MODELING CONSUMER EXPENDITURES UNDER RATIONING IN THE PEOPLE'S REPUBLIC OF CHINA

Wen S. Chern and Wang Zhi

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Wen S. Chern is a professor, and Wang Zhi is a graduate research associate, both in the Department of Agricultural Economics and Rural Sociology, The Ohio State University, Columbus, Ohio.

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INTRODUCTION

The objective of this paper is to investigate the impacts of the rationing of housing, fuels and food grains on the consumption of food and other consumer goods and services by urban households in the People's Republic of China. This topic of consumption is particularly important in discussing the consequences of recent Chinese economic reforms because there has been sudden infusion of freedom of consumer choices into the market place since 1979. Consumption has been perceived as one of the important driving forces in guiding China's resource allocations under the reforms.

In this paper, the historical trends of Chinese household consumption behaviors are first described. Previous studies by Clower (1965), Barro and Grossman (1971, 1976), Ito (1980), Gourieroux, et al. (1980) provide useful insights on the theoretical underpinning and empirical evidence on the spillover effects of rationing in a centrally planned economy like Poland. Following Deaton (1981), a complete demand system under rationing is developed for aggregate consumer expenditure components in China. The paper will then present econometric results, estimated demand elasticities, and their interpretations as related to rationing.

HIGHLIGHTS OF CONSUMPTION TRENDS OF CHINESE HOUSEHOLDS

Since 1979, there have been notable changes in Chinese household consumption patterns. Table 1 shows the per capita consumption of selected food items by urban households. The increases in nonstaple food such as edible oil, pork and eggs were phenomenal during 1981-87. The second notable change in household consumption is the surging demand for consumer durables such as color TV, washing machines, refrigerators, and other appliances

Table 1
Per Capita Annual Consumption of Selected Food Items
by Urban Households in China

Unit: Kg

Item	1981	1982	1983	1984	1985	1986	1987
Grain	145.44	144.56	144.48	142.08	134.76	137.88	133.87
Fresh Vegetables	152.34	159.08	165.00	149.04	144.36	148.32	142.58
Edible Oil	4.80	5.78	6.54	7.08	5.76	6.24	6.44
Pork	16.92	16.85	18.00	17.10	16.68	18.96	18.85
Beef & Mutton	1.68	1.82	1.86	2.76	2.64	2.64	3.05
Poultry	1.92	2.26	2.58	2.88	3.24	3.72	3.40
Fresh Eggs	5.22	5.88	6.90	7.62	6.84	7.08	6.56
Fish & Shrimps	7.26	7.67	8.10	7.80	7.08	8.16	7.88

Source: State Statistical Bureau of the People's Republic of China, China Statistical Yearbook 1988, Hong Kong: International Centre for the Advancement Of Science and Technology, Ltd. 1988. p.718.

Table 2
Ownerships of Consumer Durable Goods
by Urban Households in China

Unit: Number per 100 Households

Item	1981	1982	1983	1984	1985	1986	1987
Washing Machine	6.34	16.09	29.08	40.13	48.29	59.7	66.77
Refrigerator	0.22	0.67	1.65	3.22	6.58	12.71	19.91
Color TV	0.59	1.1	2.57	5.38	17.21	27.41	34.63
Tape Recorder	12.97	17.99	27.11	34.17	41.16	51.66	57.38
Cameras	4.29	5.57	7.28	8.92	8.52	11.91	14.34
B/W TV	57.06	72.21	80.58	82.04	66.86	65.42	64.77

Source: State Statistical Bureau of the People's Republic of China, China Statistical Yearbook 1988, Hong Kong: International Centre for the Advancement Of Science and Technology, Ltd. 1988. p.718.

(Table 2). For example, the ownerships of washing machines per 100 urban households increased dramatically from 6.34 in 1981 to 66.77 in 1987, an increase of more than 10 times during this period. This drastic increase in the demand for washing machines must reflect time saving pressure for urban households as women labor participation rate is very high in China.

SPILLOVER EFFECTS OF RATIONING

Despite the significant infusion of free market forces into the Chinese economy since 1979, the rationing system remains an important factor affecting urban households. In addition to the rationing of selected food commodities and fuels, there is a very important form of rationing in terms of in-kind subsidies of housing and medical care. Housing is rationed for people working in the state sector. Residents pay only a small rent for their housing.

Rationing can substantially reduce the choice space for consumers and drive them to concentrate their marginal purchase power on certain nonrationed goods. These phenomena are called "spillovers" between rationed and unrationed consumer markets. This kind of distortion of consumer choice and spillover effect seems a common phenomenon in centrally planned economies. Podkaminer (1982, 1986, 1988) published a series of articles analyzing the disequilibrium in the consumer markets in Poland. He concluded from his research that Polish consumers were affected negatively by relative price distortions. Food appeared to be overpriced as compared with the general equilibrium price, and the observed food shortage was caused by the spillover effects from underpriced car, housing and service. Collier (1986) used a slightly different theoretical framework to study the consumer market in East Germany. He also found evidence similar to that found by Podkaminer regarding

Poland, i.e., overconsumption of food, tobacco and alcohol and underconsumption of housing. It seems reasonable to believe that there may be similar spillover effects in China.

AN ALMOST IDEAL DEMAND SYSTEM WITH RATIONING

Since the true demand for rationed goods is not directly observable from market data, economists have attempted to derive the demand function for rationed goods from the observable demand functions for the unrationed goods. Deaton (1981) derived a "matched pair" of demand functions, one rationed and the other unrationed, from the same preference. For estimating the demand for nonrationed foods, he modified the almost ideal demand system (AIDS), originally developed by Deaton and Muellbauer (1980). The modification permits ration level to appear in a simple, theoretically satisfactory, and empirically tractable manner. Specifically, the Deaton's modified AIDS with rationed goods can be expressed as:

$$W_i = \alpha_i + \sum_{k=1}^{m} \eta_{ik} Z_k + \sum_{j=m+1}^{n} \gamma_{ij} \ln P_j + \beta_i \ln[(X - \sum_{k=1}^{m} P_K Z_k)/p] + \epsilon_i \qquad (1)$$

$k = 1,\ldots,m$, and $i = m+1,\ldots,n$

where W_i = expenditure share of unrationed good i,

Z_k = quantity of rationed good k,

P_j = price of unrationed good j,

P_k = price of rationed good k,

X = total expenditure,

p = the general price index (or Stone index),

ϵ_i = error term

and $\alpha_i, \eta_{ik}, \gamma_{ij}, \beta_i$ = parameters to be estimated.

Therefore, this model can be appropriately termed as the linear approximate AIDS with rationing or, simply, LA/AIDSR.

As in the original AIDS, the adding-up restrictions require that

$$\sum_{i=m+1}^{n} \alpha_i = 1, \quad \sum_{i=m+1}^{n} \eta_{ik} = o, \quad \sum_{i=m+1}^{n} \gamma_{ij} = 0 \text{ and } \sum_{i=m+1}^{n} \beta_i = 0$$

The homogeneity condition will require $\sum_{j=m+1}^{n} \gamma_{ij} = 0$.

Furthermore, the symmetry condition can be satisfied if $\gamma_{ij} = \gamma_{ji}$.

In the LA/AIDSR, the total expenditure elasticity can be computed by

$$e_i = 1 + \beta_i/\{W_i[x/(x - \sum_{k=1}^{m} P_k Z_k)]\}, \quad i = m+1,\ldots,n \tag{2}$$

Green and Alston (1989) suggested several ways of computing the own-price and cross-price elasticities. The formula used in this study is expressed as:

$$e_{ij} = -\delta_{ij} + \gamma_{ij}/W_i - (\beta_i/W_i)W_j \tag{3}$$

where $\delta_{ij} = 1$ for $i=j$ and 0 for $i \neq j$.

In order to analyze the effects of rationing, the following comparative static analyses are useful. Consider first the effects of changes in the prices of rationed goods. The rationed price elasticity can be computed by

$$e_{ik} = -\beta_i/\{W_i[P_k Z_k/(x - \sum_{k=1}^{m} P_k Z_k)]\}, \quad k = 1,\ldots,m \tag{4}$$

Second, the impacts of rationed quantity can be evaluated by the following two sets of elasticities:

$$W_{ik} = \partial \ln W_i/\partial \ln Z_k = \eta_{ik}/W_i - \beta_i/\{W_i[P_k Z_k/(x - \sum_{k=1}^{m} P_k Z_k)]\} \tag{5}$$

and

$$P_{ik} = \partial \ln P_i/\partial \ln Z_k = \beta_i/\{\gamma_{ii}[P_k Z_k/(x - \sum_{k=1}^{m} P_k Z_k)]\} - \eta_{ik} Z_k/\gamma_{ii} \tag{6}$$

EMPIRICAL ESTIMATION

Data and Expenditure Groups

The basic data are per capita annual expenditures for eight categories of goods and services obtained from the budget surveys of urban households from 1981 to 1987. These groups are (1) food grains, (2) nonstaple and other goods, (3) tobacco, liquor and tea, (4) clothing, (5) articles (mostly durables) for daily use and cultural life, (6) fuels, (7) services, and (8) housing. Among these categories, housing and fuels were strictly under rationing for the households working in the state sector. Food grains were also under rationing. However, virtually all urban households could purchase additional grains from free markets during the sample period. In general, the coupons for grains were sufficient for most households. Portion of the nonstaple food such as beef, edible oil, milk, and sugar were also under rationing. However, for these rationed nonstaple food items, many urban households purchased significant additional quantities in free markets. Unfortunately, for rationed grains and other nonstaple food items, we do not have data on the rationed levels and free market prices. Therefore, we can not compute the expenditure shares between ration coupon and free market purchases for the rationed food items.

Estimation Results

Several estimation methods are applied and compared in this study. When no restriction or only homogeneity is imposed, three single equation approaches are compared. They are ordinary least squares (OLS), weighted least squares (WLS) using the household size as the weighing factor, and the error component model for pooling time-series and cross-sectional data (or

POOL) based on Kementa (1986, pp.618-619). When symmetry conditions are imposed, the Zellner's seemingly unrelated regression (SUR) method is used.

For the purpose of comparison, we estimated the LA/AIDSR model for five alternative cases of rationing by considering the following sets of rationed goods and services: (1) no rationed goods and services, (2) only housing, (3) housing and fuels, (4) housing and grains, (5) housing, fuels and grains. For each of these five specifications, we compare three estimators (OLS, WLS, and POOL) under no restrictions and the homogeneity restrictions. When the symmetry conditions are imposed, we used the SUR. Therefore, for an expenditure share equation such as the one for nonstaple food, we have totally 35 alternative sets of estimates. Only the major findings from these estimation results are summarized in this paper.

Consider the three alternative estimation methods (OLS, WLS, and POOL), we found that in most cases, the estimates are very similar. The gains in efficiency from WLS and POOL over OLS are mostly marginal. Therefore, for later discussion, we will use the WLS results for the cases of no restriction and imposing the homogeneity restriction. The SUR estimates are used when the symmetry conditions are imposed.

The adding-up conditions are automatically satisfied because the dependent variables are expenditure shares in the LA/AIDSR. For testing the homogeneity conditions, we employ both the F and Wald tests. The results show that in most cases, the homogeneity conditions are rejected. Based on the Euler's theorem, the necessary condition for homogeneity condition is that the sum of expenditure and price elasticities is equal to zero. The sums of expenditure and price elasticities are considerably smaller in the

specifications where one, two, or three expenditure groups are considered under rationing.

The results of testing homogeneity and symmetry based on the Wald test suggest that the model with housing, grain and fuels as rationed goods is more plausible than the models assuming no rationed goods and other alternative rationing specifications. This model also produces the most plausible set of estimated expenditure and price elasticities as well as the estimated effects of rationing as will be discussed later.

Since one of the main objectives is to estimate expenditure (income) and price elasticities, we will focus our remaining discussion on these estimates. The detailed regression results are not presented here. However, it is noted that the overall fit is very good as the computed R^2's are all greater than 0.95, and in most cases they are as high as 0.99. Also, the majority of the estimated coefficients are statistically significant at the 5% significance level. In particular, the estimated β_i's are all statistically significant.

Table 3 presents the estimated expenditure and own-price elasticities under three alternative demand specifications (unconstrained, homogeneity imposed, and both homogeneity and symmetry imposed) for the model with housing, grains and fuels as rationed goods. The estimated expenditure elasticities are not very sensitive to alternative demand specifications. In fact, the expenditure elasticities are all very robust among alternative rationing specifications and estimation methods as well. The estimates show that nonstaple food is a necessity while the other groups of consumer goods and services are luxuries. Nonstaple food has lowest expenditure elasticities ranging from 0.75 to 0.78 while durables and articles have the largest

elasticities ranging from 1.46 to 1.51, depending upon the demand specifications. These estimates of expenditure elasticities appear to be plausible. The high expenditure elasticities explain the surging demand for durables such as washing machines during the sample period as mentioned earlier.

Estimated Effects of Rationing

Rationing restricts the quantity which can be purchased by households. The spillover effects of rationing as discussed previously would, therefore, indicate that a lower rationed quantity (i.e., a more stringent rationing) would result in excess demand for nonrationed goods. As such, we would expect the coefficients η_{ik} in Eq. (4) to have a negative sign. However, the rationing in China involved both quantity and price controls for the rationed goods. Since the state controlled prices of the rationed goods are generally lower than prices in free markets, a higher rationed quantity means a larger subsidy for urban households. Therefore, a higher rationed quantity of, say, grains may result in a lower total expenditure of grains. Thus, more income would be left to spend on other goods and services. In this case, the coefficient η_{ik} would have a positive sign. In general, the imposition of rationing would have income and substitution effects associated with the changes in rationed quantity and prices.

Table 4 presents the estimated coefficients (η_{ik}) related to the rationed quantities of housing, grains and fuels in the LA/AIDSR. Note that the adding-up condition would requires that the sum of the coefficients across the five equations equals to zero. These estimated coefficients are not very sensitive to alternative demand specification. The results show that the estimated rationed quantity coefficients are mostly statistically significant

Table 3
Estimated Expenditure and Own-price Elasticities[a]

Rationed Goods: Housing, Grains and Fuels

Expenditure Group	Alternative Demand Specifications (Estimation Method)					
	Unconstrained (WLS)		Homogeneity Imposed (WLS)		Homogeneity and Symmetry Imposed (SUR)	
	Expenditure	Own-Price	Expenditure	Own-Price	Expenditure	Own-Price
Nonstaple Food	0.75	-0.80	0.78	-0.75	0.76	-0.90
Tobacco, Liquor and Tea	0.93	-0.75	1.01	-1.06	1.09	-0.82
Clothing	1.34	-0.84	1.21	0.89	1.14	-1.22
Durables and Articles	1.51	-4.51	1.47	-5.12	1.46	-1.65
Service	0.73	0.4	0.86	-0.81	1.01	-0.84

[a]All elasticities are computed at sample means.

Table 4
Estimated Coefficients (η_{ik}) for Rationed Goods in LA/AIDSR[a]

Expenditure Group	Alternative Demand Specifications								
	Unconstrained (WLS)			Homogeneity Imposed (WLS)			Homogeneity and Symmetry Imposed (SUR)		
	Housing	Grains	Fuels	Housing	Grains	Fuels	Housing	Grains	Fuels
Nonstaple Food	1.08	-0.26	-0.3	1.34	-0.41	-0.4	1.29	-0.44	-0.26
	(1.98)	(-1.57)	(-1.71)	(2.62)	(-3.58)	(-2.49)	(4.12)	(-6.63)	(-2.46)
Tobacco, Liquor and Tea	-0.073	0.033	0.018	0.034	-0.029	-0.022	-0.019	-0.06	-0.016
	(-0.92)	(1.38)	(0.69)	(0.39)	(-1.5)	(-0.82)	(-0.24)	(-3.16)	(-0.63)
Clothing	-0.2	-0.17	-0.36	-0.66	-0.1	-0.19	-0.67	0.24	-0.26
	(-0.94)	(-2.74)	(-5.38)	(-2.37)	(1.55)	(-2.18)	(-2.82)	(4.91)	(-3.36)
Durables and Articles	-0.77	0.34	0.53	-0.92	0.43	0.58	-0.85	0.49	0.47
	(-1.59)	(2.85)	(3.38)	(-2.06)	(4.26)	(4.16)	(-2.91)	(7.71)	(4.66)
Service	-0.04	0.05	0.12	0.2	-0.08	0.03	0.249	-0.23	0.066
	(-0.52)	(2.44)	(4.92)	(1.61)	(-3.04)	(0.70)	b	b	b

[a]The figures in parentheses are estimated t-ratios.

[b]The t-ratios are not estimated because the coefficients are derived from the adding-up conditions.

at the 1% significance level. The statistical significance of these coefficients provides a strong support for the model specification used in this study. The results in Table 4 indicate that an increase in the rationed quantity of grains would reduce the expenditure shares of nonstaple food, tobacco, liquor and tea, and services while increasing the expenditure shares of clothing and durables. This pattern of rationing effects appears to be reasonable because we can expect stronger substitution effects for nonstaple food and tobacco, liquor and tea, but stronger income effects for clothing, and durables and articles. With respect to housing, an increase in rationed housing (say squared footage) will increase the expenditure shares of nonstaple food and services but decrease the shares of tobacco, liquor, and tea, clothing and durables.

The effects of rationing can also be evaluated by comparative static analyses, i.e., calculating the demand elasticity with respect to rationed prices ($\partial \ln q_i / \partial \ln P_k$), the expenditure share elasticity with respect to rationed quantities ($\partial \ln W_i / \partial \ln Z_k$), and the price flexibility with respect to the rationed quantity ($\partial \ln P_i / \partial \ln Z_k$). In general, the estimated rationed price elasticities of demand for nonrationed goods are relatively small. The largest expenditure share elasticity is found to be 0.285 for the expenditure share of services with respect to rationed grains. This elasticity implies that a 1% increase in rationed quantity of grains will increase the expenditure share of services by 0.285%.

The estimated price flexibilities with respect to the rationed quantity show the largest magnitude of the rationing effects, particularly in grain rationing. Specifically, the results show that a 1% increase in rationed quantity of grains would result in an increase in the price of nonstaple food

by 0.82% and decreases in the prices of tobacco-liquor-tea and services by 0.45% and 1.72%, respectively.

CONCLUDING REMARKS

In this study, we estimated the LA/AIDSR developed by Deaton using the household budget data observed in China. The objectives of the econometric analysis are to estimate expenditure and price elasticities of nonrationed goods and to investigate the impacts of rationing on household budget allocation.

We compared the alternative specifications of rationing scheme and found that the one including housing, grains and fuels as rationed goods performed more plausibly than other specifications. We also found that the imposition of homogeneity and symmetry conditions reduces the sensitivity in the estimated demand elasticities. This, however, may be just a result of increased statistical efficiency rather than a confirmation of the utility maximization behavior of Chinese urban households.

The regression results shows that the LA/AIDSR performs well with this set of Chinese household data. The model was used to analyze the effects of rationing. For example, an increase in the subsidized price of rationed food grains would increase the demand for nonstaple food but decrease the demands for other goods and services. However, an increase in the rationed quantity of food grains would increase the price of nonstaple food but, in the meantime, decrease the expenditure share of nonstaple food. Continuing efforts are needed to evaluate these preliminary results and their interpretation.

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