# Effects of Model Specification and Demographic Variables on Food Consumption: Microdata Evidence from Jiangsu, China

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## The Area of Focus:

## Area II Changing Consumer

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Paper Presentation for 11th Annual World Food and Agribusiness Forum, World Food and Agribusiness Symposium of the International Food and Agribusiness Management Association to be held in Sydney, Australia, June 27-28, 2001.

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## Abstract

Choosing among functional forms and specifying demographic effects are the two major tasks in this paper. Household data from Jiangsu, China, is employed by applying the Working-Leser form, the LES, QES, and LA/AIDS. Eight demographic variables indicating modernization, region, householder, and household composite are incorporated as well. The results show that the Working-Leser and LA/AIDS provide similar results, and the LES and QES are quite the same due to nesting. However, the performance of the LA/AIDS and LES are different. In addition, demographic variables improve the performance of the selected model.



*Key words: food consumption, demographic translating, Urban China, demand analysis*

# Effects of Model Specification and Demographic Variables on Food Consumption: Microdata Evidence from Jiangsu, China[1]

## I. Introduction

China is a huge market with 1.2 billion people and thus has attracted much attention in the global economy. Almost every country in the world wants to develop an economic tie with China. China's market structure has changed dramatically after its economic reforms in 1978. These socioeconomic changes not only improved the living standards and welfare among the Chinese people but also provided trade opportunities for other countries. In order to take the best advantage of this huge market, it is crucial to investigate the important factors which affect the consumption patterns of Chinese inhabitants.

Jiangsu is not only a good representative of the Chinese culture but also a good indicator to foresee the potential consumption changes in China. Geographically speaking, it is adjacent to Shanghai, the most prosperous city in China. In addition, the Yangtze River runs through its southern part, which provides many natural resources for Jiangsu province. Jiangsu is in the middle of China and has a highly varied population. With these features, it is important to take Jiangsu as an example to investigate food consumption patterns in China.

We studied Jiangsu to evaluate the effects of model specification and demographic variables on food consumption in China using two distinct approaches. First, the demand analysis is based on urban household data in China after economic reform. Microdata consists of rich demographic details and variation in expenditure levels and provides much valuable information other than prices and income. Second, the impact of demographic variables on alternative functional forms is compared in order to investigate the influence of model specification.

Chern (1997) reviewed and assessed the literature on the estimated demand in China. The methodologies, estimation results, and assessments of the recent studies of urban household demand for food, such as Lewis and Andrews (1989); Wang and Chern (1992); Chern and Wang (1994); Wu, *et al.* (1995); Shi, *et al.* (1995); have already been discussed. Since food control policy was still legitimate during the sample periods covered by these studies, most of the studies including Chern (1997) discussed or incorporated rationing in their empirical analyses. However, there existed several problems with respect to data limitation and model specifications.

First, all the previous studies did not make best use of the demographic variables. According to the consumption theory, economic factors such as prices and income are not the only determinates. Demographic profiles play a critical role when consumers make decisions. Therefore, how to incorporate the demographic variables in the analysis is profound. Second, which model specification is preferable in analyzing Chinese urban food demand is vague. Even though the AIDS[2] and the LES[3] are the most popular specifications for analyzing Chinese consumer behavior, the results showed differences between the LA/AIDS[4] and the LES (Chern, 1997). Chern and Wang (1994) presented similar estimated results in both the LES and the QES.[5] None of the studies, to our knowledge, compare the model specification using cross-sectional data. This will be interesting and important.

The remainder of the paper is organized as follows. In section II, we show the model specifications and discuss the treatment of demographic variables. In section III, we describe the data and present descriptive statistics of the variables under consideration. In section IV, we present the empirical results and discuss the effects concerning the treatment of demographic variables. In section V, we provide a brief summary and conclusion.

## II. Theoretical Framework

Under the neoclassical utility maximization framework, the quantity demanded can be expressed as a function of price and income with regularity conditions- adding-up, homogeneity, symmetry, and negativity. Theoretically, the model selection is undetermined. This allows great freedom to choose or test in empirical studies.

[1] We thank in depth to Ms. Weiland and Mr. Dangler for their constructive suggestions and comments from a seminar at The Ohio State University.

[2] The AIDS indicates the Almost Ideal Demand System developed by Deaton and Muellbauer (1980a).

[3] The LES means the linear expenditure system.

[4] The LA/AIDS is the linear approximated AIDS model to eliminate the complexity in computation.

[5] The QES is an abbreviation of the quadratic expenditure system introduced by Pollak and Wales (1978).

There are two sets of functional forms in demand analysis. One is single equation, and the other is complete demand system (CDS). In the CDS, it can be divided into two subgroups. One is the LES and QES, in which the regularity conditions have already imposed; the other is called flexible functional forms such as the AIDS, Rotterdam, and Translog, in which we can maintain or test the theoretical properties. We select the AIDS as an example in this study.

## (I) Selection of Functional Forms

### A. The Working-Leser Form (Single Equation)

Single equation is easy to estimate and has less computational work than the CDS. However, it is sometimes hard to satisfy the properties. The Working (1943)- Leser (1963) form is selected as an example due to its satisfaction of the adding-up property compared with the other single equations. The Working-Leser in share form is expressed as:

$$(1) \qquad w_i = \alpha_{i0} + \sum_{k=1}^{n} \alpha_{ik} \ln p_k + \beta_i \ln X \qquad \forall i = 1, \cdots, n,$$

where $w_i$ means budget share of commodity $i$, $p_k$ is the price of commodity $k$, and $X$ indicates the corresponding expenditure. Subscripts of $i$ and $k$ indicate commodities. $\alpha_{i0}, \alpha_i$, and $\beta_i$ are the parameters to be estimated.

### B. The LES and QES

Stone (1954) developed the LES and Pollak and Wales (1978) introduced the QES. Since the LES is nested within the QES, the LES can be derived from the QES. The QES in budget share form can be expressed as:

$$(2) \qquad w_i = \frac{p_i h^i(m, \mathrm{P})}{m} = \frac{p_i b_i}{m} + a_i \left(1 - \sum \frac{p_k b_k}{m}\right) + (c_i - a_i)\, I \prod \left(\frac{p_k}{m}\right)^{-c_k} \left(1 - \sum \frac{p_k b_k}{m}\right)^2$$

with $\sum a_i = \sum c_i = 1$, where $w_i$ indicates the budget share of food $i$, which is between 0 and 1, $p_i$ is the price of food $i$, $h^i(m, P)$ is the Marshallian quantity demand function for food $i$, and $m$ is the total expenditure. Parameters to be estimated in the QES are $a_i$'s, $b_i$'s, $c_i$'s, and $I$. If $I=0$ or $a_i = c_i$ for all $i$, then the QES is reduced to the LES.

### C. The AIDS and LA/AIDS

Deaton and Muellbauer (1980b) developed a flexible demand system and named the Almost Ideal Demand System (AIDS). This demand system has several characteristics. The AIDS demand functions in budget share form can be expressed as:

$$(3) \qquad w_i = \frac{p_i h^i(m, \mathrm{P})}{m} = \alpha_i + \sum_k \gamma_{ik} \log p_k + \beta_i \log\left(\frac{m}{\mathrm{P}^*}\right)$$

with $\sum \alpha_i = 1$, $\sum \beta_i = \sum_i \gamma_{ij} = \sum_j \gamma_{ij} = 0$, and $\gamma_{ij} = \gamma_{ji}$ to satisfy the regularity conditions. The price index ($P^*$) in the original AIDS is given by

$$(4) \qquad \log \mathrm{P}^* = \alpha_0 + \sum \alpha_k \log p_k + \frac{1}{2} \sum \sum \gamma_{ij} \log p_i \log p_j \,.$$

If this price index is replaced by Stone's index, $\log \mathrm{P}^* = \sum w_k \log p_k$, the AIDS becomes the LA/AIDS, which reduces the AIDS to a linear model. The parameters to be estimated in the AIDS are $\alpha_i$'s, $\beta_i$'s, and $\gamma_{ij}$'s.

## (II) Incorporation of Demographic Variables

Pollak and Wales (1980, 1981) described four general procedures to incorporate demographic variables into demand systems. For demonstration, this study employs linear demographic translating as an example. Hence, the treatments of demographic effects in these three cases are expressed in (5)-(7), respectively.

(5) The Working-Leser form: $\alpha_{i0} = \alpha_{i0}^{*} + \sum_{j=1}^{m} \delta_{ij} d_j \quad \forall i$,

(6) The LES and QES: $b_i = b_i^{*} + \sum_{j=1}^{m} \delta_{ij} d_j \quad \forall i$,

(7) The AIDS and LA/AIDS: $\alpha_i = \alpha_i^{*} + \sum_{j=1}^{m} \delta_{ij} d_j \quad \forall i$,

where $d_j$**'s** are demographic variables and $\delta_{ij}$**'s** are parameters introduced to estimate. To compare the impact of the demographic translating to elasticities, for the LES and QES, demographic translating will not affect the income elasticities, but influence price elasticities. It is interesting to investigate the different consumption behavior caused by demographic variables. On the other hand, for the AIDS and LA/AIDS, since demographic variables are not directly shown in the elasticities, it is difficult to reflect the demographic effects.

### (III) Marginal Budget Share (MBS) and Elasticities

Marginal budget share indicates the marginal attitude of the householder to distribute his/her additional one-dollar of budget. That shows the relative importance of the consumption items to the household. The higher the MBS, the more utility gained from that addition amount of food item. On the other hand, elasticities are another measurement. Once we estimate the parameters, we can compare the MBS as well as price and expenditure elasticities.

## III. Data and Descriptive Analysis

Urban household data of Jiangsu, China, collected and released by the National Bureau of Statistics (NBS) in 1994, is utilized in this study. The database consists of 800 household data and provides detailed food consumption and demographic variables. Besides the quantities and expenditures, we selected eight important demographic variables in our analysis.

The variables used in the analysis are listed in Table 1 with their descriptive statistics. As can be seen, there are six food items under consideration: rice (16), flour (257), pork (3), milk (271), fresh vegetables (1), and fresh fruits (0). The figures in parentheses are the number of zero value. For example, flour and milk have almost 40 per cent of zero consumption. The demographic variables used in this paper are expressed as follows:

1. **Fridge:** Modernization index: dummy variable of having refrigerators=1 yes (603[6]) and =0 no (197);
2. **Size:** Household size (HS) =1-7;
3. **Kid:** Children under age 17 (NOCUA17) =0 (292), =1 (482), and =2 (26);
4. **Gender:** =1 male (590) and =0 female (210);
5. **Age:** =0 (378) 24-44 year-old, =1 (257) 45-59 year-old, and =2 (165) above 60 year-old;
6. **Edu:** =0 middle school or lower (369), =1 high school (279), and =2 college and above (152);
7. **Region:** =0 north (200) and =1 south (600); and
8. **Urban:** Urbanization: =1 city (600) and =0 county (200).

As mentioned before, the demographic variables may be the critical factors to influence the consumption pattern. For example, will household size a major factor to influence household consumption in Jiangsu? Besides, calcium intake is the most serious problem to Chinese inhabitants, would refrigerator be the key point, or the consumer habit? We would answer these questions later in the empirical analysis.

## IV. Empirical Results and Comparison

To estimate the unknown parameters of the selected models, this study employs the Ordinary Least Square (OLS) and Iterative Seemingly Unrelated Regression (ITSUR) procedure for single equation and CDS, respectively. The

[6] Number of observations of each category is in parentheses.

estimates, both with and without demographic variables, of the Working-Leser, LA/AIDS, LES, and QES are presented in Tables 2-6, respectively.

Tables 2 and 3 show the parameter estimates of the Working-Leser form (single equation) with and without demographic effects. As can be seen, most of the parameters are statistically significant. However, it is surprising that the prices of rice and pork are not significant in the corresponding equations. In addition, income is not significant factor to rice equation without demographic variables. We might guess that the rationing still influenced the consumption behavior in rice. For flour, the income is not significant, either. As to the demographic variables, refrigerator and region have significant impact on the performance of the model. For milk, we can tell that education is another important factor except refrigerator and region. The number of children under age 17 is influential to budget share of pork and fresh vegetables. Surprisingly, household size has no effect at all. The reason might due to the multicollinearity to the number of children.

In our analysis, we suppose that the food consumption patterns of Jiangsu urban household satisfies utility maximization. Therefore, the adding-up, homogeneity, and symmetry properties are maintained in the model. Tables 4 and 5 represent the parameter estimates of the LA/AIDS model both with and without demographic variables. As can be seen, more than halves of the parameters are significant in both cases. Not surprisingly, the parameters of $\gamma_{11}$ (rice) and $\gamma_{33}$ (pork) are insignificant. However, all the betas are significant from zero. That indicates the income effects are statistically significant in the LA/AIDS. Including the demographic variables, the influence of refrigerator is still obvious except pork. Education of householder is another important factor to consumption except rice. Region difference of rice and flour is still significant. As to milk consumption, only refrigerator and education variables are significant. However, household size is still not important except to pork consumption in the LA/AIDS.

Comparing the LA/AIDS with the Working-Leser functional forms, it is obvious that they are very similar. For example, the signs of the rice, flour, and milk in the Working-Leser and the LA/AIDS are the same with little difference in magnitude. The functions of pork and fresh vegetables in both models have a few opposite signs only.

The results of the LES and the QES both with and without demographic effects are presented in Table 6. As can be seen, most of the estimates are statistically significant. The overall performances are good to the LES and QES. All the significant parameters $\alpha_i$**'s** indicates that income effects are significant. It is similar to the LA/AIDS model. It is not clear to tell the price effect with the result of parameter estimates. However, $\lambda$ in the QES with demographic variables is not significant indicates that it is possible to reduce the QES to the LES. The demographic effects in the LES and QES are quite similar due to nesting. There are several interesting evidences between the LES and QES with demographic variables. First, all the variables (8 demographic variables times 6 commodities) are included in each function to be estimated. It is hard to tell the influence of the demographic variables on the commodities. Second, gender of householder is not significant in all the estimates. It can be due to the property of the LES and QES. Third, unlike the LA/AIDS, demographic variables for milk equation are all insignificant. On the other hand, all the demographic variables excluding gender are significant in both the LES and QES. Forth, the education, region, and urban variables performed different in the LES and QES. Most of the region variables are significant in the QES, but insignificant in the LES, whereas urban variable is significant in the LES, but not significant in the QES except milk.

Table 7 represents the Root MSE and adjusted $R^2$ in the selected models. The Root MSE and $R^2$ indicate the same criteria but in the opposite direction to the performance of the model. Namely, the larger the $R^2$, the less the Root MSE, the better the performance. As can be seen, the performance with incorporating demographic variables is much better especially in flour equation of complete demand systems. For example, in the LA/AIDS model, the $R^2$ is improved from 20% to 45%. However, there is one exception that the fresh vegetables in the QES have lower $R^2$ with demographic variables (dropping from 72% down to 66%). Generally speaking, the $R^2$ of the LES and QES for rice, pork, and fresh vegetables (the three major food items in Chinese food consumption) are outstanding. However, the single equation model for flour and milk both with and without considering the demographic effects is superior to the complete demand systems. Therefore, the selection of models is an important work.

Table 8 shows the comparison of marginal budget share of the selected models. It is hardly to see the comparison of budget share in the literature especially for the AIDS model. The MBS of the Working-Leser and LA/AIDS have the same formula, that is the sum of budget share and parameter estimate beta. The MBS of the LES is constant ($\alpha_i$) but has a complicated form for the QES. As can be seen, it is obvious that people in urban Jiangsu will spend additional budget on pork, rice, and fresh vegetables more than the other food items. Moreover, the MBS is different for flour, pork, and milk, but quite similar for rice, fresh vegetables, and fresh fruits. For example, the

MBS for pork in the LA/AIDS is lower than the others. However, the MBS of milk in the LES and QES is higher than that in the LA/AIDS and Working-Leser; whereas the MBS for flour between these two groups is reversed.

Expenditure and price elasticities are the major indicators in demand analysis. Tables 9 and 10 show the expenditure and own-price elasticities among the selected models in Jiangsu, 1994. In Table 9, the expenditure elasticities perform the similar trend like MBS due to the usage of the same parameter estimates. The demographic effects on expenditure elasticities are ambiguous except fresh fruits. The elasticities go up in the selected models. Expenditure elasticity for flour in the LA/AIDS is close to 1.5 and that of milk in the LES is more than 1.6, both without demographic effects. That means as income increases, people would like to spend more to eat flour and milk to increase their utility. In Table 10, since the demographic variables affect the price elasticities in the LES and QES directly, we have to specify the demographic variables in order to demonstrate the price elasticity for classification. In the case of no effects from demographic variables, the results have the similar trend except rice and flour in the LES, which are below unity. It is obvious that the own-price elasticities of flour in the LES and QES are quite different with and without demographic effects. It is very hard to explain in the QES due to its complexity. However, in the LES, the reason of positive own-price elasticity is not only due to the significant estimate of $b_2$ and has a large value (58.96, in table 6) but also due to the decomposition of $b_i$ in equation (6). For example, we can specify the price elasticities for different demographic group of people in the LES and QES, whereas we only general elasticities for the LA/AIDS and Working-Leser.

## V. Conclusion

In our study, we first summarize three commonly used demand models including single equation and complete demand systems such as the LES, QES and LA/AIDS. Since the cross-sectional data are utilized in analyzing the consumption behavior in Jiangsu, 1994, the effects of demographic variables on food consumption are investigated. Most of the parameter estimates are statistically significant and suitable to analyze the marginal budget share and elasticities. The comparisons of the selected models, both with and without incorporation of the demographic variables indicate that the choices of functional forms and treatment of translating demographic effects are important in the empirical studies.

As to the model specification, the performance of the Working-Leser is similar to that of the LA/AIDS. However, single equation functional form is easy to execute computation work but difficult to impose or test the regularity conditions. On the other hand, the LES is nested in the QES. Hence, the results of the LES and QES are not extremely different. Since the demand properties have already been imposed in the model, we can hardly test whether or not the regularity conditions are satisfied using the urban household data. Therefore, before using the LES and QES, we should guarantee that the observations satisfied the assumption of utility maximization.

The eight plausible demographic variables are selected in the study. The effects of each demographic variable are different in the selected models. Generally speaking, the modernization indicator, the dummy variable of refrigerator, is significant, whereas the dummy variable of gender of householder is not. As mentioned before, the effects of demographic variables in the LES and QES are ambiguous. We still can conclude that, for rice and flour, the dummy variables for region and urbanization are significant. For milk, education level is significant in the Working-Leser and LA/AIDS. Household size and the number of children under age 17 are significant in the LES and QES, whereas it is not quite obvious in the Working-Leser and LA/AIDS. The statistical criteria also indicate that incorporation of the demographic effects is valuable.

As for flour and milk, even though there exists serious problem of zero consumption in the database, the performance of flour and milk are acceptable based on the Root MSE or adjusted $R^2$ criteria. The censored regression and price endogenous approaches are not applied in this study. It should be very interesting to compare the results using the different approaches to solve the problem.

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Table 1
Definitions and descriptive statistics of variables used in the selected models*

| Group | Variable** | Sample Mean | Standard Deviation | Minimum Value | Maximum Value | # of Zero Value |
|---|---|---|---|---|---|---|
| Budget | $W_1$ | 0.217 | 0.100 | 0.000 | 0.670 | 16 |
| Share | $W_2$ | 0.026 | 0.057 | 0.000 | 0.398 | 257 |
| | $W_3$ | 0.328 | 0.103 | 0.000 | 0.638 | 3 |
| | $W_4$ | 0.034 | 0.056 | 0.000 | 0.523 | 271 |
| | $W_5$ | 0.234 | 0.072 | 0.000 | 0.641 | 1 |
| | $W_6$ | 0.160 | 0.098 | 0.003 | 0.930 | 0 |
| Price | $P_1$ | 2.106 | 0.245 | 1.190 | 4.188 | |
| | $P_2$ | 1.887 | 0.300 | 1.000 | 5.600 | |
| | $P_3$ | 11.063 | 1.320 | 6.765 | 15.477 | |
| | $P_4$ | 8.794 | 6.501 | 1.137 | 49.167 | |
| | $P_5$ | 1.432 | 0.390 | 0.506 | 3.864 | |
| | $P_6$ | 1.911 | 0.718 | 0.625 | 8.000 | |
| Expenditure | $X_1$ | 461.013 | 276.811 | 0.000 | 1804.140 | 16 |
| | $X_2$ | 47.541 | 104.145 | 0.000 | 835.989 | 257 |
| | $X_3$ | 695.346 | 365.575 | 0.000 | 2094.790 | 3 |
| | $X_4$ | 68.755 | 121.378 | 0.000 | 1006.100 | 271 |
| | $X_5$ | 492.287 | 267.537 | 0.000 | 3359.250 | 1 |
| | $X_6$ | 311.259 | 187.517 | 5.100 | 1791.680 | 0 |
| | X*** | 2076.200 | 790.204 | 355.797 | 6090.660 | |
| Log(Price) | $LOGP_1$ | 0.738 | 0.115 | 0.174 | 1.432 | |
| | $LOGP_2$ | 0.624 | 0.147 | 0.000 | 1.723 | |
| | $LOGP_3$ | 2.396 | 0.124 | 1.912 | 2.739 | |
| | $LOGP_4$ | 1.925 | 0.715 | 0.129 | 3.895 | |
| | $LOGP_5$ | 0.322 | 0.279 | -0.681 | 1.352 | |
| | $LOGP_6$ | 0.587 | 0.344 | -0.470 | 2.079 | |
| Demographic | FRIDGE | 0.754 | 0.431 | 0.000 | 1.000 | |
| Variables | SIZE | 3.191 | 0.891 | 1.000 | 7.000 | |
| Or | KID | 0.668 | 0.536 | 0.000 | 2.000 | |
| Dummy | GENDER | 0.738 | 0.440 | 0.000 | 1.000 | |
| Variables | AGE | 0.734 | 0.780 | 0.000 | 2.000 | |
| | EDU | 0.729 | 0.761 | 0.000 | 2.000 | |
| | REGION | 0.750 | 0.433 | 0.000 | 1.000 | |
| | URBAN | 0.750 | 0.433 | 0.000 | 1.000 | |

* Total observations are 800.
** Subscript indicates the food items analyzed in the models: 1=rice, 2=flour, 3=pork, 4=milk and its products, 5= fresh vegetables, and 6= fresh fruits.
*** Total expenditures of the food items included in the model.

Table 2
The parameter estimates of the Working-Leser form without demographic effects, Jiangsu, 1994.

| Items | Rice | Flour | Pork | Milk and its Products | Fresh Vegetables | Fresh Fruits |
|---|---|---|---|---|---|---|
| Intercept | -0.4455* | 0.3327* | -0.1680 | 0.1640* | 0.3531* | 0.7636* |
| | (0.0936) | (0.0484) | (0.1002) | (0.0500) | (0.0692) | (0.0877) |
| $LOGP_1$ | -0.0360 | 0.0143 | -0.0211 | 0.0423* | -0.0589* | 0.0594* |
| | (0.0310) | (0.0160) | (0.0332) | (0.0166) | (0.0229) | (0.0291) |
| $LOGP_2$ | 0.0697* | -0.0687* | 0.0544* | 0.0234 | -0.0554* | -0.0234 |
| | (0.0256) | (0.0132) | (0.0274) | (0.0137) | (0.0189) | (0.0240) |
| $LOGP_3$ | 0.1298* | -0.0937* | 0.0222 | -0.0043 | -0.0816* | 0.0277 |
| | (0.0371) | (0.0192) | (0.0397) | (0.0198) | (0.0274) | (0.0347) |
| $LOGP_4$ | 0.0252* | -0.0096* | 0.0244* | -0.0302* | 0.0043 | -0.0142* |
| | (0.0047) | (0.0024) | (0.0050) | (0.0025) | (0.0035) | (0.0044) |
| $LOGP_5$ | -0.1079* | -0.0414* | 0.0240 | -0.0061 | 0.1132* | 0.0182 |
| | (0.0169) | (0.0087) | (0.0181) | (0.0090) | (0.0125) | (0.0158) |
| $LOGP_6$ | -0.0319* | -0.0262* | -0.0263* | 0.0317* | -0.0183* | 0.0711* |
| | (0.0112) | (0.0058) | (0.0120) | (0.0060) | (0.0083) | (0.0105) |
| LOGX | 0.0449 | -0.0003 | 0.0509* | -0.0164* | 0.0160* | -0.0951* |
| | (0.0088) | (0.0045) | (0.0094) | (0.0047) | (0.0065) | (0.0082) |

Note: * the asterisk indicates that the estimated coefficient is statistically significant at 5% or better.

Table 3
The parameter estimates of the Working-Leser form with demographic variables, Jiangsu 1994.

| Items | Rice | Flour | Pork | Milk and its Products | Fresh Vegetables | Fresh Fruits |
|---|---|---|---|---|---|---|
| Intercept | -0.2707* | 0.1381* | -0.1637 | 0.2128* | 0.5225* | 0.5610* |
| | (0.1042) | (0.0482) | (0.1076) | (0.0553) | (0.0759) | (0.0939) |
| $LOGP_1$ | -0.0443 | -0.0016 | 0.0306 | 0.0378* | -0.0516* | 0.0291 |
| | (0.0312) | (0.0144) | (0.0322) | (0.0166) | (0.0227) | (0.0281) |
| $LOGP_2$ | 0.0559* | -0.0447* | 0.0576* | 0.0157 | -0.0582* | -0.0262 |
| | (0.0258) | (0.0119) | (0.0266) | (0.0137) | (0.0188) | (0.0232) |
| $LOGP_3$ | 0.0763 | -0.0200 | 0.0256 | -0.0263 | -0.1186* | 0.0630 |
| | (0.0392) | (0.0181) | (0.0405) | (0.0208) | (0.0286) | (0.0353) |
| $LOGP_4$ | 0.0262* | -0.0058* | 0.0142* | -0.0289* | 0.0024 | -0.0081 |
| | (0.0048) | (0.0022) | (0.0050) | (0.0026) | (0.0035) | (0.0043) |
| $LOGP_5$ | -0.1211* | -0.0145 | 0.0351 | -0.0187* | 0.1136* | 0.0056 |
| | (0.0177) | (0.0082) | (0.0183) | (0.0094) | (0.0129) | (0.0160) |
| $LOGP_6$ | -0.0370* | -0.0125* | -0.0276* | 0.0252* | -0.0203* | 0.0724* |
| | (0.0113) | (0.0052) | (0.0117) | (0.0060) | (0.0082) | (0.0102) |
| LOGX | 0.0382* | 0.0023 | 0.0536* | -0.0189* | 0.0035 | -0.0787* |
| | (0.0101) | (0.0047) | (0.0104) | (0.0053) | (0.0073) | (0.0091) |
| $\delta_{i1}$(FRIDGE) | -0.0200* | -0.0089* | -0.0102 | 0.0144* | -0.0134* | 0.0380* |
| | (0.0085) | (0.0039) | (0.0088) | (0.0045) | (0.0062) | (0.0077) |
| $\delta_{i2}$ (SIZE) | -0.0003 | 0.0028 | -0.0085 | 0.0015 | 0.0024 | 0.0021 |
| | (0.0044) | (0.0021) | (0.0046) | (0.0024) | (0.0032) | (0.0040) |
| $\delta_{i3}$ (KID) | -0.0063 | -0.0034 | 0.0181* | 0.0071 | -0.0195* | 0.0040 |
| | (0.0082) | (0.0038) | (0.0084) | (0.0043) | (0.0059) | (0.0074) |
| $\delta_{i4}$ (GENDER) | 0.0048 | -0.0016 | 0.0054 | -0.0066 | 0.0132* | -0.0152* |
| | (0.0075) | (0.0035) | (0.0077) | (0.0040) | (0.0054) | (0.0067) |
| $\delta_{i5}$ (AGE) | -0.0045 | 0.0084* | 0.0034 | 0.0021 | 0.0018 | -0.0112* |
| | (0.0054) | (0.0025) | (0.0056) | (0.0029) | (0.0039) | (0.0049) |
| $\delta_{i6}$ (EDU) | -0.0033 | -0.0038 | -0.0058 | 0.0083* | -0.0076* | 0.0121* |
| | (0.0045) | (0.0021) | (0.0046) | (0.0024) | (0.0033) | (0.0040) |
| $\delta_{i7}$ (REGION) | 0.0393* | -0.0673* | 0.0301* | 0.0135* | 0.0294* | -0.0450* |
| | (0.0110) | (0.0051) | (0.0114) | (0.0058) | (0.0080) | (0.0099) |
| $\delta_{i8}$ (URBAN) | 0.0236* | 0.0253* | -0.0778* | 0.0037 | 0.0034 | 0.0218* |
| | (0.0086) | (0.0040) | (0.0089) | (0.0046) | (0.0063) | (0.0078) |

Note: * the asterisk indicates that the estimated coefficient is statistically significant at 5% or better.

Table 4
The estimated parameters of the LA/AIDS without demographic effects, Jiangsu, 1994.

| Parameter | Rice | Flour | Pork | Milk and its Products | Fresh Vegetables |
|---|---|---|---|---|---|
| $\alpha_I$ | -0.2430* | -0.1049* | 0.6836* | 0.1751* | -0.0340 |
| | (0.0605) | (0.0371) | (0.0716) | (0.0293) | (0.0429) |
| $\beta_I$ | 0.0752* | 0.0123* | -0.0631* | -0.0179* | 0.0448* |
| | (0.0082) | (0.0046) | (0.0090) | (0.0045) | (0.0060) |
| $\gamma_{i1}$ | -0.0280 | | | | |
| | (0.0228) | | | | |
| $\gamma_{i2}$ | 0.1031* | -0.0241 | | | |
| | (0.0123) | (0.0132) | | | |
| $\gamma_{i3}$ | -0.0322 | 0.0132 | 0.0241 | | |
| | (0.0211) | (0.0146) | (0.0300) | | |
| $\gamma_{i4}$ | 0.0203* | -0.0020 | 0.0063 | -0.0300* | |
| | (0.0041) | (0.0025) | (0.0045) | (0.0024) | |
| $\gamma_{i5}$ | -0.0492* | -0.0652* | 0.0060 | 0.0066* | 0.1027* |
| | (0.0114) | (0.0078) | (0.0132) | (0.0030) | (0.0110) |

Note: * the asterisk indicates that the estimated coefficient is statistically significant at 5% or better.

Table 5
The estimated parameters of the LA/AIDS model with demographic variables, Jiangsu, 1994.

| Parameter | Rice | Flour | Pork | Milk and its Products | Fresh Vegetables |
|---|---|---|---|---|---|
| $\alpha_I$ | -0.3636* | -0.0444 | 0.8002* | 0.1409* | 0.0548 |
| | (0.0635) | (0.0333) | (0.0713) | (0.0310) | (0.0460) |
| $\beta_I$ | 0.0767* | 0.0090* | -0.0836* | -0.0164* | 0.0435* |
| | (0.0091) | (0.0044) | (0.0096) | (0.0050) | (0.0067) |
| $\gamma_{i1}$ | 0.0036 | | | | |
| | (0.0249) | | | | |
| $\gamma_{i2}$ | 0.0330* | -0.0253* | | | |
| | (0.0113) | (0.0109) | | | |
| $\gamma_{i3}$ | 0.0215 | 0.0288* | -0.0033 | | |
| | (0.0215) | (0.0126) | (0.0281) | | |
| $\gamma_{i4}$ | 0.0289* | -0.0045* | -0.0013 | -0.0266* | |
| | (0.0043) | (0.0022) | (0.0045) | (0.0025) | |
| $\gamma_{i5}$ | -0.0631* | -0.0227* | -0.0167 | 0.0020 | 0.1047* |
| | (0.0126) | (0.0073) | (0.0136) | (0.0032) | (0.0122) |
| $\delta_{i1}$(FRIDGE) | -0.0230* | -0.0112* | -0.0019 | 0.0130* | -0.0178* |
| | (0.0081) | (0.0039) | (0.0084) | (0.0044) | (0.0060) |
| $\delta_{i2}$ (SIZE) | -0.0061 | 0.0022 | 0.0140* | 0.0010 | -0.0037 |
| | (0.0043) | (0.0021) | (0.0045) | (0.0024) | (0.0032) |
| $\delta_{i3}$ (KID) | -0.0011 | -0.0019 | 0.0009 | 0.0081 | -0.0139* |
| | (0.0080) | (0.0038) | (0.0083) | (0.0044) | (0.0059) |
| $\delta_{i4}$ (GENDER) | 0.0070 | -0.0016 | 0.0009 | -0.0055 | 0.0130* |
| | (0.0073) | (0.0035) | (0.0076) | (0.0040) | (0.0054) |
| $\delta_{i5}$ (AGE) | -0.0073 | 0.0085* | 0.0166* | 0.0023 | -0.0021 |
| | (0.0052) | (0.0025) | (0.0054) | (0.0029) | (0.0038) |
| $\delta_{i6}$ (EDU) | -0.0028 | -0.0042* | -0.0098* | 0.0091* | -0.0077* |
| | (0.0044) | (0.0021) | (0.0045) | (0.0024) | (0.0032) |
| $\delta_{i7}$ (REGION) | 0.0364* | -0.0766* | 0.0786* | 0.0071 | 0.0067 |
| | (0.0091) | (0.0043) | (0.0090) | (0.0045) | (0.0065) |
| $\delta_{i8}$ (URBAN) | 0.0111 | 0.0208* | -0.0653* | 0.0050 | -0.0062 |
| | (0.0082) | (0.0039) | (0.0085) | (0.0045) | (0.0061) |

Note: * the asterisk indicates that the estimated coefficient is statistically significant at 5% or better.

Table 6
The parameter estimates of the LES and QES, Jiangsu, 1994.

| Parameter | Without demographic variables | | With demographic variables | |
|---|---|---|---|---|
| | LES | QES | LES | QES |
| A1 | 0.2481* | 0.2414* | 0.2431* | 0.1984* |
| | (0.0086) | (0.0095) | (0.0103) | (0.0180) |
| A2 | 0.0164* | 0.0289* | 0.0183* | 0.0347* |
| | (0.0047) | (0.0057) | (0.0045) | (0.0077) |
| A3 | 0.3502* | 0.4319* | 0.3558* | 0.3499* |
| | (0.0102) | (0.0154) | (0.0118) | (0.0180) |
| A4 | 0.0545* | 0.0428* | 0.0590* | 0.0917* |
| | (0.0039) | (0.0035) | (0.0042) | (0.0103) |
| A5 | 0.2221* | 0.1642* | 0.2052* | 0.2061* |
| | (0.0071) | (0.0101) | (0.0081) | (0.0123) |
| B1 | 30.743* | -58.714* | 79.588 | 30.321 |
| | (14.158) | (21.378) | (53.927) | (39.586) |
| B2 | 8.6301 | -8.2073 | 58.9567* | 50.3479* |
| | (4.5761) | (6.9746) | (9.4155) | (9.0829) |
| B3 | 12.6327* | -25.451* | 29.6536* | 13.7629 |
| | (3.9081) | (7.6165) | (15.067) | (11.040) |
| B4 | -3.2079* | -4.2854* | -1.2959 | -5.1548* |
| | (0.5741) | (0.5847) | (2.7075) | (1.9531) |
| B5 | 102.582* | 14.0233 | 166.509* | 95.936 |
| | (16.918) | (21.993) | (69.154) | (52.375) |
| B6 | 66.4725* | 43.3354* | 86.5347* | 58.1824* |
| | (6.7649) | (7.8259) | (30.845) | (24.589) |
| C1 | | 0.2810 | | 0.7909* |
| | | (0.1508) | | (0.1795) |
| C2 | | 0.4383* | | -0.1588* |
| | | (0.1178) | | (0.0715) |
| C3 | | 2.7050* | | 0.5271* |
| | | (0.2439) | | (0.1478) |
| C4 | | 0.0641 | | -0.5956* |
| | | (0.0516) | | (0.1632) |
| C5 | | -2.4185* | | 0.3159* |
| | | (0.2507) | | (0.1054) |
| $\lambda$ | | -0.0019* | | 0.0001 |
| | | (0.0006) | | (0.0000) |

Note: the asterisk indicates that the estimated coefficient is statistically significant at 5% or better.

| Parameter | With demographic variables | | Parameter | With demographic variables | |
|---|---|---|---|---|---|
| | LES | QES | | LES | QES |
| $\delta_{0101}$ | -144.9524* | -116.164* | $\delta_{0201}$ | -21.5435* | -20.9127* |
| | (26.3270) | (20.3032) | | (5.0611) | (4.7882) |
| $\delta_{0102}$ | 46.4375* | 42.2993* | $\delta_{0202}$ | 8.8298* | 8.9442* |
| | (12.7485) | (9.6845) | | (2.2580) | (2.1435) |
| $\delta_{0103}$ | -90.5358* | -60.4366* | $\delta_{0203}$ | -13.7775* | -10.9867* |
| | (25.6334) | (20.5250) | | (4.6553) | (4.3284) |
| $\delta_{0104}$ | 3.8424 | 16.9873 | $\delta_{0204}$ | -1.5424 | -0.8111 |
| | (21.9044) | (17.4739) | | (3.9897) | (3.8774) |
| $\delta_{0105}$ | -4.9257 | 4.1738 | $\delta_{0205}$ | 6.8193* | 8.0180* |
| | (16.0699) | (12.5606) | | (2.9512) | (2.7849) |
| $\delta_{0106}$ | -15.8161 | -17.4001 | $\delta_{0206}$ | -6.2826* | -6.8254* |
| | (13.1672) | (10.4281) | | (2.3498) | (2.2693) |
| $\delta_{0107}$ | 46.6385 | 51.3805* | $\delta_{0207}$ | -79.7320* | -79.2642* |
| | (27.2293) | (19.7793) | | (4.8005) | (4.6599) |
| $\delta_{0108}$ | -53.1380* | -16.3955 | $\delta_{0208}$ | 14.5777* | 15.1293* |
| | (25.8849) | (19.3501) | | (4.7054) | (4.4648) |
| $\delta_{0301}$ | -30.5129* | -23.4576* | $\delta_{0401}$ | -2.4429 | -0.2617 |
| | (7.2756) | (5.7141) | | (1.3106) | (1.0487) |
| $\delta_{0302}$ | 10.7151* | 9.6829* | $\delta_{0402}$ | 0.3957 | 0.4378 |
| | (3.4915) | (2.6261) | | (0.6592) | (0.4662) |
| $\delta_{0303}$ | -20.2544* | -11.7784* | $\delta_{0403}$ | -1.3871 | 1.4060 |
| | (7.0855) | (5.6671) | | (1.2598) | (0.9395) |
| $\delta_{0304}$ | -0.6382 | 3.0187 | $\delta_{0404}$ | -0.0060 | -0.4144 |
| | (6.0068) | (4.7985) | | (1.1357) | (0.8381) |
| $\delta_{0305}$ | -1.2552 | 1.3741 | $\delta_{0405}$ | -0.6344 | 0.7739 |
| | (4.3973) | (3.4250) | | (0.8204) | (0.6021) |
| $\delta_{0306}$ | -4.5932 | -5.2467 | $\delta_{0406}$ | 0.8300 | 0.8777 |
| | (3.5569) | (2.8231) | | (0.6909) | (0.5013) |
| $\delta_{0307}$ | 18.4229* | 19.4032* | $\delta_{0407}$ | 1.1612 | 1.5016 |
| | (7.9074) | (5.8679) | | (1.5264) | (1.1119) |
| $\delta_{0308}$ | -30.4235* | -21.1770* | $\delta_{0408}$ | -2.2284 | -0.9262 |
| | (7.1272) | (5.3845) | | (1.3168) | (0.9745) |
| $\delta_{0501}$ | -168.7791* | -139.135* | $\delta_{0601}$ | -9.4579 | 3.3799 |
| | (33.0929) | (26.7290) | | (14.3122) | (11.9399) |
| $\delta_{0502}$ | 65.0168* | 59.8226* | $\delta_{0602}$ | 19.5203* | 17.5827* |
| | (15.8450) | (12.3591) | | (7.0385) | (5.7459) |
| $\delta_{0503}$ | -141.1751* | -104.875* | $\delta_{0603}$ | -40.8808* | -24.0133* |
| | (31.5464) | (26.0449) | | (14.4814) | (12.1675) |
| $\delta_{0504}$ | 6.7751 | 22.1614 | $\delta_{0604}$ | -2.6094 | 2.6731 |
| | (25.7550) | (21.1569) | | (11.5027) | (9.7462) |
| $\delta_{0505}$ | 1.7664 | 12.6014 | $\delta_{0605}$ | -22.0240* | -16.2612* |
| | (19.5289) | (15.7017) | | (8.7562) | (7.2413) |
| $\delta_{0506}$ | -22.2919 | -25.6142* | $\delta_{0606}$ | 8.8532 | 7.9781 |
| | (15.6423) | (12.7836) | | (6.8379) | (5.7594) |
| $\delta_{0507}$ | 72.5572 | 77.5623* | $\delta_{0607}$ | -31.8819 | -30.2018* |
| | (38.7308) | (29.6610) | | (17.1588) | (13.6439) |
| $\delta_{0508}$ | -85.6826* | -45.9147 | $\delta_{0608}$ | -17.2091 | -0.9137 |
| | (31.7715) | (24.7626) | | (14.3719) | (11.6598) |

Note: the asterisk indicates that the estimated coefficient is statistically significant at 5% or better.

Table 7
Comparison of Root MSE and Adjusted $R^2$ in the selected models, Jiangsu, 1994.

| Group | Items | Rice | Flour | Pork | Milk and its Products | Fresh Vegetables | Fresh Fruits |
|---|---|---|---|---|---|---|---|
| | | | No DemographicVariables | | | | |
| Working-Leser | Root MSE | 0.0926 | 0.0479 | 0.0991 | 0.0494 | 0.0684 | 0.0868 |
| | Adj. $R^2$ | 0.1422 | 0.3048 | 0.0781 | 0.2109 | 0.1023 | 0.2125 |
| LA/AIDS | Root MSE | 0.0911 | 0.0514 | 0.0992 | 0.0504 | 0.0670 | |
| | Adj. $R^2$ | 0.1684 | 0.1975 | 0.0768 | 0.1782 | 0.1388 | |
| LES | Root MSE | 194.048 | 105.617 | 219.654 | 117.198 | 164.808 | |
| | Adj. $R^2$ | 0.5086 | -0.0285 | 0.639 | 0.0677 | 0.6205 | |
| QES | Root MSE | 195.288 | 104.123 | 220.328 | 114.790 | 142.115 | |
| | Adj. $R^2$ | 0.5023 | 0.0004 | 0.6368 | 0.1056 | 0.7178 | |
| | | | With DemographicVariables | | | | |
| Working-Leser | Root MSE | 0.0913 | 0.0422 | 0.0942 | 0.0484 | 0.0665 | 0.0822 |
| | Adj. $R^2$ | 0.1662 | 0.4590 | 0.1667 | 0.2428 | 0.1526 | 0.2928 |
| LA/AIDS | Root MSE | 0.0890 | 0.0426 | 0.0928 | 0.0491 | 0.0656 | |
| | Adj. $R^2$ | 0.2077 | 0.4492 | 0.1918 | 0.2215 | 0.1747 | |
| LES | Root MSE | 191.751 | 83.605 | 211.111 | 112.929 | 157.345 | |
| | Adj. $R^2$ | 0.5201 | 0.3555 | 0.6665 | 0.1344 | 0.6541 | |
| QES | Root MSE | 190.030 | 83.198 | 210.631 | 109.527 | 156.294 | |
| | Adj. $R^2$ | 0.5287 | 0.3618 | 0.6680 | 0.1857 | 0.6587 | |

Table 8
Comparison of MBS in the selected models, Jiangsu, 1994.

| Group | Rice | Flour | Pork | Milk and its Products | Fresh Vegetables | Fresh Fruits |
|---|---|---|---|---|---|---|
| | | | No DemographicVariables | | | |
| Working-Leser | 0.2624 | 0.0261 | 0.3787 | 0.0174 | 0.2502 | 0.0652 |
| LA/AIDS | 0.2926 | 0.0387 | 0.2648 | 0.0160 | 0.2790 | 0.1090 |
| LES | 0.2481 | 0.0164 | 0.3502 | 0.0545 | 0.2221 | 0.1087 |
| QES | 0.2407 | 0.0212 | 0.3894 | 0.0424 | 0.2126 | 0.0938 |
| | | | With DemographicVariables | | | |
| Working-Leser | 0.2556 | 0.0287 | 0.3814 | 0.0150 | 0.2377 | 0.0816 |
| LA/AIDS | 0.2942 | 0.0354 | 0.2442 | 0.0175 | 0.2776 | 0.1311 |
| LES | 0.2431 | 0.0183 | 0.3558 | 0.0590 | 0.2052 | 0.1186 |
| QES | 0.2516 | 0.0174 | 0.3658 | 0.0301 | 0.2159 | 0.1193 |

Table 9
Comparison of Expenditure elasticities in the selected models, Jiangsu, 1994.

| Group | Rice | Flour | Pork | Milk and its Products | Fresh Vegetables | Fresh Fruits |
|---|---|---|---|---|---|---|
| | | No DemographicVariables | | | | |
| Working-Leser | 1.2067 | 0.9879 | 1.1553 | 0.5149 | 1.0682 | 0.4070 |
| LA/AIDS | 1.3457 | 1.4643 | 0.8077 | 0.4725 | 1.1913 | 0.6798 |
| LES | 1.1410 | 0.6220 | 1.0683 | 1.6086 | 0.9485 | 0.6782 |
| QES | 1.1069 | 0.8030 | 1.1879 | 1.2512 | 0.9076 | 0.5850 |
| | | With DemographicVariables | | | | |
| Working-Leser | 1.1755 | 1.0877 | 1.1636 | 0.4430 | 1.0149 | 0.5090 |
| LA/AIDS | 1.3530 | 1.3392 | 0.7450 | 0.5172 | 1.1855 | 0.8178 |
| LES | 1.1182 | 0.6916 | 1.0855 | 1.7414 | 0.8763 | 0.7399 |
| QES | 1.1571 | 0.6569 | 1.1159 | 0.8874 | 0.9219 | 0.7443 |

Table 10
Comparison of own-price elasticities in the selected models, Jiangsu, 1994.

| Group | Rice | Flour | Pork | Milk and its Products | Fresh Vegetables | Fresh Fruits |
|---|---|---|---|---|---|---|
| | | No DemographicVariables | | | | |
| Working-Leser | -1.1658 | -3.5987 | -0.9324 | -1.8904 | -0.5167 | -0.5564 |
| LA/AIDS | -1.1289 | -1.9126 | -0.9266 | -1.8847 | -0.5616 | -0.6364 |
| LES | -0.8944 | -0.6632 | -0.8694 | -1.3880 | -0.7679 | -0.6363 |
| QES | -1.2031 | -1.2329 | -1.0462 | -1.5245 | -0.6793 | -0.7581 |
| | | With DemographicVariables | | | | |
| Working-Leser | -1.2037 | -2.6909 | -0.9219 | -1.8528 | -0.5147 | -0.5486 |
| LA/AIDS | -0.9834 | -1.9592 | -1.0102 | -1.7867 | -0.5529 | -0.5974 |
| LES | -0.7248 | 1.2967 | -0.6961 | -1.1560 | -0.6150 | -0.5318 |
| QES | -0.9676 | 0.9179 | -0.8705 | -2.0567 | -0.7861 | -0.6855 |