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Food Demand Matrix Derived from Additive Quadratic Model

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It is a general belief that the pattern of food consumption has undergone . change during the recent period as a result of the high rate of economic h in Japan. In other words, consumption pattern has been markedly rnized and modernized for both food and non-food categories with greatly ved living standards (see [4, 9, 12]). It is of great interest, therefore, ucidate on the change of food consumption pattern within the framework of mic theory.

This paper is intended to adopt a dynamic approach in an attempt to analyze tructure of food demand over the past sixteen years. In the previous es [8, 10] of food demand analysis, alternative versions of the linear liture system have been fitted to Japanese data in the relatively recent ls. These models were found considerably well-fitted to the data. Since odels were static, however, there remained a problem of investigating ic factors affecting the consumer demand, particularly for food commodities.

The method applied in this study is the additive quadratic model by akker and Taylor ([2] ch.5). It is one of the major methodological opments in consumer demand analysis in late years1), and has dynamic and etically consistent aspects with wide application.

This paper chiefly concerns the analysis of preferences of urban residents period of rapidly growing economy, and the derivation of the food demand from the estimated additive quadratic model. A further research is d concerning to what extent the stability conditions are satisfied of short-run and long-run equilibria, and how effectively such a model can be d to the food demand analysis in Japan. The latter part of this paper is concentrated on a short-run equilibrium analysis of food consumption. Comparisons are made between present and previous studies for demand elas and money flexibility. Substitutional relationships are analyzed in the Hicks-Allen sense among eleven food commodity groups and a non-food categ Moreover, empirical implications of the results obtained are discussed in detail.

Model

On the assumption of a dynamic, additive and quadratic utility function, ollowing estimating equations are developed to obtain the structural icients closely associated with utility function and stock adjustment ion (see [2] ch.5 and [7]):

$$q_{it} = K_{i0} + K_{i1}q_{i,t-1} + K_{i2}\lambda_t p_{it} + K_{i3}\lambda_{t-1}p_{i,t-1} + u_t$$
$$(i = 1, 2, \ldots, n: \ t = 1, 2, \ldots, T)$$

$$\lambda_t = \frac{m_t - \Sigma\hat{K}_{i0}p_{it} - \Sigma\hat{K}_{i1}p_{it}q_{i,t-1} - \hat{\lambda}_{t-1}\Sigma\hat{K}_{i3}p_{it}p_{i,t-1}}{\Sigma\hat{K}_{i2}p_{it}^2}$$

p_i refers to the price of the ith commodity, q_i the quantity purchased apita of the ith commodity, m income (or total expenditure) and λ the nal utility of income. The K's indicate parameters to be estimated, $\hat{K}$'s ated values, and u_t a residual term. Since equation (1) is nonlinear in wn parameters K's and undetermined multiplier λ, an iteration of least es would be required.

The above estimating equations were originally presented by Houthakker and r. Imposing the adding-up condition on equation (1) yields equation (2), gives an estimate of λ_t once parameters K's have been estimated. Given lues of λ_t's, equation (1) becomes linear in unknown parameters K's. ore, it is possible to apply ordinary least squares to the estimating ion for the sake of simplicity (see [7, 11]). At the first round of ive estimation, the λ_t's could be determined arbitrarily. Thus equations d (2) can be alternately estimated and the process continues until convergence is achieved in either K's or λ_t's. It is equivalent to estim the n equations simultaneously, though the estimates of K's are obtained by equation for n commodities. Equation (1) is essentially the same as M I in [2]. However, there is no necessity for deflating prices (and hence since the marginal utility of income λ_t is a homogeneous function of degr one in prices p_{it} and income m_t (see [7]).

On the additional assumptions of directly additive preferences and c depreciation rates of (physical and psychological) stocks, the regression coefficients provide the structural coefficients in matrix form as follow

$$(3) \qquad a = -\left[K_2 - K_3\right]^{-1} K_0 ,$$

$$(4) \qquad A = \left[K_2 - K_3\right]^{-1}\left[I - K_1\right] ,$$

$$(5) \qquad B = -4\left[K_2 - K_3\right]^{-2}\left[K_1 K_2 - K_3\right] ,$$

$$(6) \qquad D = 2\left[K_2 - K_3\right]^{-1}\left[K_2 - K_3\right] ,$$

where a denotes a vector of constant terms in the marginal utility functic of commodities, A the familiar Hessian of utility function, B a matrix of coefficients which measures the effect of stock changes on marginal utilit D a depreciation rate matrix, and I the identity matrix. All (n × n) cons matrices are diagonal and nonsingular, so that these matrices and vectors be treated as if they were constants.

The coefficients a_i's are positive and A_{ii}'s are negative for all con the conditions of positive marginal utilities and of stability in static y (or in short run). The B_{ii}'s are negative for durable commodities while are positive for habit-forming commodities. Changes in preferences are fied as the influence of stocks on marginal utilities. They are expressed rms of one state variable, stock, for each commodity and there is no action between commodities. Non-measurable state variables disappear from stimating equations through some manipulation. The D_{ii}'s are usually ive.

From the sufficient condition of stability the following inequalities are ht forth:

$$A_{ii} < 0 \text{ and } A_{ii}D_{ii} - B_{ii} < 0 .$$

ormer indicates the stability condition of short-run equilibrium and the r represents that of long-run equilibrium.

The main purpose of demand analysis is to derive the effects of changes ch determinants of demand as income and prices on quantities of various dities purchased . One of the striking features of this dynamic model is istinction between short-run and long-run effects. In the short-run, e and price effects are written in matrix form:

$$\frac{\partial \lambda}{\partial m} = (p'A^{-1}p)^{-1} ,$$

$$\frac{\partial q}{\partial m} = (p'A^{-1}p)^{-1}A^{-1}p ,$$

$$\frac{\partial q}{\partial p'} = \lambda A^{-1} - \lambda(p'A^{-1}p)^{-1}A^{-1}pp'A^{-1} - \frac{\partial q}{\partial m} q' ,$$

state variables remaining unchanged with respect to changes in income and In the long-run, similar equations can be deduced for income and price ef where state variables vary in responce to income and price changes but re constant over time.

Data and Estimation

The data used here are annual ones (5), concerned with inhabitants of cities. source of data is representative of all family budget data available on a nal level in Japan. This study covers the period 1956 - 1971, in which consumption showed very rapid changes and improvements reflecting the high of income growth.

Total consumption expenditure was decomposed into twelve subgroups, as d in the tables below, with eleven food commodity groups and one non-food ory. The twelve-commodity breakdown is the same as in the previous study except that the milk and eggs group was split into three commodities; i.e., milk products and eggs. Three major notations and data used in the analysis ne following:

nominal price of commodity i ($i = 1, 2, \ldots, 12$; 1965 prices = 1) ,

quantity yearly consumed per capita of commodity i (expenditure in constant 1965 prices), which was obtained by dividing expenditure in current yen by current price for each commodity,

nominal yearly income per capita (total expenditure in current yen; unit: 1,000 yen),

indices are regarded as individual prices. Taking 1965 as the base year, ices are set equal to unity. Other notations employed are defined later.

n estimation, Method I is employed because the period covered is not so Hence, at the first round of iterative procedure, all λ_t's are set equal ty and then parameters K's are estimated by least squares. Substituting tes of K's and actual data into equation (2) gives estimates of λ_t's.

The initial value of λ_t, λ_0, is fixed at unity in every round. The estim λ_t's are now used to carry on round 2 of iteration, and the same process on. Let ε_r be the rate of error for parameter K:

$$\varepsilon_r = \frac{K_{(r-1)} - K_r}{K_r} \times 100 \quad (\%;\ r = 2, 3, \ldots) ,$$

where r denotes the number of round. It serves as a criterion of judging degree of convergence. In each round, rates of error for all estimated parameters are computed and the maximum one is picked up to compare betwe rounds. The results obtained up to round 40 are summarized in Table 1.

After round 23, the maximum rate of error shows a downward tendency, falls under 10 percent in round 27 and approaches toward convergence. Bet round 29 and 40, this rate is 5 or 6 percent, so that convergence is cons to have been practically achieved up to round 40. If further iterations a continued, new states of convergence emerge after some temporal changes i regression coefficients, but it takes so many rounds until the rates of e fall within 4 percent.2)

Here the iteration ends up in round 40, and the maximum rate of erro estimated λ_t's is no more than 0.1 percent. The regression results are p in Table 2. They make little difference comparing with the later rounds convergence. The R^2's are generally high and, in view of the Durbin-Wats ratios (D.W.), there is no marked serial correlation for all commodity gr but for other cereals. As for the regression coefficients, K_2 and K_3 are apparently insignificant for rice, other cereals and milk products, and s K_3 for milk. However, the significance of other coefficients is relativel high.

Table 1

Range of Maximum Rate of Error by Round of Iterative Estimation, $|\varepsilon|_{max}$

Range	Number of Round, r
$|\varepsilon|_{max} \geqq 50\%$	2 ~ 7 , 12 ~ 15 , 17 ~ 22
$10\% \leqq |\varepsilon|_{max} < 50\%$	8 ~ 11 , 16 , 23 ~ 26
$|\varepsilon|_{max} < 10\%$	27 ~ 40

Table 2

Coefficients for Estimating Equation
(Round 40)

Commodity group	K_0	K_1	K_2	K_3	R^2	D
1 Rice	-0.510	1.037 (4.885)[b]	0.226 (0.118)	-0.341 (0.216)	0.974	1
2 Other cereals	-0.103	0.993 (3.377)	-1.502 (1.304)	1.709 (1.551)	0.721	0
3 Fish	2.237	0.582 (2.860)	-3.466 (3.648)	4.009 (3.522)	0.614	1
4 Meat	0.253	1.152 (15.329)	-5.140 (7.184)	4.759 (7.913)	0.998	1
5 Milk	1.121	1.453 (9.407)	-1.774 (3.098)	-0.050 (0.065)	0.990	2
6 Milk products	-0.281	1.010 (23.344)	-0.085 (0.272)	0.413 (1.335)	0.986	1
7 Eggs	1.175	0.854 (9.359)	-1.713 (4.722)	0.982 (2.148)	0.992	1.
8 Vegetables	1.045	0.776 (3.819)	-1.835 (3.992)	2.098 (4.288)	0.677	2.
9 Fruit	-0.137	0.925 (16.061)	-2.440 (7.359)	3.140 (10.862)	0.994	2.
10 F.c.a.h.[a]	-0.124	0.765 (6.295)	-3.956 (3.387)	5.632 (4.394)	0.993	1.
11 Other food	-0.060	1.043 (18.343)	-11.887 (4.705)	12.449 (4.302)	0.998	2.
12 Non-food	-3.465	1.019 (43.480)	-91.473 (14.319)	103.573 (16.452)	1.000	2.

[a] Food consumed away from home.

[b] Figures in parentheses are |t|-ratios.

Substitution of the coefficients for estimating equation into equations
- (6) results in the coefficients for structural equations (see [2], ch.5),
ı are given in Table 3. According to theoretical properties, a's and D's
ld be positive, and B's are mostly expected to be positive whereas the
l comprises many non-durables. Nevertheless, such requirements are not
iciently fulfilled. Particularly striking is that quite a few dynamic
ıeters B's and D's hold contrary signs. As described above, some of the
and K_3's are insignificant for rice, other cereals, milk products and milk,
ıat the significance of the B's and D's must be low for these commodity
s.3)

As for static parameters a's and A's, on the other hand, the estimates
r reasonable with a few exceptions. The A is positive for rice, an inferior
but is negative for all others. It has shown a negative and stable
e for each of all the commodity groups except rice from early rounds of
tion. The a's also have been mostly stable.

To sum up, long-run parameters fluctuated more than short-run parameters
e process of convergence.

Table 3

Coefficients for Structural Equations

Commodity group		a	A	B	D
1.	Rice	-4.435	3.593	1.327	-0.4
2.	Other cereals	0.498	-0.621	-0.084	-0.1
3.	Fish	-4.120	-0.121	-0.143	-0.1
4.	Meat	0.664	-0.217	0.047	0.0
5.	Milk	0.615	-1.423	3.536	2.1
6.	Milk products	0.857	-4.036	-5.277	-1.3
7.	Eggs	1.607	-0.688	0.265	0.5
8.	Vegetables	-3.973	-0.452	-0.174	-0.1
9.	Fruit	0.196	-0.345	-0.113	-0.2
10.	F.c.a.h.	0.074	-0.184	-0.113	-0.3
11.	Other food	0.107	-0.084	0.000	-0.04
12.	Non-food	0.286	-0.010	-0.001	-0.12

Results

From a dynamic viewpoint, as seen in Table 3, appropriate estimates of the tural coefficients have not been obtained for many commodity groups. Meat, and eggs, which exhibited positive B and D, correspond to habit-forming dities. For other commodity groups, the resultant structural coefficients t render an account of dynamic effects. Therefore, there is no evidence ow that dynamic or long-run equilibrium has been achieved over the whole e period.

On the other hand, short-run coefficients tend to be stable with a few lities. A's exhibited negative values from early rounds except for rice id not vary widely in the iterant process. Thus consumer behavior seems ve been almost in equilibrium from a static or short-run viewpoint of food mption. Accordingly, the following discussion focuses on a short-run ibrium analysis.

Income and price derivatives of demand are evaluated at the sample means uations (4) and (5) in the short-run, using estimated A's and λ in addition tual data on income and prices. They can also be transformed into short-run icities. Derivation of price elasticites necessitates the estimate of λ. ated marginal utilities of income are tabulated in Table 4, with the ge value

$$\bar{\lambda} = 1.021 .$$

stimate of λ did not change noticeably with the rising income in the val of observation.

Likewise, income elasticity of λ is computed by equation (3). Income icities of the marginal utility of undeflated income are also presented ole 4, whose average is

Table 4

Estimated Marginal Utilities of Income and Their Elasticities with Respect to Income, λ and $\check{\omega}$

Year	m	λ	$\check{\omega}$
1956	62.364	1.000	-0.935
1957	67.389	1.025	-0.942
1958	71.346	1.065	-0.973
1959	76.057	1.093	-0.985
1960	83.217	1.095	-0.998
1961	94.701	1.057	-1.068
1962	107.936	1.017	-1.114
1963	121.715	0.997	-1.129
1964	134.114	0.994	-1.148
1965	146.693	1.006	-1.104
1966	161.429	1.009	-1.083
1967	177.501	1.018	-1.096
1968	196.868	1.017	-1.098
1969	222.165	0.996	-1.146
1970	251.514	0.974	-1.130
1971	277.128	0.980	-1.091

(m : 1,000 yen in current prices)

$\check{\omega} = -1.065$

ounts to roughly one-half of several estimates of the $\check{\omega}$ in terms of deflated
e, resulting from other models4) (see[8,10]). The income elasticity of the
mal utility of income in this case, or money flexibility for short, has
ased in absolute value without wide variations.

Elasticities of demand with respect to undeflated income and prices are
ated in Table 5, evaluated at the sample means. Those related to the milk
ggs group, and to all food are derived by means of Engel and Cournot
gations as well as the homogeneity condition. By a glance at the Table it
e seen that income and own price elasticities are rather high for all food,
cereals and fish, and that they are low for milk and milk products. Eggs
.c.a.h. have fairly large own price elasticities, exceeding unity in
te value. In comparison with the previous studies, meat, milk, milk
ts, eggs, fruit, f.c.a.h. and non-food whose consumption showed a steady
se seem to have lower elasticities with respect to undeflated income than
lated income. Many of the price elasticities in the present study are
than the previous ones, reflecting the lower income elasticity of the
al utility of undeflated income.

eferring to the changes in income elasticities over time, or with an
increase, milk products and eggs fell sharply but fish and vegetables
onsiderably. Milk, fruit and non-food are on a slight decrease while
cereals rose slowly. Little change was found for meat, f.c.a.h., other
and for rice with a negative sign.

verage estimates of the Allen partial elasticities of substitution emerge
he above results, as reported in Table 6. Twelve of the fifty-five
ve partial (or cross) elasticities of substitution between the eleven

Table 5

Average Elasticities of Demand with Respect to Undeflated Income and Prices, $\overline{E}_i$ and $\overline{e}_{ij}$[a]

	j	1	2	3	4	5	6	7		8	9	10	11		12	
i		Rice	Other cereals	Fish	Meat	Milk	Milk products	Eggs	Milk and eggs	Vegetables	Fruit	F.c.a.h.	Other food	All food	Non-food	$\overline{E}_i$
1.	Rice	.032	.000	.000	.000	.000	.000	-.000	.000	.001	.000	-.000	.001	.034	-.002	-.032
2.	Other cereals	-.046	-.657	-.004	-.002	-.005	-.001	.000	-.006	-.012	-.001	.006	-.016	-.738	.046	.692
3.	Fish	-.061	-.005	-.860	-.002	-.007	-.002	.001	-.008	-.016	-.001	.007	-.021	-.967	.061	.906
4.	Meat	-.066	-.006	-.005	-.937	-.007	-.002	.001	-.008	-.018	-.001	.008	-.023	-1.056	.066	.990
5.	Milk	-.028	-.002	-.002	-.001	-.393	-.001	.000	-.394	-.007	-.000	.003	-.010	-.441	.028	.413
6.	Milk products	-.035	-.003	-.003	-.001	-.004	-.500	.000	-.504	-.010	-.000	.004	-.012	-.564	.035	.529
7.	Eggs	-.076	-.007	-.006	-.002	-.008	-.002	-1.067	-1.077	-.020	-.001	.009	-.027	-1.207	.076	1.131
	Milk and Eggs	-.051	-.004	-.004	-.002	-.168	-.065	-.485	-.718	-.013	-.001	.006	-.018	-.805	.050	.755
8.	Vegetables	-.029	-.003	-.002	-.001	-.003	-.001	.000	-.004	-.421	-.000	.003	-.010	-.467	.029	.438
9.	Fruit	-.068	-.006	-.006	-.002	-.008	-.002	.001	-.009	-.018	-.958	.008	-.024	-1.083	.068	1.015
10.	F.c.a.h.[b]	-.090	-.008	-.008	-.003	-.010	-.002	.001	-.011	-.024	-.001	-1.264	-.032	-1.441	.090	1.351
11.	Other food	-.056	-.005	-.005	-.002	-.006	-.001	.001	-.007	-.015	-.001	.007	-.804	-.887	.056	.831
	All food	-.042	-.035	-.091	-.088	-.018	-.006	-.037	-.061	-.046	-.053	-.095	-.246	-.757	.047	.710
12.	Non-food	-.079	-.007	-.006	-.003	-.009	-.002	.001	-.010	-.021	-.001	.010	-.028	-.145	-1.028	1.173
	$\overline{w}_j$[c]	.0650	.0173	.0381	.0344	.0121	.0037	.0133	.0291	.0304	.0203	.0296	.1090	.3732	.6268	

[a] $\overline{E}_i$=average income elasticity of commodity group i; $\overline{e}_{ij}$=average elasticity of commodity group i with respect to the jth price.

[b] Food consumed away from home.

[c] $\overline{w}_j$=average budget share of commodity group j at average prices and expenditures.

Table 6

Average Estimates of the Partial Elasticities of Substitution,
$\bar{\sigma}_{ij} = e_{ij} / \bar{w}_j - \bar{E}_i$

i	j	1 Rice	2 Other cereals	3 Fish	4 Meat	5 Milk	6 Milk products	7 Eggs	Milk and eggs	8 Vegetables	9 Fruit	10 F.c.a.h.	11 Other food	All food	12 Non-food
1.	Rice	.46													
2.	Other cereals	-.02	-37.13												
3.	Fish	-.03	.59	-21.69											
4.	Meat	-.03	.65	.85	-26.26										
5.	Milk	-.01	.27	.35	.39	-75.94									
6.	Milk products	-.02	.35	.45	.49	.21	-133.78								
7.	Eggs	-.03	.74	.97	1.06	.44	.56	-79.39							
	Milk and Eggs	-.02	.49	.65	.71	-13.09	-16.77	-35.87	-23.93						
8.	Vegetables	-.01	.29	.37	.41	.17	.22	.47	.31	-13.39					
9.	Fruit	-.03	.66	.87	.95	.40	.51	1.08	.72	.42	-46.26				
10.	F.c.a.h.	-.04	.88	1.16	1.26	.53	.67	1.44	.96	.56	1.29	-41.35			
11.	Other food	-.03	.54	.71	.78	.32	.41	.89	.59	.34	.80	1.06	-6.54		
	All food	.06	-1.29	-1.68	-1.84	-.77	-.98	-2.10	-1.40	-.81	-1.89	-2.51	-1.54	-1.32	
12.	Non-food	-.04	.77	1.00	1.10	.46	.59	1.25	.84	.48	1.12	1.49	.92	.79	-.47

normal goods are greater than or equal to unity. Notably substitutable f
others are meat, eggs, fruit and f.c.a.h.. The substitution elasticity b
all food and non-food is 0.79. The substitutability, on the whole, appea
be fairly large but the complementarity between rice and the rest is quit

Finally the interpolation test is applied to the estimated system of
equations with the coefficients reported in Table 2, in order to examine
effectiveness of the model as a whole. It consists of total and final te
in this case since equation (1) contains both predetermined endogenous an
exogenous variables on the right-hand side. The λ_t, a predetermined endo
variable in equation (1), is a function of a lagged endogenous variable a
exogenous variables, so that it could be regarded as a lagged endogenous
Partial test is not applicable because there is no contemporary endogenou
variable on the right-hand side. As the measure of fitness in the two te
the ratio of estimated to actual quantities is computed, which reveals th
validity of demand analysis and prediction. Measures of fitness are give
Table 7.

Equation (1) is in effect expressed in reduced form. In the total t
therefore, the value of the contemporary endogenous variable in each equa
is calculated easily by substituting observed values into both predetermi
endogenous and exogenous variables. Evidently from the measures in the u
rows, the model indicates a fairly high fitness in the total test, greate
or equal to 78 percent. The lower limit of the measures of fitness is 88
except commodity group 6, milk products. Structural errors of the model a
considered to be relatively small in this respect.

In the final or simulation test, only the observed values of exogeno
variables and of predetermined endogenous variables in the first year of

Table 7

Measures of Fitness in Total and Final Tests[a], $\hat{x}_i/x_i$[b]

i	1	2	3	4	5	6	7	8	9	10	11	12
	.96 —	1.07 —	1.01 —	1.05 —	1.12 —	.85 —	1.08 —	1.02 —	1.04 —	1.03 —	1.02 —	.99 —
	1.01 .97	1.02 1.09	.97 .98	1.01 1.07	.96 1.10	1.12 .98	1.09 1.15	.92 .93	.99 1.03	.96 .98	.99 1.00	1.01 1.01
	.98 .95	1.04 1.13	.97 .96	1.01 1.08	1.01 1.14	1.16 1.15	.96 1.08	1.02 .97	1.00 1.03	1.02 1.00	1.02 1.03	1.00 1.01
	.98 .93	1.06 1.19	.99 .96	.97 1.07	1.05 1.23	1.22 1.37	.94 1.00	1.00 .97	.98 1.00	.99 .99	.99 1.02	1.01 1.01
	1.03 .95	.98 1.16	1.00 .98	.98 1.06	1.01 1.31	.89 1.16	1.01 1.01	1.01 .99	.97 .97	.98 .97	.99 1.00	1.00 1.01
	1.02 .96	.97 1.12	1.02 1.01	.97 1.03	1.00 *	1.04 1.19	.99 1.00	1.04 1.02	1.02 .99	1.00 .98	.99 .99	1.00 1.01
	1.02 .98	.94 1.05	1.04 1.04	1.00 1.03	.95 *	.92 1.07	.99 .99	1.04 1.06	1.02 1.01	1.00 .99	1.00 .99	1.00 1.00
	1.01 .99	.92 .97	.91 .93	.99 1.02	.93 *	.96 1.02	1.00 .99	1.01 1.06	.96 .96	1.04 1.04	1.01 1.00	1.00 1.01
	1.00 .98	.97 .94	1.11 1.07	1.01 1.03	1.02 *	.96 .98	.95 .94	1.01 1.06	1.03 1.00	1.00 1.03	1.00 .99	1.00 1.01
	1.08 1.06	1.01 .95	1.01 1.05	1.00 1.03	.96 *	1.01 .99	1.00 .94	.97 1.01	1.00 1.00	1.04 1.06	1.01 1.00	1.00 1.00
	.98 1.05	1.04 .99	.99 1.02	1.00 1.04	1.00 *	.98 .97	1.00 .96	1.00 1.01	1.00 1.00	.99 1.02	1.00 .99	1.00 1.00
	1.00 1.06	1.07 1.05	1.00 1.01	1.01 1.11	1.03 *	1.00 .98	.98 .95	1.00 1.01	1.04 1.03	.97 .99	1.01 1.00	1.00 1.00
	1.02 1.08	.99 1.04	1.03 1.04	1.00 1.05	.99 *	.99 .97	1.02 .97	1.00 1.01	.98 1.01	.98 .97	1.01 1.01	1.00 1.00
	.98 1.06	1.01 1.05	.97 .99	1.01 1.07	1.02 *	1.02 .99	1.01 .99	.96 .97	.99 1.00	1.00 .98	1.00 1.01	1.00 1.00
	.99 1.06	.98 1.02	.99 .99	1.00 1.07	1.00 *	1.01 1.00	1.03 1.02	1.02 .99	1.00 1.00	1.02 1.00	.99 1.00	1.00 1.00

pper and lower figures represent measures of fitness in total and final tests, espectively.

$_i$=actual quantity ; $\hat{x}_i$=estimated quantity.

ot applicable ; * undue

period analyzed are inserted in the model to calculate the predicted valu contemporary endogenous variables. Values of predetermined endogenous va in the years other than the first year are also computed in the model. A from commodity groups 5 and 6, the measures in the lower rows indicate at 81 percent of fitness, which is substantially high in the accuracy of dem prediction. Measures for commodity group 6 include a lower point estimat 63 percent. As regards commodity group 5, the measure of fitness increas rapidly and proves that the model is not suitable for the demand predicti this subgroup.

Concluding Remarks

This paper attempted to apply a dynamic preference model to the measurement ie food demand system in 1956-1971, the period of rapid improvement and 'sification in the postwar Japanese diet. In conclusion, even through such amic approach, it is difficult to explain at full length the influence of ic factors upon the changing pattern of food consumption.

Parameters of the estimating equation approximately reached the state of rgence in round 40. Many of them are statistically significant. Of all tructural parameters obtained by using those estimates, dynamic parameters ather unstable and do not satisfy the theoretical conditions of sign. , there is no guarantee that dynamic or long-run equilibrium has been in ence during the period under consideration.

The interval of observation is regarded as a period of transition from ional to modern type of dietary habits, and so it would be still premature m a new style of eating habits. Meat, milk and eggs have been found to be forming commodities. The other subgroups of food commodities had negative ological) stock effects. It may safely be said, however, that some tional commodities with large (psychological) stocks gradually lose public and are partly replaced by modern commodities which record small stocks se in popularity. Stock effects of conventional food commodities would positive in such a situation. In this regard, the negativity of B can erpreted for those food commodities. Although the model does not provide r and dynamic explanation in this study, it could be more effectively i to the analysis of a longer interval of observation.

s the static parameters as a whole have been duely estimated, it follows ie food demand shifted from year to year along the locus of short-run equilibrium points. Thus the short-run demand matrix and money flexibili are derived from the estimated additive quadratic model. They appear pla and comparable with the results in the previous studies. The change of f consumption pattern in the 1956-1971 period seems to be substantially exp by income and price changes within a theoretically consistent framework, it was indeed remarkable. Lastly, the Houthakker-Taylor model should be widely applied and empirically tested since there are not so many example its application hitherto.

Footnotes

There is an interesting alternative model by Phlips [6] in this connection.

The maximum rate of error fell to 4 percent in round 91 and thereafter.

It is very likely that the B's and D's appear too large in absolute value for milk, milk products and rice because of their low statistical significance.

There is much empirical evidence in a number of countries, supporting the fact that the income elasticity of the marginal utility of real income centers around a figure of -2 (see [1] IV and [3]).

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