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AN APPLICATION OF ALMOST IDEAL DEMAND SYSTEM USING CHINESE DATA[1]

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SUMMARY : *A model of Chinese meat demand system is estimated using Linear Approximation of Almost Ideal Demand System. The results are used to test the hypotheses of substitutability of various meats and increase in the share of meat demand. Comparison is also made between low and high income groups. With some exceptions, the estimated elasticities satisfy the theoretical assumptions of economic theory in sign. Estimated cross-price elasticities reject first hypothesis of substitutability. Except beef, all expenditure elasticities accept second hypothesis that claim increase in the share of meat demand.*

İDEALE YAKIN TALEP SİSTEMİNİN UYGULANMASI ÜZERİNE BİR ARAŞTIRMA

ÖZET : *Bu çalışmada ideale Yakın Talep Sistemi kullanılarak, Çin et talebi sisteminin bir modeli tahmin edilmiştir. Araştırma sonuçları kullanılarak değişik etler arasındaki ikame edilebilirlik ve et talebi payının artması hipotezleri test edilmiştir. Ayrıca, yüksek ve düşük gelir grupları arasında karşılaştırma yapılmıştır. Tahmin edilen elastikiyetler, ekonomik teorinin faraziyelerini tatmin etmektedirler. Bazı istisnalar hariç, tahmin edilen çapraz fiyat elastikiyetleri et grupları arasındaki ikame edilebilirlik hipotezini reddetmektedir. Sığır eti hariç, gelir elastikiyetleri, et talebi payının artacağı hipotezini kabul etmektedir.*

INTRODUCTION

Meat consumption occupies a significant share in the food expenditure of Chinese people. Meat consumption share in total food expenditure is 12.7 % in average, 11.5 % for low income, and 13.6 % for high income consumers according to 1985-88 data. This information leads to predict that meat demand will have larger share in the future as long as income level continues to increase in China. Besides, it is attractive to do analysis on the demand of meat as a nonstaple food in China on which consumer choices can be made rationally.

The study, Testing Restrictions on a Model of Japanese Meat Demand (Dermot et al., 1990), uses an almost ideal demand system model of the Japanese meat sector. The data satisfy both symmetry and homogenity. The results show that there is complementarity between chicken and dairy beef and chicken and beef and also indicate that fish can be treated

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as separable in the Japanese meat demand system. The study, A Dynamic Generalization of the Almost Ideal Demand System (Ray, 1984), estimates parameters on time series 1900-80 data using a dynamic generalization of the almost ideal demand system. The results indicate that generalization to the dynamic AIDS is a potential and useful method for future studies. In another study, Effects of Rationing on the Consumption Behavior of Chinese Urban Household during 1981-87 (Wang and Chern, 1992), the impacts of housing, fuel and food grain rationing on consumption behavior of Chinese urban households are investigated. Four versions of almost ideal demand system with different rationed goods were analyzed. One of the results related to meat consumption is that assuming current rationing systems remain the same, Chinese urban households would continue to increase their demand for nonstaple food, particularly for meat.

In this paper, a model of Chinese meat demand system is estimated and used to test two hypotheses and make comparison between low and high income level of households. One of the hypotheses is that meat demand in China will have larger share in the future as long as income level continues to increase. The other hypothesis is that all meats including pork, beef, poultry, and fish in Chinese meat demand are substitutes. This hypothesis is tested since economic theory suggests that the quantity of a given meat product demanded at the retail level depends on the price of that meat product, the prices of other meat products, and income. A negative correlation can be expected between the quantity demanded and the own price of the meat product. The correlation between quantity demanded and the price of substitute meats is expected to be positive. The comparisons between low and high income consumer behaviors are made on two hypotheses mentioned above and elasticities.

MODEL SPECIFICATION AND ESTIMATION

The LA/AIDS, Linear Approximation of Almost Ideal Demand System, technique was selected to estimate demand system for meat. LA/AIDS is a good approximation to AIDS that gives an arbitrary first order approximation to any demand system; it satisfies the axioms of choice exactly; it aggregates perfectly over consumers without invoking parallel linear Engel curves; it has a functional form which is consistent with known household-budget data; it is simple to estimate, largely avoiding the need for nonlinear estimation; and it can be used to test the restrictions (Deaton and Muelbouer, 1980). Although LA/AIDS does not implicitly impose the theoretical restrictions of homogenity, slutsky symmetry, and adding up, these restrictions can be imposed easily.

The equation for the budget share (W) of meat items in the LA/AIDS is

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

Table 1. Estimated Coefficients

Share of Demand	Group of Data	R Square	Explanatory Variables ln P1^	ln P2^	ln P3^	ln P4^	ln X
Pork	Whole	0.18	-0.04679	-0.28692~	0.04500	0.19967~	0.00219
(W1)			(0.1026)	(0.0686)	(0.0839)	0.06892)	(0.0356)
	Low	0.15	-0.15136	-0.29838~	0.01384	0.34312~	-0.04432
			(0.2925)	(0.1643)	(0.2250)	(0.1527)	(0.9602)
	High	0.50	0.09475	-0.40196	0.02017	0.21937	-0.08129
			(0.0749)	(0,0639)	(0.0595)	(0.0638)	(0.0343)
Beef	Whole	0.29	0.13053	-0.10676	0.02810	0.04343	0.21996~
(W2)			(0.1101)	(0.0737)	(0.0901)	(0.0743)	(0.0383)
	Low	0.10	0.23091	0.00504	-0.04689	-0.10694	0.17681
			(0.3495)	(0.1963)	(0.2695)	(0.1824)	(0.1147)
	High	0.78	-0.03333	-0.08600	0.11749	0.07876	0.12115
			(0.0281)	(0.0239)	(0.0223)	(0.0239)	(0.0128)
Poultry	Whole	0.64	-0.00427	0.14738~	-0.10903~	-0.02243	0.11350~
(W3)			(0.0379)	(0.0254)	(0.0310)	(0.0256)	(0.0132)
	Low	0.58	0.02251	0.14936~	-0.16019~	-0.01036	0.11472~
			(0.0796)	(0.0447)	(0.0614)	(0.0416)	(0.0261)
	High	0.56	-0.00575	0.14890~	-0.08964~	-0.03239	0.10677~
			(0.0488)	(0.0417)	(0.0388)	(0.0416)	(0.0223)
Fish	Whole	0.44	-0.07946	0.24630~	0.03592	-0.22066~	0.10427~
(W4)			(0.0583)	(0.0390)	(0.0477)	(0.0394)	(0.0203)
	Low	0.30	-0.10207~	0.14398~	0.19323~	-0.22581~	0.10641~
			(0.1123)	(0.0631)	(0.0865)	(0.0586)	(0.0368)
	High	0.43	-0.05566	0.33905~	-0.04802	-0.26574~	0.09568~
			(0.0728)	(0.0621)	(0.0579)	(0.0621)	(0.0333)

Note: The numbers in parentheses are standard errors for coefficients.
^ P1, P2, P3, P4 are the prices of pork, beef, poultry, and fish respectively.
~ Coefficients are significant according to t test with 0.05 alpha.
Source: orginal calculations

where Pj is the price of meat j, X is the per capita expenditures of all meats, and P is a price index. To compute P, Deaton and Muellbauer suggest using Stone's index which is

$P = \sum W_i \ln P_i$, i= 1, 2, 3, 4. Using equation (1) without any restriction, the coefficients in Table 1 were computed. Since restrictions are not imposed and the explanatory variables are the same, system of equation model reduces to single equations model. Therefore there is no difference between system and equation by equation estimation.

The data contains 112 observations from 28 cities for years from 1985 to 1988 in China. Number of observations is 48 for low level income group, and 64 for high level income group. Meat demand consists of pork, beef, poultry, and fish.

Adding up, and homogeneity can be tested on the demand system as follows;

$$\sum_{i=1}^{n} \alpha_i = 1; \quad \sum_{i=1}^{n} \gamma_{ij} = 0; \quad \text{and} \quad \sum_{i=1}^{n} \beta_i = 0 \tag{2}$$

$$\sum_{j} \gamma_{ij} = 0 \tag{3}$$

Using equations (2), and (3), all adding-up (2) conditions are satisfied, but homogenity (3) is not satisfied. The failure of homogenity is not an unusual result as indicated by Deaton and Muellbauer in their study. Plausible explanations for this phenomenon are listed as first; expenditure on several items may be relatively inflexible in the short run, second; the omission of price expectations, third; the distribution of household budgets and demographic structure, and finally; the assumption of weak intertemporal separability.

In the study of Elasticities in AIDS Models by Green and Alston, it is indicated that there are four kinds of LA/AIDS elasticity formulas one of which used in this paper provided similar elasticities to the AIDS model according to empirical results. Marshallian and Hicksian measures of price elasticities are computed from the estimated parameters of LA/AIDS as follows:

$$\epsilon_{ii} = -1 + \gamma_{ii} / W_i - \beta_i \tag{4}$$
$$\epsilon_{ij} = \gamma_{ij} / W_i - \beta_i (W_j / W_i) \tag{5}$$
$$\delta_{ii} = -1 + \gamma_{ii} / W_i + W_i; \tag{6}$$
$$\delta_{ij} = \gamma_{ij} / W_{i_j} + W_j \tag{7}$$

Expenditure elasticities are calculated by the following equation,

$$\eta_i = 1 + \beta_i / W_i \tag{8}$$

These elasticities were calculated for the demand system without imposing any restriction. All Expenditure, compensated and uncompensated own-price, and cross-price elasticities are shown in Table 2 under whole, low income, and high income groups.

Table 2. Estimated Price and Expenditure Elasticities

Type of Expenditure	All households		Low income		High income	
	Marshalian	Hicksian	Marshalian	Hicksian	Marshalian	Hicksian
Expenditure Elasticities:						
Pork	1.004		0.919		0.853	
Beef	0.624		0.112		-0.382	
Poultry	1.887		2.144		1.717	
Fish	1.566		1.711		1.456	
Own-Price Elasticities:						
Pork	-1.087	-0.532	-1.230	-0.724	-0.747	-0.275
Beef	-1.568	-1.653	-0.799	-0.775	0.316	0.068
Poultry	-1.965	-1.724	-2.713	-2.498	0.086	-1.453
Fish	-2.303	-2.014	-2.615	-2.359	-0.030	-2.056
Cross-Price Elasticities:						
Pork						
Beef	-0.520	-0.384	-0.526	-0.342	-0.713	-0.638
Poultry	0.081	0.209	0.033	0.125	0.058	1.185
Fish	0.361	0.545	0.635	0.772	0.427	0.606
Beef						
Pork	1.861	1.516	1.648	1.710	1.145	0.934
Poultry	0.415	0.335	-0.146	-0.135	1.546	1.489
Fish	0.619	0.505	-0.404	-0.387	1.188	1.109
Poultry						
Pork	-0.523	0.519	-0.406	0.775	-0.436	0.515
Beef	1.031	1.287	1.262	1.689	0.938	1.088
Fish	-0.338	0.009	-0.275	0.046	0.067	0.428
Fish						
Pork	-0.745	0.121	-1.074	-0.131	-0.517	0.288
Beef	1.261	1.473	0.820	1.161	1.575	1.703
Poultry	0.123	0.323	1.220	1.391	-0.297	-0.080

Source : Orijinal calculations.

In general, the elasticities satisfy the theoretical assumptions in sign as indicated at the beginning although there are some exceptions. For example, all expenditure elasticities have positive sign with one exception, and own price elasticities have negative sign with three exceptions. In high income group beef expenditure elasticity is negative with small value. And also own-price elasticities beef for high income group are positive against the theory. It is not easy to conclude that beef for high income group is inferior or giffen good, therefore it is assumed that there might be something wrong with beef data. Cross-price elasticities are commonly positive as theoretically expected, but there are also negative signs too.

One of the hypotheses introduced at the beginning that the meat demand in China will have larger share in food expenditure as long as income level continues to increase is tested by analyzing expenditure elasticities. Except beef, all expenditure elasticities are greater than or very close to one that is percentage change in meat demand as a result of income change is greater than percentage income changes that will affect meat demand to be increased. Low income group has more influence on meat consumption because the income elasticities for low income group are greater than high income group. The demand for poultry and fish will increase faster than pork and beef, since income elasticities for poultry and fish are greater than the others. These results lead to conclude that Pork and beef are necessity goods, and on the other hand poultry and fish are luxury goods.

All own price elasticities are negative , as expected, except for beef among high income group. Demand for meat in low income group is more sensitive to its prices as expected. Not in each case but generally compensated own price elasticities are less than uncompensated ones because price effect is lowered by income compensation.

Theoretically, all meat items are expected to be substitutes as stated at the beginning of this paper as a hypothesis. But the empirical results prove to the contrary. For example, although pork is a substitute for beef, beef is complementary for pork. The compensated cross-price elasticities have more positive values then uncompensated ones do. Compensated Hicksian elasticities provided the best results for All households with one exception that at beef.

CONCLUSION

This paper presents tests of two hypotheses regarding meat consumer behavior in China: (a) demand for meat will have larger share response to income increases, (b) substitutability of meats. These hypotheses are the basis of rationality of consumer behavior in China. The tests of these hypotheses were developed for the LA/AIDS model of the Chinese meat demand system used in this study. It satisfies adding-up restrictions but not homogeneity. Slutsky symmetry can not be tested, since the system reduces to single equations without imposing restrictions and with the same explanatory variables in each equation.

The first test examines the income elasticities to find out if the income increases will affect on increase of meat demand in China. Excluding beef, all income elasticities show that percentage increase of meat demand respond to income increases is greater than percentage increases in income. It is also evident that low income group has more sensitive to increase meat demand respond to income increases. The other evidence is that consumption of poultry, and fish are more sensitive to ineome increases.

The second test examines the cross-price elasticities to discover whether all meats including pork, beef, poultry, and fish are substitutes. Marshallian-cross price elasticities are not all positive, but Hicksian cross-price elasticities are positive with one exception, beef, appeared to be complimentary for pork. High income group also gives better substitution estimation than low income group does.

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