MODELS OF COMPLETE EXPENDITURE SYSTEMS FOR INDIA

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May 1980
WP-80-98

INTERNATIONAL INSTITUTE FOR APPLIED SYSTEMS ANALYSIS
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PREFACE

Because food production is one of the most decentralized activities of mankind, and nations are the largest units in which agricultural problems appear in their full complexity, the activities of the Food and Agriculture Program of IIASA are focused on the study of national food and agriculture systems. In order to study the world's food problems, a consistent set of national agricultural models is being developed. As a first step toward the realization of IIASA's objectives in modeling national food and agriculture systems, work has begun on the development of prototype models for countries representing various types of national agriculture systems.

Professor Kirit Parikh has developed a framework of the Indian agricultural policy model, as a prototype for Asian developing countries with limited food producing potential (RM-77-59).

The present report describes the modeling of a complete demand system for construction of an Indian Model. For the modeling of agricultural policy in a dveloping country, one needs a demand system that reflects the effect of income redistribution resulting from alternative government policies. This study, which describes an empirical estimation of such a complete demand system for India, is the second* in a set of studies which are to give empirical substance to the framework of the policy model for India and which will be published as part of a Research Report summarizing the results of the Indian Agricultural Model.

This study was initiated when Professor Radhakrishna visited IIASA, and was carried out together with Dr. Murty of the Sardar Patel Institute of Economic and Social Research, Ahmedabad, India.

*The first one is a report describing the modeling of farm supply responses through empirical estimation.

ACKNOWLEDGEMENTS

This study, carried out in collaboration with K.S. Parikh, has been tailored to a bigger study of the Agricultural Policy Model of India that is being carried out at IIASA. The model of the present study was formulated during the winter of 1978 while R. Radhakrishna was on a visit to IIASA. The stimulating discussions that he had with the research staff of IIASA, particularly with M.A. Keyzer, N.S.S. Narayana and K.S. Parikh had considerable impact on the final formulation of the model.

We are grateful to F. Rabar for initiating the study and extending support from IIASA, and to K.K. Subramanian for extending his help from the Sardar Patel Institute of Economic and Social Research, Ahmedabad, India. Our thanks are also due to V.B. Tulasidhar and D.H. Parikh.

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CHAPTER I
INTRODUCTION

Purpose

The purpose of this study is to estimate a suitable demand model for the Agricultural Policy Model of India which is being developed at the International Institute for Applied Systems Analysis (Parikh, 1977). It is proposed to formulate the demand model within the framework of a complete demand system and structure it to handle the income redistributional effects in a realistic manner. This could then meet the requirement of endogenizing the price vector in the Agricultural Policy Model. Though the demand model development was spurred by the need of the IIASA agricultural policy model, we hope that the model will also be useful for other analytical models such as those designed to give demand projections under alternative distributions or policy models dealing with price stabilization.

The Agricultural Policy Model is aimed at being a

descriptive model to evaluate the effectiveness of various policies in the food and agricultural area. Since income distribution plays a significant role in determining the extent of malnutrition, and since income distribution is affected by agricultural prices and terms of trade, both prices and incomes are endogenous in the model. Moreover, the objective of the IIASA project is also to study the effects of international trade and aid policies. Thus the economy is modeled as an open economy. The model is conceived as a general equilibrium type model to be used in a year by year simulation mode. A number of government policies are also endogenous. For this model we need to estimate a complete demand system which can handle the effects of income re-distribution resulting from alternative government policies.

We shall briefly review the studies that have been reported on Indian Consumption Patterns. This will help us to identify the considerations one has to take note of while formulating the model.

STUDIES ON CONSUMPTION PATTERNS OF INDIA

Engel Curves

The availability of the National Sample Survey (NSS) data on consumer expenditure since 1950 has stimulated a large number of studies on consumption patterns (Rudhra, 1969 and Bhattacharya, 1975). However, most of the studies based on this wealth of data in the past have been confined to the estimation of Engel curves (Coondo, 1975 and Jain, 1975). The expenditure elasticities obtained from them have become the conceptual tools for demand projection making the following assumptions: insensitivity of consumer expenditure to price

changes; invariance of income elasticities over time and price structure. Projections made at the mean level further assume away the changes in income distribution. These assumptions appear unrealistic for a number of reasons. The influence of prices both on household consumption and income elasticities has been sharply brought into focus by the few studies carried out recently on complete demand systems for India (Bhattacharya, 1967, Murty, 1977, Murty, 1978, Radhakrishna and Murty, 1973, and Radhakrishna and Murty 1977). It would also be unrealistic to ignore dependencies between shifts in income distribution and demand projections, as there is a great deal of variation in the scale of preferences among certain definable groups within the economy. Income distributional effects may be ignored in case the shifts in income distribution are marginal compared to total growth. But in a developing country like India, it is well established that frequent fluctuations in agricultural output alter the income terms of trade.

Indifference Surfaces

In a few studies, quadratic utility functions have been estimated from family budget data (Mahajan, 1972, Radhakrishna and Murty, 1975, and Radhakrishna, 1977). The estimated quadratic utility functions mostly violate the convexity conditions. All other theoretical preconditions are satisfied as they are built into the method of estimation. Further, the quadratic utility function implies linear Engel curves which are restrictive when the range of income variation is wide. Further the methods of estimation are very data demanding and the parameter estimates appear to be very susceptible to measurement errors.

Linear Expenditure System (LES)

Among the Complete Demand Systems, the Linear Expenditure System (LES) has received more attention; some have estimated LES from the time series data (Bhattacharya, 1967), whilst others from the time series of cross section data (Radhakrishna and Murty, 1973). The LES gives satisfactory properties. This is not surprising, since the additive utility functions, to which LES conforms, are very rigid in specification and ensure the fulfilment of almost all the theoretical properties. They do not tell us whether the theoretical properties do or do not hold in practice. We can only explore whether they provide a satisfactory description of consumer behavior at a reasonable level of commodity aggregation. The LES also gives rise to linear Engel curves. The severity of this restriction can be moderated, to some extent in time series models designed mainly for providing predictions at the mean level without changes in income distribution, either by introducing time trends into the parameters (Stone, 1965) or by resorting to habit formation hypothesis (Pollack and Wales, 1969). Even these moderations may fail to forge a link between consumption patterns and income distribution.

Piecewise LES (PLES)

Some attempts have been made by Radhakrishna and Murty at Sardar Patel Institute of Economic and Social Research (SPIESR) to overcome some of the above limitations of LES by the use of a piecewise LES. The NSS per capita expenditure brackets of the rural and urban areas have been stratified into three expenditure (income) classes viz., lower, middle

and higher and a separate LES (with six and nine commodity groups) has been fitted to each group. The results have clearly brought out the suitability of the LES for local approximations and show sizeable variations in the parameter estimates across the expenditure groups. For example, the foodgrains group takes a major share of the total expenditure of the lower expenditure group (about 45 per cent in rural areas and 30 per cent in urban areas) and its weightage reduces considerably as the total expenditure level rises (to about 9 per cent in rural higher expenditure group and 2 per cent in urban higher expenditure group). The rural-urban variations are also found to be sizeable: the marginal budgets of urban lower and middle expenditure groups are more varied and diversified than their counterparts in rural areas. Nevertheless, one notices that in the case of a majority of items, variation across income groups are more marked compared to rural-urban differences for corresponding income groups.

Indirect Addilog System (IAS)

An attempt has also been made to examine whether the Indirect Addilog System (IAS), a non-linear system, provides a reasonable description of consumer behavior over the entire income range (Radhakrishna and Murty, 1977). Both sample and post sample predictions of the expenditures of various income groups have shown that the IAS gives a poor fit for lower income groups. From the above study it emerges that the IAS is not flexible enough to provide a satisfactory description of the consumer behavior over the entire range of total expenditure (income). Thus, it brings out the limitations of IAS in handling the distributional effects.

Piecewise IAS (PIAS)

Some attempts have also been made at the SPIESR to estimate the IAS separately for each expenditure group. The parameter estimates differ markedly across the expenditure groups, thus reinforcing the need for distinguishing expenditure groups. In a large number of cases, the IAS is found to violate the convexity conditions. There is not much difference between PLES and PIAS in terms of goodness of fit.

CHOICE OF THE MODEL

It would seem from the foregoing discussion that no single complete demand system can adequately represent the consumption patterns over a wide range of total expenditure and one has to resort to grouping and estimate separate models for each group. The choice is now between PLES and PIAS. As pointed out in the preceding discussion, there is not much to discriminate between the two models from the point of view of goodness of fit. If one takes into consideration the fulfilment of theoretical properties as a desirable feature, the LES has a distinct edge over the IAS since only LES fulfills all the theoretical properties and the IAS violates convexity conditions. Further, consistency in theoretical properties is an extremely desirable property for the computation of exchange equilibrium in the Agricultural Policy Models (Parikh, 1977). The above considerations have led us to opt for the PLES.

COMMODITY CLASSIFICATION

Taking into consideration the availability of data and the requirements of the Agricultural Policy Model, the following commodity classification has been used as shown in Table 1 below.

Table 1. Commodity list

Commodity Group No	Commodity Title	Items Included
1	2	3
1	Rice	Rice
2	Wheat	Wheat
3	Other cereals	Jowar, bajra, maize, barley, small millets, ragi, Bengal gram and their products
4	Milk & milk products	Liquid milk, milk (condensed, powered), ghee, butter, dahi, ghol, lassi and other milk products
5	Edible oil	Oil, oilseeds and products
6	Meat, egg & fish	Meat, egg & fish
7	Sugar & gur	Canned sugar, gur (unrefined sugar) and sugar candy
8	Pulses	Tur, gram, moong, masoor, urad, peas and thur products
9	Fruits & vegetables	Fruits and nuts, vegetables
10	Other food	Spices, beverages, refreshments and procured food; pickles, jams and jellies
11	Clothing	Cotton (mill made, hand-woven and khadi) woollen, silk, rayon, etc., including bedding and upholstery
12	Fuel & light	Coke, coal, firewood, electricity, gas, dung-cake, charcoal, kerosene, candle, matches and other lighting oil

1	2	3
13	Other non-food	Pan, tobacco and its products, drugs and intoxicants, amusements and sports, education, medicine, toilets, rent,sundry goods, furniture, services, etc.

Formation of Income Groups

In earlier studies carried out at the SPIESR, the following procedure has been adopted for the formation of income groups. The LES has been estimated utilizing the data of all expenditure classes. The signs of the residuals are found to have distinct patterns across expenditure classes. The patterns are also found to be stable over the periods. Taking into consideration the signs of the residuals, three expenditure groups have been formulated - the first four expenditure classes forming the lower group, the next four forming the middle group and the last four or five expenditure classes forming the higher expenditure group. Since total expenditure is a monotonic function of income we have also labeled total expenditure groups as income groups.

In the above grouping, the expenditure range of each expenditure group remains the same at current prices. However, with a change in price level, the expenditure range of a group expressed in terms of constant prices is likely to vary. In this study we have taken into consideration price movements while formulating the expenditure groups. Further, a finer disaggregation of expenditure groups as compared to the previous study has been adopted. In other words, the expenditure range in terms of constant prices would remain the same and the expenditure groups are more than three. In this scheme, given the current expenditure

of an individual at current price structure, we shall express his current expenditure at base year prices by using appropriate price deflators and locate his expenditure group.

We present below the grouping that has been adopted: Taking into consideration the previous grouping and the requirements, we have formed five expenditure groups on the basis of the 17th round expenditure classes at 1961,62 prices: Rs. 0-8 forming the first group; 8-11, 11-13 the second group; 13-15, 15-18, 18-21 forming the third group; 21-24, 24-28, 28-34 forming the fourth group and 34-43, 43-55, 55-75, 75 and above forming the fifth group. The class boundaries have then been expressed at the price structures of other rounds by using separate cost of living index for each class boundary and then grouping has been made. The price deflators are taken from a study by Radhakrishna and Atul Sarma (1975) carried out at SPIESR. The study cited above gives cost of living indices for each fractile class separately for the rural and urban areas. In the end the following groupings of expenditure classes at constant prices has emerged for the rural and urban areas (Figures 1a and 1b). It can be seen that expenditure classes contained in Group I covers only the class Rs. 0-8 during the initial rounds but covers classes Rs. 0-8, 8-11, 11-13, 13-15 and 15-18 during the 25th round. This is due to price rise.

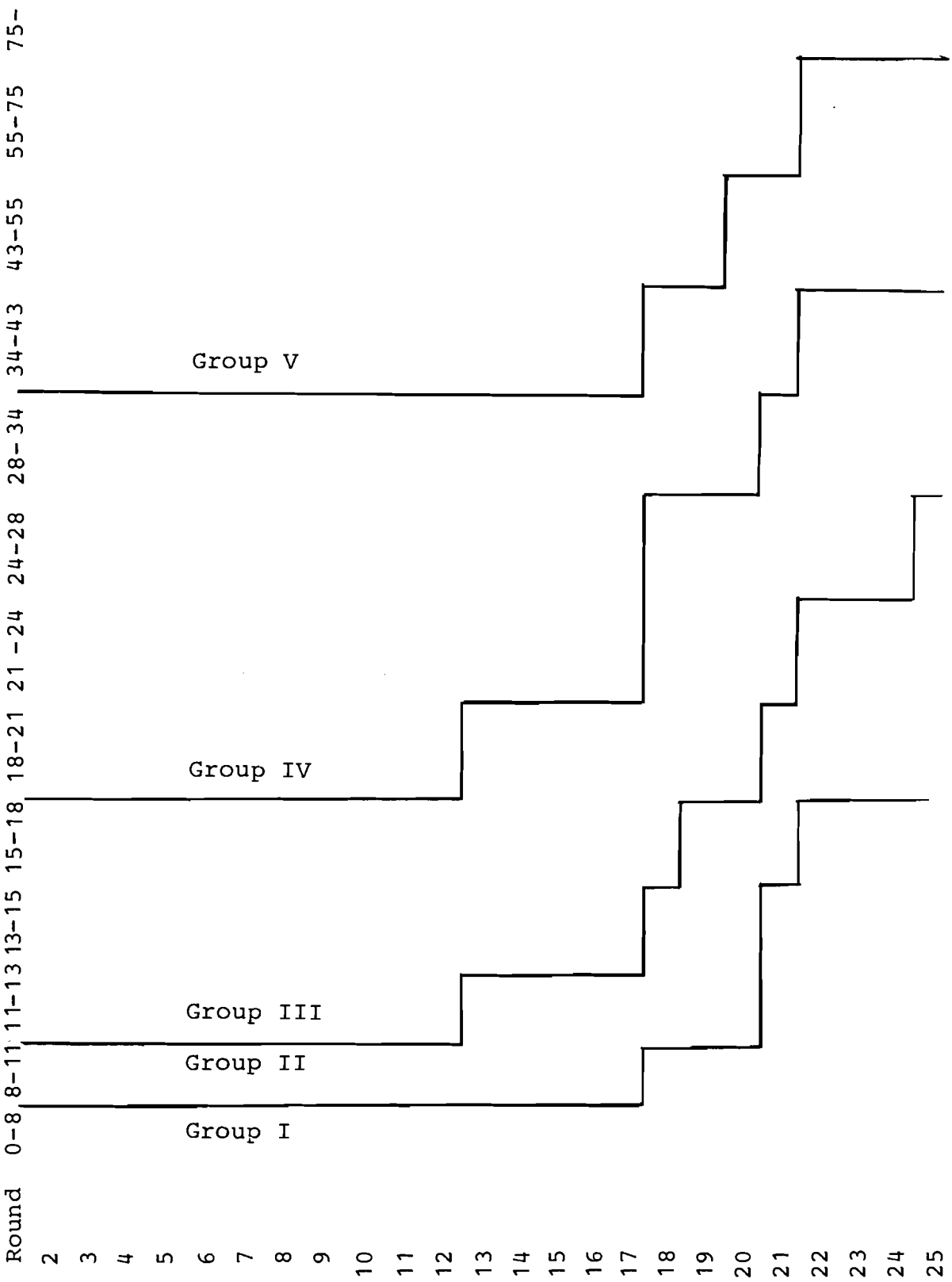

Figure 1a. Grouping of NSS current price expenditure class into constant price expenditure classes - RURAL

NSS current price expenditure class in Rs 0.00 per person for 30 days - RURAL

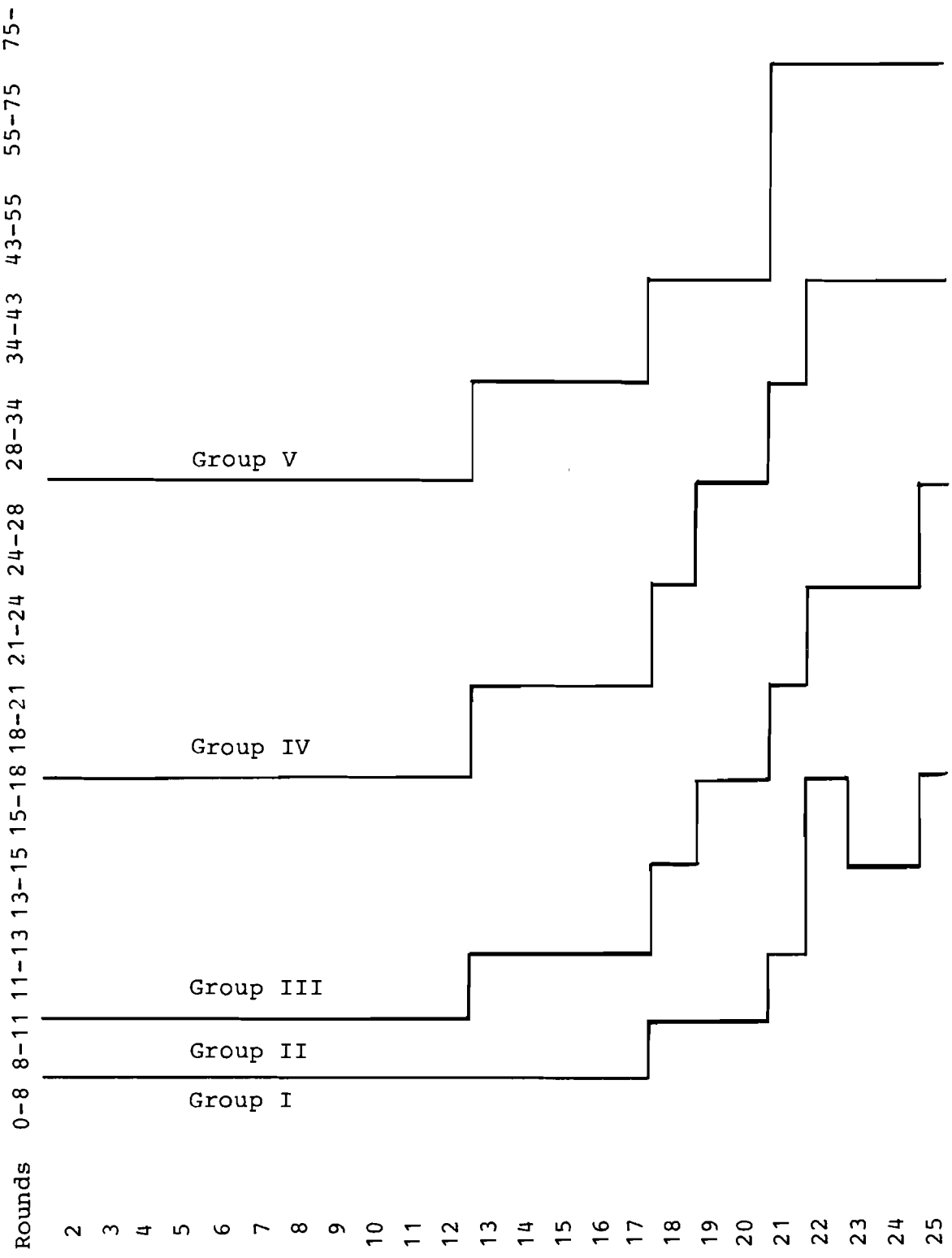

Figure 1b. Grouping of NSS current price expenditure class into constant price expenditure classes - URBAN

NSS current price expenditure class in Rs 0.00 per person for 30 days - URBAN

CHAPTER II

MODEL AND ESTIMATION

We have utilized the LES which has been extensively applied in analyzing the consumption patterns for a large number of countries[1]. The LES is usually written in the form

$$v_i = p_i q_i = c_i p_i + b_i \left[\mu - \sum_{j=1}^{n} c_j p_j\right] \qquad (1)$$

$$\sum_{i=1}^{n} b_i = 1$$

$$(i=1,\ldots,n)$$

where q_i represents the quantity consumed of i^{th} commodity; p_i is the price of i^{th} commodity and μ is total expenditure such that $\mu = \sum_{i=1}^{n} v_i$. The b's and the c's are parameters of the system. The b's are the marginal budget shares and c's are sometimes interpreted as committed quantities. This interpretation is only suggestive and it is not always possible to do so: particularly when c_i is negative. A

negative c_i is not inconsistent with theory. The LES can be derived from maximization of the ordinal utility function.

$$u(q) = \sum_{i=1}^{n} b_i \log (q_i - c_i), \quad \sum_i b_i = 1$$

subject to the budget constraint $\sum_i p_i q_i = \mu$

The fulfilment of the second order condition of equilibrium requires that $b_i > 0$ i.e. no inferior goods and $\mu > \sum_j c_j p_j$. Since it can be derived from a utility function, it meets the theoretical properties - adding up, homogeneity and symmetry of the Slutsky substitution matrix. However, the LES has a few limitations. Since the underlying utility function is additive it becomes an unrealistic specification when we deal with finer level of commodity aggregation. The additivity, besides not allowing inferior goods, imposes too strong a specification on price effects. Nevertheless, this may not pose a problem for broad groups of consumption.

For commodity i the income elasticity η_{io}, own price elasticity η_{ii} and cross price elasticity with respect to j^{th} price η_{ij} are given by

$$\eta_{io} = b_i / w_i \qquad w_i = p_i q_i / \mu$$

$$\eta_{ii} = -1 + (1 - b_i)\, c_i / q_i \qquad (2)$$

$$\eta_{ij} = -b_i p_j c_j / p_i q_i \qquad (i \neq j)$$

Subgroup Model

Though the NSS reports provide information on expenditure for broad groups of consumption for a good many number of rounds, they provide information for specific items, only for

a few rounds. Under these circumstances, the best strategy would be tc estimate the LES in a hierarchical manner (Stone, 1965, Deaton, 1974a). We may carry out the calculations first for the broad groups and then for subgroups. The first stage model can be estimated from data from a large number of rounds while the subgroup models from the data of a few rounds. The first stage model and the second stage model can be integrated as follows.

We shall denote indices by capital letter subscripts and assume that n individual goods are partitioned into G groups. Let us consider G^{th} group. Summing over all goods belonging to G^{th} group and writing v_G for the group expenditure, we have

$$v_G = \sum_{k \in G} p_k c_k + b_G \left(\mu - \sum_j c_j p_j\right) \qquad (3)$$

The above expression can be written in a form identical to Eqn. 1 by defining group price indices p_G , as

$$p_G = \sum_{k \in G} p_k c_k \Big| \sum_{k \in G} c_k \qquad (4)$$

and the corresponding quantity indices q_G , as

$$q_G = v_G | p_G \qquad (5)$$

These may be substituted in Eqn. 3 to give the group equivalent of Eqn. 1 as:

$$v_G = p_G q_G = c_G p_G + b_G \left(\mu - \sum_H p_H c_H\right) \qquad (6)$$

Turning to subgroups, the equations of the items belonging to G^{th} group can be written as:

$$v_i = p_i q_i = c_i p_i + \frac{b_i}{b_G} (v_G - \sum_{k \in G} c_k p_k) \qquad (7)$$

It can be seen that the parameters of the first stage model (Eqn. 6) and subgroup models (Eqn. 7) together give the estimates of model (Eqn. 1.). It can be seen from the above expressions that for consistent grouping, the weights of the group price indices (Eqn. 4) should be C_i which can be estimated from subgroup models. In other words, we have to estimate the sub models first, compute the group price indices and then estimate the first stage models. In practice, base year budget proportions are used for compiling the group price indices. Since individual prices are mostly collinear , these indices are likely to give close approximation (see Deaton, 1974a, pp. 159-161).

Estimation of LES

Let us introduce error terms in the LES and write it as

$$v_{it} = p_{it} q_{it} = c_i p_{it} + b_i [\mu_t - \sum_j c_j p_{jt}] + \varepsilon_{it} \qquad (8)$$

$$E(\varepsilon_{it}) = 0$$

$$E(\varepsilon_t \varepsilon_t') = \Omega$$

$$E(\varepsilon_t \varepsilon_s') = 0 , \quad t \neq s$$

In the above equations Ω is singular because of the adding up property which implies that $i'\Omega = 0$. Let us formulate the likelihood function for Eqn. 8 by deleting one equation for each t; without loss of generality we delete the last equation [2] . Denoting the truncated residuals as $\tilde{\varepsilon}_t$, truncated b as $\tilde{b}$ and truncated Ω as $\tilde{\Omega}$, the likelihood in logarithmic form can thus be written as

$$\text{Ln } L = -\frac{1}{2} m(n-1)\text{Ln } 2\Pi - \frac{m}{2}\text{Ln det. } \tilde{\Omega} - \frac{1}{2}\sum_t \tilde{\varepsilon}_t' \tilde{\Omega}^{-1} \tilde{\varepsilon}_t \quad (9)$$

Since the first order conditions of the maximum likelihood function give rise to nonlinear equations in parameters, the maximum likelihood estimates can only be obtained by employing iterative methods. Let us employ the linearization method which yields the m.l. estimates (Solari, 1971, and Slater, 1972)[3]

Linearizing the LES after deleting the n^{th} equation around an initial value $\tilde{b}_o$ and c_o we have

$$v_{it} = c_{io}p_{it} + \delta c_i p_{it} + b_{io}(\mu_t - \sum_j c_{jo}p_{jt}) + \delta b_i$$

$$(\mu_t - \sum_j c_{jo}p_{jt}) + b_{io}(\mu_t - \sum_j \delta c_j p_{jt}) + \varepsilon_{it} \quad (10)$$

$$(i = 1,\ldots,n-1 \quad , \quad t = 1,\ldots,m)$$

The above equations are linear in $\delta\tilde{b}$ and δc . They can be estimated by employing the maximum likelihood method developed for seemingly unrelated regressions. The iteration continues till $\delta\tilde{b}$ and δc become negligible.

The above procedure does not yield an estimate of b_n . It can, however, be evaluated from $\tilde{b}$ by employing the adding up property.

The estimation of hierarchic model poses some econometric problems for the subgroup models. The total expenditure of the first stage model (broad group model) can be taken as predetermined and the model is concerned with its allocation;

the errors sum to zero and the co-variance between ε_i and μ is zero. However, in the case of subgroup model, the group expenditure v_G cannot be taken as predetermined; the errors in each expenditure on the specific items get reflected in the group expenditure and this does not ensure the absence of co-variance between the errors in the expenditure on specific items and the error in their group expenditure. This introduces simultaneous equation bias in the estimation of subgroup model and makes the estimates inconsistent. Nevertheless, the bias is likely to be small (see Deaton, 1974a, pp. 165-168).

CHAPTER III

LINEAR EXPENDITURE SYSTEM

Introduction

It is possible, using the NSS data on monthly per capita expenditure, to distinguish nine commodity groups for which data are available for a good many number of the NSS rounds. It is also possible to distinguish eleven commodity groups for some rounds in the sample period. A few rounds of data also permit us to estimate two submodels - one for cereals and the other for other food. The details of the commodity classifications are given in Table 2.

The LES has been estimated by using the linearization iterative procedure stated in Chapter II for all the ten expenditure groups (Rural and Urban) defined in Chapter I. Though we have estimated LES with 9 and 11 commodity classification, we have made use of the results of the 9 commodity LES while drawing policy implications. The data are abundant for 9 commodity groups. Further, additivity may

not be very restrictive at this level of commodity aggregation.

Nine Commodity LES

Fitting of the Model

LES has been estimated making two alternative specifications for the covariance of the disturbance terms. In model I we have assumed that $\Omega = \sigma^2 I$ and model II we have assumed that non-diagonal terms of Ω exist.

We have employed the linearization procedure while estimating the models. It may be noted that no equation has been deleted while estimating model I.

Table 2. Commodity classification

First Stage Models:

9 Sector LES	11 Sector LES
1. Cereals	1. Rice
2. Milk & milk products	2. Wheat
3. Edible oil	3. Other cereals
4. Meat, egg & fish	4. Milk & milk products
5. Sugar & gur	5. Edible oil
6. Other food	6. Meat, egg & fish
7. Clothing	7. Sugar & gur
8. Fuel & light	8. Other food
9. Other nonfood	9. Clothing
	10. Fuel & light
	11. Other non-food

Other Food Subgroup

1. Pulses
2. Fruits & vegetables
3. Other food

The data needed for estimating the models are taken from the NSS reports for the rounds 2-25 [4]. The group price indices with prices for 1961-62 as unity are compiled from the

Economic Adviser's wholesale price relatives[5].

Parameter Estimates

The parameter estimates along with the standard errors of the generalized least squares[6] estimates of the linearized LES at the last iteration which provide approximate confidence contours (see Goldfeld and Quandt, 1972, p. 52, and Deaton, 1974b, pp. 45-46), are also given below the paramters in Table 3.

In order to examine the goodness of fit, we have computed for each commodity group, the value of the square of the correlation coefficient between the observed and predicted expenditures (R^2) for the sample period. The above goodness of fit measure is also supplemented by Thiel's average information inaccuracy (II), (Thiel, 1975) given by

$$II = \frac{1}{m} \sum_i \sum_t w_{it} \; Ln \; \frac{\hat{w}_{it}}{w_{it}}$$

Where w_{it} stands for the proportion of expenditure devoted to i^{th} item in t^{th} period. These goodness of fit measures are also furnished in the following Table along with the parameter estimates of LES.

Table 3. LES parameter estimates

All India Rural: Group I

Sr. No.	Commodity Groups	Model - I b	Model - I C	Model - I R^2	Model - II b	Model - II C	Model - II R^2
1	Cereals	0.5774 (0.0051)	1.0365 (0.2047)	0.9932	0.5789 (0.0111)	1.6475 (0.1275)	0.9924
2	Milk & milk products	0.0361 (0.0050)	-0.0539 (0.0274)	0.7215	0.0333 (0.0034)	-0.0041 (0.0141)	0.7140
3	Edible oil	0.0405 (0.0047)	-0.0241 (0.0260)	0.9485	0.0388 (0.0014)	0.0263 (0.0071)	0.9667
4.	Meat, fish & egg	0.0271 (0.0047)	-0.0161 (0.0221)	0.8864	0.0238 (0.0014)	0.0222 (0.0063)	0.8964
5	Sugar & gur	0.0247 (0.0039)	-0.0027 (0.0173)	0.9164	0.0272 (0.0016)	0.0130 (0.0043)	0.9278
6	Other food items	0.1495 (0.0049)	0.1205 (0.0512)	0.9763	0.1497 (0.0045)	0.2652 (0.0280)	0.9785
7	Clothing	0.0152 (0.0050)	0.0579 (0.0339)	0.0002	0.0222 (0.0075)	0.0423 (0.0421)	0.0182
8	Fuel & light	0.0537 (0.0050)	0.3800 (0.0384)	0.9696	0.0516 (0.0028)	0.4630 (0.0160)	0.9645
9	Other non-food items	0.0758 (0.0051)	0.1066 (0.0469)	0.9035	0.0746	0.2200 (0.0307)	0.9004
		II = 0.0147			II = 0.0130		

Table 3 contd. All India Rural: Group II

Sr. No	Commodity Groups	Model - I b	Model - I C	Model - I R^2	Model - II b	Model - II C	Model - II R^2
1	Cereals	0.4653 (0.0133)	2.7093 (0.2547)	0.9880	0.5154 (0.0211)	1.7926 (0.2970)	0.9864
2	Milk & milk products	0.0775 (0.0148)	-0.1892 (0.1238)	0.8731	0.0620 (0.0071)	-0.1196 (0.0522)	0.8770
3	Edible oil	0.0395 (0.0106)	0.0575 (0.0788)	0.9653	0.0295 (0.0025)	0.1091 (0.0170)	0.9804
4	Meat, fish & egg	0.0369 (0.0108)	-0.0297 (0.0759)	0.9333	0.0272 (0.0022)	0.0186 (0.0166)	0.9403
5	Sugar & gur	0.0379 (0.0077)	-0.0248 (0.0522)	0.9214	0.0231 (0.0016)	0.0631 (0.0074)	0.9655
6	Other food items	0.1388 (0.0128)	0.4574 (0.1132)	0.9928	0.1372 (0.0062)	0.3778 (0.0062)	0.9938
7	Clothing	0.0208 (0.0105)	0.2472 (0.1002)	0.0026	0.0675 (0.0127)	-0.2630 (0.1410)	0.0533
8	Fuel & light	0.0727 (0.0109)	0.3307 (0.1016)	0.9745	0.0549 (0.0032)	0.4406 (0.0360)	0.9787
9	Other non-food items	0.1106 (0.0119)	0.0892 (0.1243)	0.9302	0.0832	0.2653 (0.0921)	0.9289
		II = 0.0090			II = 0.0116		

Table 3 contd.

All India Rural: Group III

Sr. No.	Commodity Groups	Model - I b	Model - I C	Model - I R^2	Model - II b	Model - II C	Model - II R^2
1	Cereals	0.2992 (0.0138)	5.3016 (0.3097)	0.9510	0.2340 (0.0247)	6.4452 (0.1954)	0.9459
2	Milk & milk products	0.1368 (0.0144)	-0.2778 (0.2062)	0.9147	0.1471 (0.0076)	-0.0082 (0.0571)	0.9192
3	Edible oil	0.0309 (0.0120)	0.2393 (0.1201)	0.9660	0.0307 (0.0018)	0.3198 (0.0131)	0.9716
4	Meat, fish & egg	0.0402 (0.0121)	0.0431 (0.1163)	0.9204	0.0394 (0.0023)	0.1450 (0.0168)	0.9242
5	Sugar & gur	0.0440 (0.0104)	0.0536 (0.0933)	0.9366	0.0466 (0.0026)	0.1390 (0.0135)	0.9393
6	Other food items	0.1439 (0.0134)	0.7053 (0.1756)	0.8310	0.1751 (0.0146)	0.8181 (0.1099)	0.8164
7	Clothing	0.0812 (0.0127)	0.1706 (0.1770)	0.5922	0.0966 (0.0077)	0.2856 (0.0916)	0.6725
8	Fuel & light	0.0548 (0.0129)	0.6433 (0.1560)	0.9517	0.0452 (0.0032)	0.8816 (0.0319)	0.9510
9	Other non-food items	0.1760 (0.0136)	-0.0160 (0.2504)	0.9371	0.1853	0.4236 (0.1537)	0.7267
		II = 0.0180			II = 0.0180		

Table 3 contd.

All India Rural: Group IV

Sr. No.	Commodity Groups	Model - I b	Model - I C	Model - I R^2	Model - II b	Model - II C	Model - II R^2
1	Cereals	0.1791 (0.0116)	9.4852 (0.2607)	0.9304	0.1880 (0.0241)	8.3591 (0.4009)	0.9298
2	Milk & milk products	0.1560 (0.0118)	1.7259 (0.2451)	0.9275	0.1551 (0.0099)	0.8119 (0.1384)	0.9239
3	Edible oil	0.0230 (0.0113)	0.7174 (0.0880)	0.9557	0.0239 (0.0018)	0.5650 (0.0220)	0.9570
4	Meat, fish & egg	0.0296 (0.0117)	0.5780 (0.0916)	0.8731	0.0323 (0.0028)	0.3763 (0.0344)	0.8811
5	Sugar & gur	0.0453 (0.0114)	0.6368 (0.0949)	0.9082	0.0399 (0.0031)	0.4592 (0.0296)	0.9368
6	Other food items	0.1098 (0.0116)	2.7443 (0.1645)	0.9696	0.1119 (0.0062)	2.1223 (0.0993)	0.9737
7	Clothing	0.1370 (0.0113)	1.9618 (0.2472)	0.8164	0.1357 (0.0103)	1.0132 (0.1610)	0.8083
8	Fuel & light	0.0343 (0.0114)	1.5380 (0.1078)	0.8528	0.0322 (0.0038)	1.3493 (0.0560)	0.8819
9	Other non-food items	0.2859 (0.0115)	3.1264 (0.4716)	0.8602	0.2810	1.2488 (0.4074)	0.8561
		II = 0.0082			II = 0.0082		

Table 3 contd.

All India Rural: Group V

Sr. No.	Commodity Groups	Model - I b	Model - I C	Model - I R^2	Model - II b	Model - II C	Model - II R^2
1	Cereals	0.0802 (0.0084)	12.8666 (0.4785)	0.8573	0.0801 (0.0102)	11.0851 (0.5601)	0.8599
2	Milk & milk products	0.0726 (0.0084)	5.1797 (0.4627)	0.7493	0.0703 (0.0080)	3.5670 (0.4723)	0.7456
3	Edible oil	0.0279 (0.0083)	1.3852 (0.2542)	0.7946	0.0269 (0.0025)	0.7384 (0.1414)	0.7905
4	Meat, fish & egg	0.0128 (0.0083)	1.1775 (0.2104)	0.5842	0.0153 (0.0020)	0.7403 (0.1055)	0.6026
5	Sugar & gur	0.0282 (0.0083)	1.6719 (0.2349)	0.8237	0.0260 (0.0028)	1.1228 (0.1300)	0.8294
6	Other food items	0.0722 (0.0083)	5.2532 (0.4139)	0.9210	0.0703 (0.0044)	3.7599 (0.3046)	0.9293
7	Clothing	0.1216 (0.0084)	5.9263 (0.8339)	0.7242	0.1202 (0.0118)	2.8124 (0.8728)	0.7339
8	Fuel & light	0.0213 (0.0085)	2.3541 (0.2659)	0.6803	0.0209 (0.0026)	1.8529 (0.1476)	0.6949
9	Other non-food items	0.5633 (0.0084)	11.9762 3.5406	0.9520	0.5700	-2.9908 (3.3455)	0.9485
		II = 0.0166			II = 0.0171		

Table 3 contd. All India Urban: Group I

Sr. No.	Commodity Groups	Model - I b	Model - I C	Model - I R^2	Model - II b	Model - II C	Model - II R^2
1	Cereals	0.4870 (0.0092)	0.5702 (0.3174)	0.9724	0.4862 (0.0177)	1.0101 (0.2630)	0.9714
2	Milk & milk products	0.0439 (0.0088)	-0.0637 (0.0524)	0.7007	0.0452 (0.0051)	-0.0296 (0.0279)	0.7026
3	Edible oil	0.0451 (0.0082)	-0.0067 (0.0494)	0.9073	0.0456 (0.0030)	0.0334 (0.0216)	0.9158
4	Meat, fish & egg	0.0290 (0.0083)	0.0095 (0.0429)	0.8078	0.0356 (0.0035)	0.0070 (0.0196)	0.7941
5	Sugar & gur	0.0303 (0.0088)	0.0170 (0.0531)	0.7823	0.0336 (0.0048)	0.0315 (0.0239)	0.7760
6	Other food items	0.1753 (0.0089)	0.1326 (0.1126)	0.9357	0.1799 (0.0109)	0.2688 (0.0855)	0.9526
7	Clothing	0.0183 (0.0091)	-0.0290 (0.0658)	0.0286	0.0172 (0.0095)	0.0013 (0.0589)	0.0002
8	Fuel & light	0.0741 (0.0092)	0.2148 (0.0888)	0.9134	0.0700 (0.0048)	0.3259 (0.0556)	0.9088
0	Other non-food items	0.0970 (0.0092)	0.2529 (0.1025)	0.7737	0.0867	0.4261 (0.0896)	0.7797
		II = 0.0263			II = 0.0258		

Table 3 contd.

All India Urban: Group II

Sr. No.	Commodity Groups	Model - I b	Model - I C	Model - I R^2	Model - II b	Model - II C	Model - II R^2
1	Cereals	0.3446 (0.0116)	2.1788 (0.2148)	0.9880	0.3428 (0.0204)	2.4493 (0.2485)	0.9874
2	Milk & milk products	0.0934 (0.0115)	-0.2113 (0.1050)	0.8868	0.0947 (0.0072)	-0.1482 (0.0635)	0.8876
3	Edible oil	0.0437 (0.0091)	0.1403 (0.0712)	0.9688	0.0493 (0.0040)	0.1362 (0.0263)	0.9694
4	Meat, fish & egg	0.0345 (0.0094)	0.0354 (0.0692)	0.9076	0.0415 (0.0034)	0.0154 (0.0238)	0.9092
5	Sugar & gur	0.0317 (0.0110)	0.1181 (0.0926)	0.9084	0.0250 (0.0052)	0.1941 (0.0345)	0.9210
6	Other food items	0.1690 (0.0110)	0.5544 (0.1181)	0.9823	0.1741 (0.0126)	0.6480 (0.0928)	0.9813
7	Clothing	0.0192 (0.0105)	0.0583 (0.1048)	0.0108	0.0364 (0.0121)	-0.0778 (0.1176)	0.0001
8	Fuel & light	0.0752 (0.0116)	0.3424 (0.1255)	0.9781	0.0640 (0.0041)	0.5098 (0.0544)	0.9785
9	Other non-food items	0.1888 (0.0118)	0.0832 (0.1750)	0.9473	0.1721	0.2402 (0.1482)	0.9471
		II = 0.0115			II = 0.0121		

Table 3 contd.

All India Urban: Group III

Sr. No.	Commodity Groups	Model - I b	Model - I C	Model - I R^2	Model - II b	Model - II C	Model - II R^2
1	Cereals	0.1722 (0.0088)	4.6711 (0.1282)	0.9813	0.1798 (0.0138)	4.3387 (0.1736)	0.9815
2	Milk & milk products	0.1474 (0.0090)	0.0689 (0.1241)	0.9362	0.1419 (0.0071)	-0.1129 (0.0859)	0.9362
3	Edible oil	0.0486 (0.0080)	0.4038 (0.0713)	0.9805	0.0457 (0.0031)	0.3523 (0.0271)	0.9817
4	Meat, fish & egg	0.0513 (0.0083)	0.1487 (0.0702)	0.9411	0.0457 (0.0025)	0.1239 (0.0275)	0.9448
5	Sugar & gur	0.0452 (0.0088)	0.2415 (0.0807)	0.9403	0.0379 (0.0032)	0.2409 (0.0275)	0.9522
6	Other food items	0.1824 (0.0088)	1.4274 (0.1324)	0.9785	0.1727 (0.0088)	1.2359 (0.0951)	0.9817
7	Clothing	0.0358 (0.0083)	0.3963 (0.0876)	0.0464	0.0676 (0.0103)	-0.0683 (0.1444)	0.1220
8	Fuel & light	0.0581 (0.0088)	0.9141 (0.0997)	0.9748	0.0576 (0.0029)	0.8084 (0.0500)	0.9765
9	Other non-food items	0.2592 (0.0089)	0.8242 (0.2156)	0.9629	0.2511	0.4240 (0.1975)	0.9629
		II = 0.0098			II = 0.0115		

Table 3 contd.

All India Urban: Group IV

Sr. No.	Commodity Groups	b	C	R^2	b	C	R^2
1	Cereals	0.0371 (0.0095)	6.6035 (0.1151)	0.9584	0.0488 (0.0133)	6.2814 (0.2063)	0.9600
2	Milk & milk products	0.1506 (0.0097)	1.1009 (0.2123)	0.9608	0.1512 (0.0072)	0.4521 (0.1862)	0.9608
3	Edible oil	0.0435 (0.0092)	0.7991 (0.1179)	0.9748	0.0402 (0.0030)	0.6654 (0.0505)	0.9765
4	Meat, fish & egg	0.0524 (0.0095)	0.4175 (0.1225)	0.9061	0.0406 (0.0032)	0.3991 (0.0604)	0.9118
5	Sugar & gur	0.0278 (0.0094)	0.6564 (0.1207)	0.9403	0.0270 (0.0025)	0.5469 (0.0441)	0.9432
6	Other food Items	0.2289 (0.0097)	2.4216 (0.2811)	0.9694	0.2260 (0.0122)	1.5243 (0.2756)	0.9720
7	Clothing	0.0647 (0.0086)	1.0932 (0.1487)	0.5360	0.0855 (0.0084)	0.3337 (0.2056)	0.5892
8	Fuel & light	0.0424 (0.0092)	1.5716 (0.1418)	0.9614	0.0480 (0.0027)	1.2476 (0.0726)	0.9671
9	Other non-food items	0.3527 (0.0095)	2.6596 (0.4622)	0.9679	0.3327	1.2888 (0.4690)	0.9677
		II = 0.0076			II = 0.0081		

Table 3 contd.

All India Urban: Group V

Sr. No.	Commodity Groups	b	C	R^2	b	C	R^2
1	Cereals	0.0124 (0.0065)	7.6253 (0.1420)	0.8655	0.0186 (0.0048)	6.6439 (0.2751)	0.8692
2	Milk & milk products	0.0924 (0.0065)	6.3125 (0.4460)	0.9158	0.0921 (0.0038)	1.2018 (0.3760)	0.9305
3	Edible oil	0.0126 (0.0065)	1.9846 (0.1531)	0.9434	0.0123 (0.0009)	1.2884 (0.0636)	0.9469
4	meat, fish & egg	0.0247 (0.0065)	1.9692 (0.1774)	0.8219	0.0252 (0.0015)	0.5903 (0.1184)	0.8716
5	Sugar & gur	0.0110 (0.0065)	1.5293 (0.1514)	0.8870	0.0110 (0.0009)	0.8835 (0.0604)	0.8853
6	Other food items	0.1443 (0.0065)	10.6081 (0.6607)	0.8808	0.1288 (0.0128)	3.6358 (0.8979)	0.8979
7	Clothing	0.0994 (0.0065)	5.5231 (0.5542)	0.8997	0.0993 (0.0044)	-0.8298 (0.5540)	0.8959
8	Fuel & light	0.0268 (0.0065)	3.3279 (0.2173)	0.9074	0.0281 (0.0012)	1.4927 (0.1368)	0.9378
9	Other non-food items	0.5766 (0.0065)	23.3548 (2.9862)	0.9813	0.5847	-13.2699 (2.9875)	0.9759
		II = 0.0112			II = 0.0126		

Goodness of Fit

On the whole the fit is satisfactory: the value of R^2 exceeds 0.80 in 146 out of 180 equations. The fit for clothing is poor for the lower expenditure groups of rural and urban areas. It is worth noting that models I and II are giving more or less closer estimates, particularly for b and the values of R^2 are very similar. The parameter estimates also possess the right signs: all b's are positive. Significantly, the parameters differ across the expenditure groups. This rules out the use of a single LES for all groups.

Marginal Budget Shares

In Table 3, b's give the marginal budget shares. It is obvious that there are sizeable variations in them both across income groups and between rural and urban areas. Nevertheless, there are some visible patterns. Cereal group takes a major share of the marginal budgets of the lower groups and its weightage loses with the total expenditure level. For example, as we move from lower to higher expenditure groups, the marginal budget share of cereals declines from 0.58 to 0.08 in rural areas and from 0.49 to 0.01 in urban areas. One notices that the fall in the marginal budget share of cereals is compensated by other non-food items. The marginal budget share of other non-food increases from 0.08 to 0.56 in rural areas and from 0.10 to 0.58 in urban areas. Thus the marginal budgets of higher income groups (both in rural and urban areas) are striking in their heavy weightage given to non-food items.

Rural-urban dichotomy is also seen. Nevertheless, these differences are less in magnitude in contrast with the differences across the income groups.

The above results imply that the expansion of demand for individual items depends very much upon which income group or groups are favored by economic growth. It is the lower income group which exerts a significantly greater influence on the expansion or contraction of agricultural products like cereals. Any policy of income transfers, to these groups, will result in demand pressure in the foodgrains market. Also any growth of supply of cereals has to be absorbed by the growth of income of this group. On the other hand, the demand for non-food items, which are mostly industrial products, expands with the incomes of the higher income groups.

Expenditure Elasticities

We have computed the expenditure elasticities at the mean level from model I. They are presented in Table 4a. These elasticities more or less reinforce the findings based on marginal budget shares. The expenditure elasticities in general decline with rising income level with the exception of other non-food items where we notice a rise. Rural-urban differences are more prominent for food items and rural elasticities are generally higher for food items and in particular for foodgrains. Again it is worth noting that the variations across income groups are more prominent in contrast with rural-urban variation.

Table 4a. Expenditure elasticities from 9 commodity LES

Sr. No.	Commodity groups	Rural Group I	Rural Group II	Rural Group III	Rural Group IV	Rural Group V	Urban Group I	Urban Group II	Urban Group III	Urban Group IV	Urban Group V
1	Cereals	0.954	0.827	0.583	0.460	0.343	0.971	0.758	0.461	0.140	0.094
2	Milk & milk products	1.962	2.245	2.222	1.701	0.728	1.712	2.030	2.053	1.547	0.886
3	Edible oil	1.527	1.247	0.968	0.783	0.985	1.244	0.997	1.067	0.980	0.410
4	Meat, fish & egg	1.546	1.693	1.569	1.149	0.606	1.129	1.247	1.589	1.512	0.798
5	Sugar & gur	1.363	1.655	1.537	1.379	0.803	1.092	0.966	1.302	0.828	0.445
6	Other food	1.115	1.008	1.121	0.871	0.674	1.043	0.984	1.069	1.290	0.808
7	Clothing	0.823	0.644	1.468	1.541	1.044	1.589	1.075	0.979	1.088	1.178
8	Fuel & light	0.589	0.963	0.814	0.587	0.508	0.825	0.947	0.792	0.646	0.550
9	Other non-food	1.072	1.370	1.763	1.816	1.781	1.852	1.494	1.601	1.593	1.573

Table 4a contd. Own price elasticities

Sr. No.	Commodity Groups	Rural Group I	Rural Group II	Rural Group III	Rural Group IV	Rural Group V	Urban Group I	Urban Group II	Urban Group III	Urban Group IV	Urban Group V
1	Cereals	-0.881	-0.760	-0.528	-0.254	-0.157	-0.900	-0.694	-0.348	-0.089	-0.016
2	Milk & milk products	-1.459	-1.459	-1.234	-0.442	-0.238	-1.399	-1.389	-0.951	-0.658	-0.123
3	Edible oil	-1.143	-0.839	-0.568	-0.175	-0.262	-1.029	-0.715	-0.515	-0.405	-0.028
4	Meal, fish & egg	-1.159	-1.125	-0.902	-0.258	-0.159	-0.937	-0.882	-0.744	-0.605	-0.054
5	Sugar & gur	-1.025	-1.101	-0.885	-0.308	-0.219	-0.907	-0.691	-0.616	-0.338	-0.028
6	Other food	-0.863	-0.718	-0.693	-0.264	-0.225	-0.888	-0.745	-0.584	-0.613	-0.171
7	Clothing	-0.625	-0.442	-0.853	-0.402	-0.346	-1.310	-0.761	-0.470	-0.457	-0.140
8	Fuel & light	-0.473	-0.669	-0.495	-0.147	-0.143	-0.707	-0.691	-0.401	-0.281	-0.047
9	Other non-food	-0.821	-0.924	-1.007	-0.544	-0.754	-0.734	-1.042	-0.804	-0.751	-0.602

Table 4b. Cross price elasticity with respect to cereal price

Sr. No.	Commodity Groups	Rural Group I	Rural Group II	Rural Group III	Rural Group IV	Rural Group V
1	Milk & milk products	-0.335	-0.567	-0.743	-0.602	-0.156
2	Edible oil	-0.261	-0.315	-0.324	-0.277	-0.211
3	Meat, egg & fish	-0.264	-0.427	-0.524	-0.406	-0.130
4	Sugar & gur	-0.233	-0.417	-0.514	-0.488	-0.172
5	Other food	-0.190	-0.254	-0.375	-0.308	-0.144
6	Clothing	-0.140	-0.162	-0.491	-0.545	-0.224
7	Fuel & light	-0.101	-0.243	-0.272	-0.208	-0.109
8	Other non-food	-0.183	-0.346	-0.589	-0.642	-0.382

Table 4b contd.

Sr. No.	Commodity Groups	Urban Group I	Urban Group II	Urban Group III	Urban Group IV	Urban Group V
1	Milk & milk products	-0.168	-0.430	-0.604	-0.389	-0.367
2	Edible oil	-0.122	-0.211	-0.314	-0.247	-0.215
3	Meat, egg & fish	-0.111	-0.264	-0.467	-0.381	-0.272
4	Sugar & gur	-0.107	-0.205	-0.383	-0.208	-0.192
5	Other food	-0.102	-0.209	-0.314	-0.324	-0.303
6	Clothing	-0.156	-0.228	-0.288	-0.274	-0.360
7	Fuel & light	-0.081	-0.201	-0.233	-0.162	-0.177
8	Other non-food	-0.084	-0.317	-0.471	-0.401	-0.360

Own and Cross Price Elasticities

We have also computed the own and cross price elasticities at the mean level from model I. The own price elasticities are given in Table 4a and the cross price elasticities with regard to cereal price are shown in Table 4b. For food items, there is a tendency for the absolute value of the own price elasticity to fall implying that with development, conceived as a shift of population from lower to higher income groups, price flexibility of food items increases.

Among the cross price effects, cereals cross price effect dominates. It is sizeable and negative. It is worth noting that the large numerical value observed for non-food items, which implies that any increase in cereal price will result in a cut in the expenditure on non-food items. It is also noticeable that the magnitude of the cross-price effects declines with total expenditure.

Demand Potential for Cereals

Since cereals play a crucial role in the Indian economy we shall examine its demand potential vis-a-vis expenditure groups.

The per capita demand for cereals (q_1) for each group expressed in time derivatives can be written as [7]

$$\dot{q}_1 = \eta_{10} \dot{\mu} + \sum_{j=1}^{\eta} \eta_{1j} \dot{p}_j$$

where dot on the variable denotes the rate of change over time. Denoting for each group Q_1 as its aggregate foodgrains demand, Y as its aggregate total expenditure (income) and r

as its population growth rate, we can write the aggregate demand for foodgrains for each group as

$$\dot{Q}_1 = r(1 - \eta_{10}) + \eta_{10}\,\dot{Y} + \sum_{j=1}^{\eta} \eta_{ij}\,\dot{p}_j$$

In the above expression, we can ignore the cross price elasticities as they are observed to be minimal. For the lowest rural and urban expenditure groups, since their expenditure elasticities (η_{10}) are close to unity, their cereals demand can be expressed as

$$\dot{Q}_1 \simeq \eta_{10}\,\dot{Y} + \eta_{11}\dot{p}_1$$

and for higher expenditure groups (rural and urban), since expenditure and price elasticities are low, their cereals demand can be expressed as:

$$\dot{Q}_1 \simeq r$$

It is clear from the above expressions that demand for cereals by the lowest rural and urban expenditure groups depend on their income,while for higher expenditure groups, on their population growth. The demand relations of other groups lie in between the above two polar cases. The above results imply that in the short run it is the incomes of the lower strata that influence the demand for cereals. Incidentally, it may be noted that any substantial strides in the grains production, if at all possible due to the green revolution, will be absorbed without any fall in its price if the prosperity is widespread and augments the incomes of the lower strata.

Cereals Price Fluctuations

The low value observed for own price elasticity for cereals implies that any turns (up or down) in grains production releases forces of destabilization. Any extra demand created by either autonomous investment or defence expenditure, etc., if not accompanied by corresponding increase in grains supply, will set inflationary forces in the grains market. Incidentally, it may be noted that the revenue accruing to all farmers will be more if the aggregate supply is less since the demand for cereals is price inelastic. If the shortages are not expected to be temporary, the traders will tend to hold on to their stocks and accentuate the price rise. On the other hand, with a sizeable increase in grains production due to favorable weather, grains price will crash. Production may often be more than what the market clears at a price that covers the cost of production. Paradoxically, this phenomenon may coexist with low level of intake by the lower strata.

Effects of Cereals Price Rise

The consequences of cereals price rise can also be analysed with our results. The effects of cereals price on the consumption of different items for urban groups can be had from the cross price elasticities given in Table 4b. It can be seen that any increase in grains price will reduce the demand for all items consumed by the lower and middle income groups and also marginally for the items which the higher income group consumes.

In order to examine the impact of cereal price rise

in rural areas, the cross price elasticities given in Table 4b need to be adjusted for changes in the income of the rural groups as a sequel to cereals price rise. It is obvious that the movement of the price of cereals positively influences the incomes of the rural groups. Suppose the total expenditure of a group increases by α percent due to one percent increase in price. Now the percentage change in the demand for the i^{th} commodity due to the one per cent change in foodgrains price rise will be given by $\eta_{i1} + \alpha\eta_{io}$ where η_{i1} stands for the cereal cross price effect on the i^{th} item and, η_{io} stands for the expenditure elasticity of the i^{th} item.

It is clear from the above expression, that the knowledge of α for various rural groups is necessary for analysing the effects of cereals price rise. It is quite likely when the price of cereals rises, the rural lower expenditure groups which constitute the landless laborers do not gain anything from it, while the higher groups who possess marketed surplus gain and the richest groups net relatively more. Thus, the value of α is likely to be negligible for lower groups and would increase as we move from lower to higher groups. In such a situation in the above expression i.e. $\eta_{i1} + \alpha\eta_{io}$, the first term dominates for lower expenditure groups. For these groups we have observed earlier that the values of η_{i1} , the first term, are numerically large particularly for non-food items other than fuel & light. The above results suggest that an increase in the cereals price results in reductions in the demand for non-food items by the lower income groups. Assuming that

traditional sector caters mostly to their demand we expect a shrinkage in its market. This offers an explanation for the negative association between cereals price and coarse cloth demand observed for India.

For rural rich groups, the second term of the expression $\eta_{i1} + \alpha\eta_{io}$ is likely to dominate and the expression would turn out to be positive since the values of the first term is observed to be low and α is likely to be large. Thus, cereals price rise may result in expansion of demand by the rural rich groups particularly for non-food items. However, there may not be much expansion in the demand for food items as the elasticities for them are low for rural rich groups.

The above analysis brings forth the following consumptions linkages through cereal price movements. When cereal price rises, there will be a cut in the demand for all items by all the urban groups; the percentage cut will be marginal for higher groups but it increases as one moves from higher to lower groups. In the case of rural areas, the lower expenditure groups cut their consumption of all items particularly non-food items, while the higher expenditure groups increase their demand. The net consequences of cereal price rise is a depression in the markets of the products catering to the needs of the lower expenditure groups (rural and urban) and excess pressure in the markets catering to the needs of the rich [8].

These effects may have differing impacts on the traditional and modern sectors. Conventional wisdom suggest that traditional sector mainly caters to the needs of the poor.

Perhaps the foregoing results may offer an explanation to the observed feature of the Indian economy that whenever cereal prices go up, there will be depression in the demand for coarse cloth resulting in the piling of stocks and pressure in the demand for mill cloth.

LES for 11 Commodity Groups

Fitting of LES

We could segregate 6 NSS rounds (rounds 14-17 and 19-20) for which requisite data on consumer expenditure are available for fitting the 11 commodity LES. This has enabled us to re-estimate for each expenditure group LES with enlarged commodity classification; the cereals group of the previous model has been split up into three components without affecting the other commodity groups. The data base of the estimated LES consists of the following numbers of quantity vectors (n) for each of the 10 expenditure groups, as shown in Table 5 below.

Table 5. Number of observations

Expenditure Groups	No of quantity vectors	
	Rural	Urban
I	7	7
II	13	13
III	18	17
IV	18	17
V	19	19

It can be seen that the data base is scanty as compared to that of the 9 commodity LES. Since the parameter estimates for 9 commodity LES are similar in both the two types of

specification adopted for Ω , we have confined to the computationally simpler i.e. $\Omega = \sigma^2 I$ and utilized the same iterative procedure for the estimation of the parameters.

Parameter Estimates

Parameter estimates, along with the goodness of fit measures, are presented in Table 6. On the whole, the model fits well: for a large number of equations, R^2 exceeds 0.80. Here too, the fit for clothing is not very satisfactory. The signs of b are positive in all the models with the exception of LES fitted to urban group V for which the b value for other cereal items is found to be negative. Thus, of the 10 LES fitted to various groups, only one is violating the convexity conditions.

Let us compare the above estimates with those for 9 commodities (Table 3). It may be noted that if we aggregate the first three items of the 11 commodity model, we arrive at the commodity classification adopted for the 9 commodity LES. As the base period i.e. 1961-62, prices are expressed as unity, the C estimates of the first three items (rice, wheat and other cereals) of the 11 commodity LES should add to the C estimate of cereals in the 9 commodity LES. However, this is found to be violated in a number of cases. In general, the totals of C values of the 11 commodity LES fall short of the C estimate of the 9 commodity LES for the lowest 3 to 4 groups. Though the sample sizes are different, it may not account for the observed differences.

As the items other than cereals are common to both the models, one can straightaway compare their parameter estimates.

Table 6. Parameter estimates of 11 commodity LES

Sr. No.	Commodity Groups	Rural Group I b	Rural Group I C	Rural Group I R^2	Rural Group II b	Rural Group II C	Rural Group II R^2
1	Rice	0.3366 (0.0244)	-2.1357 (0.5495)	0.9754	0.3139 (0.0206)	-2.9779 (0.8861)	0.9456
2	Wheat	0.0504 (0.0192)	-0.2946 (0.2256)	0.7266	0.0619 (0.0168)	-0.5605 (0.3410)	0.7298
3	Other cereals	0.2226 (0.0206)	-0.9223 (0.1537)	0.8149	0.1210 (0.0141)	-0.0660 (0.1855)	0.6031
4	Milk & milk products	0.0372 (0.0221)	-0.3650 (0.2828)	0.8714	0.0870 (0.0202)	-1.4694 (0.4901)	0.9347
5	Edible oil	0.0095 (0.0114)	0.0514 (0.1283)	0.8158	0.0154 (0.0094)	0.0239 (0.1726)	0.9251
6	Meat, fish & egg	0.0152 (0.0128)	-0.0554 (0.1547)	0.7989	0.0265 (0.0110)	-0.2848 (0.2175)	0.7049
7	Sugar & gur	0.0198 (0.0173)	-0.1300 (0.1985)	0.6111	0.0349 (0.0160)	-0.4458 (0.3154)	0.7560
8	Other food	0.1538 (0.0234)	-0.9451 (0.3497)	0.9596	0.1535 (0.0204)	-1.5528 (0.5656)	0.9370
9	Clothing	0.0201 (0.0160)	-0.1619 (0.2189)	0.3399	0.0272 (0.0144)	-0.2326 (0.3321)	0.1085
10	Fuel & light	0.0765 (0.0223)	-0.3414 (0.2977)	0.6172	0.0794 (0.0182)	-0.7633 (0.4214)	0.8105
11	Other non-food	0.0581 (0.0178)	-0.2432 (0.2413)	0.8573	0.0794 (0.0161)	-0.7773 (0.3836)	0.8055
		II = 0.0045			II = 0.0069		

Table 6 contd.

Sr. No.		Rural Group III			Rural Group IV			Rural Group V		
		b	C	R^2	b	C	R^2	b	C	R^2
1	Rice	0.1196 (0,0295)	3.2394 (0.6047)	0.7069	0.1013 (0.0122)	4.6630 (0.3691)	0.9372	0.0562 (0.0082)	6.0492 (0.7109)	0.7004
2	Wheat	0.0407 (0.0276)	0.5571 (0.3466)	0.6800	0.0782 (0.0121)	0.8474 (0.2779)	0.9094	0.0418 (0.0082)	2.6309 (0.5240)	0.8510
3	Other cereals	0.0828 (0.0239)	1.3358 (0.2781)	0.8558	0.0191 (0.0118)	2.1518 (0.1369)	0.7405	0.0084 (0.0082)	2.4767 (0.2513)	0.3352
4	Milk & milk products	0.0624 (0.0279)	0.1753 (0.4433)	0.6540	0.1190 (0.0120)	0.8328 (0.4413)	0.9181	0.0522 (0.0082)	4.2931 (0.6964)	0.8560
5	Edible oil	0.0129 (0.0216)	0.3599 (0.2503)	0.8000	0.0257 (0.0118)	0.4567 (0.1604)	0.9534	0.0281 (0.0082)	0.8326 (0.4148)	0.8656
6	Meat, fish & egg	0.0264 (0.0226)	0.1096 (0.2871)	0.3921	0.0207 (0.0119)	0.4238 (0.1708)	0.6582	0.0104 (0.0082)	1.0666 (0.3146)	0.4738
7	Sugar & gur	0.0026 (0.0267)	0.4085 (0.3122)	0,4581	0,0281 (0.0117)	0.4820 (0.1782)	0.9251	0.0323 (0.0081)	1.2041 (0.4374)	0.9322
8	Other food	0.2557 (0.0285)	-1.3441 (0.9920)	0.4430	0.1273 (0.0121)	1.8832 (0.4389)	0.9349	0.0739 (0.0082)	4.7257 (0.8875)	0.9038
9	Clothing	0.1017 (0.0317)	-0.3597 (0.6590)	0.7080	0.1653 (0.0118)	0.5734 (0.6106)	0.9681	0.1320 (0.0081)	5.0172 (1.7158)	0.9675
10	Fuel & light	0.0391 (0.0277)	0.6312 (0.3760)	0.4243	0.0295 (0.0122)	1.1122 (0.1931)	0.7014	0.0136 (0.0082)	2.0594 (0.3279)	0.7508
11	Other non-food	0.2562 (0.0326)	-1.8809 (1.2568)	0.5379	0.2859 (0.0120)	0.5005 (0.9883)	0.9594	0.5512 (0.0082)	5.9913 (6.7471)	0.9821
		II = 0.0310			II = 0.0046			II = 0.0069		

Table 6 contd.

Sr. No.	Commodity Groups	Urban Group I b	Urban Group I C	Urban Group I R^2	Urban Group II b	Urban Group II C	Urban Group II R^2	Urban Group III b	Urban Group III C	Urban Group III R^2
1	Rice	0.3137 (0.0435)	-6.6047 (1.7036)	0.9795	0.2860 (0.0275)	-5.4502 (1.3708)	0.8582	0.1466 (0.0180)	0.2634 (0.6280)	0.9206
2	Wheat	0.1643 (0.0369)	-3.0794 (1.0095)	0.8129	0.0390 (0.0185)	0.2819 (0.5013)	0.9560	0.0368 (0.0159)	0.9416 (0.3351)	0.8407
3	Other cereals	0.2049 (0.0358)	-3.4155 (0.5711)	0.2146	0.1014 (0.0168)	-1.3540 (0.3168)	0.0325	0.0675 (0.0144)	-0.2167 (0.2640)	0.0310
4	Milk & milk products	0.0311 (0.0285)	-0.6304 (0.7571)	0.3989	0.0950 (0.0230)	-2.1615 (0.7656)	0.8374	0.1240 (0.0183)	-1.4247 (0.6048)	0.9460
5	Edible oil	0.0089 (0.0185)	0.0040 (0.4451)	0.8656	0.0129 (0.0108)	0.1127 (0.2865)	0.8692	0.0258 (0.0118)	0.2147 (0.2438)	0.9514
6	Meat, fish & egg	0.0143 (0.0192)	-0.2116 (0.4846)	0.7049	0.0225 (0.0122)	-0.3267 (0.3386)	0.6092	0.0323 (0.0129)	-0.1252 (0.2814)	0.8608
7	Sugar & gur	0.0393 (0.0257)	-0.7909 (0.6727)	0.7137	0.0507 (0.0194)	-1.0263 (0.5834)	0.8608	0.0429 (0.0173)	-0.2906 (0.4080)	0.9258
8	Other food	0.1124 (0.0284)	-1.7865 (0.8297)	0.8913	0.2035 (0.0227)	-3.9035 (0.9568)	0.9771	0.2002 (0.0174)	-1.2972 (0.7742)	0.9450
9	Clothing	0.0150 (0.0192)	-0.3310 (0.5475)	0.5162	0.0251 (0.0154)	-0.5736 (0.4906)	0.4674	0.0509 (0.0147)	-0.5845 (0.3949)	0.6488
10	Fuel & light	0.0465 (0.0263)	-0.6585 (0.7618)	0.8720	0.0595 (0.0217)	-0.8424 (0.7207)	0.8345	0.0561 (0.0167)	0.0844 (0.4559)	0.9411
11	Other non-food	0.0496 (0.0232)	-0.6188 (0.6695)	0.6891	0.1046 (0.0192)	-1.7088 (0.6805)	0.7758	0.2169 (0.0167)	-2.1059 (0.8014)	0.8815
		II = 0.0182			II = 0.0081			II = 0.0058		

Table 6 contd.

Sr. No.	Commodity Groups	Urban Group IV b	Urban Group IV C	Urban Group IV R^2	Urban Group V b	Urban Group V C	Urban Group V R^2
1	Rice	0.0247 (0.0133)	3.6892 (0.3055)	0.7512	0.0012 (0.0065)	4.3616 (0.2603)	0.1403
2	Wheat	0.0426 (0.0132)	1.2482 (0.3122)	0.8358	0.0057 (0.0065)	2.6026 (0.2604)	0.7505
3	Other cereals	0.0120 (0.0110)	0.5782 (0.2049)	0.1139	-0.0036 (0.0065)	0.5507 (0.2365)	0.1666
4	Milk & milk products	0.1104 (0.0131)	0.2272 (0.6021)	0.9191	0.0764 (0.0065)	4.0952 (1.3586)	0.9565
5	Edible oil	0.0285 (0.0106)	0.5909 (0.2156)	0.9432	0.0142 (0.0065)	1.3994 (0.3258)	0.9172
6	Meat, fish & egg	0.0376 (0.0111)	0.2133 (0.2544)	0.6831	0.0233 (0.0065)	1.2668 (0.4624)	0.8795
7	Sugar & gur	0.0235 (0.0132)	0.4593 (0.3095)	0.8668	0.0063 (0.0064)	1.2775 (0.2858)	0.3728
8	Other food	0.2062 (0.0131)	0.6434 (1.0120)	0.9212	0.1965 (0.0065)	6.4882 (3.4277)	0.9090
9	Clothing	0.0916 (0.0125)	-0.4740 (0.5438)	0.9074	0.1196 (0.0064)	1.8495 (2.2409)	0.9825
10	Fuel & light	0.0535 (0.0128)	0.7559 (0.4108)	0.8830	0.0265 (0.0065)	2.3127 (0.5773)	0.9287
11	Other non-food	0.3696 (0.0132)	-2.1150 (1.8375)	0.9580	0.5340 (0.0065)	6.3377 (9.7840)	0.9940
		II = 0.0037			II = 0.0058		

The comparison indicates the closeness of the b estimates and the existence of differences in the C estimates; the differences in the C estimates are more striking for lower groups. The differences in C estimates could be attributed to the inadequacy of additive utility specification when the commodities are finer like rice, wheat, etc.

Marginal Budget Shares

For comparable groups, the marginal shares of the 11 commodity LES reinforces the findings of the 9 commodity LES. The present model will allow us to examine the marginal budget shares of specific cereal items viz., rice, wheat and other cereals. Among the three constituents of cereals considered, rice takes a larger share of the marginal budgets followed by other cereals. Marginal budget share of wheat is lower than that of rice in all the rural groups as well as in the urban lower expenditure groups; while it is marginally higher than that of rice in the marginal budgets of urban higher expenditure groups. Marginal budget share of wheat is also higher than that of other cereals for the rural and urban higher expenditure groups. We have observed earlier that the demand for cereals depends on how the growth affects the various expenditure groups. It is now apparent that changes in the income distribution are also likely to affect the composition of the cereals demanded.

Elasticities

We have computed, at the mean level expenditure elasticities (η_{io}s) and own price elasticities (η_{ii}s) . These

are given in Table 7.

For some of the items, the price and expenditure elasticities of both the models (9 and 11 commodity LES) can be broadly compared. Even a cursory look at the Tables 4 and 7 shows glaring differences in the own price and expenditure elasticities for the first three groups. Generally, the own price elasticities computed from the 11 commodity LES are numerically large. Nevertheless, the elasticities for higher groups are closer. The following factors might have contributed to these differences. Additivity assumption could be very unrealistic at finer aggregation; utility interaction is likely to exist among the cereal items. Perhaps, we may have to look for non-additive models at finer aggregation. This limitation is likely to affect all the models fitted to various expenditure groups. But the extent of damage is likely to be more in the lower expenditure groups where cereal items take a major share of the marginal budgets.

Table 7. Expenditure elasticities computed from 11 commodity LES

Sr. No.	Commodity Groups	Rural					Urban				
		Group I	Group II	Group III	Group IV	Group V	Group I	Group II	Group III	Group IV	Group V
1	Rice	1.122	1.049	0.399	0.454	0.457	1.695	1.305	0.738	0.156	0.017
2	Wheat	1.096	1.065	0.589	1.112	0.665	1.307	0.313	0.349	0.515	0.120
3	Other cereals	0.881	0.557	0.511	0.186	0.172	1.041	0.871	0.962	0.363	-0.450
4	Milk & milk products	2.533	3.033	1.065	1.399	0.585	1.200	1.945	1.690	1.183	0.757
5	Edible oil	0.354	0.498	0.385	0.865	1.121	0.251	0.302	0.574	0.640	0.470
6	Meat, fish & egg	0.742	1.170	0.977	0.827	0.503	0.612	0.815	0.972	1.025	0.743
7	Sugar & gur	1.243	1.661	0.090	0.887	0.948	1.303	1.475	1.181	0.667	0.269
8	Other food	1.100	1.131	2.333	0.975	0.678	0.661	1.204	1.141	1.131	0.995
9	Clothing	1.308	0.879	1.770	1.716	1.018	1.224	1.545	1.584	1.678	1.390
10	Fuel & light	0.825	1.044	0.563	0.539	0.352	0.522	0.742	0.753	0.801	0.568
11	Other non-food	0.771	1.000	3.023	1.897	1.727	0.468	0.865	1.389	1.739	1.492

Table 7 contd. Own price elasticities computed from 11 commodity LES

Sr. No.	Commodity Groups	Rural					Urban				
		Group I	Group II	Group III	Group IV	Group V	Group I	Group II	Group III	Group IV	Group V
1	Rice	-1.769	-1.649	-0.390	-0.292	-0.233	-4.861	-2.617	-0.933	-0.142	-0.010
2	Wheat	-2.052	-1.916	-0.475	-0.556	-0.303	-4.436	-0.790	-0.457	-0.423	-0.065
3	Other cereals	-1.541	-1.030	-0.443	-0.104	-0.078	-3.442	-2.058	-1.187	-0.289	0.228
4	Milk & milk products	-4.728	-5.226	-0.829	-0.693	-0.279	-4.579	-4.497	-1.970	-0.922	-0.424
5	Edible oil	-0.683	-0.925	-0.305	-0.418	-0.474	-0.982	-0.758	-0.724	-0.508	-0.244
6	Meat, fish & egg	-1.421	-2.141	-0.757	-0.398	-0.214	-2.373	-2.015	-1.206	-0.799	-0.384
7	Sugar & gur	-2.364	-3.011	-0.716	-0.430	-0.407	-4.933	-3.551	-1.453	-0.526	-0.139
8	Other food	-1.944	-1.931	-1.590	-0.524	-0.331	-2.406	-2.601	-2.339	-1.899	-0.593
9	Clothing	-2.485	-1.615	-1.323	-0.833	-0.494	-4.729	-3.792	-1.927	-0.013	-0.727
10	Fuel & light	-1.542	-1.864	-0.454	-0.273	-0.156	-1.992	-1.804	-0.943	-0.638	-0.301
11	Other non-food	-1.456	-1.788	-1.983	-0.917	-0.868	-1.789	-2.042	-1.574	-1.216	-0.879

Hierarchic Model

Subgroup Models

We have also estimated subgroup models for other food using the specification $\Omega = \sigma^2 I$ and for which we have made use of the NSS rounds 17-25. The parameter estimates along with the goodness of fit measures are given in Table 8.

The sum of the C values of the submodel also differ from the corresponding value of C given by the aggregate model. Nevertheless, the direction of the values with total expenditure level coincides.

We have expanded the other food group of the 9 commodity LES by using the parameter estimates of the other food subgroup. The results are given in Table 9.

The 13 sector LES has been estimated from the 11 sector LES and other food subgroup model, after making necessary adjustments for the marginal budget shares of the submodel. The results are given in Table 10. Since the b value for other cereals is found to be negative for the 11 sector model fitted to Group V of urban areas, we have re-estimated the model constraining that the marginal budget share of other cereals is zero. Finally, using the parameter estimates of other food submodel, we have re-estimated the 13 sector LES for urban group V. These results are also given in Table 10.

Table 8. Parameter estimates of sub group LES

Sr. No.	Commodity Group	Rural Group I			Rural Group II			Rural Group III			Rural Group IV		
		b	C	R^2	b	C	R^2	b	C	R^2	b	C	R^2
1	Pulses	0.3214	-0.0309	0.9281	0.2495	0.0693	0.8662	0.2897	0.1339	0.8551	0.1964	0.4815	0.8376
		(0.0150)	(0.0246)		(0.0298)	(0.0433)		(0.289)	(0.0673)		(0.0343)	(0.1070)	
2	Fruits & Vegetables	0.2560	0.0961	0.9390	0.3229	0.0009	0.9874	0.3449	0.0528	0.9805	0.3352	0.2585	0.9807
		(0.0154)	(0.0304)		(0.0337)	(0.0955)		(0.0312)	(0.1357)		(0.0369)	(0.2598)	
3	Other food	0.4227	0.1000	0.9366	0.4277	0.0549	0.9752	0.3654	0.2708	0.9612	0.4684	0.1181	0.9637
		(0.0151)	(0.0493)		(0.0316)	(0.0981)		(0.0298)	(0.1347)		(0.0356)	(0.3316)	

	Rural Group V		
	b	C	R^2
1	0.1951	0.2207	0.6901
	(0.0428)	(0.3339)	
2	0.3338	-0.7466	0.9038
	(0.0474)	(0.8557)	
3	0.4710	-1.0981	0.9113
	(0.0469)	(1.1169)	

Table 8 contd.

Sr. No.	Commodity Group	Urban Group I			Urban Group II			Urban Group III			Urban Group IV		
		b	C	R^2	b	C	R^2	b	C	R^2	b	C	R^2
1	Pulses	0.2685 (0.0237)	0.0567 (0.0379)	0.8482	0.2267 (0.0262)	0.1138 (0.0405)	0.8403	0.1860 (0.0183)	0.1572 (0.0490)	0.8876	0.0885 (0.0119)	0.4641 (0.0605)	0.9115
2	Fruits & Vegetables	0.2916 (0.0239)	0.1254 (0.0579)	0.9222	0.3195 (0.0276)	0.1367 (0.0858)	0.9859	0.3450 (0.0199)	-0.0026 (0.1253)	0.9936	0.2801 (0.0129)	0.3204 (0.1928)	0.9918
3	Other food	0.4399 (0.0237)	0.3707 (0.0940)	0.8911	0.4538 (0.0273)	0.3490 (0.1155)	0.9757	0.4690 (0.0193)	0.1438 (0.1570)	0.9827	0.6314 (0.0125)	-0.7380 (0.4058)	0.9964

	Urban Group V		
	b	C	R^2
1	0.0369 (0.0081)	0.5887 (0.1036)	0.8328
2	0.2083 (0.0092)	0.2265 (0.4110)	0.9777
3	0.7547 (0.0091)	-4.5389 (1.5754)	0.9980

Table 9. LES estimates under hierarchic method

All India Rural

Sr. No.	Commodity Group	Group I		Group II		Group III		Group IV		Group V	
		b	C	b	C	b	C	b	C	b	C
1	Cereals	0.5774	1.0365	0.4653	2.7093	0.2922	0.5302	0.1791	9.4852	0.0802	12.8666
2	Milk & milk products	0.0361	-0.0539	0.0775	-0.1892	0.1368	-0.2778	0.1560	1.7259	0.0726	5.1797
3	Edible oil	0.0405	-0.0241	0.0395	0.0575	0.0309	0.2393	0.0230	0.7174	0.0279	1.3852
4	Meat, fish & egg	0.0271	-0.0161	0.0369	-0.0297	0.0402	0.0431	0.0296	0.5780	0.0128	1.1775
5	Sugar & gur	0.0247	-0.0027	0.0379	-0.0248	0.0440	0.0536	0.0453	0.6368	0.0282	1.6719
6	Pulses	0.0480	-0.0309	0.0346	0.0693	0.0417	0.1339	0.0216	0.4815	0.0141	0.2207
7	Fruits & vegetables	0.0383	0.0961	0.0448	0.0009	0.0496	0.0528	0.0368	0.2585	0.0241	-0.7466
8	Other food	0.0632	0.1000	0.0594	0.0549	0.0526	0.2708	0.0514	0.1181	0.0340	-1.0981
9	Clothing	0.0152	0.0579	0.0208	0.2472	0.0812	0.1706	0.1370	1.9618	0.1216	5.9263
10	Fuel & light	0.0537	0.3800	0.0727	0.3307	0.0548	0.6433	0.0343	1.5380	0.0213	2.3541
11	Other non-food	0.0758	0.1066	0.1106	0.0892	0.1760	-0.0160	0.2859	3.1264	0.5633	11.9762

Table 9 contd.

Urban

Sr. No.	Commodity Group	Group I		Group II		Group III		Group IV		Group V	
		b	C	b	C	b	C	b	C	b	C
1	Cereals	0.4870	0.5702	0.3446	2.1788	0.1722	4.6711	0.0371	6.6035	0.0124	7.6253
2	Milk & milk products	0.0439	-0.0637	0.0934	-0.2113	0.1474	0.0689	0.1506	1.1009	0.0924	6.3125
3	Edible oil	0.0451	-0.0067	0.0437	0.1403	0.0486	0.4038	0.0435	0.7991	0.0126	1.9846
4	Meat, fish & egg	0.0290	0.0095	0,0345	0.0354	0.0513	0.1487	0.0524	0.4175	0.0247	1.9692
5	Sugar & gur	0.0303	0.0170	0.0317	0.1181	0.0452	0.2415	0.0278	0.6564	0.0110	1.5293
6	Pulses	0.0471	0.0567	0.0383	0.1138	0.0339	0.1572	0.0203	0.4641	0.0053	0.5887
7	Fruits & vegetables	0.0511	0.1254	0.0540	0.1367	0.0629	-0.0026	0.0641	0.3204	0.0301	0.2265
8	Other food	0.0771	0.3707	0.0767	0.3490	0.0855	0.1438	0.1445	-0.7380	0.1089	-4.5389
9	Clothing	0.0183	-0.0290	0.0192	0.0583	0.0358	0.3963	0.0647	1.0932	0.0994	5.5231
10	Fuel & light	0.0741	0.2148	0.0752	0.3424	0.0581	0.9141	0.0424	1.5716	0.0268	3.3279
11	Other non-food	0.0970	0.2529	0.1888	0.0832	0.2592	0.8242	0.3527	2.6596	0.5766	23.3548

Table 10. Hierarchical model (13 commodities)

Rural Groups

Sr. No.	Commodity Group	Group I		Group II		Group III		Group IV		Group V	
		b	c	b	c	b	c	b	c	b	c
1	Rice	0.3366	-2.1357	0.3139	-2.9779	0.1196	3.2394	0.1013	4.6630	0.0562	6.0492
2	Wheat	0.0504	-0.2946	0.0619	-0.5605	0.0407	0.5571	0.0782	0.8474	0.0418	2.6304
3	Other cereals	0.2226	-0.9223	0.1210	-0.0660	0.0828	1.3358	0.0191	2.1518	0.0084	2.4767
4	Milk & milk products	0.0372	-0.3650	0.0870	-1.4694	0.0624	0.1753	0.1190	0.8328	0.0522	4.2931
5	Edible oil	0.0095	0.0514	0.0154	0.0239	0.0129	0.3599	0.0257	0.4567	0.0281	0.8326
6	Meat, fish & egg	0.0152	-0.0554	0.0265	-0.2848	0.0264	0.1096	0.0207	0.4228	0.0104	1.0666
7	Sugar & gur	0.0198	-0.1300	0.0349	-0.4458	0.0026	0.4085	0.0281	0.4820	0.0323	1.2041
8	Pulses	0.0494	-0.0309	0.0383	0.0693	0.0741	0.1339	0.0250	0.4815	0.0144	0.2207
9	Fruits & vegetables	0.0394	0.0961	0.0496	0.0009	0.0882	0.0528	0.0427	0.2584	0.0247	-0.7466
10	Other food	0.0650	0.1000	0.0657	0.0549	0.0934	0.2708	0.0596	0.1181	0.0348	-1.0981
11	Clothing	0.0201	-0.1619	0.0272	-0.2326	0.1017	-0.3597	0.1653	0.5734	0.1320	5.0172
12	Fuel & light	0.0765	-0.3414	0.0794	-0.7633	0.0391	0.6312	0.0295	1.1122	0.0136	2.0594
13	Other non-food	0.0581	-0.2432	0.0794	-0.7773	0.2562	-1.8809	0.2859	0.5005	0.5512	5.9913

Table 10 contd.

Urban Groups

Sr. No.	Commodity Group	Group I		Group II		Group III		Group IV		Group V	
		b	c	b	c	b	c	b	c	b	c
1	Rice	0.3137	-6.6047	0.2860	-5.4502	0.1466	0.2634	0.0247	3.6892	0.0012	4.3616
2	Wheat	0.1643	-3.0794	0.0390	0.2819	0.0368	0.9416	0.0426	1.2482	0.0057	2.6026
3	Other cereals	0.2049	-3.4155	0.1014	-1.3540	0.0675	-0.2167	0.0120	0.5782	-0.0036	0.5507
4	Milk & milk products	0.0311	-0.6304	0.0950	-2.1615	0.1240	-1.4247	0.1104	0.2272	0.0764	4.0952
5	Edible oil	0.0089	0.0040	0.0129	0.1127	0.0258	0.2147	0.0285	0.5909	0.0142	1.2994
6	Meat, fish & egg	0.0143	-0.2116	0.0225	-0.3267	0.0323	-0.1252	0.0376	0.2133	0.0233	1.2668
7	Sugar & gur	0.0393	-0.7909	0.0507	-1.0263	0.0429	-0.2906	0.0235	0.4593	0.0063	1.2775
8	Pulses	0.0302	0.0567	0.0461	0.1138	0.0372	0.1572	0.0183	0.4641	0.0072	0.5887
9	Fruits & vegetables	0.0328	0.1254	0.0650	0.1367	0.0691	-0.0026	0.0578	0.3204	0.0408	0.2265
10	Other food	0.0494	0.3707	0.0923	0.3490	0.0939	0.1438	0.1302	-0.7380	0.1480	-4.5389
11	Clothing	0.0150	-0.3310	0.0251	-0.5736	0.0509	-0.5845	0.0916	-0.4740	0.1196	1.8495
12	Fuel & light	0.0465	-0.6585	0.0595	-0.8424	0.0561	0.0844	0.0535	0.7559	0.0265	2.3127
13	Other non-food	0.0496	-0.6188	0.1046	-1.7088	0.2169	-2.1059	0.3696	-2.1150	0.5340	6.3377

Table 10 contd.

Sr. No.	Commodity Groups	Group V (revised) b	c
1	Rice	0.0012	4.3621
2	Wheat	0.0057	2.6127
3	Other cereals	0.0000	0.4556
4	Milk & milk products	0.0762	4.2955
5	Edible oil	0.0140	1.4378
6	Wheat, fish & egg	0.0230	1.3318
7	Sugar & gur	0.0064	1.2858
8	Pulses	0.0072	0.5887
9	Fruits & vegetables	0.0408	0.2265
10	Other food	0.1480	-4.5389
11	Clothing	0.1193	2.1814
12	Fuel & light	0.0265	2.3811
13	Other non-food	0.5316	7.8473

Conclusions

This chapter has attempted at estimating the Linear Expenditure System (LES) for rural and urban groups stratified by total expenditure. The LES has been estimated for each group at three levels of commodity aggregation viz., 9, 11 and 13 commodities. The data base of the 9 commodity LES is adequate while that of 11 and 13 is not. We have estimated the LES for 9 commodities under two specifications about the error covariance matrix: (i) $\Omega = \sigma^2 I$ i.e. scalar covariance specification and (ii) Ω is full i.e. full covariance specification. Since the LES estimates are closer under both the specifications, we have used the simpler scalar covariance specifications for the rest of the models. The 13 commodity LES has been estimated in a hierarchical manner.

The 9 commodity LES is giving reasonably good fit. The results of 11 and hence 13 commodity LES are not so encouraging for lower expenditure groups.

The parameter estimates of the LES differ a good deal across the expenditure groups and between rural and urban areas, indicating the existence of nonlinearities in the consumption patterns. This rules out the use of one LES for cross-section data. Strikingly, the variations across the expenditure groups, are more striking than the rural-urban variations for the corresponding expenditure groups. There are very distinct patterns in the expenditure and price derivatives across the expenditure groups. As one moves from the lower to higher expenditure groups, the marginal

budget share of cereals declines sharply in both rural and urban areas. The fall in the marginal budget shares is compensated by other non-food items. Rural-urban dichotomy is also noticed. The expenditure elasticities also reinforce the above findings. Among the cross price effects, cereal cross price effect dominates. It is sizeable and negative. It is worth pointing out the large numerical value observed for non-food items.

NOTES

1. Since the pioneering study of Stone (1954), a large number of studies on the LES have been reported for developed countries (Stone 1954; Parks 1969; Pollack and Wales 1969; Yoshihara 1969; Goldburger and Gameletsos 1970; Deaton 1974a) and for developing countries (Radhakrishna and Murty 1973; Bhattacharya 1967; Lluch, Powell and Williams 1977).

2. The maximum likelihood estimates are invariant to the choice of the equation. See Barten (1967). In case we assume $\Omega = \sigma^2 I$, we need not delete any equation.

3. A comprehensive treatment of numerical procedures is given in Deaton (1974b).

4. We would not use the 18th round data due to non-availability at desired aggregation. For urban areas, data are available for (3-25) rounds only.

5. Details are provided in the appendix.

6. OLS in the case of Model I.

7. The subscript 1 of q denotes cereals.

8. The urban rich may cut their consumption but it will be negligible since cereals cross price effect is very low (Table 4). The total effect has been examined by assuming hypothetical values for α in Radhakrishna (1978).

9. The office of the Economic Adviser publishes monthly price indices for 112 commodities by collecting 555 price quotations scattered over 143 markets. Weekly quotations for the

prescribed varieties prevailing on or about Friday are collected. The price relatives are computed as percentage ratios which current price quotations bear to those prevailing in the base period. The commodity index is arrived at as the simple arithmetic average of the price relatives of varieties. Monthly data are simple arithmetic average of weekly indices.

10. For a few agricultural commodities both retail and wholesale price indices are available for Gujarat State. An examination of this data has shown very high collinearity between the two series.

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APPENDIX

Consumption Data

The consumption data have been taken from the National Sample Survey Reports. The National Sample Survey (NSS) is a repetitive, multipurpose and socio-economic enquiry carried out in the form of rounds to furnish data which can be used for a variety of purposes. The duration of the rounds prior to the 14th varied from 3 to 9 months and from the 14th round the duration of the rounds has been made one year in order to avoid seasonal fluctuations. The sample size has also increased over the rounds. The details of the duration of the NSS rounds are shown in Table 11.

The NSS reports furnish the details of consumer expenditure for 12/13 per capita monthly expenditure classes viz. Rs. 0-8, 8-11, 11-13, 13-15, 15-18, 18-21, 21-24, 24-28, 28-34, 34-43, 43-55, and 55 and above. In later rounds the last expenditure class has been further split up into two

Table 11. Period of NSS enquiries

Round No.	Period of Survey
2	April 1951 - June 1951
3	August 1951 - November 1951
4	April 1952 - September 1952
5	December 1952 - March 1953
6	May 1953 - September 1953
7	October 1953 - March 1954
8	July 1954 - March 1955
9	May 1955 - November 1955
10	December 1955 - May 1956
11	August 1956 - February 1957
12	March 1957 - August 1957
13	September 1957 - May 1958
14	July 1958 - June 1959
15	July 1959 - June 1960
16	July 1960 - June 1961
17	September 1961 - July 1962
18	February 1963 - January 1964
19	July 1964 - June 1965
20	July 1965 - June 1966
21	July 1966 - June 1967
22	July 1965 - June 1968
23	July 1968 - June 1969
24	July 1969 - June 1970
25	July 1970 - June 1971

classes. For each expenditure class, average monthly per capita expenditure on various commodity groups are given. The usual commodity groups and their components are given in Table 1.

Although the NSS collects information on both quantity and value of consumption for the food items, it publishes mostly value figures. The value figures include both the value of the quantity purchased, valued at actual purchase price and the imputed value for the quantity that was not purchased such as consumption from own farm production. Until the 8th round, consumption out of home grown stock was evaluated at retail prices, thereafter it has been evaluated at ex-farm prices.

Price-data

The relevant price data for this study would be retail price indices if they have been constructed by the NSS itself. In its absence it is decided to use the available extraneous information on prices. Since no satisfactory retail prices collected by any other agency are available, we have been constrained to use the wholesale price relatives complied by the office of the Economic Adviser [9] as an approximation to the retail price relatives for both rural and urban sectors. Although Economic Adviser's price series have been used for the rural and urban sectors, separate weighing diagrams for both the sectors based on the proportions of expenditure in the 13th round have been used for computing the group indices with 1961-62 as base. Thus the group indices differ between rural and urban sectors but they remain the same across the

expenditure classes.

A few limitations in using wholesale price relatives in place of retail price relatives may be worth pointing out. The differences between the wholesale and retail price relatives are mostly due to trade margins, transport charges and taxes. The implicit assumption involved in using wholesale price index as proxy to retail price index is that trade margins, etc., form a fixed proportion of the wholesale prices. The fixed proportions assumption may not be true for a few commodities. Since we do not have adequate retail price data, there is no way to check this assumption [10] .