Chapter 9

SUMMARY AND CONCLUSIONS

9.1 Introduction

This study has attempted to estimate three complete demand systems from time series of cross section data on per capita monthly consumer expenditure for India, distinguishing rural-urban dualism and six expenditure groups (three each in rural and urban areas). Since some studies have already been reported on a few complete demand systems, we have confined our attention to the analysis of Indirect Addilog System (IAS) from additive class, Indirect Translog System (ITS) and Rotterdam models from non-additive class. In each of these models, focus has been made on the following aspects: (i) the goodness of fit, (ii) the adequacy of a single model to approximate the non-linearities in the observed expenditure series, (iii) the inter-expenditure class and inter-sectoral variation in consumption patterns, (iv) the patterns in expenditure and price elasticities across expenditure groups and between rural-urban sectors and (v) the extent to which the available data upholds the postulates of microeconomic theory of consumer

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1/ Extensive studies on linear expenditure system, indirect addilog system and quadratic utility function for India have been carried out at Sardar Patel Institute of Economic and Social Research. The other studies on LES for India include those of Paul and Rudra (1964), Bhattacharya (1967) and Joseph (1968).
behaviour. We mention, briefly, about the data used, and the conclusions drawn in each case.

9.2 Data and Estimation

The data that has been used in empirical estimation include timeseries as well as time series of cross section on per capita monthly consumer expenditure from National Sample Survey (NSS) reports for the rounds (2-20) rural India and (3-20) urban India. The price data has been constructed from Economic Advisor's wholesale price indices for detailed items with 1952-53 as base and using NSS 13th round's expenditure shares as weights. In order to capture the curvature in observed expenditure series, the 12/13 per capita total expenditure classes have been grouped into three expenditure groups - lower, middle and higher, consisting of the first four, middle four and top

2/ While estimating IAS at nine commodity disaggregation viz. (1) Foodgrains, (2) Milk & milk products, (3) Edible oil, (4) Meat, fish & egg, (5) Sugar & gur, (6) Other food, (7) Clothing, (8) Fuel & light and (9) Other nonfood, we could use information from only (8-20) rounds. However, for estimating ITS at four commodity level and Rotterdam model at four and six commodity level, we have used (2-20) rounds for rural India and (3-20) rounds for urban India. The aggregation of items (1) to (6) in 9 commodity classification would give the first group viz. food in 4 commodity model while items (3) to (6) would give the third group viz. other food in 6 commodity model. In the case of Rotterdam model, we have used data from subsamples 1, 2&combined sample.
four or five expenditure classes respectively, of each round. Each of the three models have been estimated for all the three expenditure groups as well. Two types of error specifications have been used while estimating IAS and ITS by linearisation procedure. In the first case, the errors are homoscedastic with zero contemporaneous covariances while they are heteroscedastic with non-zero contemporaneous covariances in the latter case. Accordingly, we have used OLS and CLS procedures for the above two specifications. For Rotterdam model, the problem of singularity has been taken care of by a suitable transformation of error covariance matrix.

3/ Since Rotterdam model is in first difference form and due to non-availability of prices separately for expenditure classes, we estimated this model at group mean level only. The proportion of population in each expenditure bracket is used as weight for aggregation.

4/ In view of the adding-up property, one equation in the system is redundant and can be deleted. But this is inconsistent with specification (i). Moreover, the parameter estimates are not invariant of the equation deleted in this case. To avoid this, we have used all equations while estimating IAS. However, the last equation corresponding to other nonfood item has been deleted in the estimation using error specification (ii). In this case, as it has been frequently pointed out, the parameter estimates are invariant of the equation deleted.
9.3 Empirical Results

Indirect Addilog System

We call the IAS estimated from time series and time series of cross section as IAS(T) and IAS(TC) respectively. The empirical results indicate that the overall goodness of fit as shown by quasi-$R^2$ and average information inaccuracy is satisfactory. For predicting the expenditures at mean level during the sample period, IAS(T) is performing better than IAS(TC). This too could not do well in the case of predictions of clothing expenditure.\(^5\)

For predicting the classwise expenditures, the IAS(T) is performing very bad. The IAS(TC) model is giving closer predictions for classwise expenditures of middle and higher income groups. For lower income group, it predicts uniformly higher for food items and lower for nonfood items than the observed expenditures for most of the items.

The IAS estimated separately for lower, middle and higher expenditure groups, which we call Piecewise Indirect Addilog System (PIAS), shows considerable improvement in goodness of fit as well as closeness of

\(^5\) The consistently bad performance of clothing in all most all models can be attributed to the durability nature and seasonality of its consumption. This can also be seen from the cycles in observed consumption expenditure of clothing.
observed and predicted expenditures during the sample period. Both IAS and PIAS models indicate the violation of convexity conditions as a consequence of the reaction coefficients falling below -1 for foodgrains and fuel & light items.

The estimates of expenditure elasticities given by time series models are usually higher than the corresponding cross section estimates for food and fuel & light items and lower for clothing. When a single model is used for the entire expenditure range, the estimates of expenditure elasticities decline with total expenditure, by the same amount for all items. This is a built-in property of IAS. However, the piecewise models do not support this for some of the nonfood items. From the groupwise expenditure elasticities, it can also be inferred that the intergroup variation in expenditure elasticities is more marked than the inter-sectoral (rural-urban) differences.

IAS being a member of the additive class, its price elasticities are influenced by expenditure elasticities and an additional parameter like income flexibility. The accuracy of this parameter is quite crucial for getting meaningful estimates of price elasticities. In our time series models, due to lack of enough variation in observed data, the parameter estimates and hence the income
and price elasticities tend to become unreliable. But
in a time series of cross section model the expenditure
elasticities are better determined and hence the price
elasticities would also be more meaningful, if the model
specification is correct. Here again, the piecewise
models would go a long way in reducing the range of
uncertainty for these estimates.

**Indirect Translog System**

In the case of ITS, for each of the five data
sets (time series, time series of cross section, piecewise
lower, middle and higher), we have four variants. These
are ITS under no constraints (homogeneity), symmetry,
implicit and explicit additive. These hypotheses are
imposed as restrictions in the estimation procedure. The
overall goodness of fit as shown by $R^2$ and average
information inaccuracy is satisfactory. There seems to be
not much of reduction in $R^2$ with the imposition of
constraints. The items clothing and other nonfood have
positive ownprice elasticity, indicating thereby, the
violation of convexity conditions.

About 50 per cent of the estimated coefficients are
statistically significant at 5 per cent level. The food
coefficient is dominant in all models. Its interaction
with the other three items is quite considerable before
the imposition of constraints. The symmetry and additivity
would reduce the importance of food item and distribute it
other items. The expenditure elasticities are quite insensitive to model specification and their behaviour over expenditure groups is in broad conformity with other models. As can be expected, the price elasticities are more sensitive to the imposition of constraints. Additive models tend to overestimate the own-price elasticities.

The tests of hypotheses using likelihood ratio criteria, indicate that the available data do not support the validity of Slutsky conditions or additivity of either type. The rejection of these hypotheses even at a broad commodity level is a matter of concern for the empirical demand analyst. Needless to say that the tests are asymptotic.

Rotterdam Demand System

For Rotterdam model, we have 48 data sets - three samples (subsamples 1, 2, and combined sample); four income categories (weighted averages of all classes, lower, middle and higher income classes); two levels of commodity aggregation (four and six) and two sectors (Rural and Urban).

The empirical results with this model indicate, broadly, that the overall goodness of fit as shown by quasi-$R^2$ and average information inaccuracy is satisfactory in both four and six commodity models. There is not much reduction in explanatory power due to the imposition of
homogeneity conditions. Symmetry and additivity constraints seem to reduce the explanatory power; particularly for clothing and fuel & light items. As in the case of other flexible models, the items clothing and other nonfood indicate the violation of convexity conditions in most of the cases.

A majority of income coefficients (also known as marginal budget shares) are statistically significant at 5 per cent level. The coefficients that are insignificant come from, mainly food item in higher income group models. In all income classes models, the income coefficients for food and nonfood in four commodity model; other food and other nonfood in six commodity model are insensitive to the imposition of constraints. However, in lower income group models, the income coefficients for foodgrains are reduced considerably - from 0.5520 to 0.2732 (51%) in rural areas and from 0.3427 to 0.2103 (38%) in urban areas - with the imposition of additivity (Table 8.2.5). This might possibly be due to the larger share of foodgrains item in the consumer's budget. The marginal budget shares of food and foodgrains items show a declining trend with total expenditure while those of clothing and other nonfood indicate rising tendency. The rest of the items have saturation levels. The expenditure elasticities decline with total expenditure for items like foodgrains,
milk & milk products and other food while they rise initially and then fall for nonfood items.

In six commodity models, a majority of own-price coefficients, with the exception of clothing and other nonfood, are significant. The price coefficients are sensitive to symmetry and additivity restrictions. The own-price coefficients tend to be overestimated under additivity. The foodgrains price effect on other items is more in the case of models without constraints and it gets reduced gradually with the imposition of constraints.

The tests of hypotheses indicate that Slutsky conditions are in general valid at four commodity level but not at six. However, additivity is rejected consistently with each model, in all samples, and at both levels of commodity aggregation.

9.4 Overview of the three models

In the empirical study, we have analysed three alternative functional forms: indirect addilog system, indirect translog system and Rotterdam model. These systems underlie different assumptions for the individual's consumption behaviour. Among the three models, indirect addilog system is relatively simpler. Slutsky conditions (except convexity) and additivity are built into this system. The other two models are flexible and the
postulates implied by theory are to be imposed in order to make them theoretically consistent. Since we do not have any uniform measure of goodness of fit, we can not compare the three models based on empirical results. However, given the data and the crude measures that have been considered ($R^2$, quasi-$R^2$ and average information inaccuracy), the following observations are in order.

It emerges from a purely statistical point of view, flexible models have performed better than restrictive type. Our results show that there is always a trade off between theoretical consistency and goodness of fit (explanatory power). If our purpose is to build a demand system as an integral part of a wider general equilibrium model, it is desirable to have theoretical consistency.

The questions to be examined next are: which of the theoretical hypotheses are more restrictive? The results indicate that Slutsky symmetry (i.e. consistency of choice on the part of individual consumer) is less desirable, statistically, than homogeneity (i.e. money illusion). The negativity conditions are violated whenever the model is flexible. At both levels of commodity aggregation, we find that Slutsky conditions are as restrictive (in terms of reducing explanatory power) as additivity, particularly for items like food, foodgrains and other nonfood. For other items like clothing and fuel & light, additivity seems to
be more restrictive. This might possibly be due to durability nature and seasonality of their consumption rather than the specification of the models as such. These items also show considerable improvement, when the income range is narrowed down, as in the case of piecewise models. Thus, if we accept theoretical consistency as desirable, perhaps additivity is also a strong contender.

Next, we examine the adequacy of a single model, time series (mean level) or time series of cross section, to describe the consumption behaviour over the entire income range. In order to have a satisfactory description of the consumption behaviour (i.e. to capture the non-linearities in observed consumer expenditure over the entire income range), the experiments that have been carried out indicate that neither a time series model nor a single time series of cross section model are adequate. It is desirable to divide the income range into a few meaningful groups, such as lower, middle and higher, for studying the structural features relating to income distribution, rural-urban dualism etc. However, for purposes of planning which do not envisage changes in income distribution, mean-level models may be adequate. The time series or a single time series of cross section model could approximate well the consumption behaviour of middle income classes only. For lower income classes, these models predict uniformly higher for necessary items like foodgrains and
uniformly lower for luxury goods. The piecewise models not only improve the explanatory power but also narrow down considerably, the range of variation in expenditure and price elasticities among alternative model specifications.

9.5 Some Implications of the results

From the empirical results, one comes to the conclusion that although different models would tend to give different numerical estimates for parameters like marginal budget shares, expenditure and price elasticities, it emerges that broad patterns across expenditure groups or between rural-urban sectors remain the same. Hence, we shall discuss their development implications with reference to Rotterdam demand system with all theoretical constraints imposed.

Although there are sizeable variations in the marginal budget shares across income groups, there are distinct patterns. Foodgrains takes a major share of the marginal budgets of the lower income groups (42% in rural and 33% in urban) and its weightage declines with income level and takes almost a negligible share of the marginal budgets of higher income groups (6% in rural and 0.5% in urban).

Thus the demand for foodgrains depends very much not only on growth but also on its distribution. It is clear that any strategy to augment the incomes of the poor results in pressure in the foodgrains market. Also any substantial increase in the foodgrains supply due to new seed technology
can only be absorbed, if the incomes of the poor expands. The other nonfood items which are likely to be produced by manufactured sector takes a major share of the marginal budgets of the higher income groups (40% in rural and 52% in urban). Thus the markets for manufactured products crucially depend on the incomes of the rich. It emerges that any abrupt shifts in income distribution, which often happens in India due to the fluctuations in the agricultural produce, will result in demand pressure in some sectors and recession in others.

The own price elasticities show that the demand for foodgrains is price inelastic (Table 8.3.3) both in rural and urban areas. It implies that a reduction in supply is likely to raise the price considerably. The foodgrains cross price effect is dominant among the cross price effects. It is interesting to note that a rise in the price of foodgrains, reduces considerably, the demand for clothing (Table 8.3.b). This broadly supports the often observed feature of slackness in the cloth market when there is a crop failure for foodgrains due to bad monsoon. There will also be secondary effects through changes in rural income distribution as a sequel of foodgrain price change. It is likely that those who have marketed surplus gain from the foodgrain price rise.

Thus fluctuations in agricultural product is likely to change income distribution as well as the prices of
foodgrains. This will have repercussions on the demand for manufactured items. The net effect mostly depends on the relative shifts in the income distribution due to fluctuations in agricultural production and the cross price effects of foodgrains with other items.

It is worthwhile to mention some limitations of the present study apart from those of data, which have already been pointed out in chapter 5. India being a vast and diverse country with substantial variations in regional consumption patterns, an all India analysis may be inadequate. However, if the development process do not alter the income distribution across the regions and their peculiarities, the present study may be useful in understanding the trends and movements in aggregate sectoral demand for various consumer goods in the Indian economy. The major hurdle for a regional or a more disaggregated analysis would be the non-availability of data for sufficiently long period. Another important limitation is, an element of arbitrariness in forming income groups. This can however be rectified by forming income (expenditure) groups based on real expenditure, i.e. current expenditure expressed in terms of some base year prices, for fixing the income group boundaries.