to incorporate household-level microdata, we apply various single equation models: Working-Leser model estimated by OLS, Heckman's sample selection model, and the Tobit model. All coefficients have correct signs and are statistically significant. For a complete demand system analysis, we apply the linearly approximated almost ideal demand system (LA/AIDS) and almost ideal demand system (AIDS). The concept of a flexible complete demand system yields consumption behavior estimates with many desirable properties: the adding-up, homogeneity, and symmetry conditions can be tested, which preceding demand studies on this topic had rarely imposed. The LA/AIDS poses a unit of measurement problem. In order to obtain more accurate estimation, the LA/AIDS models with two price indexes are compared: the Stone price index and the Laspeyres price index. In order to correct a censored dependent variable problem, we also utilize a censored regression approach as mentioned earlier in Chapter 3.

4.3.1 Empirical Results

In order to investigate the differences in demand structure amongst income groups, we divided the original sample of 95,223 households according to their annual income level (**Table 4.2**).

Table 4.2: Classification of Household by Income Level

Household Class	Annual Income Level	
	In Japanese Yen	In U.S. dollar equivalent
Income Class 1	less than ¥4,020,000	Less than $31,904
Income Class 2	between ¥4,020,000 and ¥5,680,000	between $31,904 and $45,079
Income Class 3	between ¥5,680,000 and ¥7,450,000	between $45,079 and $59,217
Income Class 4	between ¥7,450,000 and ¥9,900,000	between $59,217 and $78,571
Income Class 5	¥9,900,000 and higher	$78,571 and higher

Note: The exchange rate of 1 US$ = 126 Yen (as of July 23, 2001) is used.

Source: FIES, 1997.

When the Working-Leser model is estimated with the price data constructed above, zero consumption households with a zero budget share are assumed to be facing the mean prices for the particular geographic location, month, and income level. In the censored regression, data are corrected by Heckman's two-step procedure. All econometric models and estimation models are described in Chapter 3. In addition to the usual expenditure and price variables, many demographic variables are also considered. Specifically, we include age of household head, household size, number of wage earners, number of children aged five or younger, aged between six and twelve, and aged between thirteen and eighteen.

The estimates of expenditure and income elasticities from whole-sample working-Leser model (OLS) are shown in **Table 4.3**. First of all the results indicate that rice is not an inferior good from this estimation. Expenditure elasticity of rice actually exceeds one. Other commodities are relatively expenditure inelastic except for food away from home, which has the highest expenditure elasticity. It is noteworthy that own-price elasticity for rice is very elastic. This indicates that Japanese consumers are sensitive to price changes in rice. If this estimate represents the Japanese consumer's behavior correctly, then rice imports, which should lead to a reduction in price, might benefit not only consumers but also rice farmers. The high expenditure and own-price elasticities for rice seem to be problematic. Their credibility needs further validation.

Table 4.4 shows the expenditure elasticities by income bracket. Most estimates are relatively invariant with income level. Fresh fish and meat show that lower income consumers' demands tend to be expenditure more elastic, while higher income consumers are less elastic. **Table 4.5** shows the own-price elasticities by income bracket. There are no significant variations of elasticity estimates by income level. The own-price and expenditure elasticities for rice remain to be very high in these income sub models.

The parameters of the LA/AIDS and AIDS model with demographic and seasonal dummy variables are estimated by dropping one equation, which is food away from home. The homogeneity and symmetry conditions are imposed in the estimation. We apply the iterative seemingly unrelated regression procedure (ITSUR) in SAS for estimation. ITSUR runs less than 15 iterations to meet the convergence criteria of 0.0001 for all models. In ITSUR model, FAFH equation is dropped.

Tables 4.6 and 4.7 show the elasticity estimates from the AIDS model with the inverse Mills ratios of rice, fats and oil, and food away from home for which there were substantial numbers of households with zero consumption as discussed earlier. **Table 4.6** shows the results of uncompensated price elasticities and expenditure elasticity. Expenditure elasticity of rice indicates that rice is a normal good, and it exceeds one. Rice is a mild complement with all commodities but FAFH. The results clearly indicate the substitutability between rice and food way from home. In fact, most of estimated cross price elasticities are numerically small except these associated with the price of FAFH. The results suggest a strong substitutability between FAFH and at-home consumption of bread, noodle, fresh meat, eggs, and fats and oil. In **Table 4.7**, compensated price elasticity shows the mixed results. Rice is a substitute for fresh fish, while it is a complement for fresh meat consumed at home. In addition, a moderate substitution (with a cross-price elasticity larger than 0.1) appears to occur between fresh fish and fresh meat, fresh fish and vegetables, fresh fruit and fresh meat, and between fats and oil and vegetables. A moderate complementarity is estimated between rice and fats and oil.

In order to validate the robustness of estimation results, we compare the estimation results from OLS, Heckman's two-step, Tobit, LA/AIDS, and AIDS models. **Table 4.8** compares the own-price elasticity estimates from all models. It is surprising that uncompensated own-price elasticity for rice exceeds 1.7 in absolute term in LA/AIDS and AIDS models. Additionally, high own price elasticity of rice is robust across all models. The lowest

Table 4.3: Whole Sample Elasticities for Major 11 Food Products (OLS)

Food Items	Mean Budget Share	Own Price Elasticity	Expenditure Elasticity
Non-glutinous Rice	8.05%	-1.824	1.076
		(0.029)	(0.009)
Bread	5.56%	-0.706	0.474
		(0.003)	(0.005)
Noodle	3.83%	-0.607	0.493
		(0.008)	(0.007)
Fresh Fish	13.14%	-0.703	0.843
		(0.005)	(0.005)
Fresh Meat	12.43%	-0.518	0.713
		(0.006)	(0.004)
Milk	4.71%	-0.106	0.569
		(0.012)	(0.007)
Eggs	1.89%	-0.433	0.411
		(0.006)	(0.005)
Fresh Vegetables	14.30%	-0.770	0.682
		(0.005)	(0.003)
Fresh Fruits	7.94%	-0.660	0.960
		(0.006)	(0.006)
Fats and Oil	0.86%	-0.925	0.778
		(0.014)	(0.016)
Food Away from Home	27.29%	-2.523	1.655
		(0.171)	(0.005)

Notes: The numbers in parentheses below the elasticity estimates are standard errors. All estimates are statistically significant at 5% level.

Table 4.4: Expenditure Elasticities by Income Bracket (OLS)

Food Items	Income Level (thousand yen)									
	Income 1 < 402		Income 2 402 - 568		Income 3 568 - 745		Income 4 745 - 999		Income 5 999 <	
	Mean Budget Share	Elasticity Estimate	Mean Budget Share	Elasticity Estimate	Mean Budget Share	Elasticity Estimate	Mean Budget Share	Elasticity Estimate	Mean Budget Share	Elasticity Estimate
Non-glutinous Rice	10.21%	1.109 (0.017)	8.06%	1.185 (0.020)	7.45%	1.168 (0.021)	7.47%	1.178 (0.022)	6.84%	1.157 (0.021)
Bread	5.66%	0.502 (0.012)	5.85%	0.468 (0.013)	5.75%	0.450 (0.012)	5.61%	0.451 (0.013)	4.92%	0.445 (0.012)
Noodle	4.16%	0.525 (0.015)	4.11%	0.536 (0.015)	4.00%	0.535 (0.016)	3.71%	0.493 (0.016)	3.14%	0.485 (0.017)
Fresh Fish	14.33%	0.948 (0.010)	12.75%	0.878 (0.011)	12.42%	0.846 (0.012)	12.78%	0.806 (0.012)	13.31%	0.714 (0.011)
Fresh Meat	11.88%	0.797 (0.010)	12.39%	0.708 (0.009)	12.61%	0.673 (0.010)	12.72%	0.682 (0.010)	12.58%	0.666 (0.009)
Milk	5.00%	0.610 (0.015)	4.98%	0.536 (0.015)	4.75%	0.492 (0.016)	4.53%	0.540 (0.016)	4.23%	0.495 (0.015)
Eggs	2.05%	0.406 (0.012)	1.96%	0.427 (0.012)	1.91%	0.413 (0.013)	1.83%	0.404 (0.012)	1.68%	0.393 (0.013)
Fresh Vegetables	15.92%	0.719 (0.007)	14.47%	0.685 (0.008)	13.72%	0.674 (0.008)	13.58%	0.657 (0.008)	13.65%	0.618 (0.008)
Fresh Fruits	9.08%	0.982 (0.013)	7.70%	0.919 (0.015)	7.40%	0.923 (0.016)	7.39%	0.931 (0.016)	8.02%	0.947 (0.016)
Fats and Oil	0.99%	0.839 (0.035)	0.91%	0.824 (0.037)	0.84%	0.802 (0.036)	0.83%	0.775 (0.039)	0.74%	0.770 (0.040)
Food Away from Home	20.73%	1.698 (0.013)	26.82%	1.645 (0.011)	29.14%	1.630 (0.011)	29.54%	1.625 (0.011)	30.89%	1.644 (0.010)

Notes: The numbers in parentheses below the elasticity estimates are standard errors. All estimates are statistically significant at 5% level.

Table 4.5: Own-price Elasticities by Income Bracket (OLS)

Food Items	Income Level (thousand yen)									
	Income 1 < 402		Income 2 402 - 568		Income 3 568 - 745		Income 4 745 - 999		Income 5 999 <	
	Mean Budget Share	Elasticity Estimate	Mean Budget Share	Elasticity Estimate	Mean Budget Share	Elasticity Estimate	Mean Budget Share	Elasticity Estimate	Mean Budget Share	Elasticity Estimate
Non-glutinous Rice	10.21%	-1.551 (0.058)	8.06%	-1.906 (0.067)	7.45%	-1.865 (0.069)	7.47%	-1.751 (0.066)	6.84%	-1.886 (0.065)
Bread	5.66%	-0.710 (0.008)	5.85%	-0.683 (0.007)	5.75%	-0.706 (0.007)	5.61%	-0.717 (0.007)	4.92%	-0.721 (0.007)
Noodle	4.16%	-0.647 (0.017)	4.11%	-0.616 (0.016)	4.00%	-0.614 (0.017)	3.71%	-0.557 (0.017)	3.14%	-0.587 (0.018)
Fresh Fish	14.33%	-0.712 (0.010)	12.75%	-0.704 (0.011)	12.42%	-0.675 (0.011)	12.78%	-0.72 (0.011)	13.31%	-0.705 (0.011)
Fresh Meat	11.88%	-0.571 (0.013)	12.39%	-0.551 (0.012)	12.61%	-0.498 (0.013)	12.72%	-0.503 (0.012)	12.58%	-0.454 (0.012)
Milk	5.00%	-0.025 (0.027)	4.98%	-0.152 (0.026)	4.75%	-0.094 (0.027)	4.53%	-0.182 (0.026)	4.23%	-0.073 (0.025)
Eggs	2.05%	-0.433 (0.013)	1.96%	-0.441 (0.012)	1.91%	-0.455 (0.012)	1.83%	-0.436 (0.012)	1.68%	-0.409 (0.013)
Fresh Vegetables	15.92%	-0.790 (0.010)	14.47%	-0.782 (0.011)	13.72%	-0.787 (0.012)	13.58%	-0.733 (0.012)	13.65%	-0.754 (0.012)
Fresh Fruits	9.08%	-0.662 (0.013)	7.70%	-0.678 (0.014)	7.40%	-0.675 (0.014)	7.39%	-0.655 (0.014)	8.02%	-0.628 (0.015)
Fats and Oil	0.99%	-0.891 (0.031)	0.91%	-0.972 (0.030)	0.84%	-0.946 (0.028)	0.83%	-0.863 (0.030)	0.74%	-0.928 (0.032)
Food Away from Home	20.73%	-3.511 (0.486)	26.82%	-2.525 (0.393)	29.14%	-1.721 (0.360)	29.54%	-1.933 (0.354)	30.89%	-2.973 (0.344)

Notes: The numbers in parentheses below the elasticity estimates are standard errors. All estimates are statistically significant at 5% level.

Table 4.6: Uncompensated Price and Expenditure Elasticities: AIDS Model with Inverse Mills Ratio

Food Items	Mean Budget Share	Uncompensated Price Elasticity											Expenditure Elasticity
		Rice	Bread	Noodle	Fish	Meat	Milk	Eggs	Vegt.	Fruits	Oil	FAFH	
Non-glutinous Rice	8.05%	-1.736	-0.050	-0.046	-0.089	-0.172	-0.006	-0.007	-0.137	-0.048	-0.030	1.256	1.065
Bread	5.56%	-0.106	-0.708	0.003	-0.052	-0.018	-0.080	-0.016	-0.077	-0.077	-0.012	0.639	0.503
Noodle	3.83%	-0.131	0.007	-0.618	-0.085	-0.078	-0.066	-0.019	-0.096	-0.073	-0.012	0.657	0.513
Fresh Fish	13.14%	-0.075	0.034	0.012	-0.705	0.049	0.002	0.011	-0.007	-0.060	-0.005	-0.111	0.855
Fresh Meat	12.43%	-0.125	-0.034	-0.043	-0.038	-0.519	-0.082	-0.025	-0.089	-0.029	-0.016	0.272	0.728
Milk	4.71%	-0.046	-0.060	-0.032	-0.085	-0.124	-0.111	-0.009	-0.059	-0.110	0.006	0.060	0.569
Eggs	1.89%	-0.072	-0.035	-0.032	-0.070	-0.080	-0.047	-0.438	-0.011	-0.064	-0.011	0.435	0.424
Fresh Vegetables	14.30%	-0.101	-0.014	-0.016	-0.076	-0.021	-0.025	0.002	-0.765	-0.069	0.009	0.383	0.694
Fresh Fruits	7.94%	-0.063	-0.001	0.000	-0.076	0.025	-0.030	0.005	-0.046	-0.677	0.000	-0.087	0.948
Fats and Oil	0.86%	-0.293	-0.094	-0.062	-0.139	-0.233	0.012	-0.032	0.103	-0.030	-0.914	0.874	0.809
Food Away from Home	27.29%	0.443	-0.023	-0.009	0.010	-0.139	-0.065	-0.025	0.011	0.049	0.015	-1.907	1.640

Table 4.7: Compensated Price Elasticities: AIDS Model with Inverse Mills Ratio

	Mean Budget	Hicksian Compensated Price Elasticity										
Food Items	Share	Rice	Bread	Noodle	Fish	Meat	Milk	Eggs	Vegt.	Fruits	Oil	FAFH
Non-glutinous Rice	8.05%	-1.650	0.009	-0.005	0.050	-0.039	0.044	0.013	0.015	0.036	-0.021	1.547
Bread	5.56%	-0.066	-0.680	0.023	0.015	0.044	-0.056	-0.007	-0.005	-0.037	-0.008	0.777
Noodle	3.83%	-0.090	0.035	-0.598	-0.018	-0.014	-0.042	-0.009	-0.022	-0.032	-0.007	0.797
Fresh Fish	13.14%	-0.006	0.081	0.045	-0.593	0.155	0.042	0.027	0.116	0.008	0.002	0.122
Fresh Meat	12.43%	-0.066	0.006	-0.015	0.058	-0.429	-0.048	-0.011	0.015	0.028	-0.010	0.471
Milk	4.71%	0.000	-0.028	-0.010	-0.010	-0.053	-0.084	0.002	0.023	-0.065	0.011	0.216
Eggs	1.89%	-0.038	-0.011	-0.016	-0.014	-0.027	-0.027	-0.430	0.050	-0.030	-0.008	0.551
Fresh Vegetables	14.30%	-0.045	0.024	0.011	0.015	0.065	0.007	0.015	-0.666	-0.014	0.015	0.572
Fresh Fruits	7.94%	0.014	0.052	0.037	0.048	0.143	0.015	0.023	0.090	-0.602	0.008	0.172
Fats and Oil	0.86%	-0.228	-0.049	-0.031	-0.033	-0.133	0.050	-0.017	0.218	0.034	-0.907	1.095
Food Away from Home	27.29%	0.575	0.068	0.054	0.226	0.065	0.012	0.006	0.245	0.179	0.030	-1.460

Table 4.8: Own-price Elasticities Comparison

Food Items	Mean Budget Share	% of zero Cons	Working Leser (OLS)	Heckit		Tobit	
				Un-conditional	Conditional	Un-conditional	Conditional
Non-glutinous Rice	8.05%	43.75%	-1.824 (0.029)	-1.845	-1.234	-1.705	-1.286
Bread	5.56%	4.15%	-0.706 (0.003)	-0.721	-0.791	-0.751	-0.825
Noodle	3.83%	6.14%	-0.607 (0.008)	-0.664	-0.774	-0.702	-0.816
Fresh Fish	13.14%	2.45%	-0.703 (0.005)	-0.694	-0.764	-0.734	-0.797
Fresh Meat	12.43%	1.92%	-0.518 (0.006)	-0.546	-0.628	-0.542	-0.623
Milk	4.71%	8.36%	-0.106 (0.012)	-0.389	-0.683	-0.296	-0.565
Eggs	1.89%	5.51%	-0.433 (0.006)	-0.632	-0.812	-0.509	-0.657
Fresh Vegetables	14.30%	0.24%	-0.770 (0.005)	-0.781	-0.811	-0.776	-0.799
Fresh Fruits	7.94%	5.50%	-0.660 (0.006)	-0.685	-0.783	-0.739	-0.834
Fats and Oil	0.86%	42.12%	-0.925 (0.014)	-0.782	-0.867	-1.157	-1.055
Food Away from Home	27.29%	12.65%	-2.523 (0.171)	-2.766	-2.090	-2.585	-2.130

Notes: The numbers in parentheses below the elasticity estimates are standard errors. All estimates are statistically significant at 5% level.

Table 4.8 (continued)

Food Items	Mean Budget Share	% of zero Cons	LA/AIDS								AIDS	
			Stone Price Index				Laspeyres Price Index					
			without IMRs		with IMRs		without IMRs		with IMRs		with IMRs	
			Uncom-pensated	Com-pensated	Uncom-pensated	Com-pensated	Uncom-pensated	Com-pensated	Uncom-pensated	Com-pensated	Uncom-pensated	Com-pensated
Non-glutinous Rice	8.05%	43.75%	-1.801 (0.028)	-1.682 (0.028)	-1.781 (0.020)	-1.681 (0.020)	-1.792 (0.028)	-1.705 (0.028)	-1.769 (0.020)	-1.683 (0.020)	-1.736	-1.650
Bread	5.56%	4.15%	-0.721 (0.003)	-0.695 (0.003)	-0.721 (0.003)	-0.696 (0.003)	-0.706 (0.003)	-0.680 (0.003)	-0.706 (0.003)	-0.680 (0.003)	-0.708	-0.680
Noodle	3.83%	6.14%	-0.620 (0.008)	-0.597 (0.008)	-0.618 (0.008)	-0.596 (0.008)	-0.615 (0.008)	-0.596 (0.008)	-0.614 (0.008)	-0.595 (0.008)	-0.618	-0.598
Fresh Fish	13.14%	2.45%	-0.670 (0.005)	-0.583 (0.005)	-0.674 (0.005)	-0.587 (0.005)	-0.670 (0.005)	-0.559 (0.005)	-0.673 (0.005)	-0.562 (0.005)	-0.705	-0.593
Fresh Meat	12.43%	1.92%	-0.538 (0.005)	-0.460 (0.005)	-0.534 (0.005)	-0.457 (0.005)	-0.543 (0.005)	-0.454 (0.005)	-0.539 (0.005)	-0.450 (0.005)	-0.519	-0.429
Milk	4.71%	8.36%	-0.129 (0.012)	-0.087 (0.012)	-0.129 (0.012)	-0.087 (0.012)	-0.101 (0.012)	-0.075 (0.012)	-0.101 (0.012)	-0.074 (0.012)	-0.111	-0.084
Eggs	1.89%	5.51%	-0.448 (0.005)	-0.438 (0.005)	-0.448 (0.005)	-0.437 (0.005)	-0.445 (0.005)	-0.437 (0.005)	-0.444 (0.005)	-0.436 (0.005)	-0.438	-0.430
Fresh Vegetables	14.30%	0.24%	-0.789 (0.005)	-0.668 (0.005)	-0.786 (0.005)	-0.666 (0.005)	-0.770 (0.005)	-0.672 (0.005)	-0.769 (0.005)	-0.671 (0.005)	-0.765	-0.666
Fresh Fruits	7.94%	5.50%	-0.657 (0.006)	-0.565 (0.006)	-0.657 (0.006)	-0.564 (0.006)	-0.648 (0.006)	-0.572 (0.006)	-0.648 (0.006)	-0.572 (0.006)	-0.677	-0.602
Fats and Oil	0.86%	42.12%	-0.901 (0.013)	-0.894 (0.013)	-0.912 (0.012)	-0.905 (0.012)	-0.902 (0.013)	-0.895 (0.013)	-0.912 (0.012)	-0.905 (0.012)	-0.914	-0.907
Food Away from Hon	27.29%	12.65%	-1.909	-1.515	-1.951	-1.535	-1.895	-1.443	-1.900	-1.448	-1.907	-1.460

Notes: The numbers in parentheses below the elasticity estimates are standard errors. All estimates are statistically significant at 5% level.

Table 4.9: Expenditure Elasticities Comparison

Food Items	Mean Budget Share	% of zero Cons	Working Leser (OLS)	Heckit		Tobit		LA/AIDS				AIDS
								Stone		Laspeyres		
				Un-cond.	Cond.	Un-cond.	Cond.	without IMRs	with IMRs	without IMRs	with IMRs	with IMRs
Non-glutinous Rice	8.05%	43.75%	1.076 (0.009)	1.436	1.121	1.318	1.129	1.472 (0.008)	1.249 (0.006)	1.080 (0.009)	1.078 (0.006)	1.065
Bread	5.56%	4.15%	0.474 (0.005)	0.486	0.614	0.545	0.679	0.460 (0.005)	0.452 (0.005)	0.475 (0.005)	0.475 (0.005)	0.503
Noodle	3.83%	6.14%	0.493 (0.007)	0.536	0.688	0.608	0.758	0.583 (0.007)	0.573 (0.007)	0.495 (0.007)	0.495 (0.007)	0.513
Fresh Fish	13.14%	2.45%	0.843 (0.005)	0.766	0.820	0.867	0.899	0.660 (0.004)	0.658 (0.004)	0.843 (0.005)	0.843 (0.005)	0.855
Fresh Meat	12.43%	1.92%	0.713 (0.004)	0.656	0.718	0.733	0.780	0.629 (0.004)	0.623 (0.004)	0.717 (0.004)	0.717 (0.004)	0.728
Milk	4.71%	8.36%	0.569 (0.007)	0.724	0.856	0.678	0.801	0.883 (0.007)	0.888 (0.007)	0.567 (0.007)	0.567 (0.007)	0.569
Eggs	1.89%	5.51%	0.411 (0.005)	0.642	0.816	0.496	0.648	0.570 (0.005)	0.556 (0.005)	0.416 (0.005)	0.416 (0.005)	0.424
Fresh Vegetables	14.30%	0.24%	0.682 (0.003)	0.678	0.722	0.690	0.722	0.851 (0.003)	0.836 (0.003)	0.689 (0.003)	0.688 (0.003)	0.694
Fresh Fruits	7.94%	5.50%	0.960 (0.006)	0.864	0.906	0.999	0.999	1.163 (0.006)	1.175 (0.006)	0.960 (0.006)	0.960 (0.006)	0.948
Fats and Oil	0.86%	42.12%	0.778 (0.016)	0.652	0.788	1.077	1.027	0.904 (0.016)	0.862 (0.015)	0.799 (0.016)	0.795 (0.015)	0.809
Food Away from Hom	27.29%	12.65%	1.655 (0.005)	1.830	1.513	1.716	1.511	1.446	1.524	1.655	1.656	1.640

Notes: The numbers in parentheses below the elasticity estimates are standard errors. All estimates are statistically significant at 5% level.

Table 4.10: Income Elasticities Comparison

Food Items	Working Leser (OLS)	Heckit		Tobit		LA/AIDS				AIDS
		Un-cond.	Cond.	Un-cond.	Cond.	Stone		Laspeyres		
						without IMRs	with IMRs	without IMRs	with IMRs	with IMRs
Non-glutinous Rice	0.311	0.416	0.324	0.382	0.327	0.426	0.362	0.312	0.312	0.308
Bread	0.137	0.141	0.178	0.158	0.197	0.133	0.131	0.137	0.137	0.146
Noodle	0.143	0.155	0.199	0.176	0.219	0.169	0.166	0.143	0.143	0.148
Fresh Fish	0.244	0.222	0.237	0.251	0.260	0.191	0.190	0.244	0.244	0.248
Fresh Meat	0.206	0.190	0.208	0.212	0.226	0.182	0.180	0.207	0.207	0.211
Milk	0.165	0.209	0.248	0.196	0.232	0.256	0.257	0.164	0.164	0.165
Eggs	0.119	0.186	0.236	0.144	0.188	0.165	0.161	0.120	0.120	0.123
Fresh Vegetables	0.197	0.196	0.209	0.200	0.209	0.246	0.242	0.199	0.199	0.201
Fresh Fruits	0.278	0.250	0.262	0.289	0.289	0.337	0.340	0.278	0.278	0.274
Fats and Oil	0.225	0.189	0.228	0.312	0.297	0.262	0.249	0.231	0.230	0.234
Food Away from Home	0.479	0.530	0.438	0.497	0.437	0.418	0.441	0.479	0.479	0.475

Table 4.11: Coefficients for Demographic Variables from AIDS Model

Food Items	log of age of household head	log of household size	# of wage earners	# of children		
				aged 5 or under	aged between 6 and 12	aged between 13 and 18
Non-glutinous Rice	0.046	0.017	-0.004	-0.007	-0.009	-0.003
	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)
Bread	-0.003	0.016	-0.001	0.006	0.003	0.006
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Noodle	-0.003	0.015	0.000	0.000	0.002	0.004
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Fresh Fish	0.082	0.041	-0.002	-0.018	-0.022	-0.016
	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)
Fresh Meat	-0.028	0.070	0.003	-0.014	-0.010	0.006
	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)
Milk	0.015	0.017	-0.003	0.008	0.002	0.005
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Eggs	0.001	0.009	0.000	-0.001	0.000	0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Fresh Vegetables	0.039	0.038	-0.006	-0.014	-0.018	-0.012
	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)
Fresh Fruits	0.065	-0.010	-0.006	-0.001	-0.005	-0.006
	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)
Fats and Oil	0.001	0.003	0.000	0.000	-0.001	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Food Away from Home						

Notes: The numbers in parentheses below the elasticity estimates are standard errors. All estimates are statistically significant at 5% level.

Table 4.12: Coefficients for Regional Dummy Variables

Food Items	Hokkaido	Tohoku	Kanto	Hokuriku	Toukai	Kinki	Tyugoku	Shikoku	Kyushu
Non-glutinous Rice	**-0.012** **(0.002)**	**-0.043** **(0.001)**	**-0.032** **(0.001)**	**-0.028** **(0.001)**	**-0.024** **(0.001)**	**-0.027** **(0.001)**	**-0.044** **(0.001)**	**-0.038** **(0.002)**	**-0.029** **(0.001)**
Bread	**-0.003** **(0.001)**	**-0.003** **(0.001)**	**0.008** **(0.001)**	**0.009** **(0.001)**	**0.006** **(0.001)**	**0.019** **(0.001)**	**0.015** **(0.001)**	**0.013** **(0.001)**	**0.003** **(0.001)**
Noodle	**0.005** **(0.001)**	**0.008** **(0.001)**	**0.007** **(0.001)**	**0.008** **(0.001)**	**0.005** **(0.001)**	**0.008** **(0.001)**	**0.007** **(0.001)**	**0.012** **(0.001)**	**0.002** **(0.001)**
Fresh Fish	**0.036** **(0.002)**	**0.035** **(0.002)**	**0.004** **(0.002)**	**0.032** **(0.002)**	**0.010** **(0.002)**	**0.014** **(0.002)**	**0.039** **(0.002)**	**0.025** **(0.002)**	**0.024** **(0.002)**
Fresh Meat	**-0.023** **(0.002)**	**-0.027** **(0.001)**	**-0.023** **(0.001)**	**-0.028** **(0.002)**	**-0.016** **(0.001)**	**0.010** **(0.001)**	**-0.001** **(0.001)**	**0.001** **(0.002)**	**0.008** **(0.001)**
Milk	**0.002** **(0.001)**	**0.002** **(0.001)**	**0.004** **(0.001)**	**0.004** **(0.001)**	**0.003** **(0.001)**	**0.006** **(0.001)**	**0.005** **(0.001)**	**0.003** **(0.001)**	**-0.001** **(0.001)**
Eggs	**-0.002** **(0.000)**	**-0.001** **(0.000)**	**-0.002** **(0.000)**	**-0.001** **(0.000)**	**-0.001** **(0.000)**	**0.001** **(0.000)**	**0.000** **(0.000)**	**0.001** **(0.000)**	**-0.001** **(0.000)**
Fresh Vegetables	**0.005** **(0.002)**	**0.011** **(0.001)**	**0.012** **(0.001)**	**0.009** **(0.001)**	**-0.005** **(0.001)**	**0.003** **(0.001)**	**-0.012** **(0.001)**	**-0.008** **(0.002)**	**-0.007** **(0.001)**
Fresh Fruits	**0.015** **(0.002)**	**0.017** **(0.001)**	**0.007** **(0.001)**	**0.009** **(0.002)**	**0.003** **(0.001)**	**-0.006** **(0.001)**	**0.005** **(0.002)**	**0.009** **(0.002)**	**0.002** **(0.001)**
Fats and Oil	**-0.007** **(0.000)**	**-0.006** **(0.000)**	**-0.005** **(0.000)**	**-0.007** **(0.000)**	**-0.007** **(0.000)**	**-0.006** **(0.000)**	**-0.005** **(0.000)**	**-0.006** **(0.000)**	**-0.006** **(0.000)**
Food Away from Home									

Notes: The numbers in parentheses below the elasticity estimates are standard errors. All estimates are statistically significant at 5% level. Okinawa is an omitted variable.

estimate of own-price elasticity for rice is -1.2 in the conditional estimates of Heckman's two-step and Tobit estimators.

Fresh fish has a higher own-price elasticity than fresh meat in all models. There are some possible reasons behind this finding. First of all, the importance of fish in the Japanese diet reflects this result. The fish eating culture in Japan has induced a wide range of variations in fish prices and its consumption levels. Second, fish has many varieties for its kind and for its use. These varieties offer many substitution opportunities, which tend to result in a higher own-price elasticity.

The low elasticities for milk and egg are expected; there are not much variations of price for those products. Dairy products are getting popular, but there are not many varieties of price and characteristics of those products.

Table 4.9 presents a comparison of expenditure elasticity estimates among all models. Results are robust across the models. The largest expenditure elasticity for rice is 1.472 of LA/AIDS model with the Stone price index, while the smallest is the estimate of the AIDS model, which is 1.065. This result is somewhat surprising; if rice is a staple food, an expenditure elasticity of 1.0 to 1.4 is fairly high. In every model estimated, rice and FAFH are only two food items with an expenditure elasticity exceeding unity. The result with respect to rice is contrary to one's expectation. Combining this finding with the results from **Table 4.8**, there is a possibility that rice is not a staple food any longer.

It is interesting to note that fresh fish has a higher expenditure elasticity than fresh meat, and this pattern is robust across the estimated models. Again, this result shows the importance of fish in the Japanese diet. Recently, meat consumption has been increasing, while the high price and expenditure elasticity shows that consumers are sensitive for fish price and their income when they determine their consumption patterns. Another possibility is that processed meats like ham, sausage, and bacon, are not included in the category of fresh meat. The inclusion of processed meats might change the result.

The expenditure elasticity is relatively high for fresh fruits. This might be a reflection of the fact that the fruits are relatively costly amongst the goods in question. In the marketplace, there always exist more expensive fruits than the one a consumer purchased. Additionally, it might be true that some fruits are purchased as gifts. In this sense, a high expenditure elasticity might not reflect the true behavior for at-home consumption.

Table 4.10 shows the income elasticities for all models. All expenditure elasticity estimates are linearly transformed to the income elasticity using Equation (3.6) in Chapter 3. In all estimations, the results show that Japanese rice is a normal good, and its income elasticity is in the range of 0.30 to 0.42. The results also show that only food away from home has a higher income elasticity than rice as the estimates range from 0.418 to 0.530. This result is robust across models. The estimated income elasticities indicate that all food items are not luxury goods in Japan. But then why is the income elasticity for rice greater than that for fish, meat, fruits or vegetables? The question arises because of our expectation of rice being a staple food. However, the robustness of our econometric results rather than the intuition should be used for reaching the conclusion on rice demand pattern in Japan.

Table 4.11 reports the coefficients for demographic variables from the AIDS model. For rice, if a household head is old or household has more family members, the household tends to have a higher rice budget share. On the other hand, if a household has more wage earners or children, the household tends to have a lower rice budget share. If a household head age is young, then this household tends to have a higher budget share for bread, noodle, and meat than older households. If a household has children of any age, it tends to consume more bread, noodle, and milk, but less of fish, vegetables, and fruits than those without any children. **Table 4.12** shows the coefficients for regional dummy variables. Okinawa dummy is omitted from the model. It is noted that all regional dummy variables for rice have a negative coefficient, implying that the budget shares for rice are smaller in all regions as compared with that in Okinawa. Tyugoku and Tohoku regions have the smallest budget shares for rice.

4.4 Concluding Remarks for Rice Cross-sectional Analysis

In this study, we estimate the Japanese demand for major 11 products: non-glutinous rice, bread, noodle, fresh fish and shellfish, fresh meat, milk, eggs, fresh vegetables, fresh fruits, fats and oil, and food away from home (FAFH). Own-price, cross-price, and expenditure elasticities of major 11 products are estimated, and some selected demographic variables are analyzed. In conclusion, contrary to previous studies on rice consumption patterns, our empirical results show that own-price and expenditure elasticities for rice are high in absolute term. In addition, these high elasticities are robust across different estimators. These results imply that Japanese rice is no longer a staple food, and indeed rice becomes more luxury than many other foods. Econometric results additionally show that rice and FAFH are strong substitutes. From estimation results of other goods, we confirm that FAFH is a substitute for bread, noodle, fresh meat, eggs, and fats and oil. These results are not surprising, if one is reminded that this study utilizes the purchase data. However, these results imply the importance of FAFH in the Japanese dietary patterns. Results from demographic variables show that Japanese food consumption patterns are different across household age groups. Namely, households with an old household head tend to have a more traditional dietary pattern, which has a higher rice budget share. General dietary patterns of younger households can be characterized to be westernized; those households tend to consume more bread, noodle, and meat, which are not traditional Japanese food items.

Utilizing 1997 household survey data, econometric results indicate that the traditional Japanese dietary patterns have changed. Rice is not a staple food any longer, and FAFH plays an important role in food consumption. There is no evidence that rice is an inferior good. We might be at the point where we should change our *a priori* expectations for grain consumption in high-income countries.

5. MEAT DEMAND ANALYSIS

5.1 Introduction

Meat and poultry consumption is getting more important in the Japanese diet. Some studies report that Japanese diets have become more and more westernized; as the per capita income increases, Japanese are consuming more meats and poultry than grain products. Since there is a limit on total calorie intake, the ratio of the meat products to other foods becomes larger in comparison to other grain commodities. In Chapter 4, we find fish and meat are moderate substitutes to each other (see **Table 4.7**). Furthermore, in June of 1988, Japan signed the Beef Market Access Agreement (BMAA) with the United States. This agreement might have accelerated the increasing trend of Japanese beef consumption due to an influx of cheaper beef from abroad. According to Persaud and Chern (1999), Japan's meat production began first to stagnate and then actually fall, while meat imports rapidly increased after the agreement.

The main objectives of this meat demand analysis are to analyze meat consumption patterns and to conduct an econometric analysis of the meat demand structure in Japan. We use cross-sectional household data from the *Family Income and Expenditure Survey 1997* (FIES), conducted by the Statistics Bureau, Management and Coordination Agency in Japan. FIES provides household data on a monthly basis. The total number of observations used for estimation is 94,200. Meat items are beef, pork, poultry, ground meat, ham, sausage, and bacon. We do not include fish in this model because there are many heterogeneous groups for fish and the substitution patterns between the aggregate groups of meat and fish were analyzed in the previous chapter of 11-food model, and we found fresh meat and fresh fish were mild substitutes. We note a study by Eales and Wessells (1999) finding that meat and fish were not weakly separable in recent years. The results of separability tests tend to highly depend upon a particular database. Eales and Wessells used the time-series data generated from the FIES for 1981-1995. They did not include high-valued processed meats in their study. The results for testing separability may be different for our study using household-level data and including other processed meats in the model. In any case, we assume the weak separability between the seven meats and other foods including fish.

Much research has been conducted on the structural change of meat and poultry demand with aggregate time-series data in Japan (Hayes, et al. (1990), Capps, et al. (1994), and Eales and Wessells (1999)). After a decade of trade liberalization, it is extremely important to have an accurate estimate of Japanese meat and poultry demand elasticities. This study offers another estimation with cross sectional data. As noted earlier, cross-sectional data yields more reliable estimates of expenditure and income elasticities than time-series data. In this study, we estimate own-price, cross-price, and expenditure elasticities by various single equation models and the Almost Ideal Demand System (AIDS) developed by Deaton and Muellbauer (1980a, 1980b) as discussed in Chapter 3. These elasticity estimates are utilized to analyze Japanese consumption patterns of meat and its products.

5.2 Stylized Facts and Literature Review

There are two main characteristics of meat and poultry consumption in Japan over the last three decades. One is the increasing trend of meats and poultry consumption, and the other is the rapid increase of meat imports.

Historically, increases in per capita income in Japan accelerated meat consumption. **Figure 5.1** shows annual per capita beef, pork, and poultry consumption. As can be seen from the diagram, meats and poultry per capita consumption have been steadily increasing since 1960. Pork consumption had increased until the early 1980s, and its growth of consumption seemed to be leveled off thereafter. On average, over the last thirty years, the consumption of beef has not increased as fast as that of pork and poultry; however, its increases were accelerated after the middle of the 1980s. In recent years, beef consumption has been increasing more rapidly than pork and poultry. In 1960, the per capita consumption of beef, pork, and poultry were 1.1, 1.1, and 0.8 kilograms, respectively. Ten years later, beef consumption nearly doubled, and pork and poultry consumption were increased by four times. In 1980, compared to 1960, beef consumption tripled, and pork and poultry consumption were increased tenfold. In 1995, beef, pork, and poultry consumption increased 7.5 times (beef) to nearly 14 times (poultry) over the level of consumption in the 1960s.

The Japanese government protected beef producers through import quotas. Before the 1988 BMAA agreement, all beef imports, except a small portion under the private quota, were monopolized by the Livestock Industries Promotion Corporation (LIPC). (See Hayami (1979) and Alston et al. (1990).) Under the 1988 BMAA, quotas were raised by sixty thousand metric ton each year from April 1988 to April 1991 (Persaud and Chern, 1999). Thereafter, the quota restriction was replaced by an import tariff. This agreement significantly curtailed the LIPC's beef market intervention. Consequently, a freer market was introduced to the Japanese beef market; the Japanese cattle industry had to adjust its supply and pricing to the market situation, and consumers enjoyed the benefits from increasing competition from foreign countries.

The increases in meat imports after the 1988 agreement have been remarkable[7]. **Figure 5.2** shows the trends of beef, pork and poultry imports. All meat imports increased rapidly after the mid 1980s, with beef imports surpassing pork imports during most of the 1990s. Poultry import has been smaller than beef and pork during the last three decades. As **Figure 5.3** shows, domestic beef production has been stagnant since the mid 1980s, and beef import has grown at even a faster rate than before. These figures clearly show that beef imports have exceeded domestic production after 1992. Given the historical restrictive beef quota and its trade liberalization in 1988, the relatively high growth rates of beef consumption was stimulated by the increases in import in the late 1990s. **Figure 5.3** also shows that the production of pork and poultry has been decreasing since the late 1980s. **Figure 5.4** shows the one-year percentage change of nominal unit prices for beef, pork, and poultry. Beef price has been more volatile than pork and poultry. After the trade liberalization, beef price shows a downward trend; however, the magnitude of the trend is not as large as one might have expected.

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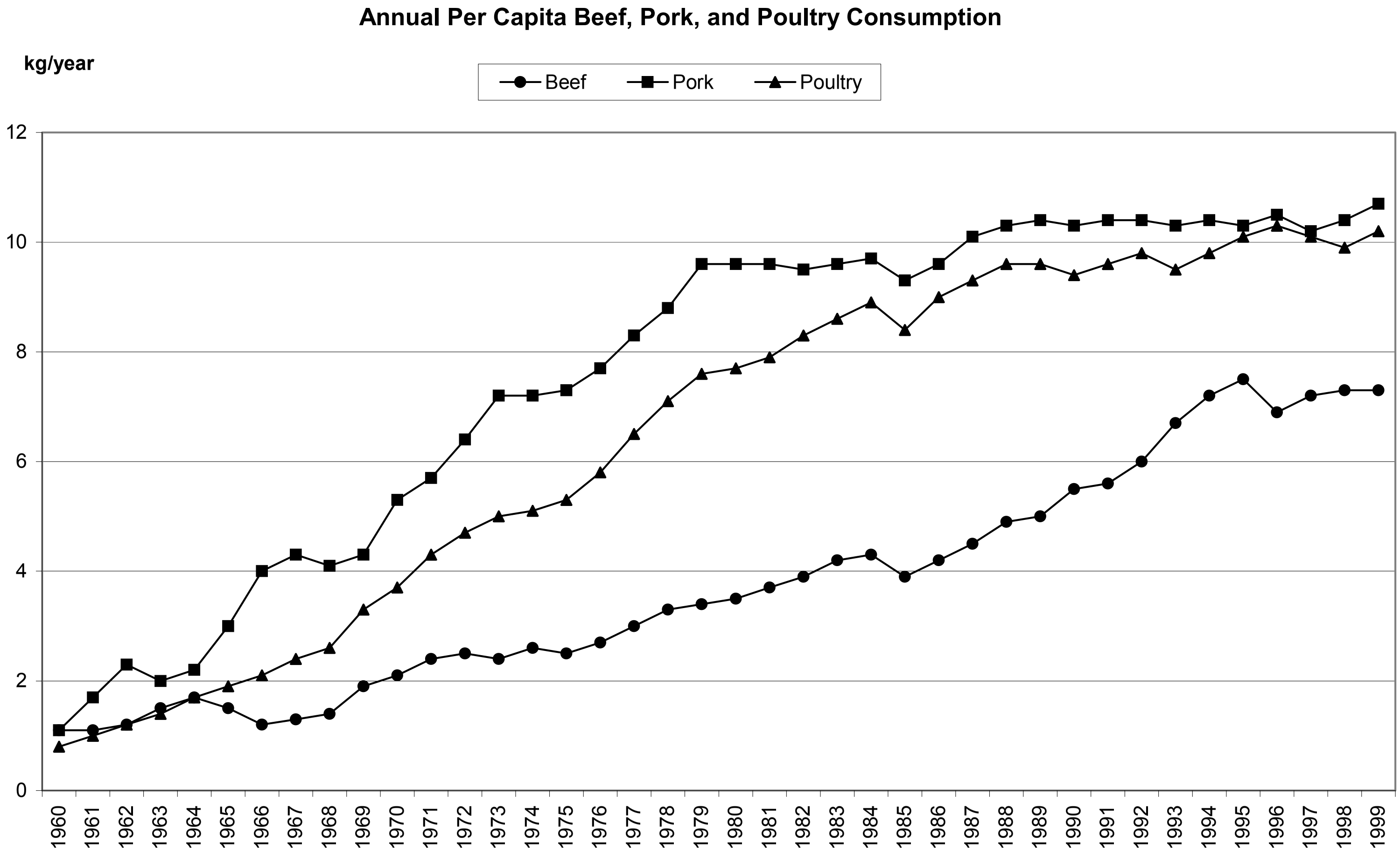
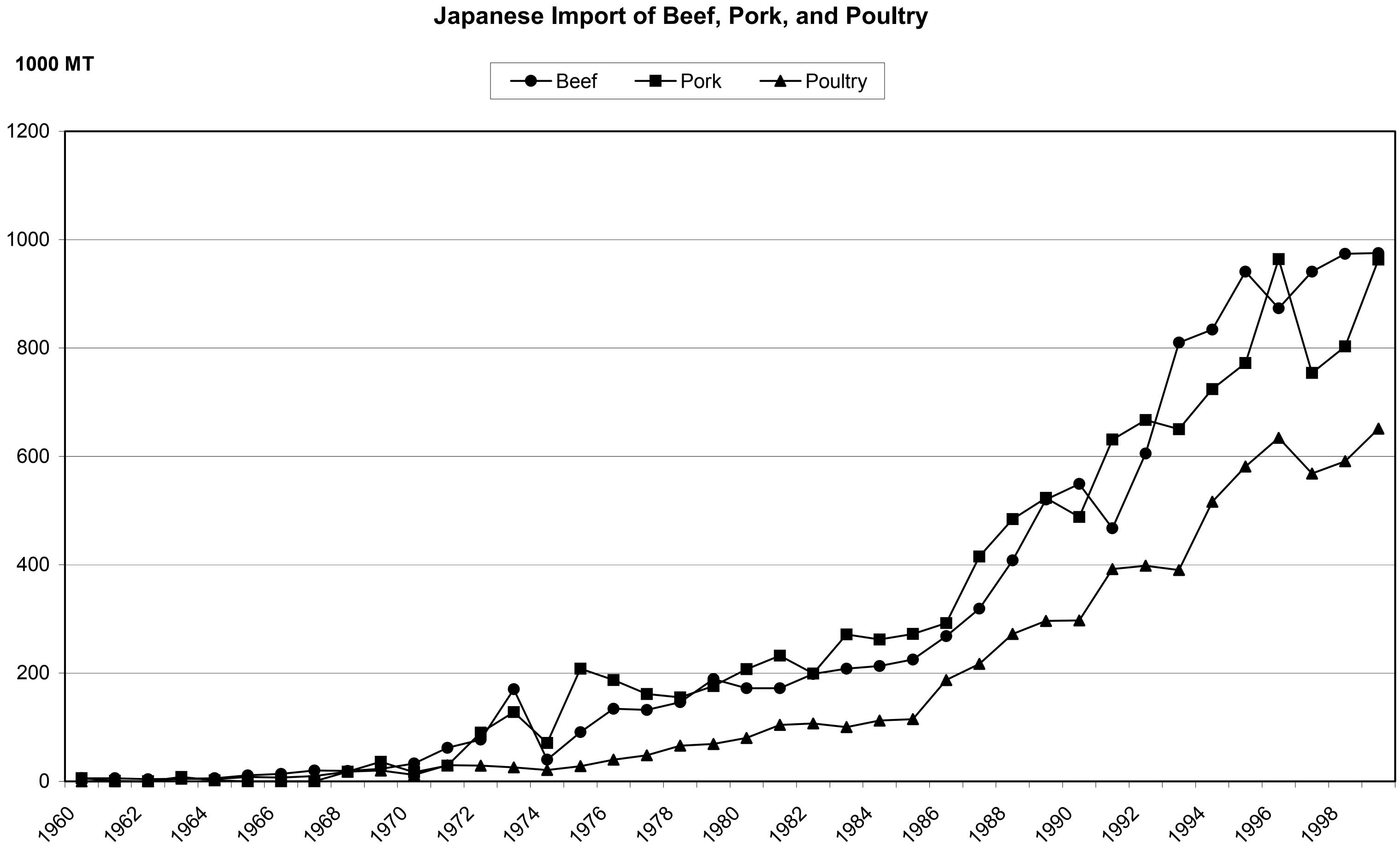
[7] There is virtually no export, on the other hand.

Figure 5.1: Annual per Capita Beef, Pork, and Poultry Consumption, 1960-1999



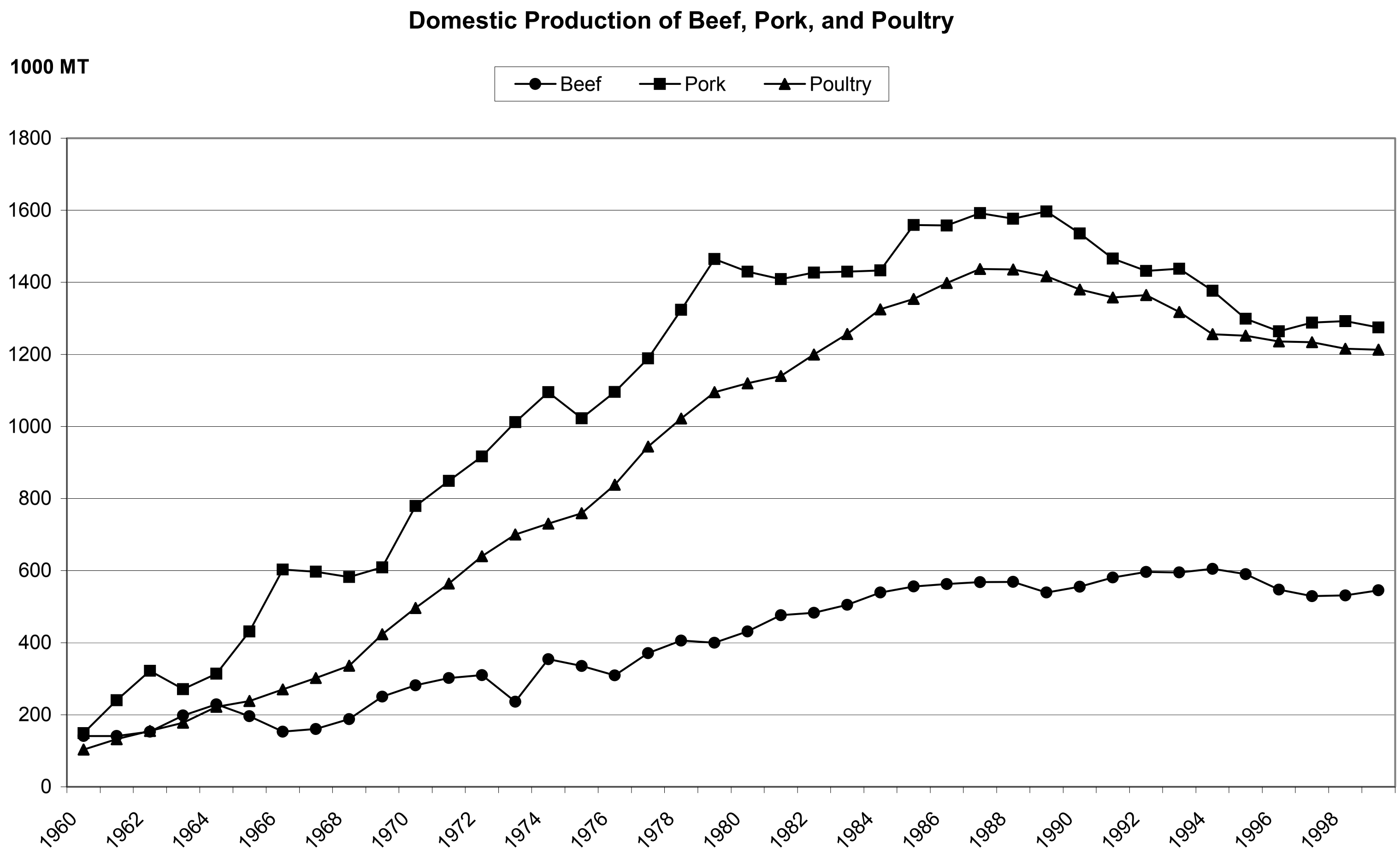
Source: Food Balance Sheet (MAFF, 2001)

Figure 5.2: Japanese Import of Beef, Pork, and Poultry, 1960 - 1999



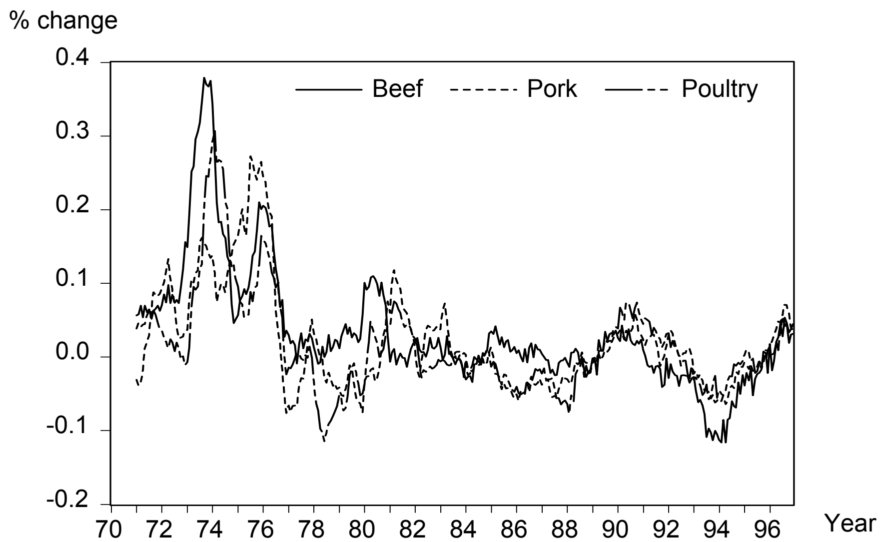
Source: Food Balance Sheet (MAFF, 2001)

Figure 5.3: Domestic Production of Beef, Pork, and Poultry, 1960 - 1999



Source: Food Balance Sheet (MAFF, 2001)

Figure 5.4: One-year Percentage Change of Prices for Beef, Pork, and Poultry, 1970 - 1997



Source: FIES (various issues)

Food prices in Japan have been generally considered as high relative to other developed countries. Hayami (1979) reports the price differentials of food commodities based on 1977 data. Two decades ago, the retail price of beef in Tokyo was seven to nine times higher than in the capitals of other developed countries. In order to have an overview of the price differentials, the Japanese Ministry of Agriculture, Forestry, and Fisheries (MAFF) regularly reports the price comparison of food items in major cities in the world. From **Table 5.1** based on 1996 data, beef in Tokyo is still the most expensive compared to other major cities; however, the price differential is merely twice, at most, to none. Pork prices vary amongst major cities. It is interesting to note that poultry in Tokyo is cheaper than several other major cities in the world. Combined with Hayami's survey, this table shows that the price differentials amongst large cities in developed countries become much smaller than they used to be twenty years ago.

Estimation results on own-price elasticities of meat demand among Japanese, U.S. and Canadian vary considerably. Hayami (1979) investigated the consequences of Japanese beef trade liberalization. In the study, the author reported the results of the own-price elasticity for beef from other studies; the results vary from -1.3 to -1.8. Applying the Rotterdam demand system, Sasaki (1995) estimated various meat demand elasticities in Japan. Own-price elasticities of beef, pork, poultry, and meat products are, respectively, -1.26, -1.53, -0.68, and -0.81. These results are consistent with Hayami's survey; beef and pork are highly price elastic, while poultry is relatively inelastic.

Table 5.1: International Price Comparison (November 1996)

	U.S. New York	U.K. London	France Paris	Germany Hamburg	Switzerland Geneva
Beef	53	53	67	69	97
Pork	73	103	65	46	125
Chicken	115	199	144	173	201

Note: Price comparison to Tokyo (Price in Tokyo = 100)

Source: "Food and Eating Out Retail Price Survey at Tokyo and Major Five Overseas Cities" in Statistical Yearbook of Ministry of Agriculture Forestry and Fisheries (MAFF, 1997)

Table 5.2: Summary Statistics for Canadian Meat Demand Own-price Elasticity Estimates Published in the 1990s

	# of Studies	Mean	Standard Deviation	Min Abs Value	Max Abs Value
Beef	6	-0.76	0.23	0.4	1.08
Pork	6	-0.59	0.26	0.1	0.82
Chicken	6	-0.65	0.26	0.32	0.95

Source: Table 4 in Eales and Unnevehr (1993)

Table 5.3: Summary Statistics for Canadian Meat Demand Expenditure Elasticity Estimates Published in the 1990s

	# of Studies	Mean	Standard Deviation	Min Abs Value	Max Abs Value
Beef	6	1.24	0.41	0.82	1.88
Pork	6	0.81	0.32	0.31	1.14
Chicken	6	0.57	0.36	0.18	1.04

Source: Table 4 in Eales and Unnevehr (1993)

There are many studies on American and Canadian meat and poultry consumption. Eales and Unnevehr (1993) conducted a survey of meats and poultry demand elasticity studies in Canada. **Table 5.2** shows excerpts from their survey results. In their survey, the estimates of own-price elasticity are considerably lower in absolute value than the one from Hayami's study particularly for beef and pork. Chen and Veeman (1991) reported, using the AIDS mode estimated with U.S. data, own-price elasticities of beef, pork and poultry to be, respectively, -0.77, -0.87, and -0.95. The Chen and Veeman study on U.S. meat demand yields estimates much closer to those obtained from Canadian data. In sum, the comparisons of the previous studies between western countries and Japan indicate that Japanese meats and poultry's own-price elasticities are higher than that of American and Canadian meats and poultry demand.

Expenditure elasticity is one of the key determinants of future meat demand. It is important to have an accurate estimate of expenditure elasticity in order to forecast the medium to long-run demand for meat. Ealses and Unnevehr (1993) showed the results of a survey on expenditure elasticity on Canadian data. **Table 5.3** shows a part of the survey result taken from the Easles and Unnevehr study. Using U.S. data, Moschini and Meilke (1989) reported various expenditure elasticities on meat demand. The estimated expenditure elasticities of beef, pork, and poultry are, respectively, 1.39, 0.85, and 0.21 in the post structural change period of fourth quarter of 1975 and thereafter in 1967-87 data set. There are only slight differences between the estimates with Canadian and U.S. data. In the Ealses and Unnevehr study, expenditure elasticities for beef, pork, and poultry are positive; however, only beef expenditure elasticity exceeds one in the Moschini and Meilke study.

Sasaki (1995) reported the income elasticities of meats and poultry in Japan. According to Sasaki, the income elasticities of beef, pork, poultry and other meat products are, respectively, 0.80, 1.29, 1.42, and 2.10. Interestingly, Sasaki's study shows that beef is a normal good; however, pork, poultry and meat products are superior goods. These results are quite different from the findings from the cited Canadian and U.S. studies. Sasaki's estimates depend on the specification of the Rotterdam model and the use of time-series data. We apply the AIDS model with cross-sectional data, which should yield more reliable estimates of expenditure elasticities.

5.3 Empirical Results

The usable data from the survey consist of 94,200 observations for seven meat products. Price data are constructed for the households with zero consumption and thus zero budget share, according to their geographic location, month, and income level, as described in the previous section. In order to have a consistent result, we compare OLS, Heckman's two-step, and Tobit estimators. For system modeling, we utilize the LA/AIDS models with Stone and Laspeyres index, and include the inverse Mills ratio to correct for the zero consumption problem. The full version of AIDS model is also applied, and all results are compared. Both LA/AIDS and AIDS are estimated with homogeneity and symmetry conditions imposed.

Table 5.4 reports the comparison of estimated own-price elasticities. It is noteworthy that the own-price elasticity for beef is the most inelastic amongst seven meat commodities except sausage in the single-equation models. These results indicate that Japanese consumers are insensitive to the changes in beef price. If beef was price inelastic, then the recent increases of beef consumption were caused not by price decreases, but either by per capita income increase or by substitution with other meat products. **Table 5.5** reports the (Hicksian) compensated price elasticities obtained from the AIDS model with inverse Mills Ratios for all seven variables. Most products are net substitutes. Only beef and ground meats show a negative Hicksian cross-price elasticity, which is caused by a net complementarity.

The estimates of expenditure elasticity are compared in **Table 5.6**. Amongst all meat products, only the expenditure elasticity of beef exceeds unity. Other commodities' expenditure elasticities are less than unity. This result is very similar to what we reviewed in U.S. and Canadian studies reported by Eales and Unnevehr, and Moschini and Meilke. Sasaki's study, based on old Japanese data, shows nearly the opposite results.

Table5.4: Own-price Elasticities Comparison

Food Items	Mean Budget Share	% of zero Cons	Working Leser (OLS)	Heckit		Tobit		LA/AIDS with Inverse Mills Ratio				AIDS	
								Stone Index		Laspeyres Index			
				Un-cond	Cond	Un-cond	Cond	Uncom-pensated	Com-pensated	Uncom-pensated	Com-pensated	Uncom-pensated	Com-pensated
Beef	31.62%	20.63%	-0.597 (0.006)	-0.593	-0.686	-0.731	-0.825	-0.549 (0.004)	-0.173 (0.004)	-0.607 (0.004)	-0.202 (0.004)	-0.605	-0.197
Pork	29.57%	9.50%	-0.796 (0.010)	-0.807	-0.873	-0.823	-0.872	-0.722 (0.007)	-0.441 (0.007)	-0.708 (0.007)	-0.443 (0.007)	-0.723	-0.459
Poultry	15.25%	19.67%	-0.874 (0.012)	-1.080	-1.030	-0.931	-0.962	-0.779 (0.009)	-0.630 (0.009)	-0.775 (0.009)	-0.646 (0.009)	-0.785	-0.658
Ground Meat	2.50%	70.37%	-1.261 (0.045)	-1.710	-1.131	-1.365	-1.092	-1.028 (0.025)	-1.003 (0.025)	-1.013 (0.025)	-0.989 (0.025)	-1.007	-0.983
Ham	8.05%	39.29%	-0.610 (0.018)	-1.405	-1.104	-0.947	-0.979	-0.691 (0.081)	-0.624 (0.013)	-0.708 (0.013)	-0.633 (0.013)	-0.716	-0.639
Sausage	9.59%	33.39%	-0.918 (0.017)	-0.109	-0.103	-0.101	-0.100	-0.823 (0.096)	-0.749 (0.012)	-0.829 (0.012)	-0.757 (0.012)	-0.830	-0.757
Bacon	3.41%	59.21%	-1.311 (0.031)	-1.890	-1.173	-1.422	-1.128	-1.201	-1.174	-1.212	-1.184	-1.211	-1.183

Notes: The numbers in parentheses below the elasticity estimates are standard errors.

Table 5.5: Hicksian Compensated Price Elasticities of AIDS Model with Inverse Mills Ratio

	Hicksian Compensated Price Elasticity						
Food Items	Beef	Pork	Poultry	Ground Meat	Ham	Sausage	Bacon
Beef	-0.197	0.141	0.081	-0.030	0.032	-0.006	-0.020
Pork	0.099	-0.459	0.108	0.046	0.057	0.101	0.047
Poultry	0.107	0.204	-0.658	0.031	0.093	0.155	0.069
Ground Meat	-0.013	0.411	0.081	-0.983	0.089	0.191	0.225
Ham	0.070	0.219	0.185	0.034	-0.639	0.072	0.059
Sausage	0.105	0.227	0.187	0.073	0.042	-0.757	0.123
Bacon	0.041	0.300	0.229	0.181	0.121	0.310	-1.183

Table 5.6: Elasticity Comparison of Expenditure Elasticities for Meat Products

Food Items	Mean Budget Share	% of zero Cons	Working Leser (OLS)	Heckit		Tobit		LA/AIDS		AIDS
				Un-cond.	Cond.	Un-cond.	Cond.	Stone with IMRs	Laspeyres with IMRs	with IMRs
Beef	31.62%	20.63%	1.291 (0.003)	1.151	1.116	1.415	1.270	1.191 (0.002)	1.284 (0.002)	1.289
Pork	29.57%	9.50%	0.894 (0.003)	0.900	0.934	0.942	0.958	0.950 (0.003)	0.897 (0.002)	0.893
Poultry	15.25%	19.67%	0.838 (0.004)	1.157	1.059	0.966	0.981	0.980 (0.004)	0.844 (0.004)	0.837
Ground Meat	2.50%	70.37%	0.950 (0.010)	1.333	1.061	1.365	1.092	0.999 (0.007)	0.957 (0.007)	0.958
Ham	8.05%	39.29%	0.942 (0.007)	1.401	1.103	1.164	1.065	0.836 (0.006)	0.940 (0.005)	0.947
Sausage	9.59%	33.39%	0.752 (0.006)	0.832	0.939	0.959	0.982	0.771 (0.005)	0.756 (0.004)	0.753
Bacon	3.41%	59.21%	0.820 (0.009)	1.510	1.099	1.215	1.065	0.785	0.825	0.826

Notes: The numbers in parentheses below the elasticity estimates are standard errors.

Table 5.7: Coefficients of Demographic Variables from AIDS Model

	Dependent Variable: Budget share of		
	Beef	**Pork**	**Chicken**
Age of HH Head	**0.0577***	**0.0334***	**0.0112***
# of HH Member	**-0.0922***	**0.0584***	**0.0224***
# of Wage Earners	**0.0048***	**-0.0021***	**-0.0028***
# of Children Age between 6 and 12	**-0.0038***	**-0.0131***	**-0.0034***
# of Children age between 13 and 18	**-0.0055***	**-0.0027***	**-0.0003**

Note: Asterisk denotes statistically significant at the 5 per cent level.

From this study, we can conclude that the Japanese meat consumption pattern has been westernized in a sense that expenditure elasticities have become similar to those estimated in North American countries. This preference change might have been caused by the increases in imported beef. The comparison of expenditure elasticities from various models reveals that results are robust. Additionally, a high expenditure elasticity of beef indicates that beef consumption will not decrease dramatically as long as Japanese consumers maintain their high per capita income.

It is interesting to compare our estimates with those obtained by Eales and Wessells (1999) using the quarterly time-series data for 1981-1995. Eales and Wessells tested the separability between meats and fish and estimated two models: one non-separable model and one separable model including only meats (namely beef, pork and poultry). As it turns out, our estimates of the own-price and expenditure elasticities for beef, pork and poultry (**Tables 5.4 to 5.6**) are closer to their estimates from the non-separable model than separable model. For example our estimates of the own-price elasticities for beef range from –0.549 to –0.605, while Eales and Wessells obtained the estimate of –0.516 from their non-separable model and –0.166 from the separable model. There are also notable differences. First, our estimates of price elasticities in absolute value are higher than those estimated by Eales and Wessells from their non-separable model, especially for pork and poultry. With respect to expenditure elasticities, they are not strictly comparable because the models included different additional items other than beef, pork and poultry. We include ground meat, ham, sausage, and bacon while they included three categories of fish. Despite of this difference, our estimates of expenditure elasticities are higher than those estimated by Eales and Wessells (1999).

Table 5.7 shows the estimation results of selected demographic variables obtained from the AIDS model. Considering the high expenditure elasticity for beef, it is reasonable to expect that the age of household head and the number of wage earners in the household should have a positive impact on its budget share. While as the number of household members increases, the expenditure on beef tends to decrease. The number of children shows negative impacts on the expenditure shares of beef, pork, and poultry.

5.4 Concluding Remarks for Cross-sectional Analysis

In this study, we estimate the Japanese demand for beef, pork, poultry, and processed meat products. Own-price, cross-price, and expenditure elasticities of seven meat products are estimated, and some selected demographic variables are analyzed. In conclusion, the results indicate that recent Japanese consumption behavior is similar to U.S. and Canadian consumers as measured by elasticity estimates.

This study is based on 1997 cross-sectional household survey data. After the beef trade liberalization, a decade has passed. Beef is inelastic to price, and expenditure elasticity of beef exceeds unity. From this study, we cannot tell whether a structural change has occurred or not because this is a cross-sectional analysis. Estimation results from time-series data will reveal further information about the structural changes in consumer preference. This study shows via expenditure elasticity that beef is the only superior good amongst seven meat commodities. In this regard, as with other reported estimates, Japanese preference in the late 1990s became closer to those in Western nations.

6. Conclusions

This report documents the research results from modeling food consumption behavior by Japanese households using the household-level data in 1997. The Family Income and Expenditure Survey (FIES) data offers rich information and data for estimating food demand in Japan. In this study, we only present two empirical food demand models - one for 11 aggregate foods including rice and the other for seven meats. There are, of course, more can be done with this database as well as similar data for 1996. We will continue our collaborative efforts to learn more about Japanese food consumption behavior from this unique data source.

This report presents analyses of descriptive statistics of food consumption by demographic groups and econometric estimation of the two food models. Several single-equation demand models and the almost ideal demand system (AIDS) are estimated.

Our econometric results indicate that Japanese rice is not an inferior good, and demographic variables are important indicators of the future trend of Japanese rice consumption. According to our meat demand analysis, Japanese dietary patterns have become more and more westernized.

One puzzling set of results is related to the estimated own-price elasticity of rice demand. Our estimates of this elasticity range from -1.5 to -1.9, which are very high. Since this elasticity has important implications for the impacts of Japanese agricultural and trade policies, it needs to be carefully assessed. We feel very confident that the estimates are reliably estimated because the range is relatively robust among several model specifications. We note, however, the survey data are observations of purchase behavior, which may not be the same as the consumption behavior. This is especially true for rice because households buy rice in response to changes in price. We note there were substantial variations on rice prices among households and months. We suspected that the differences might have been caused by quality differences. High-income households tend to buy higher quality of rice than lower income households. We attempted to address this question by estimating various demand models by income level. However, the estimates of the own-price elasticity of rice remain very similarly high. We are unable to address the question on the differences between purchase and actual consumption in this study. The issue is important and we should try to employ a more elaborated modeling framework based on the concept of infrequency of purchase.

Some of our findings contradict with previous studies from aggregated time-series data. We hope that these findings shed more lights on the continuing debate about the income and price effects of food demand, especially for rice in Japan. The results presented in this report should also be useful to agricultural policy makers in assessing the impacts of various agricultural and trade policies.

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Appendix A. Daily Consumption of Rice and Meats by Income Level & Age Group

Table A.1 Distibution of Sample by Income and Age

		Income Level (10 thousand Yen)					
		<402	402-568	568-745	745-999	999<	Total
Age	<35	2864	4257	2745	1420	502	11788
	35-44	2341	4125	5638	4664	2854	19622
	45-54	2460	2797	4260	6500	7496	23513
	55-64	4158	3686	3694	3944	5691	21173
	64<	8488	4684	2408	1627	1922	19129
	sum	20311	19549	18745	18155	18465	95225

Table A.2 Annual Total Household Income (10 thousand Yen) by Income and Age

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
Age	<35	315.75	484.14	639.71	852.53	1268.37
	35-44	304.03	494.39	655.79	848.31	1300.36
	45-54	295.74	488.97	658.17	866.83	1387.15
	55-64	294.65	483.90	650.39	863.04	1432.65
	64<	292.87	474.18	644.00	857.13	1561.45

Table A.3 Household Size by Income and Age

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
Age	<35	3.15	3.32	3.28	3.30	3.48
	35-44	3.57	4.05	4.04	4.12	4.31
	45-54	3.18	3.47	3.76	3.80	3.90
	55-64	2.50	2.60	2.87	3.10	3.33
	64<	2.21	2.27	2.68	3.07	3.39

Table A.4 Average Age of Household Head by Income and Age Group

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
Age	<35	28.56	30.34	30.90	31.22	31.98
	35-44	39.43	39.21	39.34	40.13	40.39
	45-54	49.26	49.02	48.98	49.13	49.82
	55-64	60.47	59.86	59.39	58.75	58.48
	64<	72.22	70.86	69.99	70.44	70.13

Table A.5 Monthly Household Total Expenditure (Yen) by Income and Age

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
Age	<35	202056	260591	288587	331966	415102
	35-44	224581	277936	328340	375026	470749
	45-54	223652	269225	325646	415433	524780
	55-64	219407	261680	299592	365478	465894
	64<	196380	272366	318037	336051	462335

Table A.6 Monthly Household Food Expenditure (Yen) by Income and Age

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	<35	49073	59903	67305	73700	88659
Age	35-44	65239	75331	85653	94934	111842
	45-54	68540	79237	89199	98529	109600
	55-64	67773	77513	86234	93300	108864
	64<	62813	79545	88384	97717	114788

Table A.7 Daily Consumption of Non-Glutinous Rice (g) Per Household by Income and Age

		Income Level (10 thousand Yen)					
		<402	402-568	568-745	745-999	999<	Total
	<35	137.60	141.45	137.46	146.16	132.72	141.08
Age	35-44	218.24	219.96	235.69	244.63	259.76	239.32
	45-54	279.73	293.76	324.71	340.66	332.32	327.92
	55-64	302.35	294.68	294.95	330.16	327.50	316.26
	64<	269.05	292.21	285.17	304.05	320.13	289.03
All Ages		258.19	243.15	266.36	307.45	309.34	267.64

Table A.8 Per Capita Daily Consumption of Non-Glutinous Rice (g) by Income and Age, 1997

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	<35	44.32	43.99	42.85	43.99	38.99
Age	35-44	62.69	54.60	58.44	59.79	61.10
	45-54	90.30	88.83	87.72	90.67	85.50
	55-64	125.45	116.46	107.33	112.19	101.48
	64<	124.07	129.43	114.76	105.48	98.78

Table A.9 Daily Consuption of Pork (g) Per Household by Income and Age

		Income Level (10 thousand Yen)					
		<402	402-568	568-745	745-999	999<	Total
	<35	30.67	35.73	34.46	34.10	37.45	34.08
Age	35-44	37.15	45.40	48.47	51.87	54.19	48.11
	45-54	42.31	46.36	54.44	54.63	57.33	53.18
	55-64	33.04	33.98	39.12	42.12	44.30	38.98
	64<	24.50	25.75	31.52	37.95	38.39	28.23
All Ages		30.63	37.98	45.76	49.64	53.01	46.50

Table A.10 Daily Consumption of Beef (g) Per Household by Income and Age

		Income Level (10 thousand Yen)					
		<402	402-568	568-745	745-999	999<	Total
	<35	19.35	21.30	22.98	22.92	29.02	21.51
Age	35-44	28.30	31.09	33.03	36.76	39.47	34.14
	45-54	30.75	35.37	38.23	40.95	41.52	39.75
	55-64	22.43	25.84	29.79	33.14	33.84	30.10
	64<	16.90	19.96	22.29	30.02	26.98	21.22
All Ages		20.93	25.80	29.50	34.96	39.70	30.72

Table A.11 Daily Consumption of Poultry (g) Per Household by Income and Age

		Income Level (10 thousand Yen)					
		<402	402-568	568-745	745-999	999<	Total
	<35	27.16	30.25	27.94	29.02	27.19	28.68
Age	35-44	32.28	36.14	38.29	39.47	42.36	37.99
	45-54	33.66	37.02	42.86	41.52	41.90	40.53
	55-64	25.80	27.94	30.06	33.84	34.06	30.63
	64<	19.19	21.07	23.48	26.98	31.36	22.08
All Ages		24.56	29.95	34.96	36.81	39.39	35.03

Table A.12 Daily Consumption of Grounded Meat (g) Per Household by Income and Age

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	<35	6.14	6.69	6.14	6.16	5.18
Age	35-44	7.01	7.17	7.46	7.77	8.10
	45-54	4.73	5.48	6.33	6.77	7.36
	55-64	2.30	2.43	3.26	3.76	4.18
	64<	1.62	1.65	2.43	2.88	3.57

Table A.13 Daily Consumption of Ham (g) Per Household by Income and Age

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	<35	4.52	6.27	6.72	7.06	6.76
Age	35-44	6.89	9.06	9.99	10.08	12.94
	45-54	7.30	8.23	10.27	10.82	11.21
	55-64	5.78	7.17	7.71	9.32	9.13
	64<	5.32	6.32	7.54	8.93	9.87

Table A.14 Daily Consumption of Sausge (g) Per Household by Income and Age

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	<35	12.68	15.12	14.10	13.49	13.90
Age	35-44	16.43	20.28	20.29	20.93	20.22
	45-54	11.69	14.23	16.65	16.27	16.15
	55-64	7.85	8.76	10.13	11.08	11.18
	64<	5.03	5.97	7.52	10.32	11.47

Table A.15 Daily Consumption of Bacon (g) Per Household by Income and Age

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	<35	3.30	3.95	3.76	3.67	3.87
Age	35-44	3.57	4.39	4.80	5.32	5.58
	45-54	3.53	3.64	4.47	4.81	5.18
	55-64	2.60	2.59	2.90	3.38	3.50
	64<	1.71	2.15	2.37	3.48	3.40

Table A.16 Price of Non-Glutinous Rice (Yen/100g) by Income and Age

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	<35	44.88	45.84	47.47	47.97	49.59
Age	35-44	46.09	45.53	46.42	47.79	49.82
	45-54	46.60	47.08	47.14	47.74	49.10
	55-64	48.05	48.46	48.84	48.95	50.77
	64<	49.20	50.20	50.53	50.94	52.49

Table A.17 Price of Pork (Yen/g) by Income and Age

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	<35	1.32	1.36	1.41	1.43	1.52
Age	35-44	1.33	1.37	1.42	1.45	1.54
	45-54	1.42	1.47	1.45	1.50	1.57
	55-64	1.49	1.54	1.57	1.57	1.64
	64<	1.56	1.64	1.65	1.68	1.70

Table A.18 Price of Beef (Yen/g) by Income and Age

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	<35	2.03	2.25	2.40	2.58	2.75
Age	35-44	2.23	2.26	2.36	2.51	2.82
	45-54	2.44	2.51	2.53	2.66	2.92
	55-64	2.79	2.99	3.04	3.04	3.37
	64<	3.00	3.28	3.42	3.37	3.75

Table A.19 Price of Poultry (Yen/g) by Income and Age

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	<35	0.93	0.98	1.00	1.04	1.09
Age	35-44	0.95	0.96	0.99	1.03	1.12
	45-54	0.98	0.99	0.98	1.02	1.13
	55-64	1.02	1.04	1.06	1.05	1.15
	64<	1.04	1.09	1.11	1.12	1.22

Table A.20 Price of Grounded Meat (Yen/g) by Income and Age

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	<35	1.03	1.06	1.07	1.09	1.14
Age	35-44	1.04	1.06	1.08	1.12	1.17
	45-54	1.11	1.11	1.13	1.13	1.15
	55-64	1.15	1.16	1.18	1.15	1.18
	64<	1.18	1.20	1.23	1.22	1.17

Table A.21 Price of Ham (Yen/g) by Income and Age

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
Age	<35	2.13	2.16	2.24	2.31	2.38
	35-44	2.04	2.10	2.15	2.25	2.36
	45-54	2.11	2.17	2.20	2.26	2.34
	55-64	2.30	2.35	2.33	2.37	2.46
	64<	2.32	2.42	2.52	2.47	2.53

Table A.22 Price of Sausage (Yen/g) by Income and Age

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
Age	<35	1.37	1.44	1.50	1.54	1.60
	35-44	1.39	1.42	1.45	1.48	1.53
	45-54	1.46	1.44	1.46	1.50	1.55
	55-64	1.49	1.55	1.56	1.54	1.61
	64<	1.53	1.57	1.58	1.58	1.61

Table A.23 Price of Bacon (Yen/g) by Income and Age

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
Age	<35	1.86	1.91	1.97	2.02	2.18
	35-44	1.84	1.90	1.93	2.00	2.06
	45-54	1.83	1.89	1.91	1.97	2.04
	55-64	1.92	2.02	1.97	2.00	2.05
	64<	1.98	1.98	2.04	2.00	2.11

Appendix B. Daily Consumption of Rice and Meats by Income & Household Size

Table B.1 Distibution of Sample by Income and Household Size

		Income Level (10 thousand Yen)					
		<402	402-568	568-745	745-999	999<	Total
	2	12122	8018	5289	4017	3532	32978
# of	3	4280	4640	4484	4522	4801	22727
Family	4	2750	4515	5453	5607	5685	24010
Members	5	781	1670	2406	2666	2699	10222
	6 or more	378	706	1113	1343	1748	5288
	Total	20311	19549	18745	18155	18465	95225

Table B.2 Annual Total Household Income (10 thousand Yen) by Income and Household Size

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	2	289.90	479.36	644.91	857.63	1454.32
# of	3	301.95	485.11	651.24	856.96	1349.14
Family	4	322.24	489.48	654.40	861.10	1394.40
Members	5	308.80	491.81	658.11	855.30	1399.76
	6 or more	319.40	491.45	653.66	872.09	1476.72

Table B.3 Average Age of Household Head by Income and Household Size

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	2	64.03	59.66	54.90	53.90	57.18
# of	3	49.18	46.95	48.96	51.14	54.29
Family	4	43.52	40.58	43.08	46.36	50.36
Members	5	45.25	42.31	43.79	46.36	48.87
	6 or more	47.56	43.15	47.67	49.01	52.36

Table B.4 Monthly Household Total Expenditure (Yen) by Income and Household Size

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	2	194837	260932	361632	486851	486851
# of	3	216452	260223	367136	478987	478987
Family	4	234429	274253	389926	495199	495199
Members	5	253331	294450	405363	493451	493451
	6 or more	272545	311026	350481	394010	491679

Table B.5 Monthly Household Food Expenditure (Yen) by Income and Household Size

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	2	58685	71371	75938	82435	97312
# of	3	64233	70648	79761	88004	103032
Family	4	70773	73982	86883	97690	111273
Members	5	79760	86255	94597	106326	119786
	6 or more	88951	95659	106354	115053	132258

Table B.6 Daily Consumption of Non-Glutinous Rice (g) by Income and Household Size

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	2	237.41	227.74	203.27	212.15	198.32
# of	3	260.50	245.94	244.84	265.19	277.61
Family	4	266.28	229.46	260.68	295.57	327.77
Members	5	357.70	289.98	332.88	386.24	403.10
	6 or more	342.67	422.88	422.51	462.61	453.94

Table B.7 Per Capita Daily Consumption of Non-Glutinous Rice (g) by Income and Houaehold Size, 1997

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	2	118.71	113.87	101.63	106.08	99.16
# of	3	86.83	81.98	81.61	88.40	92.54
Family	4	66.57	57.37	65.17	73.89	81.94
Members	5	71.54	58.00	66.58	77.25	80.62
	6 or more	55.52	66.85	66.95	73.49	71.12

Table B.8 Daily Consumption of Pork (g) Per Household by Income and Household Size

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	2	22.70	24.79	25.13	28.16	24.97
# of	3	36.31	34.56	40.31	40.01	40.25
Family	4	44.26	46.76	51.36	55.52	56.54
Members	5	59.56	56.00	60.43	63.16	70.58
	6 or more	67.34	72.51	72.79	74.12	77.63

Table B.9 Daily Consumption of Beef (g) Per Household by Income and Household Size

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	2	16.26	25.12	30.31	39.18	41.16
# of	3	19.49	25.43	30.24	38.32	45.44
Family	4	20.77	28.69	34.81	41.19	39.75
Members	5	23.68	31.85	40.08	45.56	48.62
	6 or more	40.96	44.93	43.52	47.93	56.67

Table B.10 Daily Consumption of Poultry (g) Per Household by Income and Household Size

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	2	19.05	20.86	20.51	23.02	19.51
# of	3	28.52	27.88	30.82	30.59	31.29
Family	4	35.56	37.58	39.57	42.40	42.46
Members	5	48.41	47.18	49.14	48.69	50.28
	6 or more	47.13	53.84	55.73	55.27	60.92

Table B.11 Daily Consumption of Grounded Meat (g) Per Household by Income and Household Size

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	2	1.71	1.88	2.48	2.57	2.02
# of	3	4.71	4.64	4.79	4.15	4.21
Household	4	6.04	6.55	7.18	7.42	6.98
Members	5	9.61	9.72	8.40	9.31	9.49
	6 or more	9.99	10.75	8.87	9.70	10.89

Table B.12 Daily Consumption of Ham (g) Per Household by Income and Household Size

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	2	4.83	5.92	6.50	7.28	7.61
# of	3	6.38	6.66	8.55	8.66	9.66
Household	4	7.26	8.88	9.65	10.91	10.92
Members	5	8.03	9.84	10.99	11.60	12.77
	6 or more	11.00	11.73	12.03	13.55	14.60

Table B.13 Daily Consumption of Sausge (g) Per Household by Income and Household Size

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	2	5.36	6.69	7.38	7.35	7.33
# of	3	10.54	12.20	12.05	12.01	11.15
Household	4	16.62	18.21	19.49	19.35	16.12
Members	5	18.96	22.34	22.06	21.14	21.19
	6 or more	22.09	26.02	24.42	25.59	24.70

Table B.14 Daily Consumption of Bacon (g) Per Household by Income and Household Size

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	2	1.74	2.30	2.40	2.50	2.50
# of	3	3.25	3.05	3.67	3.65	3.57
Household	4	3.89	4.34	4.61	5.15	4.96
Members	5	5.01	4.82	5.24	5.93	6.25
	6 or more	5.92	6.27	5.40	6.74	6.91

Table B.15 Price of Non-Glutinous Rice (Yen/100g) by Income and Household Size

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	2	48.88	49.83	50.62	50.63	53.73
# of	3	47.07	47.28	47.77	49.22	49.99
Household	4	45.61	45.34	46.79	47.55	49.61
Members	5	45.65	44.96	45.68	46.53	48.82
	6 or more	44.68	45.89	44.98	46.10	46.86

Table B.16 Price of Pork (Yen/g) by Income and Household Size

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	2	1.53	1.58	1.59	1.61	1.72
# of	3	1.44	1.47	1.51	1.56	1.64
Household	4	1.35	1.37	1.44	1.47	1.57
Members	5	1.35	1.36	1.35	1.44	1.51
	6 or more	1.32	1.36	1.37	1.40	1.49

Table B.17 Price of Beef (Yen/g) by Income and Household Size

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	2	2.90	3.11	3.15	3.25	3.81
# of	3	2.48	2.58	2.72	2.91	3.26
Household	4	2.21	2.25	2.44	2.57	2.94
Members	5	2.09	2.24	2.27	2.45	2.76
	6 or more	2.00	2.25	2.33	2.34	2.67

Table B.18 Price of Poultry (Yen/g) by Income and Household Size

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	2	1.03	1.07	1.08	1.08	1.17
# of	3	1.00	1.02	1.03	1.07	1.10
Household	4	0.95	0.96	1.00	1.02	1.08
Members	5	0.90	0.93	0.96	1.01	1.03
	6 or more	0.90	0.97	0.94	0.98	1.00

Table B.19 Price of Grounded Meat (Yen/g) by Income and Household Size

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	2	1.15	1.15	1.15	1.17	1.23
# of	3	1.10	1.11	1.15	1.16	1.21
Household	4	1.08	1.06	1.11	1.13	1.14
Members	5	1.02	1.06	1.06	1.11	1.14
	6 or more	1.00	1.05	1.09	1.08	1.09

Table B.20 Price of Ham (Yen/g) by Income and Household Size

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	2	2.30	2.39	2.44	2.47	2.68
# of	3	2.18	2.23	2.29	2.37	2.44
Household	4	2.12	2.11	2.19	2.24	2.37
Members	5	1.97	2.07	2.07	2.23	2.24
	6 or more	2.02	2.02	2.05	2.09	2.18

Table B.21 Price of Sausage (Yen/g) by Income and Household Size

		Income Level (million Yen)				
		<402	402-568	568-745	745-999	999<
	2	1.51	1.54	1.58	1.58	1.67
# of	3	1.44	1.48	1.53	1.53	1.61
Household	4	1.40	1.43	1.47	1.49	1.56
Members	5	1.34	1.40	1.41	1.50	1.51
	6 or more	1.35	1.38	1.40	1.43	1.47

Appendix C. Daily Consumption of Rice and Meats by Income Level & Number of Wage Earners

Table C.1 Distibution of Sample by Income and Number of Wage Earners

		Income Level (10 thousand Yen)					
		<402	402-568	568-745	745-999	999<	Total
	0	7555	3018	921	215	112	11821
# of	1	7647	9659	8602	7447	5427	38782
Wage	2	4231	5756	7239	7600	8079	32905
Earners	3	714	875	1590	2243	3361	8783
	4 or more	164	241	393	650	1486	2934
	sum	20311	19549	18745	18155	18465	95225

Table C.2 Annual Total Household Income (10 thousand Yen) by Income and Number of Wage Earners

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	0	290.00	465.67	632.70	829.50	1183.27
# of	1	303.23	486.93	649.57	853.22	1348.58
Wage	2	300.84	489.64	653.97	862.11	1388.28
Earners	3	311.51	489.85	661.04	869.58	1467.55
	4 or more	302.12	485.85	648.91	869.44	1548.25

Table C.3 Household Size by Income and Number of Wage Earners

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	0	2.12	2.13	2.16	2.24	2.22
# of	1	2.88	3.23	3.44	3.45	3.34
Wage	2	3.01	3.25	3.44	3.60	3.63
Earners	3	3.84	3.80	4.04	4.03	4.06
	4 or more	4.85	4.90	5.05	5.00	5.00

Table C.4 Age of Household Head by Income and Number of Wage Earners

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	0	69.91	69.69	68.13	65.88	66.23
# of	1	47.71	45.17	45.06	48.40	51.70
Wage	2	51.26	47.46	47.47	48.21	51.27
Earners	3	56.93	54.47	54.57	53.32	55.41
	4 or more	56.04	54.19	57.30	56.26	56.47

Table C.5 Monthly Household Total Expenditure (Yen) by Income and Number of Wage Earners

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	0	204235	294307	349280	401209	422554
# of	1	206270	266391	319664	384870	502488
Wage	2	215504	257700	311274	389574	497661
Earners	3	230120	271854	296918	356111	473171
	4 or more	227623	276662	270437	303264	430959

Table C.6 Monthly Household Food Expenditure (Yen) by Income and Number of Wage Earners

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	0	62844	59405	66089	76559	82305
# of	1	80510	70786	73562	83638	92771
Wage	2	86839	82781	83823	89879	94808
Earners	3	102437	93123	94305	95941	103694
	4 or more	86263	109795	109055	110625	112421

Table C.7 Daily Consumption of Non-Glutinous Rice (g) Per Household by Income and Number of Wage Earners

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	0	274.91	273.51	255.45	265.47	156.39
# of	1	221.45	214.96	233.68	269.98	269.40
Wage	2	252.64	253.32	263.06	287.97	301.28
Earners	3	330.86	374.33	355.71	352.70	354.70
	4 or more	356.62	409.39	382.69	480.56	452.48

Table C.8 Per Capita Daily Consumption of Non-Glutinous Rice (g) by Income and Number of Wage Earners

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	0	130.67	129.42	120.67	113.76	67.39
# of	1	82.65	73.49	72.88	83.07	86.09
Wage	2	88.30	84.19	79.86	83.29	85.54
Earners	3	91.27	103.93	92.00	91.56	89.83
	4 or more	76.31	84.85	79.19	97.39	90.52

Table C.9 Daily Consumption of Pork (g) Per Household by Income and Number of Wage Earners

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	0	23.17	24.18	23.66	35.20	23.18
# of	1	31.96	36.49	42.18	47.37	47.03
Wage	2	37.43	40.07	44.69	46.36	48.11
Earners	3	48.55	48.78	55.21	53.58	51.67
	4 or more	71.39	67.19	61.69	62.23	73.30

Table C.10 Daily Consumption of Beef (g) Per Household by Income and Number of Wage Earners

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	0	16.35	19.56	19.30	26.99	14.84
# of	1	22.11	24.93	28.75	34.53	37.94
Wage	2	26.10	28.78	32.86	36.16	39.63
Earners	3	31.52	36.07	36.51	38.01	40.78
	4 or more	51.85	39.44	37.90	41.06	47.25

Table C.11 Daily Consumption of Poultry (g) Per Household by Income and Number of Wage Earners

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	0	19.34	20.06	19.51	25.66	11.40
# of	1	26.56	30.51	33.60	35.72	36.72
Wage	2	29.38	31.76	35.01	36.21	36.21
Earners	3	34.54	38.14	39.03	42.03	40.14
	4 or more	49.84	48.25	51.55	48.55	50.32

Table C.12 Per Capita Daily Consumption of Non-Glutinous Rice (g) by Income and Number of Wage Earners

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	0	130.67	129.42	120.67	113.76	67.39
# of	1	82.65	73.49	72.88	83.07	86.09
Wage	2	88.30	84.19	79.86	83.29	85.54
Earners	3	91.27	103.93	92.00	91.56	89.83
	4 or more	76.31	84.85	79.19	97.39	90.52

Table C.12 Daily Consumption of Grounded Meat (g) Per Household by Income and Number of Wage Earners

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	0	1.62	1.49	1.37	2.91	1.02
# of	1	4.35	5.33	5.84	6.13	6.38
Wage	2	4.54	4.88	5.72	6.06	5.70
Earners	3	4.24	4.75	5.18	5.13	5.59
	4 or more	7.48	7.48	6.58	7.24	8.06

Table C.13 Daily Consumption of Ham (g) Per Household by Income and Number of Wage Earners

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	0	5.30	6.31	7.10	9.13	7.86
# of	1	5.46	7.30	8.54	9.71	10.44
Wage	2	6.41	7.52	9.17	9.57	10.68
Earners	3	8.00	8.52	9.35	10.74	10.64
	4 or more	9.50	11.74	9.89	11.56	10.61

Table C.14 Daily Consumption of Sausge (g) Per Household by Income and Number of Wage Earners

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	0	5.24	5.89	5.68	9.82	6.84
# of	1	10.74	13.92	15.33	15.65	13.77
Wage	2	11.04	13.92	15.59	15.74	14.84
Earners	3	10.47	13.34	15.02	14.50	14.50
	4 or more	18.28	17.00	14.63	18.81	18.32

Table C.15 Daily Consumption of Bacon (g) Per Household by Income and Number of Wage Earners

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	0	1.74	2.24	2.18	2.39	1.73
# of	1	2.92	3.46	4.04	4.30	4.73
Wage	2	3.02	3.54	3.94	4.52	4.30
Earners	3	3.62	3.46	3.88	4.61	4.40
	4 or more	6.20	4.72	3.60	4.67	5.22

Table C.16 Price of Non-Glutinous Rice (Yen/100g) by Income and Number of Wage Earners

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	0	48.82	49.87	51.71	46.92	54.43
# of	1	47.22	47.33	47.91	49.03	51.44
Wage	2	47.12	47.33	47.26	48.02	49.56
Earners	3	47.68	46.35	47.31	47.60	49.61
	4 or more	45.86	45.26	46.99	46.95	48.25

Table C.17 Price of Pork (Yen/g) by Income and Number of Wage Earners

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	0	1.55	1.62	1.65	1.68	1.63
# of	1	1.42	1.44	1.47	1.53	1.65
Wage	2	1.43	1.45	1.47	1.50	1.59
Earners	3	1.45	1.47	1.47	1.48	1.58
	4 or more	1.36	1.45	1.48	1.48	1.51

Table C.18 Price of Beef (Yen/ g) by Income and Number of Wage Earners

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	0	2.98	3.32	3.56	3.16	3.29
# of	1	2.43	2.53	2.65	2.83	3.28
Wage	2	2.53	2.54	2.57	2.70	3.06
Earners	3	2.64	2.70	2.66	2.68	3.11
	4 or more	1.98	2.59	2.69	2.66	2.85

Table C.19 Price of Poultry (Yen/g) by Income and Number of Wage Earners

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	0	1.03	1.07	1.12	1.11	1.08
# of	1	0.98	1.01	1.02	1.06	1.12
Wage	2	0.99	1.00	1.00	1.02	1.08
Earners	3	0.98	0.99	1.01	1.02	1.07
	4 or more	0.99	1.00	1.01	1.03	1.02

Table C.20 Price of Grounded Meat (Yen/g) by Income and Number of Wage Earners

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	0	1.16	1.19	1.21	1.31	1.11
# of	1	1.07	1.09	1.11	1.15	1.18
Wage	2	1.11	1.08	1.12	1.12	1.17
Earners	3	1.13	1.14	1.15	1.14	1.14
	4 or more	1.05	1.06	1.15	1.10	1.12

Table C.21 Price of Ham (Yen/g) by Income and Number of Wage Earners

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	0	2.33	2.47	2.56	2.52	2.30
# of	1	2.18	2.20	2.27	2.36	2.50
Wage	2	2.15	2.17	2.19	2.27	2.38
Earners	3	2.12	2.31	2.24	2.18	2.32
	4 or more	2.03	2.12	2.16	2.22	2.23

Table C.22 Price of Sausage (Yen/g) by Income and Number of Wage Earners

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	0	1.50	1.60	1.66	1.51	1.69
# of	1	1.44	1.47	1.50	1.54	1.60
Wage	2	1.44	1.45	1.47	1.50	1.56
Earners	3	1.46	1.46	1.48	1.47	1.57
	4 or more	1.44	1.42	1.47	1.53	1.50

Table C.23 Price of Bacon (Yen/g) by Income and Number of Wage Earners

		Income Level (10 thousand Yen)				
		<402	402-568	568-745	745-999	999<
	0	1.97	2.02	2.01	1.91	1.99
# of	1	1.90	1.93	1.97	2.03	2.11
Wage	2	1.84	1.91	1.92	1.97	2.07
Earners	3	1.88	1.94	1.93	1.91	2.00
	4 or more	1.66	1.91	1.95	1.98	1.94