Studies on Level of Living and Poverty in Rural India

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Preface and Acknowledgements

This dissertation is concerned with studies on level of living and incidence of poverty in rural India based on a special retabulation of NSS 28th round (October 1973 - June 1974) disaggregated household budget data from the Central Sample. Two of the special features of this dissertation are the analyses of disparities in level of living and incidence of poverty across (i) social groups, such as Scheduled Castes and Scheduled Tribes, etc. and across (ii) NSS regions which are well defined geographical units typically larger than districts but smaller than states. In addition, disparities in level of living and poverty across occupational classes, size classes of household land possessed and household size are also examined.

This dissertation is organised in seven Chapters and five Appendices. Chapter 1 presents a survey of literature on inequality, level of living and poverty with special reference to Indian studies. Part I of this chapter deals with the technical aspects of measures of inequality and poverty existing in the literature, while *Part II surveys empirical* studies in the area. Chapter 2 describes the data analysed in the present dissertation, especially the NSS household budget data. Chapter 3 examines disparities in level of living across social groups in rural India. Chapter 4 studies the variation in the incidence of poverty across states and different socio-economic groups such as social groups, occupational classes, size classes of household land possessed and household size. It also estimates the contribution of different states and different socio-economic groups to overall poverty in rural India. Chapter 5 examines the variation in level of living (as measured by PCE (total per capita expenditure per 30 days)) and in the incidence of poverty across NSS regions in rural India. This Chapter includes a comparative study of some results from NSS 18th and 28th rounds. Chapter 6 carries out a regression analysis of household-wise PCE for rural areas of nine selected states. In Chapter 7, the variables which were found to explain variation in PCE across households in Chapter 6 - ln PCL (logarithm of per capita land possessed by a household), N_m (the number of adult males in the household), N_f (the number of adult females in the household), N_c (the number of children in the household), and dummy variables corresponding to the NSS region, social group and occupational class to which the household belonged and the sub-round (that is, season) to which the household was allotted for interview - were used to explain poverty status (that is, whether poor or non-poor) of rural households in these nine states. Appendices A, B, C, D and E are supplementary to Chapters 3,5,6 and 7 (both Dand E), respectively.

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Chapter 0

STUDIES ON LEVEL OF LIVING AND POVERTY IN RURAL INDIA : A SUMMARY

The present dissertation consists of several studies on disparities in level of living and poverty in rural India. These studies are based on a special tabulation of disaggregated household budget data, from the Central Sample of the Indian National Sample Survey (NSS) 28th round (October 1973-June 1974). This was based on a copy of the updated Honeywell tape provided by the authorities of the NSS Organisation, Government of India. Two of the main aims of this dissertation are to study disparities in level of living and incidence of poverty across (i) Social groups, such as Scheduled Castes, Scheduled Tribes, etc. and across (ii) NSS regions which are well defined geographical units typically larger than districts, but smaller than states.

This dissertation consists of seven Chapters and five Appendices. The contents of these Chapters and Appendices are briefly summarised below.

Chapter 1 presents a survey of the literature on inequality, level of living and poverty. This Chapter is divided into two parts. The first part surveys methodological aspects while the second reviews empirical studies with special reference to India. Section 1.1.1 of Part I of Chapter 1 is introductory. Section 1.1.2 deals with various conceptual issues on the measurement of income/expenditure inequality. Sections 1.1.3 and 1.1.4 survey the inequality and poverty measures proposed in the literature, respectively. They discuss the properties of different inequality and poverty measures, and also describe the methodology of decomposition of inequality and poverty measures carried out in some of the following Chapters. Section 1.2.1 of Part II of Chapter 1 is again introductory. Section 1.2.2 surveys some major studies on inequality and poverty found in the international literature. The remaining Sections relate to Indian studies. Section 1.2.3 surveys studies on income distribution in India. Sections 1.2.4 and 1.2.5 review studies on level of living and incidence of poverty in India, respectively. Finally, Section 1.2.6 deals with two economically weaker sections of the Indian population - the Scheduled Castes and Scheduled Tribes - whose level of living and poverty have been examined in subsequent Chapters. Sub-section 1.2.6.1 gives a brief account of the Scheduled Castes and Scheduled Tribes. And, lastly, sub-section 1.2.6.2 surveys studies on level of living and poverty of the Scheduled Castes and Scheduled Tribes.

Chapter 2 describes the data analysed in the present dissertation. This Chapter consists of six sections. Section 2.1 gives an introduction. Section 2.2 describes the scope, coverage and design of the NSS 28th round consumer expenditure enquiry and outlines the method of estimation. Section 2.3 compares the sample sizes and mean per capita expenditures for rural India by States as obtained from this special tabulation with corresponding figures published by the NSSO. Section 2.4 describes the variables used in the present dissertation, while Section 2.5 discusses the reliability and validity of NSS household budget data. Finally, Section 2.6 gives a brief description of different consumer price indices used for making price adjustments in various parts of this study.

A good number of studies have been undertaken on rural-urban and inter-state differentials in level of living and poverty in India, mainly on the basis of estimates of monthly household per capita expenditure on all items of consumption (PCE) thrown up by the NSS Organisation, Government of India (vide Bhattacharya (1978, 1978a)). Variation in levels of PCE by occupational classes (Mukherjee (1969); Vaidyanathan (1974)) and by size classes of landholdings (Minhas (1974); Vaidyanathan (1974); Visaria (1981)) have also been examined. However, not much work has been done to study the levels of living by social groups, and in particular those of the Scheduled Castes (SC) and the Scheduled Tribes (ST), who have been among the depressed sections of the Indian population for centuries. The present dissertation aims at filling this gap. Thus, Chapter 3 of this study examines disparities in level of living across social groups (such as SC, ST, etc.) in rural India. This chapter has five sections. Section 3.1 is introductory. Section 3.2 compares the distributions of the SC, ST and non-SC/ST population of rural India by occupation, by size classes of household land possessed and by household size. This section also examined the reliability of data on SC and ST and on land possessed by households as collected through the NSS 28th round Consumer Expenditure Enquiry Schedule. Comparisons of average <u>nominal</u> PCE across different social groups are carried out in Section 3.3. Such comparisons are undertaken for rural India as a whole as well as for rural areas of individual states. This Section also examines inequality in the distributions of PCE within different social groups. In Section 3.4, a decomposition of the observed inequality in the PCE distribution into inter-social group and intra-social group components is done using Atkinson-Kolm-Sen indices of relative inequality. The decompositions are presented for rural India as a whole as well as for rural areas of different states. Finally, Section 3.5 concludes Chapter 3 with some observations.

The findings of this chapter are summarised below :

(i) The agreement of the state-and-sectorwise percentages of the SC and ST population of India as obtained from Census of India, 1971, with the corresponding estimates thrown up by NSS 28th round household budget data were encouraging. The same may be said of the agreement of NSS 28th round data on household land possessed with data on land operated as collected through the NSS 26th round (July 1971 - September 1972) survey on landholdings.

(ii) Comparisons of distributions of population by occupation and by landholdings possessed showed the SC to be worse-off than the non-SC/ST. The rural SC population were concentrated in low paid occupations like agricultural labour, and also in households with small landholdings.

(iii) A comparison of average nominal PCE across different social groups showed the SC and ST to be the worst-off, while the 'others' (that is, non-ST populations belonging to other religions - Buddhism, Jainism, Zoroastrianism, Christianity, etc.) were relatively most well-off. The average PCE of 'other Hindus' (i.e., non-SC/ST Hindus) was somewhat above the average for the general population, while that for the 'other Muslims' (i.e., non-ST Muslims) was a little below the average. However, the average PCE for all Hindus (including some belonging to SC and ST) was almost at par with that for the general population of rural India.

(iv) This all-India (rural) picture is found to be roughly repeated in rural areas of most states, with a few exceptions.

However, on applying the sign test to compare the average PCE of each pair of social groups within a state, no significant difference was found in the average PCE of 'other Hindus' and 'other Muslims' within a state.

(v) Gini coefficients of inequality, computed for the different social groups named above, showed the poorer groups (for example, the SC and ST) to have lower inequality in their distributions of PCE.

(vi) Decompositions of the Atkinson-Kolm-Sen indices of relative inequality showed intra-social group-inequality to be mainly responsible for overall inequality, both at all-India (rural) level and at the level of individual states.

Chapter 4 studies variation in the incidence of absolute poverty across states and different socio-economic groups such as social groups, occupational classes, size classes of household land possessed and household size classes. It first seeks to identify the poorer sub-groups of the rural population, and then find the contributions of different sub-groups to total poverty in rural India, employing two additively decomposable measures of absolute poverty, namely, the head-count ratio and Chakravarty's index. This Chapter consists of seven sections, including an introductory one. In Section 4.2, the socio-economic groups selected for the study are briefly described. The statewise (and all-India) poverty lines used and the methodology adopted for the study are described in Section 4.3. Section 4.4 reports on the incidence of absolute poverty in different states as measured by the head-count ratio, Chakravarty's indices and Sen's index of poverty. Section 4.5 presents estimates of these indices for different social groups, occupational classes and size classes of household land possessed for rural India as a whole. This is done first, on the basis of nominal PCE and next, after adjusting all PCE's for inter-state consumer price differentials. Head-count ratios are also presented for these three socio-economic groupings in different states. Section 4.6 carries out the decomposition of poverty measures in turn, by states, social groups, occupational classes and size classes of household land possessed, and presents, the contributions of different sub-groups to overall poverty in rural India. The Chapter is concluded in Section 4.7.

A summary of the findings of Chapter 4 is given below :

(i) The different poverty indices, viz., the head-count ratio, Chakravarty's index (for three different values of e) and Sen's index gave, in general, similar rankings of different states or different socio-economic groups. Marginal differences in the rankings of sub-groups by the head-count ratio and by Sen's or Chakravarty's indices were observed for some sub-groups. This was mainly because of differences in the degree of deprivation of the poor, which the latter two indices take account of but the head count ratio does not.

(ii) There was wide variation in the incidence of absolute poverty across states and across different socio-economic groups.

(iii) Among the states, West Bengal, Orissa and Bihar were the poorest. The Punjab and Himachal Pradesh were least poor, relatively speaking.

(iv) The SC and ST were the poorest social groups.

(v) Among occupational classes, the agricultural labourers were the poorest, followed by 'other agricultural workers, hunters, loggers, fishermen, etc.'. The 'professional, technical, etc.' class was the least poor and this was followed by the 'owner cultivator' class.

(vi) Households possessing small areas of land (i.e., 0.005 - 1.00 acre) appeared to be the poorest — in fact, they were even poorer than the landless households. However, poverty appeared to decrease as one moved to higher size classes of household land possessed.

(vii) Poverty appeared to increase with household size upto households with six members, after which it declined to some extent.

(viii) The contributions of the poorest states and the poorest socio-economic groups to overall rural poverty in India is found to be higher according to Chakravarty's indices than by the head-count ratio index. This is largely due to the fact that Chakravarty's indices take account of the deprivation of the poor, which the head-count ratio does not.

(ix) The SC and ST, who together constituted about 27 per cent of the rural population, contributed nearly 36 (40 to 41) per cent to total poverty in rural India as judged by the head-count ratio index (Chakravarty's indices); on the other hand, households possessing small landholdings (i.e., 0.005-1.00 acre) made up 32 per cent of the total rural population but contributed 40 (46 to 47) percent to total rural poverty in the country measured by the head-count ratio (Chakravarty's indices); finally, the agricultural labourers, who were the poorest of the occupational classes, constituted 26 per cent of the rural population and accounted for 37 (44 to 45) per cent of rural poverty in India according to the head-count ratio (Chakravarty's indices).

Chapter 5 of this dissertation examines the variation in level of living (as measured by PCE) and in the incidence of poverty across NSS regions in rural India. It is, in fact, a follow-up of a part of a pioneering study by Mukherjee (1969).

Regionwise estimates of average PCE and percentages of regionwise population belonging to the bottom 10 per cent and 20 per cent and the top 10 per cent and 20 per cent groups of the population of rural India, based on a ranking of households by PCE - these are called 'densities' — are examined here. This is done both on the basis of nominal PCE and after correcting PCE for interregional price differences by expressing all PCE's at all-India rural prices. The Paasche-type indices of inter-state consumer price differentials constructed by Bhattacharyya et al (1980) were utilized for this purpose. In addition, head-count ratio indices of poverty are estimated for the different NSS regions using statewise poverty lines. This Chapter consists of seven sections including an introductory one. Section 5.2 describes the methodology followed. Section 5.3 describes the Tables and Maps containing the main empirical findings of this Chapter. The findings based on NSS 28th round budget data are reported in Section 5.4. This section first discusses inter-regional variation in average PCE and in the incidence of poverty in rural India, and then describes inter-regional variation within states. It also seeks to examine the relationship between the percentage of SC and ST population in a region and average PCE or incidence of poverty in that region. Section 5.5 compares some of these results with those of Mukherjee (1969), which relate to the NSS 18th round (February 1963 - January 1964) period. The NSS seldom publishes data for regions typically smaller than states, one of the reasons being inadequate sample sizes. Section 5.6 contains a discussion on the sample size needed for reliable region-level estimates. The Chapter is concluded in Section 5.7.

The main findings of this Chapter are summarised below :

(i) Wide disparities in level of living (average PCE) and in the incidence of absolute poverty was observed across 61 regions in rural India. The head-count ratio index of absolute poverty, for example, varied from nearly 15 per cent for region 50 in Gujarat to 88 per cent for region 27 in Orissa. The average PCE, adjusted for inter-state consumer price differentials, and the density of the poor (0-10 per cent group or 0-20 per cent group, based on adjusted PCE) also showed large inter-regional variation. The corresponding variation across states was relatively narrow.

(ii) Inter-regional variation in average PCE or the head-count ratio within states was considerable for Rajasthan, Madhya Pradesh, Orissa and Karnataka. However, states like the Punjab, Uttar Pradesh and Maharashtra seemed to be relatively homogeneous in this respect.

(iii) In general, regions with a high density of SC and ST population had a relatively high incidence of absolute poverty. At the same time, many regions with a low density of SC and ST also showed higher incidence of poverty.

(iv) The patterns of variation in average adjusted PCE across states and across the 13 NSS regions during the NSS 18th and 28th round periods, was more similar than the patterns of the corresponding nominal figures. The finding points to marked differences in the pattern of inter-state consumer price differentials between the two time periods.

(v) The wide inter-regional variation in average PCE and in the incidence of absolute poverty within states stresses the need of publishing region (NSS)-level estimates.

(vi) Fairly reliable regionwise estimates of poverty can be obtained with a sample size of about 200 households for any region, and NSS can easily ensure this minimum size for each NSS region.

Chapters 3, 4 and 5 discovered wide variations in level of living (average PCE) or in the incidence of poverty across states, NSS regions, social groups, occupational classes, size classes of household land possessed or household size, taking one or two factors at a time. Chapter 6 sets out to find how these factors, taken together, explain the observed variation in PCE across households by developing a multiple linear regression model for ln PCE. This is done for rural areas of nine states, taking one state at a time. The states were selected on the basis of their sample size, their levels of poverty or relative prosperity, and inter-regional variation in average PCE etc. within the state. The states selected were Rajasthan, the Punjab, Uttar Pradesh, Orissa, West Bengal, Tamil Nadu, Kerala, Gujarat and Maharashtra. The main quantitative explanatory variables of ln PCE were taken to be the natural logarithm of per capita land possessed by a household (ln PCL), the number of adult males (N_m), the number of adult females (N_f) and the number of children (N_c) in the household. The qualitative factors such as social group, occupational class and NSS region were introduced in the model through dummy variables representing differential slopes and intercepts. In addition, seasonal dummy variables corresponding to the sub-rounds were introduced to get better estimates for other variables. The multiple linear regression model estimated for any state thus shows how ln PCL, N_m, N_f and N_c explained variations in ln PCE of households in different social groups, occupational classes and NSS regions during the NSS 28th round period.

Chapter 6 consists of six sections. Section 6.1 is introductory. Section 6.2 describes the selection of nine states to be studied while Section 6.3 describes the variables used in the regression analysis. Section 6.4 describes the stepwise method of selection of regressors and estimation of the multiple linear regression model. The empirical findings of the regression analysis of PCE are discussed in Section 6.5. Finally, Section 6.6 concludes the Chapter. The major findings of this Chapter are as follows :

(i) In general, among household classificatory factors, household occupation appeared to be the most important determinant of household PCE, followed by the NSS region or social group to which the household belonged. Sub-round (that is, the season to which the household was allotted for interview) seemed to be least important in many of the states.

(ii) When the classificatory factors were considered one at a time, household PCE did not appear to vary significantly (a) across regions in the Punjab and Kerala; (b) across social groups in Tamil Nadu and Maharashtra; (c) across occupational classes in the Punjab and (d) across sub-rounds in Rajasthan, the Punjab, Kerala, Gujarat and Maharashtra.

(iii) *Ceteris paribus*, SC households in Rajasthan, Uttar Pradesh and Orissa had a lower average PCE compared to 'other Hindu' (reference group) households in the state. A similar result is observed for Scheduled Tribe households in Rajasthan, Orissa and Gujarat. Similarly, all other factors remaining constant, significant variation in average PCE is observed over NSS regions in Rajasthan and Gujarat.

(iv) In general, an increase in PCL appeared to bring about a rise in average PCE of most groups of households, other factors remaining constant. Similarly, an increase in N_c in any household seemed to make average PCE fall. The coefficients of N_f were, in general, negative or close to zero. The coefficients of N_m, on the other hand, usually tended to be positive.

(v) The elasticity of PCE with respect to PCL was usually the highest for 'cultivator' households.

(vi) The regression models for ln PCE were quite inadequate for explaining inter-household variations in ln PCE for some of the states. Thus, the adjusted coefficients of multiple determination ($\bar{R}^2$) was quite small for Rajasthan, Uttar Pradesh and Maharashtra. This could be largely due to the omission of such important determinants of level of living of a household as occupations of individual earners, number of earners, education of earners and the age-distribution of members of the household, data on which were not available for this study. Also, it is possible that PCL is not an adequate measure of land resources, since it is a simple sum of land owned and land leased in minus land leased out.

Chapter 7 attempts to explain poverty status of individual rural households (that is, whether they are poor or not-poor according as their PCE $\leq$, or $>$ poverty line) in the nine states covered in Chapter 6, in terms of logit models taking as explanatory variables the variables that were found to provide explanation of variation in ln PCE. It should be mentioned that no fresh search was made to find variables explaining the poverty status of a household. A logit model of poverty relates the probability of a household being poor to the explanatory variables. Thus, for rural areas of each of the nine states, the estimated logit models quantify the effects of ln PCL, N_m, N_f and N_c on the probability of individual households being poor, allowing for variation in this probability across households belonging to different NSS regions, social groups and occupational classes with the help of dummy variables corresponding to these categories.

Chapter 7 is made up of six Sections. Section 7.1 is introductory. Section 7.2 describes the logit model. Its estimation procedure is outlined in Section 7.3. The logit model estimated for a state also implies an alternative model for explaining variations in ln PCE. Hence, Section 7.4 compares the logit model estimated for each state with the corresponding regression model for ln PCE set up in the previous Chapter. Section 7.5 describes the results from the logit models of poverty estimated for the nine states. Section 7.6 concludes the Chapter.

The findings of this Chapter are summarised below :

(i) The number of significant explanatory variables is generally lower for the logit model compared to the regression model. This is probably because standard errors (SE) of estimated parameters of the logit model are generally higher than the corresponding SE's in the regression model. An explanatory variable which has a significant increasing (decreasing) effect on ln PCE of a household tends to have a significant decreasing (increasing) effect on the probability of a household being poor, but the latter effect is non-significant in many cases. Even though the logit model does not use the full information on PCE, it does fairly well in predicting the values of ln PCE. Also, the two models agree very well in predicting ln PCE of a household.

(ii) The logit model does better in predicting the poverty status of households observed to be poor in Uttar Pradesh, compared to the regression model. Similar differences of smaller magnitude can be observed for Gujarat, Orissa and Tamil Nadu. Both models are unsuccessful in predicting the status of households observed to be poor in Rajasthan and the Punjab.

(iii) On the whole, the regression models perform better than the logit model in predicting the poverty status of households observed to be non-poor.

(iv) An increase in PCL appeared to decrease the probability of a household being poor in most of the household categories, all other factors remaining constant.

(v) With the exception of Orissa, an increase in N_C in households belonging to most categories in the different states seemed to increase the probability of the households sliding below the poverty line.

As mentioned earlier, there are five appendices in this dissertation. Appendix A contains tables that compare the data on land possessed as collected during the NSS 28th round consumer expenditure enquiry with data on land operated thrown up by the NSS 26th round (1971-72) survey on landholdings. The results of these comparisons are discussed in the text of Chapter 3.

Appendix B describes the NSS regions studied in Chapter 5.

Appendix C examines the validity of the F and t-tests performed in Chapter 6 in connection with the estimation of multiple linear regression models developed in the Chapter. This appendix consists of three sections. Section C.1 is introductory. Section C.2 studies the possible effects of heteroscedastic disturbances using White's method for three states, viz., Rajasthan, Punjab and West Bengal. Section C.3 uses half-sample based standard errors that take into account the complications of the NSS sampling design to study the significance of the estimated regression coefficients. This is done for all nine states. The conclusions drawn from this appendix are :

(i) The standard errors of estimated regression coefficients, estimated by the ordinary least squares (OLS) method and by White's method are fairly close. Consequently, the t-tests based on OLS standard errors agree well with those based on White's estimates of SE.

(ii) The half-sample based SE's of estimated regression coefficients were, on the whole, smaller than those estimated by OLS techniques or by White's method. However, the t-test based on half-sample estimates had only 1 d.f. Presumably for this reason, the t-test based on half-sample based SE's gave fewer significant verdicts than t-tests based on other estimates of SE's, both when t-values were positive and when t-values were negative.

Appendix D gives the details of the computer program for maximum likelihood estimation of the logit models fitted in Chapter 7.

Appendix E shows how the logit models estimated in Chapter 7 can be used to find the change in the head-count ratio of poverty for each household category (social group or occupational class or NSS region) in response to (i) a marginal increase in per capita land possessed by households in the same category or to (ii) a unit increase in the average number of children per household in the category. However, no empirical results are presented.

Chapter 1

SURVEY OF LITERATURE I : METHODOLOGICAL ASPECTS

1.1.1 Introduction

The present dissertation aims at analyzing Indian National Sample Survey household budget data for examining different aspects of the level of living and poverty of India's rural population. This Chapter makes a broad survey of the literature on this subject, beginning with the technical literature on measurement of inequality and poverty, which is reviewed in Part I of this Chapter.

Studies on level of living need to be carried out from time to time in order to assess the success of Government policies in distributing the fruits of economic development over the different segments of the population of a country. Level of living is, however, a multi-dimensional concept. The level of living of a community is indicated by the level and composition of private consumption of individuals or households in the community, their nutritional intake in terms of calories, protein, etc., their housing conditions, stocks of consumer durables, literacy, availability and utilization of health and education services, morbidity and mortality rates, leisure and recreation, etc.

The total consumption of a household consists of private consumption and consumption of public goods and services. However, consumption of public goods like free medical services or free schooling facilities pose serious problems of measurement, and such data are hard to come by. Therefore, studies on the level of consumption of a household concentrate on the analysis of private consumption expenditure.

Data on private consumption expenditure are usually collected through household budget surveys which are frequently conducted in different countries. In India, the household consumer expenditure surveys and other surveys carried out by the National Sample Survey (NSS) (later, National Sample Survey Organisation (NSSO)) are a rich source of information on different indicators of level of living of the Indian people.

The simplest measure of level of living of a household is its per capita total consumption expenditure per 30 days, say, (PCE). Among other measures are the Engel ratios of expenditure on food or cereals[1/]. The Engel ratio for food is well-known. Engel's law states that the

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[1/] Engel ratio of expenditure on an item for a household

$$= \frac{\text{amount spent on the item by the household during a given time period}}{\text{total consumption expenditure incurred by the household during the same period}}$$

proportion of expenditure incurred on food decreases as income increases. Thus, the lower the Engel ratio for food, the better-off (relatively) is the household under consideration likely to be. Studies on level of living require the examination of such indicators over time to detect any improvements or deterioration in living standards. Studies on relative levels of living or disparities are based on comparisons of size distributions of population by PCE or of other indicators over regions and over different sub-groups of the population.

Closely related to the concept of level of living is the concept of absolute poverty. Those households which are at very low levels of living and are unable to meet their minimum needs required for subsistence are considered to be poor. In this context, in most countries a minimum level of per capita income or consumer expenditure[2/], called the poverty line, is decided upon and any household with per capita income or expenditure less than this amount is considered to be poor. As opposed to this concept of absolute poverty, there is the concept of relative poverty, where the focus is on the relative deprivation of the poorest units of a society.

This part of the Chapter is organised as follows : Section 1.1.2 discusses some conceptual issues in measurement

[2/] Household income data being difficult to collect and/or unreliable, total consumer expenditure of a household is often taken as a proxy for household income.

of economic inequality/poverty. The technical literature on measurement of income/consumption inequality is surveyed in Section 1.1.3, while that on measures of poverty is summarised in Section 1.1.4.

Part II of this Chapter surveys empirical studies on level of living, inequality and poverty, with special reference to India.

1.1.2 Conceptual Issues in Measurement of Inequality/Poverty

Most studies on inequality or poverty are based on the size distributions of population by per capita income or consumer expenditure. Therefore, before surveying the technical literature on measurement of inequality and poverty, it would be desirable to clarify certain basic issues relating to the following choices which must be made in collecting income or consumption data : (i) choice of the definition of income/ consumer expenditure, (ii) choice of the accounting period for collecting income/expenditure data and (iii) choice of the recipient unit of income[3/].

(i) Definition of Income/Consumer Expenditure

In any given year, say, a person's income is the sum of his wage/salary earnings, investment income from assets that he owns, transfers (e.g., student grant, pension) and

[3/] See Atkinson (1975).

capital transfers (e.g., legacies or gifts). A comprehensive definition of income, accepted by economists, is this : Income in a period is the maximum amount a person could have spent while maintaining the value of his wealth intact (Atkinson (1975), p. 33). Simons (1938, p.50) defined personal income as the sum of (1) the market value of rights exercised in consumption and (2) the increase in the value of the store of property rights between the beginning and the end of the period.

However, much of the statistical data on the distribution of income fall short of Simons' comprehensive definition of income. For example, the income data often exclude the following, wholly or partly : capital gains, wages in kind, especially fringe benefits, production for home consumption, imputed rent of owner-occupied houses, etc. Also, the definition strictly refers to real income, or its purchasing power, and allowances should be made whenever necessary for differing price levels across geographical regions and across population sub-groups in a country.

Consumer expenditure is given by :

Expenditure = Income (after tax) - Capital transfers - Saving.

Expenditure thus represents the purchasable benefits which a person enjoys. Income, on the other hand, represents the potential spending power of a person. In using income as an indicator of economic welfare the control over capital transfers is considered.

For a developing country like India with a fairly large non-monetized sector, household consumption has to include imputed values of consumption of home produce, consumption out of wages in kind and out of gifts, loans and free collections, besides imputed rental of owner-occupied houses.

(ii) The Accounting Period for Income/Consumer Expenditure Data

The shortest period for measurement of income that seems to be feasible is the week. However, the weekly income of many persons vary widely due to, say, fluctuations in weather conditions or seasonality, and other short-run factors (like illness). As a result of such short-run fluctuations, the distribution of weekly income appears more unequal than when income is measured over a longer period such as a month or year. In general, the averaging of income over a longer period reduces the observed disparities. If one wants to eliminate the effects of seasonality, one must consider annual income, if not the average income over a period of several years. Even annual income is subject to year-to-year fluctuations, and the average income over several years would be close to Friedman's (1957) concept of permanent income.

While persons at the upper end of the income scale possess assets which help them tide over short-period fluctuations, this is not so for persons in the lower income classes. Choice of the accounting period for income, therefore, largely depends on the purpose of the study. For measuring the number of poor persons, one may base one's analysis on weekly income. On the other hand, for measuring inequality in the distribution of income among the population as a whole, income averaged over a year may seem more appropriate. In practice, income data are usually collected for a one-year reference period.

The above discussion relates to the measurement of income in the current period. There is also the concept of lifetime income. At a given time, there are persons having low incomes currently who will have higher incomes later (e.g., students or apprentices) and other persons who enjoyed higher incomes in the past (e.g., pensioners). Lifetime income will, therefore, be less unequally distributed than current period incomes which exaggerate the extent of inequality because different persons are observed at different stages of their life-cycle.

Lifetime income is not very relevant in measuring poverty. However, for measurement of income inequality lifetime income is, in principle, better than income in any single period.

Lifetime income is defined to mean the total value of all receipts in the form of wages/salaries, capital transfers and state benefits, discounted to a common date. Thus, lifetime income is given by :

$$\text{Lifetime income} = \text{income in period 1} + \frac{\text{income in period 2}}{(1 + \text{rate of interest})} + \frac{\text{income in period 3}}{(1 + \text{rate of interest})^2} + \ldots$$

where the incomes in different periods are expressed at constant prices. Difficulties in measuring lifetime income arise from (a) difficulties in choice of the rate of interest to be used, (b) difficulties in collection of data over a person's lifetime and (c) difficulties in expressing the time series of incomes at constant prices before adding the incomes.

Data on consumer expenditure are often collected through household surveys by the interview method. Weekly expenditures tend to vary to a large extent, while data on yearly expenditure might be subject to 'recall errors'. Thus, 'last month' would appear to be appropriate for collecting data on consumer expenditure by the interview method. However, practice varies in this regard from one country to another. In some countries, the reference period varies from one group of items to another. Countries like Japan and South Korea depend on self-enumeration — sample households maintain daily records for a number of months.

(iii) Choice of the Recipient Unit

One has to decide upon the recipient unit of income in collecting income data. Is it to be an individual, or a nuclear family (husband, wife and dependent children), or a household ('a group of people living together at the same address with common housekeeping'[4/])? Taking the individual as the basic unit would show a large number of individuals, mainly children and housewives, having no recorded income. However, in reality, these individuals may enjoy a high standard of living as a result of sharing the incomes of their parents or husbands. If the extent of these intra-family transfers were known, then these could be added to be incomes of wives and children, and the individual could be used as the income receiving unit. In practice, however, such information is not available.

By considering the nuclear family as the income recipient unit, one would take into account the extent of income sharing within a nuclear family. For, taking the nuclear family as the unit is tantamount to assuming that all income received by members of a nuclear family is shared, and for any distribution of income by individuals the amalgamation into nuclear family incomes would reduce the variation in income. Taking the household as the unit would further reduce this inequality.

[4/] Definition of household used in the family expenditure survey in Britain.

The choice between the different units depends in part on the empirical question of how far incomes are actually shared.

Households and families differ in size and age-sex composition and have differing needs which should be taken into account. The simplest method of taking into account household size and composition is to assume that all members have identical needs and to calculate the per capita income. However, needs vary with age, sex and nature of occupation and also economies of scale operate in households or families. To allow for these factors, attempts have been made to construct adult equivalent scales or other types of equivalent scales which allow comparisons to be made between different types of nuclear families/households : one has to consider the inequality of income/consumer expenditure per equivalent adult.

1.1.3 Measurement of Income Inequality

Many studies on level of living and economic inequality are concerned with inter-temporal and inter-regional comparisons of personal distributions of income[5].

[5] See, among others, Kuznets (1955, 1963), Kravis (1960), Lydall (1960), Soltow (1965), Stark (1972), Weisskoff (1970), Fishlow (1972), Oshima (1962, 1970), Adelman and Morris (1973), Ahluwalia (1974), Ranadive (1971), Ojha and Bhatt (1974), Ahmed and Bhattacharya (1972) and Swamy (1967).

Such comparisons require a summary index of income inequality which, in addition to measuring inter-personal differences in income, should, in principle, reflect the amount of social welfare lost owing to unequal distribution of income.

Let there be n income earning units in a society whose income distribution is given by the vector :

$$\underline{y}' = (y_1, y_2, \ldots, y_n) \qquad \ldots (1.1)$$

where $y_i > 0$ is the income of the ith unit, $i = 1, 2, \ldots, n$. The mean income of the population is :

$$\mu = \frac{1}{n} \sum_{i=1}^{n} y_i \qquad \ldots (1.2)$$

The set Y of all possible income vectors $\underline{y}$ is called the income space. A measure of inequality is defined as a scalar function on Y, and denoted by $I(y)$.

An inequality index is a relative measure or an absolute measure according as it satisfies :

(SI) Scale Invariance, that is

$$I(c\,\underline{y}) = I(\underline{y}) \qquad \ldots (1.3)$$

for all scalars $c > 0$. This takes care of price changes and changes in the unit of money in the community.

OR

(TI) Translation Invariance, that is, for all real numbers α, such that $(\underline{y} + \alpha \underline{1}) \in Y$,

$$I(\underline{y} + \alpha \underline{1}) = I(\underline{y}) \qquad \ldots (1.4)$$

where $\underline{1}' = (1, 1, \ldots, 1)$ ... (1.5)

is the n-coordinated vector of ones.

1.1.3.1 Desirable Properties of an Inequality Index

A good measure of inequality, whether relative or absolute, should possess the following properties[6/] :

(P1) Zero at Equality :

For all $0 < \mu < \infty$,

$$I(\mu \underline{1}) = 0 \qquad \ldots (1.6)$$

(P2) Positivity out of Equality :

For any vector $\underline{y} \neq \mu \underline{1}$,

$$I(\underline{y}) > 0 \qquad \ldots (1.7)$$

[6/] The desirable properties of an index of inequality have been discussed, among others, by Dalton (1920, 1925), Atkinson (1970), Sen (1973), Champernowne (1974), Cowel and Kuga (1976, 1977), Kolm (1976), Cowel (1977), Kurabayashi and Yatsuka (1977) and Feilds and Fei (1978).

(P3) Impartiality

Any permutation of the y_i's leaves the value of I unaltered, that is,

$$I(P\underline{y}) = I(\underline{y}) \qquad \ldots (1.8)$$

where P is any permutation matrix[7] of order n.

(P4) Principle of Population

If a population is replicated m times, where m is a natural number, the measure of inequality remains unchanged, provided $n \geq 2$. In other words, let $\underline{x}$ be an nm dimensional income vector such that

$$\underline{x} = (x_{ij}), \text{ where } x_{ij} = y_i, \quad i = 1, 2, \ldots, n; \quad j = 1, 2, \ldots, m.$$

If $I_n(\underline{y})$ and $I_{nm}(\underline{x})$ represent the inequality indices of $\underline{y}$ and $\underline{x}$, respectively, then I is said to satisfy Dalton's (1920) principle of population if and only if

$$I_{nm}(\underline{x}) = I_n(\underline{y}) \qquad \ldots (1.9)$$

for all $n, m \in N$, the set of natural numbers, and $n \geq 2$.

[7] A non-negative square matrix of order n is said to be a bi-stochastic matrix if all row sums and column sums are unity. A permutation matrix is a bi-stochastic matrix which has one and only one positive element in each row and column.

(P5) Principle of Transfers[8]

The inequality index I should strictly decrease if some amount of income is transferred from a richer person to a poorer person without altering their relative positions. Let $\underline{y}$, $\underline{x} \in Y$ be two income vectors such that $x_i = y_i$, $i = 1, 2, \ldots, n$, $i \neq j$, k and $y_j < x_j = y_j + \delta < x_k = y_k - \delta < y_k$, for some $\delta > 0$. The principle of transfers or rectifiance (Kolm (1976, 1976a)) requires that

$$I(\underline{y}) > I(\underline{x}) \qquad \ldots (1.10)$$

Conversely, a transfer of income from a poor unit to a richer unit must increase I.

(P5′) Principle of Diminishing Transfers[9]

This is an extension of the principle of transfers mentioned above. It requires that the impact of a transfer of income on I be greater, the lower down the income scale that it takes place. If (i, j) and (i′, j′) are two pairs of units such that $y_i > y_j$, $y_{i'} > y_{j'}$ and $y_i > y_{i'}$, and $y_i - y_j = y_{i'} - y_{j'}$, then

$$I(\underline{y}^T(i', j')) - I(\underline{y}) > I(\underline{y}^T(i, j)) - I(\underline{y}) \qquad \ldots (1.11)$$

[8] Also known as the Pigou-Dalton criterion (Pigou (1912), Dalton (1920)).

[9] Discussed in Dalton (1920), Atkinson (1970), Sen (1973), and Kolm (1976a).

where $\underline{y}^T(i, j)$ and $\underline{y}^T(i', j')$ are income profiles obtained from $\underline{y}$ by the transfer of an amount $\delta > 0$ from the jth unit to the ith unit and from the j'th unit to the i'th unit, respectively, such that their rankings are unaltered.

(P6) The inequality measure should have an upper bound which is attained when one unit monopolises all the income (Champernowne (1974)).

1.1.3.2 Measures of Inequality[10/]

Measures of inequality can be divided into two classes :

(i) Positive measures which are statistical measures of variation of income and are not based explicitly on social welfare considerations. Relative measures of this class include the relative mean deviation, the Elteto-Frigyes (1968) measures, the coefficient of variation, the standard deviation of logarithms, the Gini coefficient, Gastwirth's measure (Gastwirth (1974)) and Theil's entropy measure. Absolute measures of this class are variance or standard deviation of incomes, Gini mean difference and mean deviation.

10/ Measures of inequality are discussed in detail in Sen (1973).

(ii) Normative measures of inequality which have a direct bearing on measurement of social welfare[11]. Relative measures of this class include Dalton's measure and Atkinson's measure, while absolute measures of this class include Kolm's index.

1.1.3.2a Positive Measures of Income Inequality

The most commonly used indices, namely, the standard deviation of logarithms, the Gini coefficient, the coefficient of variation and Theil index are briefly discussed here :

The Standard Deviation of Logarithms[12]

The standard deviation of logarithms of an income profile $\underline{y}$ is defined as :

$$SD(\log) = \left[\frac{1}{n} \sum_{i=1}^{n} \left(\log \left(y_i/\mu\right)\right)^2 \right]^{\frac{1}{2}} \quad \ldots (1.12)$$

SD(log) is scale invariant, but even though it attaches greater weight to transfers of income at the lower end of the income scale, it fails to satisfy the Pigou-Dalton principle of transfers at high levels of income.

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[11] The normative approach to the measurement of inequality is discussed in Dalton (1920), Champernowne (1952), Aigner and Heins (1967), Atkinson (1970), Tinbergen (1970), Bentzel (1970), and Sen (1973).

[12] This index has been discussed in Atkinson (1970) and Stark (1972). Strictly, this is not the SD of log-incomes - the geometric mean of incomes should be used in place of μ.

The Gini Coefficient[13/]

This classical measure defined by Gini (1912) is given by

$$G = \frac{\frac{1}{n^2} \sum_{i=1}^{n} \sum_{j=1}^{n} \left| y_i - y_j \right|}{2 \mu} \qquad \ldots (1.13)$$

The numerator of the expression (1.13) is called the Gini mean difference (with repetition). Following Sen (1973), G can be rewritten as

$$G = 1 + \frac{1}{n} - \frac{2}{n^2 \mu} \sum_{i=1}^{n} i\, y_i \qquad \ldots (1.14)$$

$$= 1 - \frac{1}{n^2 \mu} \sum_{i=1}^{n} (2i - 1)\, y_i \qquad \ldots (1.15)$$

where $y_1 \geq y_2 \geq \ldots \geq y_n$.

The sensitivity of the Gini coefficient to transfers of income depends on the difference in size ranks of the incomes affected rather than on the absolute values of these incomes. It is, therefore, most sensitive to transfers around the middle of the income profile (vide Kakwani (1980a), p. 72). It is equal to the ratio of the area of concentration

13/ The Gini coefficient was analysed by Ricci (1961), Dalton (1920), Atkinson (1970), Newbery (1970), Sheshinski (1972), Kats (1972), Sen (1973, 1973a, 1974, 1976), Pyatt (1976), Blackorby and Donaldson (1978), Michal (1978), Takayama (1979), Dorfman (1979), Weymark (1981), Donaldson and Weymark (1980), Yitzhaki (1979, 1980), Thon (1980), Kakwani (1980a) and Hey and Lambert (1980).

(which is the area enclosed between the egalitarian line of the Lorenz box and the Lorenz curve[14/] to the area of the triangular region below the egalitarian line (see Fig. 1.1). Equivalently, the Gini coefficient is twice the area of concentration. In symbols,

$$G = 1 - 2 \int_0^1 F_1 dF.$$

The relationship between the Lorenz curve and the Gini coefficient is one of the reasons why the Gini coefficient has been widely used as a measure of inequality in spite of its shortcomings like the inability to satisfy the principle of diminishing transfers. The maximum value that can be attained by G is 1 when one unit monopolises all the income. The minimum value is 0 when all incomes are equal.

14/ Due to Lorenz (1905). Consider a continuous type income distribution with frequency density $f(y)$, $y \geq 0$, and finite mean $\mu = \int_0^\infty y\, f(y)\, dy$. Then, let

$$F(y) = \int_0^y f(u)du = \text{proportion of population with income} \leq y,$$

and $$F_1(y) = \frac{\int_0^y u\, f(u)\, du}{\int_0^\infty u\, f(u)\, du} = \text{proportionate share in aggregate income of those earning} \leq y.$$

The graph of F_1 against F is called the Lorenz or concentration curve. See Fig. 1.1.

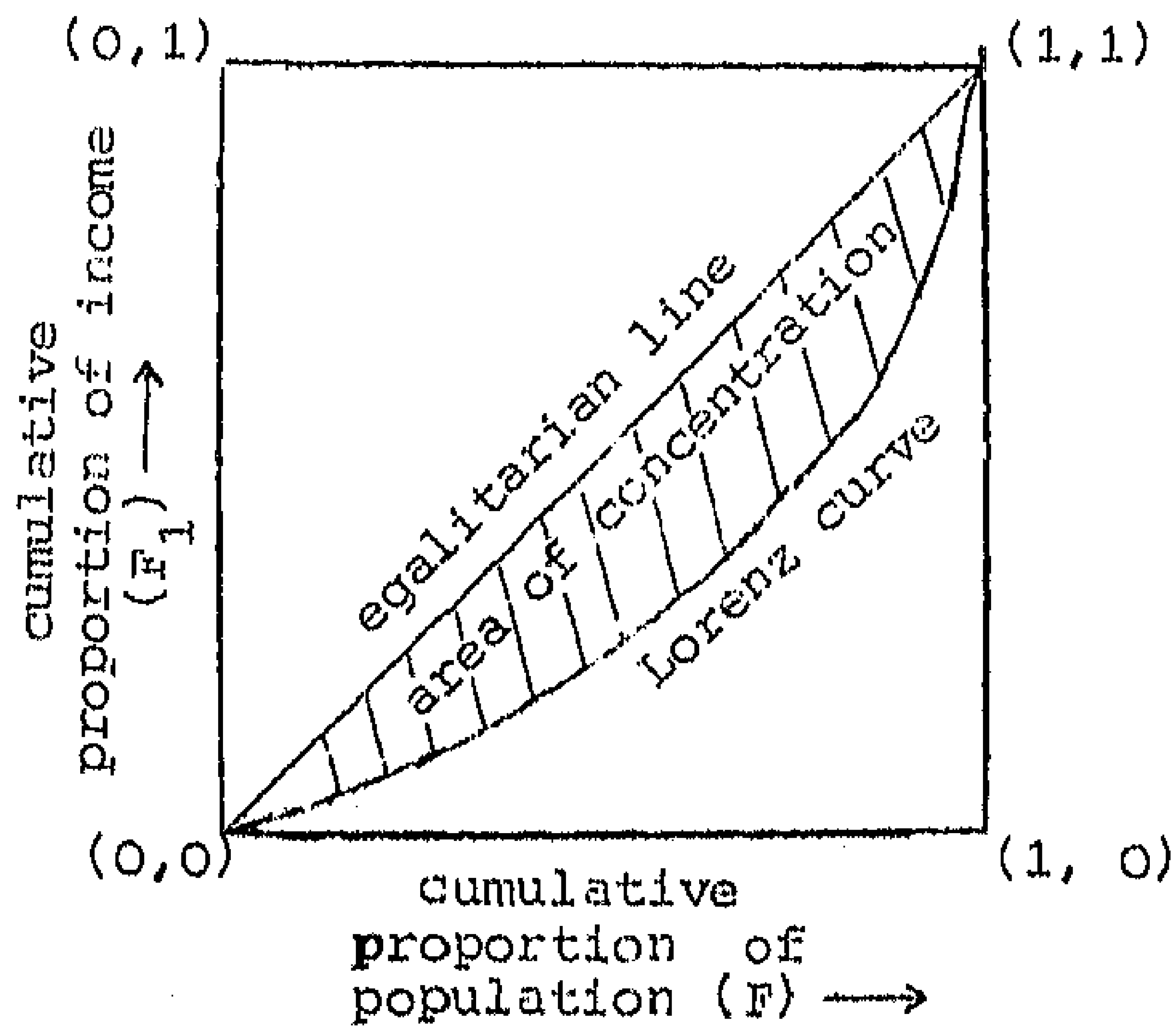

Fig. 1.1. The Lorenz diagram.

The Coefficient of Variation

The coefficient of variation is defined by

$$CV = \frac{V}{\mu} \qquad \ldots (1.16)$$

where $$V = +\sqrt{\frac{1}{n}\sum_{i=1}^{n}(y_i - \mu)^2} \qquad \ldots (1.17)$$

is the s.d. of the incomes $y_1, y_2, \ldots, y_n$. The coefficient of variation satisfies the Pigou-Dalton principle of transfers but violates the principle of diminishing transfers by attaching equal weight to transfers at all levels of income. CV attains a maximum value of $\sqrt{n-1}$ when one unit gets all the income.

The Theil Entropy Measure

The Theil measure of inequality (Theil (1967)) owes its origin to the notion of entropy in information theory. It is defined as

$$T = \sum_{i=1}^{n} x_i \log (n x_i) \qquad \ldots (1.18)$$

where $x_i = \frac{y_i}{n\mu}$, is the income share of the ith unit, i = 1, 2, ..., n.

T has the minimum value zero when all incomes are equal. The maximum value of T is log n which is obtained when one unit gets all the income, that is, $x_i = 1$ for some i and $x_j = 0$ for all $j \neq i$. The effect of a transfer of income between two persons increases with the ratio of their incomes, and therefore, T satisfies the principle of diminishing transfers.

It will be shown below that the Gini coefficient, the normalised coefficient of variation and the normalised Theil measure can be derived as normative measures[15].

1.1.3.1b Normative Measures of Income Inequality

Relative Measures

Normative measures of income inequality are acquiring great importance in studies on level of living as they are

[15] In fact, any inequality index that satisfies the Pigou-Dalton principle of transfers, on suitable normalisation, can be written as a normative index of inequality.

based on explicit normative judgements by which a choice can be made between two income profiles (Dalton (1920)). Individual preferences are aggregated to form a social welfare function (swf) such that it ranks all possible income profiles in the order of society's preference. A normative measure of inequality is constructed on the basis of such a swf.

Dalton's Measure of Inequality

Let $U_i\ (y_i) = U(y_i) > 0$ denote the utility function of the ith unit such that $U'(y_i) > 0$ and $U''(y_i) < 0$ (that is, $U(.)$ is concave), $i = 1, 2, \ldots, n$. The swf is defined as

$$W(\underline{y}) = \sum_{i=1}^{n} U(y_i) \qquad \ldots (1.19).$$

By Jensen's inequality,

$$n\ U(\mu) \geq W(\underline{y}) \qquad \ldots (1.20).$$

Dalton's measure

$$D = 1 - \frac{\sum_{i=1}^{n} U(y_i)}{n\ U(\mu)} \qquad \ldots (1.21)$$

gives the proportion of welfare lost owing to unequal distribution of income[16].

16/ Dalton (1920). This approach was taken up much later by Aigner and Heins (1967), who derived inequality indices for different specifications of W. However, Dalton's ideas were really revived in the seminal paper by Atkinson (1970).

Atkinson (1970) pointed out that Dalton's measure is not invariant under affine transformations of U(.). He adopted the swf given by (1.19) and modified Dalton's measure to remove this deficiency.

Atkinson's Measure

Atkinson (1970) introduced the concept of 'equally distributed equivalent' (ede) income, y_e, as that income which, if equally enjoyed by every unit of the community, would yield the same level of social welfare as the given income profile. Therefore,

$$y_e = y \;\Big|\; n\,U(y_e) = \sum_{i=1}^{n} U(y_i) \qquad \ldots (1.22)$$

Concavity of $W(\underline{y})$ ensures that, $y_e \leq \mu$. Atkinson's measure[17/] is given by

$$A = 1 - \frac{y_e}{\mu} \qquad \ldots (1.23)$$

Then A is the fraction of total income that could be disposed of without any loss of social welfare if incomes were distributed equally.

17/ Atkinson's measure of inequality has been employed and discussed by Allingham (1972), Bruno (1974), Bartels and Nijkamp (1976), Bruno and Habib (1976), Shorrocks (1978), von Weizsacker (1978), Blackorby, Donaldson and Auersperg (1981) and Bhattacharya, Chatterjee and Pal (1986), among many others.

Drawing upon results obtained by Pratt (1964) and Arrow (1965), Atkinson showed that A is scale invariant if and only if U(.) is of the form

$$U(y) = C + D \cdot \frac{y^r}{r} \quad \text{for } r \neq 0 \qquad \ldots (1.24.1)$$

$$= C + D \log y \quad \text{for } r = 0 \qquad \ldots (1.24.2)$$

where $r \leq 1$ for concavity and C and D are constants. Using this form of U(.), one gets

$$A = 1 - \frac{\left(\frac{1}{n} \sum_{i=1}^{n} y_i^r\right)^{1/r}}{\mu} \quad \text{for } r \neq 0 \qquad \ldots (1.25.1)$$

$$= 1 - \frac{\prod_{i=1}^{n} y_i^{1/n}}{\mu} \quad \text{for } r = 0 \qquad \ldots (1.25.2).$$

As r decreases, greater weight is attached to transfers at the lower end of the income profile, and less weight to transfers at the top. As $r \longrightarrow -\infty$, $A \longrightarrow 1 - \frac{\min_i \{y_i\}}{\mu}$ which corresponds to the Rawlsian maximin rule (Rawls (1958, 1971)) that ranks social states in terms of the welfare of the worst-off unit in the state.

<u>The Atkinson-Kolm-Sen Approach</u>

Sen (1973) adopted a more general form of swf, W, defined on y_i's, such that :

(S1) W is continuous and increasing in individual incomes;

(S2) W is symmetric in $y_1, y_2, \ldots, y_n$, that is,

$$W(P\underline{y}) = W(\underline{y}) \qquad \ldots (1.26)$$

for any permutation matrix P of order n;

(S3) W is strictly S-concave, that is,

$$W(Q\underline{y}) > W(\underline{y}) \qquad \ldots (1.27)$$

for all bistochastic matrices Q which are not permutation matrices.

The generalised ede income, y_f, associated with the income profile $\underline{y}$ is defined as

$$y_f = y \mid W(y_f \cdot \underline{1}) = W(\underline{y}) \qquad \ldots (1.28)$$

and is obtained by solving

$$W(y_f \cdot \underline{1}) = W(\underline{y}) \qquad \ldots (1.29)$$

Sen then defined the more general index of inequality as

$$S = 1 - \frac{y_f}{\mu} \qquad \ldots (1.30)$$

S is the fraction of total income that could be disposed of without any loss of social welfare if society distributed incomes equally. S is continuous, bounded between zero and one, where the lower bound is attained when incomes are distributed equally.

Henceforth, y_f will be referred to as the Atkinson-Kolm-Sen (AKS) representative income and S the AKS relative inequality index.

Blackorby and Donaldson (1978) showed that S is scale invariant if and only if W is homothetic, that is, W is of the form

$$W = \emptyset(\bar{W}(\underline{y})) \quad \ldots (1.31)$$

where $\bar{W}(\underline{y})$ is positively, linearly homogeneous and $\emptyset$ is increasing in $\bar{W}$.

Given assumptions (S1) - (S3) on W, (1.29) can be solved for y_f :

$$y_f = E(\underline{y}) \quad \ldots (1.32)$$

where E is a particular numerical representation of W, that is,

$$W(\underline{y}) \geq W(\underline{x}) \iff E(\underline{x}) \leq E(\underline{y}) \quad \ldots (1.33)$$

Given assumptions (S1) - (S3) on W, E is continuous, increasing, strictly S-concave and linearly homogeneous if W is homothetic. To every form of E, there corresponds a different relative inequality index. Thus one has the following :

1. If $$E_G(\underline{y}) = \frac{1}{n^2} \sum_{i=1}^{n} (2i - 1)\, y_i, \quad \ldots (1.34)$$

where $y_1 \geq y_2 \geq \ldots \geq y_n$, then S is the Gini coefficient given by (1.15).

2. If $E_{CV}(\underline{y}) = \frac{1}{n}\sum_{i=1}^{n} y_i - \left[\frac{1}{n}\sum_{i=1}^{n}(y_i - \mu)^2\right]^{1/2}$ ... (1.35)

then S reduces to the normalised coefficient of variation.

3. If $E_T(\underline{y}) = \frac{1}{n \log n}\left[n\mu \log(n\mu) - \sum_{i=1}^{n} y_i \log y_i\right]$

... (1.36)

then S is the normalised Theil index.

4. If $E_A(\underline{y}) = \left(\frac{1}{n}\sum_{i=1}^{n} y_i^{r}\right)^{1/r}, \quad r \neq 0, r \leq 1$ ... (1.37.1)

$= \prod_{i=1}^{n} y_i^{1/n}, \quad r = 0$ ... (1.37.2)

then S is the Atkinson index of inequality A given by (1.23).

Given any strictly S-convex inequality index, it is obvious that there exists a strictly S-convave swf that corresponds to it[18]. Thus, it appears rewarding to characterize these indices axiomatically through welfare theoretic axioms. Sen (1974) proposed an axiomatization of the Gini swf. The same job for the Theil index was done by Chakravarty (1981, 1982).

It may be mentioned that the standard deviation of logarithms is not S-convex.

[18] An inequality index $I(\underline{y})$ is said to be S-convex if $I(\underline{y}) \geq I(Q\underline{y})$ for all $\underline{y}$ and for all bistochastic matrices Q of order n. $I(\underline{y})$ is strictly S-convex if the inequality is strict whenever the vector $Q\underline{y}$ is not a permutation of $\underline{y}$.

Absolute Measures

Kolm's Absolute Measure

Kolm's (1976) absolute measure of income inequality is defined as

$$K = \frac{1}{\alpha} \log \left[\frac{1}{n} \sum_{i=1}^{n} e^{\alpha(\mu - y_i)} \right] \qquad \ldots (1.38)$$

where $\alpha > 0$. As α increases, K increases and greater weight is attached to transfers lower down the income scale. As $\alpha \longrightarrow \infty$, $K \longrightarrow \mu - \min_i \{ y_i \}$, the absolute maximin index.

Blackorby and Donaldson's Approach

Blackorby and Donaldson (1980) considered a continuous, non-decreasing, S-concave swf W on Y. Let y_f be the AKS representative income for the given income profile according to W. Then their absolute inequality index is

$$B(\underset{\sim}{y}) = \mu - y_f \qquad \ldots (1.39)$$

B is continuous, symmetric and bounded below by zero. B gives the per capita income that would be saved without any loss of social welfare, if society distributed incomes equally.

B is translation invariant if and only if

$$W(\underset{\sim}{y}) = \phi (\overline{W} (\underset{\sim}{y})) \qquad \ldots (1.40)$$

where $\emptyset$ is increasing in $\overline{W}$, and $\overline{W}$ is unit translatable, that is,

$$\overline{W}(\underline{y} + \theta \underline{1}) = \overline{W}(\underline{y}) + \theta \qquad \ldots (1.41)$$

where θ is any scalar such that $(\underline{y} + \theta \underline{1}) \varepsilon Y$. Corresponding to every translatable swf of the form (1.40), there exists a different absolute inequality index.

Earlier, Pollak (1971) had suggested the following additively separable and translatable utility function :

$$W_p (\underline{y}) = - \sum_{i=1}^{n} e^{-\alpha y_i} \qquad \ldots (1.42)$$

where $\alpha > 0$. This function is an increasing transformation of $y_f = E_K(\underline{y})$ where

$$E_K(\underline{y}) = - \frac{1}{\alpha} \log \left[\frac{1}{n} \sum_{i=1}^{n} e^{-\alpha y_i} \right] \ldots (1.43)$$

The Blackorby-Donaldson absolute index corresponding to $W_p (\underline{y})$ is then

$$B(\underline{y}) = \mu + \frac{1}{\alpha} \log \left[\frac{1}{n} \sum_{i=1}^{n} e^{-\alpha y_i} \right]$$

$$= \frac{1}{\alpha} \left[\log e^{\mu\alpha} + \log \left(\frac{1}{n} \sum_{i=1}^{n} e^{-\alpha y_i}\right) \right]$$

$$= \frac{1}{\alpha} \log \left[\frac{1}{n} \sum_{i=1}^{n} e^{\alpha(\mu - y_i)} \right]$$

which is Kolm's absolute measure K. K will be called the Kolm-Pollak (KP) index and the corresponding swf, the KP swf.

If $y_f = E(\underline{y})$ takes the form (1.35), then the absolute index obtained is the standard deviation of incomes, while y_f of the form (1.34) gives the absolute Gini coefficient.

1.1.3.3 Decomposition of Measures of Inequality

An index of inequality gives an overall measure of inter-personal differences in income. In order to formulate policies for arriving at a socially preferable income profile with less inequality, information is required about the source of inequality, that is, the structure of the inequality index with respect to population characteristics. In other words, an inequality index that is decomposable over population subgroups or over income sources is called for.

1.1.3.3a Decomposition over Population Subgroups

Let the community of n units be divided into M disjoint subgroups by one or more characters like age, sex, ethnic groups, etc. Let $\underline{y}^m$ denote the income vector of the mth subgroup with n_m units and mean income μ_m, m = 1, 2,...,M. Then

$$\underline{y}^m = (y_1^m, y_2^m, \ldots, y_{n_m}^m), \qquad \ldots (1.44)$$

$$\mu_m = \frac{1}{n_m} \sum_{i=1}^{n_m} y_i^m, \qquad \ldots (1.45)$$

$$\underline{y} = (\underline{y}^1, \underline{y}^2, \ldots\ldots, \underline{y}^m) \qquad \ldots (1.46)$$

and $$\sum_{m=1}^{M} n_m = n, \qquad \ldots (1.47)$$

An additively decomposable measure of inequality is one which can be expressed as a weighted sum of inequality measures within subgroups plus the inequality arising from the differences between subgroup averages, that is,

$$I(\underline{y}) = I(\underline{y}^1, \underline{y}^2, \ldots, \underline{y}^M)$$

$$= I_A + I_B \qquad \ldots (1.48)$$

where I_A = weighted sum of within group inequalities

$$= \sum_{i=1}^{M} w_i^M \; I(\underline{y}^i) \qquad \ldots (1.49)$$

$$w_i^M = h_i \; (\mu_1, \mu_2, \ldots, \mu_M, n_1, n_2, \ldots, n_M);$$

and I_B = between group inequality

$$= I(\mu_1 \underline{1}_{n_1}, \mu_2 \underline{1}_{n_2}, \ldots, \mu_M \underline{1}_{n_M}) \qquad \ldots (1.50)$$

In other words,

$$I(\underline{y}) = \sum_{i=1}^{M} w_i^M \, I(\underline{y}^i) + I(\mu_1 \underline{1}_{n_1}, \mu_2 \underline{1}_{n_2}, \ldots\ldots, \mu_M \underline{1}_{n_M}), \qquad \ldots (1.51)$$

When the mean incomes of the subgroups are equal then total inequality is attributable solely to inequality within subgroups. On the other hand, if all within group inequalities vanish then inequality arises because of unequal subgroup means.

Shorrocks (1980) showed that an inequality index which is continuous and twice differentiable, satisfies (1.51), postulates (P1) - (P5), and is scale invariant, must be of the form :

$$I_c(\underset{\sim}{y}) = \frac{1}{n} \cdot \frac{1}{c(c-1)} \sum_{i=1}^{n} \left[\left(\frac{y_i}{\mu} \right)^c - 1 \right], \quad c \neq 0, 1, \qquad \ldots (1.52)$$

$$I_0(\underset{\sim}{y}) = \frac{1}{n} \sum_{i=1}^{n} \log \left(\frac{\mu}{y_i} \right), \quad c = 0 \qquad \ldots (1.53)$$

and $$I_1(\underset{\sim}{y}) = \frac{1}{n} \sum_{i=1}^{n} \frac{y_i}{\mu} \log \left(\frac{y_i}{\mu} \right), \quad c = 1 \qquad \ldots (1.54)$$

The weights w_i^M for the decomposition of $I_c(\underset{\sim}{y})$ according to (1.51) are as follows :

$$w_i^M = \frac{n_i}{n} \left(\frac{\mu_i}{\mu} \right)^c \qquad \ldots (1.55)$$

$I_c(\underset{\sim}{y})$ is bounded between 0 and $(n^{c-1} - 1)/[c(c-1)]$ for $c > 0$. However, if $I_c(\underset{\sim}{y})$ is normalised, the principle of population will not be satisfied. If $c \leq 0$, the indices are unbounded above. The measures (1.52) - (1.54) are known as the 'Generalised Entropy Family'.

I_0 and I_1 given by (1.53) and (1.54) are Theil's entropy measures[19] which are decomposable in the following manner :

$$I_0(\underline{y}) = \sum_{i=1}^{M} \frac{n_i}{n} I_0(\underline{y}^i) + \sum_{i=1}^{M} \frac{n_i}{n} \log \left(\frac{\mu}{\mu_i}\right) \quad \ldots (1.53.1)$$

$$I_1(\underline{y}) = \sum_{i=1}^{M} \frac{n_i \mu_i}{n\mu} I_1(\underline{y}^i) + \sum_{i=1}^{M} \frac{n_i}{n} \frac{\mu_i}{\mu} \log \left(\frac{\mu_i}{\mu}\right) \quad \ldots (1.54.1)$$

The measures (1.52) - (1.54) include monotonic transformations of the entire set of indices (1.25.1) and (1.25.2). Thus

$$1 - \exp(-I_0) = 1 - \prod_{i=1}^{n} \left(\frac{y_i}{\mu}\right)^{1/n} \quad \ldots (1.53.2)$$

The expression on the right hand side of (1.53.2) corresponds to that of expression (1.25.2) and

$$1 - \left[\left\{ I_c + \frac{1}{c(c-1)} \right\} c(c-1) \right]^{1/c}$$

$$= 1 - \left[\frac{1}{n} \sum_{i=1}^{n} \left(\frac{y_i}{\mu}\right)^c \right]^{1/c} \quad \ldots (1.52.1)$$

$c \leq 1$, $c \neq 0$, is the right hand side of expression (1.25.1).

In the expression (1.52), if $c = 2$, then $I_2(\underline{y})$ is a monotonic transformation of the coefficient of variation :

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[19] Theil's entropy measures have been decomposed for empirical investigations, by Theil (1967, 1972), Murray (1979), Das and Parikh (1977), and Raghuprasad (1986), among others.

$$I_2(y) = \frac{1}{2n\,\mu^2} \sum_{i=1}^{n} (y_i^2 - \mu^2)$$

$$= \frac{1}{2}\,(CV)^2 \qquad \ldots (1.52.1)$$

<u>The Analysis of Variance of Log-incomes</u>

This is a commonly used[20] statistical procedure for gauging the relative importance of income inequality within groups as compared with variability of mean incomes across groups. The sum of squared deviations of log incomes from log of mean income can be written as :

$$SS_{\log y} = \sum_{i=1}^{n} \left[\log \left({}^{y_i}/_{\mu} \right) \right]^2$$

$$= SS_{\text{within groups}} + SS_{\text{between groups}} \qquad \ldots (1.55)$$

where,

$$SS_{\text{within groups}} = \sum_{i=1}^{M} \sum_{j=1}^{n_i} \left[\log \left({}^{y_j^i}/_{\mu_i} \right) \right]^2 \qquad \ldots (1.55.1)$$

$$\text{and } SS_{\text{between groups}} = \sum_{i=1}^{M} n_i \left[\log \left(\frac{\mu_i}{\mu} \right) \right]^2 \qquad \ldots (1.55.2)$$

This decomposition is not strictly correct since μ_i's and μ are arithmetic means of income. They would be exact if geometric means were used instead.

[20] This procedure was employed by Bhattacharya and Mahalanobis (1967) and Fields (1979).

$SS_{\log y}$ is a monotonic transformation of SD(log y) given by (1.12), which does not fully satisfy the principle of transfers.

The most commonly used measure of inequality, namely, the Gini coefficient, cannot be resolved clearly into a within groups component and a between groups component[21]. This is possible if and only if the groupwise distributions are all non-overlapping (Bhattacharya and Mahalanobis (1967)).

The AKS index was decomposed by Das and Parikh (1982).

The Approach of Blackorby, Donaldson and Auersperg for Decomposition of Inequality

In the procedure described above, inter-group inequality is measured as the inequality between the M group means. Blackorby, Donaldson and Auersperg (1981) objected to this approach and defined inter-group inequality as that inequality which would result if each unit had income equal to the ede income of its group. This approach has clearer support from welfare economic considerations. Suppose $\underline{y}$ = (10, 50, 20, 30) is an income profile and the two subgroups to be used are (10, 50) and (20, 30). The subgroup means are 30 and 25, respectively. The conventional approach would measure inequality between these two figures — 30 and 25. Since the second subgroup has much less of inequality, its representative income may become greater than

[21] The decomposition of the Gini index has been considered by Bhattacharya and Mahalanobis (1967), Paglin (1975), Pyatt (1976), and Murray (1979).

that of the first subgroup, thus giving a different assessment of inter-group inequality[22].

Blackorby et al considered three procedures for decomposition of AKS indices and found their procedure I as the most useful.

Let $\underline{y}^{1'}$ be rewritten as $\underline{y}^{1'} = (y_1, y_2, \ldots, y_{n_1})$, $\underline{y}^{2'}$ as $\underline{y}^{2'} = (y_{n_1+1}, y_{n_1+2}, \ldots, y_{n_1+n_2})$, and so on upto $\underline{y}^{M'}$. Let y_f^i denote the ede income of group i, i = 1, 2, ..., M and y_f the overall ede income. They considered the three income profiles

(1) $\underline{y} = (\underline{y}^1, \underline{y}^2, \ldots, \underline{y}^M)$, (2) $(y_f^1 \, \underline{1}_{n_1}, \ldots, y_f^M \, \underline{1}_{n_M})$ and (3) $(y_f \cdot \underline{1}_n)$, all of which have the same level of welfare.

The AKS index of relative inequality measures the proportion of total income saved in moving from (1) to (3), that is

$$S(\underline{y}) = 1 - \frac{y_f}{\mu} .$$

Intra-group inequality, $S_A(\underline{y})$, is the proportion of total income saved in moving from income profile (1) to income profile (2), where there is no intra-group inequality, that is,

$$S_A(\underline{y}) = 1 - \frac{\sum_{i=1}^{M} n_i \, y_f^i}{n \, \mu} \qquad \ldots (1.56)$$

[22] This example is taken from Blackorby, Donaldson and Auersperg (1981).

Inter-group inequality, $S_R(\underset{\sim}{y})$, is the proportion of total income saved in going from profile (2) to profile (3) :

$$S_R(\underset{\sim}{y}) = 1 - \frac{ny_f}{\sum_{i=1}^{M} n_i \; y_f^i} \qquad \ldots (1.57)$$

Then,

$$\left[1 - S_A(\underset{\sim}{y})\right] \left[1 - S_R(\underset{\sim}{y})\right] = 1 - S(\underset{\sim}{y}) \qquad \ldots (1.58)$$

As mentioned before, the swf for AKS relative indices is homothetic, continuous, increasing and strictly S-concave. To these properties of the swf is added the condition of additive separability which ensures that inequality in group i does not depend on incomes outside group i, i = 1, 2, ..., M.

Given these conditions on the swf, the only admissible swf's are of the form (1.37.1) and (1.37.2), that is, means of order r, $r \leq 1$.

This procedure has been applied in Chapter 3 of this thesis to decompose the AKS relative index of inequality of the size distribution of PCE in rural India into inter-social group and intra-social group components.

Following Blackorby et al (1981), the inter-group absolute index is defined as

$$B_R\,(\underset{\sim}{y}) = \sum_{i=1}^{M} \frac{n_i}{n} y_f^i - y_f \qquad \ldots (1.59)$$

and the intra-group index is

$$B_A(\underset{\sim}{y}) = \sum_{i=1}^{M} \frac{n_i}{n} (\mu_i - y_f^i) \qquad \ldots (1.60)$$

Then, the absolute inequality index defined in (1.39) can be written as :

$$B(\underset{\sim}{y}) = B_R(\underset{\sim}{y}) + B_A(\underset{\sim}{y}) \qquad \ldots (1.61).$$

Given that the underlying swf is continuous, non-decreasing, strictly S-concave , translatable and additively separable, the only admissible absolute indices that are additively decomposable are the KP absolute indices.

1.1.3.3b <u>Source Decomposition of Income Inequality</u>

The total income of each unit may be disaggregated into income from different sources like wages and salaries, business incomes and transfers. The contribution of each source to total income inequality is sometimes studied with great interest.

Let there be J sources of income, then income of ith unit can be written as

$$y_i = y_i^1 + y_i^2 + \ldots + y_i^J, \qquad \ldots (1.62)$$

$i = 1, 2, \ldots, n$, where $y_i^j \geq 0$ is the income of the ith unit from the jth source, $j = 1, 2, \ldots, J$. If the vector $\underset{\sim}{y}^{j'} = (y_1^j, y_2^j, \ldots, y_n^j)$ indicates the incomes accuring from source j, then $\underline{y} = \sum_{j=1}^{J} \underline{y}^j$. Let $S_j(\underline{y}^1, \underline{y}^2, \ldots, \underline{y}^J)$ denote the contribution of the jth source to total income inequality $I(\underline{y})$, which is continuous, symmetric and takes the value zero at equality, then source decomposition requires

$$\sum_{j=1}^{J} S_j(\underline{y}^1, \underline{y}^2, \ldots, \underline{y}^J) = I(\underline{y}) \qquad \ldots (1.63)$$

Further, if each $S_j(\underline{y}^1, \underline{y}^2, \ldots, \underline{y}^J)$ is continuous and symmetric in income sources, independent of the level of disaggregation (so that $S_j(\underline{y}^1, \underline{y}^2, \ldots, \underline{y}^J)$ can be written as $S(\underline{y}^j, \underline{y})$), is not independent of the inequality of source j incomes, vanishes if source j incomes are equal and satisfies population symmetry[23/] and also two source permutation symmetry[24/], then Shorrocks (1982) showed that

$$S(\underline{y}^j, \underline{y}) = \frac{\text{cov}\ (\underline{y}^j, \underline{y})}{V(\underline{y})} \cdot I(\underline{y}) \qquad \ldots (1.64)$$

for all $\underline{y}^j$ and $\underline{y} \neq \mu\, \underline{1}_n$.

The proportional contribution of each source to total income inequality is thus independent of the inequality measure employed.

[23/] Population symmetry implies that for any n xn permutation matrix P, $S(P\underline{y}^j, P\underline{y}) = S(\underline{y}^j, \underline{y})$.

[24/] This means that for all permutation matrices P, $S(\underline{y}^1, \underline{y}^1 + P\underline{y}^1) = S(P\underline{y}^1, \underline{y}^1 + P\underline{y}^1)$.

The most commonly employed index for source decomposition of income inequality is the Gini coefficient[25].

1.1.3.4 Lorenz Curve Comparisons

Let x and y be two income profiles. The income profile x is said to Lorenz dominate income profile y if the Lorenz curve of x is nowhere outside the Lorenz curve of y and is at some place (at least) strictly inside the latter. This relation is expressed by writing xLy and illustrated in Fig. 1.2. This relation is sometimes referred to as strict Lorenz dominance, while x Lorenz dominates y is taken to mean that the Lorenz curve of x is nowhere outside the Lorenz curve of y.

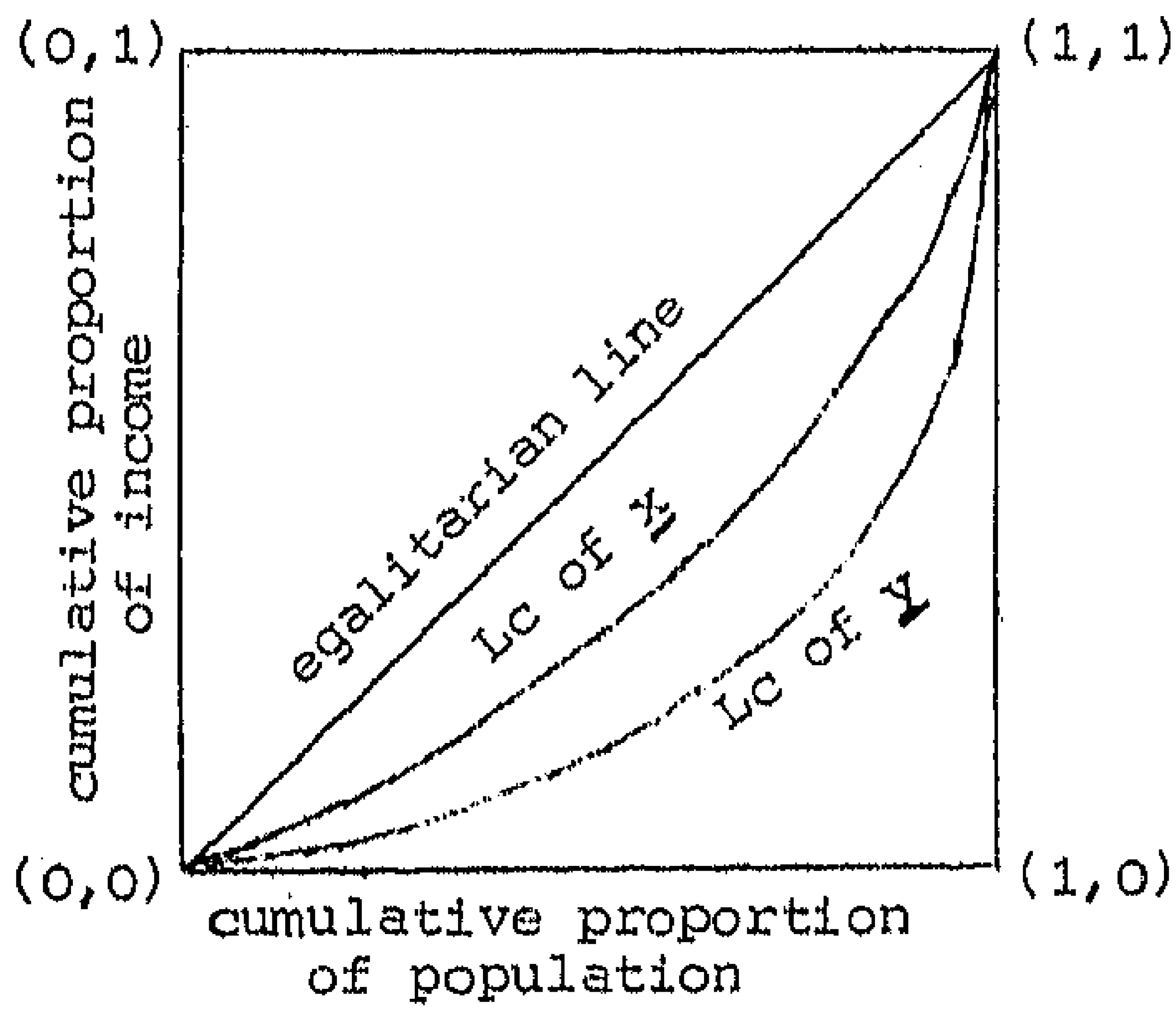

Fig. 1.2. Illustrating Lorenz curve dominance where xLy.

[25] The Gini coefficient has been decomposed for this purpose by Rao (1969), Kakwani (1977), Fei et al (1978, 1979), Fields (1979, 1979a), among others.

Atkinson (1970) proved the following result relating to Lorenz curve dominance of one income profile by another :

If there are two income profiles, $\underline{x}' = (x_1, x_2, \ldots, x_n)$ and $\underline{y}' = (y_1, y_2, \ldots, y_n)$, over the same number of units (n) and with the same mean income (that is, $\sum_{i=1}^{n} x_i = \sum_{i=1}^{n} y_i$), then xLy implies that the $\underline{x}$ profile gives a higher level of social welfare (*as measured* by $W(\underline{x}) = \sum_{i=1}^{n} U(x_i)$ where U is any strictly concave utility function) than the income profile $\underline{y}$ whatever the unknown utility function $\angle U(.)$ may be. The converse is also true. Thus, if $W(\underline{x}) > W(\underline{y})$ irrespective of which U function is chosen (U is strictly concave), then xLy[26]. However, if the Lorenz curves of the profiles $\underline{x}$ and $\underline{y}$ intersect, then there exist two strictly concave functions U that will rank $\underline{x}$ and $\underline{y}$ differently in regard to the level of social welfare.

Atkinson's choice of the swf $W = \sum_{i=1}^{n} U(x_i)$ is quite restrictive. Dasgupta, Sen and Starrett (1973) and Rothschild and Stiglitz (1973) generalised Atkinson's result. These generalised versions do not require W to be a sum of individual U functions. W may be defined directly on the income profile. Dasgupta, Sen and Starrett proved that :

26/ This condition of Lorenz dominance is also equivalent to the condition that $\underline{y}$ can be transformed into $\underline{x}$ by a finite sequence of transformations where each transformation transfers some income from a richer unit to a poorer unit.

If F is any strictly S-concave swf and if for two income profiles with the same number of units and the same mean income xLy, then $F(\underline{x}) > F(\underline{y})$. The converse is also true. And if not xLy, then for some F, $F(\underline{x}) \leq F(\underline{y})$[27].

The results mentioned above relate to comparison of income profiles over the same number of units. To compare income profiles with different population sizes, Dasgupta, Sen and Starrett (1973) proposed the following axiom :

If r communities with the same number of units and identical income profiles are considered together, then the mean welfare of the whole must be equal to the mean welfare of each part (community). With this axiom they proved that, given the level of mean income, Lorenz dominance implies a higher mean (per capita) welfare level even for variable population sizes.

Rothschild and Stiglitz (1973) showed that for two income profiles $\underline{x}$ and $\underline{y}$ over the same number of units and with the same mean income, $\underline{x}$ Lorenz dominates $\underline{y}$ is equivalent to saying that $\underline{x}$ is preferable to $\underline{y}$ under all real-valued

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[27] This result will be referred to as Lorenz quasi-ordering and the corresponding weak version as weak Lorenz quasi-ordering.

locally equality preferring monotonic functions W which satisfy $W(z) = W(\pi(z))$ for π any permutation of z[28].

The above results show that given the mean income, if $\underline{x}$ Lorenz dominates $\underline{y}$, one can be sure that $\underline{x}$ is preferable to $\underline{y}$ under a broad class of swf's. But if the two Lorenz curves intersect then the two income profiles cannot be ranked uniquely in terms of social welfare without assuming some specific swf for the comparison.

1.1.4 The Measurement of Poverty

The problem of poverty is one of grave concern not only in developing countries in many of which a large proportion of the population subsist in near starvation levels, but also in developing countries. Therefore, formulation of policies for the alleviation of poverty occupies an important

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28/ A function $W(\underline{x})$ is locally equality preferring if for every vector $\underline{x} \in Y$

$$W(\underline{x}) \leq W(\alpha\, \underline{y} + (1 - \alpha)\, \underline{x}) \quad \text{for } 0 \leq \alpha \leq 1.$$

where

$$y_i = x_i\,, \qquad i \neq k, l$$

$$y_k = y_l = \frac{x_k + x_l}{2}\,.$$

Locally equality preferring is a weaker concept than quasi-concavity (which implies that if $\underline{z} = t\,\underline{x} + (1-t)\,\underline{y}$, $0 < t < 1$, then $W(\underline{z}) \geq \min\,(W(\underline{x}), W(\underline{y})\quad)$ for while every quasi-concave function is locally equality prefering, the converse is not true.

position in economic planning for development of nations. But before one begins to deal with the problem of poverty in a society, one should have a measure of the incidence and intensity of poverty in the society and investigate the factors responsible for some of its members being poor.

In order to measure the incidence/intensity of poverty in a society it is necessary to (i) identify the 'poor' in the society, and (ii) to aggregate the extent of deprivation of the poor units into an index of poverty. Identification of the poor requires a definition of poverty which usually leads one to a minimum level of income, called the poverty line, which demarcates the poor from the non-poor. Any unit whose income is less than the poverty line is considered to be poor[29/].

Since one of the aims of this dissertation is to investigate poverty in rural India employing an exogenously given poverty line, the concepts of poverty will be briefly reviewed. To be precise, the different definitions of poverty and methods of determining the poverty line will be briefly discussed before proceeding to survey the existing literature on the measurement of poverty.

29/ Alternatively, units whose intake of calorie and other nutrients falls short of reasonable norms may be considered as poor.

1.1.4.1 Concepts of Poverty

Poverty can be considered in two ways —— absolute poverty and relative poverty[30]. In the absolute poverty approach, units whose incomes fall short of a given minimum income (that is, the poverty line) required for their subsistence are considered to be poor. In the relative poverty approach, on the other hand, the focus is on the relatively deprived units of society. For example, a family whose income is less than one-half the median family income may be defined to be poor in the relative sense[31]. Relative poverty exists even in the developed countries. The relative approach to the measurement of poverty is more useful in developed countries, whereas in developing countries, where there is widespread hunger, starvation and malnutrition, it is the absolute approach that is more relevant even though the definition of the poverty line is beset with difficulties.

Two other approaches may be briefly mentioned. One is the bahaviouristic approach[32], where families or households that spend, say, 70 per cent or more of their income on

[30] The different concepts of poverty are discussed in some detail in Atkinson (1975), Townsend (1979), and Sen (1979, 1981, 1983).

[31] See Fuchs (1967). This approach has also been followed by Rainwater (1974), Perlman (1976), Plotnick and Skidmore (1975) and Stark (1972).

[32] The behaviouristic approach has been followed by Rose (1969), Oshima (1977) and Shari (1979).

food are considered to be poor. This approach has its basis in Engel's (1857, 1895) observation that the proportion of total income or expenditure incurred on food decreases as income increases. The other approach, called the demoscopic approach[33], depends on opinion polls regarding the minimum level of income required by a family of four to get along in society for defining its poverty line.

1.1.4.2 Determination of the Poverty Line

In the relative poverty approach, the poverty line is derived directly from the definition of poverty, which may be somewhat arbitrary. If families who have less than one-half of the median income are considered to be poor, then one-half of the median family income is the poverty line.

In the absolute poverty approach, however, the determination of the poverty line is not so simple. There are a variety of opinions regarding the minimum income required for the subsistence of an individual or a family[34]. Should a poverty line represent income required for bare physical survival of an individual or should it include 'other components

[33] The demoscopic approach is discussed in Rainwater (1974). It has been employed to find poverty lines by Goedhart, Halberstadt, Kapteyn and van Praag (1977), van Praag, Goedhart, Kapteyn (1980), Kapsalis (1981), van Praag, Split and van der Stadt (1982), Danzinger, van der Gaag, Taussig and Smolensky (1984).

[34] Atkinson (1975) discusses the problems of defining a poverty line.

of basic needs essential for human existence at a tolerable level' (Rao (1977))?[35] Some authors (Rowntree (1901), Orshansky (1965)) started from low or minimum cost diets that just secure the physical survival/efficiency of an individual and adjusted these figures to allow for such indispensable needs like clothing and shelter to arrive at their poverty lines.

There are today two distinct methods of identifying the poor in the absolute sense for a given set of basic needs — the direct method and the income method. In the direct method, those whose actual consumption baskets leave some basic need (e.g., calories, protein, etc.) unsatisfied are considered to be poor. This method does not involve any comparison of income or total consumer expenditure with the poverty line figure, which is the estimated minimum income required to meet the given set of basic needs. In the income method, on the other hand, one whose income or total consumer expenditure lies below this estimated poverty line is identified as poor. Of the two methods, the income method for the identification of the poor seems to be more appropriate. For example, a person may have income higher than the poverty line determined by the income approach but his calorie or

[35] Raj Krishna (1981) found an 'augmented poverty line' by adding an estimate of public benefits to the norm for private expenditure.

protein intake may be smaller than the prescribed minimum. In such a case, the person is poor by the direct method but non-poor by the income method. It would be justified to take this person to be non-poor because he has the ability to meet the basic needs even though he does not choose to do so. Another advantage of the income method is that it gives a numerical measure of the short-falls of the incomes of the poor from the poverty line. The direct method, on the other hand, would give a separate short-fall for each type of basic need.

For India, several poverty lines have been derived by different researchers. Most of them based their figure on the cost of food baskets that ensure some minimum requirement norms in terms of calorie intake[36]. However, the first poverty line for India was suggested by a distinguished Study Group set up by the Government of India in 1962 who recommended that a per capita monthly expenditure of Rs. 20 (this excluded expenditure on health and education which was to be provided free by the State) at 1960-61 prices should be the national desirable minimum. The basis of this figure is not

[36] One such normative diet has been worked out by the FAO. Sukhatme (1965) took into account recommendations of the FAO and the Nutrition Advisory Committee (NAC), availabilities of items, consumption habits and different requirements of persons belonging to different age-sex groups to evaluate two food baskets : one relating to average requirement and the other to minimum requirement. Another minimum diet food basket recommended by Dr. Patwardhan was worked out by Bardhan (1973). These methods are discussed in Rudra (1974) and Dandekar (1981).

known. However, this figure adjusted for price changes has been used in many studies. But in recent periods the poverty line has been determined more often by 'the income approach'. Here the poverty line is taken to be the level of PCE (per capita total consumer expenditure per 30 days) at which the average daily intake of calorie is equal to some norm. This approach was followed by Dandekar and Rath (1971) in their famous study, " Poverty in India", and is also applied in the 'Report of the Task Force on Projections of Minimum Needs and Effective Consumption Demand' of the Planning Commission, Government of India. At present this is the official procedure for determining the poverty line for India. Many less developed countries seem to be following a similar approach. In some of them, both calorie and protein are considered in finding the poverty line figure by the 'income approach'.

1.1.4.3 Measures of Poverty

In order to discuss the different poverty indices proposed in the literature, it would be convenient to write $\underset{\sim}{y}' = (y_1, y_2, \ldots, y_n)$ as a vector representing the incomes of n units (persons) constituting the society. Let $z > 0$ be the exogenously given poverty line. For convenience, it is assumed that the incomes are arranged in ascending order as follows :

$$y_1 \leq y_2 \leq \ldots \leq y_q < z \leq y_{q+1} \leq \ldots \leq y_n \qquad \ldots (1.65)$$

The mean incomes μ_p and μ of the poor units and of the population as a whole, respectively, are defined as :

$$\mu_p = \frac{1}{q} \sum_{i=1}^{q} y_i \qquad \ldots (1.66.1)$$

and $$\mu = \frac{1}{n} \sum_{i=1}^{n} y_i \qquad \ldots (1.66.2)$$

Ad hoc (positive) Poverty Measures and the Axioms Proposed

Before the pioneering work of Sen (1974, 1976), the two most commonly used indices of poverty were the head-count ratio and the aggregate poverty gap.

The head-count ratio[37] is given by

$$H = \frac{q}{n} \qquad \ldots (1.67)$$

which is the proportion of population falling below the poverty line.

[37] This index has been employed in empirical studies, like Booth (1889), Rowntree (1901), Orshansky (1965, 1966), Abel-Smith and Townsend (1965), Ojha (1970), Dandekar and Rath (1971), Minhas (1970, 1971), Bardhan (1970, 1971, 1973), Mukherjee, Bhattacharya and Chatterjee (1972), Vaidyanathan (1974), Lal (1976), Chenery, Ahluwalia, Bell, Duloy and Jolly (1974), Ahluwalia (1978), and Pal, Chakravarty and Bhattacharya (1986).

The aggregate poverty gap is given by

$$P_g = \sum_{i=1}^{q} (z - y_i) \qquad \ldots (1.68)$$

Another measure related to P_g is the income-gap ratio[38]

$$I_g = \frac{1}{qz} \sum_{i=1}^{q} (z - y_i)$$

$$= 1 - \frac{\mu_p}{z} \qquad \ldots (1.69)$$

which measures the proportionate short-fall of the average income of the poor from the poverty line.

H measures the incidence of poverty but does not reflect its intensity, while I_g measures the intensity of poverty but fails to capture its incidence. However, these indices possess the desirable property of anonymity, which means that the identity of a unit is of no consequence when measuring poverty. If $\underline{x}$ is a permutation of the income vector $\underline{y}$, then, other things remaining unchanged, anonymity requires that $P(\underline{y}, z) = P(\underline{x}, z)$, where P is a poverty measure.

In his pioneering work on normative measures of poverty, Sen (1976) proposed an axiomatic framework based on welfare theory for the construction of poverty indices that take account of both incidence and intensity of poverty and also

[38] This measure has been discussed in Batcheldor (1971) and Beckerman (1977).

the extent of relative deprivation of the poor. The two main axioms suggested by Sen (1976) are not satisfied by the head-count ratio. These are :

1. <u>The Monotonicity Axiom (M)</u> : Given other things, a reduction in the income of a poor unit must increase P. Let $\underline{x}' = (x_1, x_2, \ldots, x_n)$ be another income vector such that $x_i = y_i$, $i = 1, 2, \ldots, n$, $i \neq j$ and $x_j < y_j$. Then $P(\underline{x}, z) > P(\underline{y}, z)$;

and

2. <u>The Transfer Axiom (T)</u>[39/] : A pure transfer of income from a poor person to anyone who is richer must increase P.

The income-gap ratio and aggregate poverty gap satisfy axiom M but violate axiom T.

Sen's axiomatic approach was developed further by Sen (1979) himself, and by Hamada and Takayama (1977), Kakwani (1980), Kundu and Smith (1983), Foster, Greer and Thorbecke (1984) and Donaldson and Weymark (1985). Besides axioms M and T, the other main axioms appearing in the literature stating the desirable properties of a poverty index will be stated first and the existing poverty indices will be examined in the light of these axioms.

39/ Axiom T was later modified by Sen (1979). Other variants of the transfer axiom are discussed in Donaldson and Weymark (1985).

These axioms are :

Axiom M [40] (Focus Axiom) : Income variations of the non-poor should not affect P except when a unit falls below the poverty line.

Axiom of Monotonic Sensitivity (MS) [41] : Let $(\Delta P)_i$ represent an increase in P caused by a small reduction in the income of the ith poor unit (by a fixed amount $\delta > 0$), then it is required that $(\Delta P)_i > (\Delta P)_j$ if $i < j$, $i, j = 1, 2, \ldots, n$.

Axiom of Transfer Sensitivity (TS) [42] : If a fixed amount of income is transferred from the ith poor unit with income y_i to a poor unit with income $y_i + h$, then for given $h > 0$, the magnitude of increase in P decreases as i increases. This axiom attaches greater weight to transfers lower down the income scale.

Axiom of Continuity (C) : $P(\underline{y}, z)$ is continuous in $\underline{y}$ and z.

Axiom of Scale Invariance (SI) :

$$(\quad P(\lambda\underline{y}, \lambda z) = P(\underline{y}, z) \text{ for any } \lambda > 0.$$

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[40] This axiom is due to Hamada and Takayama (1977) and Sen (1979).

[41] This axiom was proposed by Kakwani (1980).

[42] Axiom TS, due to Kakwani (1980), is analogous to a similar axiom in the literature on income inequality proposed by Dalton (1920), Atkinson (1970), Sen (1973) and Kolm (1976, 1976a).

Axiom of Translation Invariance (TI)

$$P(\underline{y} + \delta\,\underline{1},\ z + \delta) = P(\underline{y},\ z), \text{ where } \delta > 0$$

and $\underline{1}' = (1, 1, \ldots, 1)$.

Normalization Axiom (N) : If all n units are poor and have zero income, then $P(\underline{y}, z) = 1$.

Population Growth Axiom (PG)[43] : Let $\underline{x}' = (y_1, y_2, \ldots, y_n, y_{n+1})$ be another income vector. Then,

$$P(\underline{x}, z) > P(\underline{y}, z) \quad \text{if } y_{n+1} < z$$

and $$P(\underline{x}, z) < P(\underline{y}, z) \quad \text{if } y_{n+1} > z.$$

Axiom of Additive Decomposability (AD) :

Let $\underline{y}$ be partitioned into K sub-vectors such that $\underline{y}' = (\underline{y}_1', \underline{y}_2', \ldots, \underline{y}_K')$, the jth sub-vector having n_j units, then $P(\underline{y}, z)$ can be written as

$$P(\underline{y}, z) = \sum_{j=1}^{K} \frac{n_j}{n} \cdot P(\underline{y}_j, z) \quad \ldots (1.70).$$

A poverty measure that satisfies axiom AD is very useful in empirical work where one is interested in determining the contribution of different sub-groups of the population to total poverty in the society.

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[43] The population growth axiom was proposed by Kundu and Smith (1983).

The normative poverty measures may be grouped as follows :

(1) Sen's measure (Sen, 1976) and the related indices of Kakwani (1980) , Anand (1977) and Thon (1980);

(2) Indices based on censored income distributions[44/];

(3) Indices based on 'representative income' or 'representative poverty gap' approach[45/] [46/][47/]; and

(4) Additively decomposable measures of poverty[48/].

Sen's Measure

Starting from an axiomatic framework based on welfare economic theory, Sen (1976) defined his index as a normalised weighted sum of poverty gaps of the different units, the

[44/] This approach was developed by Hamada and Takayama (1977) and Takayama (1979).

[45/] The representative income approach was developed by Blackorby and Donaldson (1980a) while the representative poverty gap approach was employed by Clark, Hemming and Ulph (1981).

[46/] Sen's (1976) measure can be derived from Blackorby and Donaldson's representative income approach.

[47/] The approaches in (2) and (3) were combined to define poverty indices by Clark, Hemming and Ulph (1981) and Chakravarty (1983).

[48/] None of the measures in (1), (2) and (3) is additively decomposable over population sub-groups.

weight for a unit being its rank in the inter-personal welfare ordering of the poor. Sen's index[49] is :

$$P_S = \frac{2}{(q + 1) nz} \sum_{i=1}^{q} (z - y_i) (q + 1 - i) \quad \ldots (1.71)$$

P_S satisfies axiom M but not axiom T. A transfer from a poor person to a richer person may not increase P_S if the recipient crosses the poverty line; however, P_S increases when the recipient remains poor (Sen (1979)). P_S also violates axiom TS in that it may be more sensitive to income transfers around the middle of the distribution of incomes of the poor.

For large values of q, P_S can be written as :

$$P_{S1} = H [I_g + (1 - I_g) G_p] \quad \ldots (1.72)$$

where G_p = Gini coefficient of the income distribution of the poor

$$= 1 + \frac{1}{q} - \frac{2}{q^2 \mu_p} \sum_{i=1}^{q} (q + 1 - i) y_i, \quad \ldots (1.73)$$

and I_g is the income-gap ratio given by (1.69). P_{S1} can also be expressed as :

$$P_{S2} = H [1 - (1 - G_p) \frac{\mu_p}{z}] \quad \ldots (1.72.1)$$

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[49] Sen's index has been employed to measure poverty in India, among others, by Bhatty (1974), Ahluwalia (1978), Dutta (1978), Pal, Chakravarty and Bhattacharya (1986).

or

$$P_{S3} = H\, I_g\, (1 + G_g)$$ [50] ... (1.72.2)

where, G_g = Gini coefficient of the distribution of poverty gaps.

Following Borda (1781), Sen (1976) took the weights of different poverty gaps to be equidistanced. Kakwani (1980) and Thon (1980) applied more sophisticated weights to arrive at their poverty indices.

Kakwani's Measures

In order to arrive at a poverty measure satisfying axioms TS and MS, Kakwani (1980) modified Sen's ordinal rank weights and proposed the following as an index of poverty[51] :

$$P_{K1} = \frac{q}{n\, z\, S_q(r)} \sum_{i=1}^{q} (z - y_i)\, (q + 1 - i)^r \qquad \ldots (1.74)$$

where $$S_q(r) = \sum_{i=1}^{q} i^r \qquad \ldots (1.75).$$

[50] This form is due to Clark, Hemming and Ulph (1981).

[51] In earlier studies, Kakwani (1977, 1980a) derived alternative poverty indices which are of some interest. He considered the income of a unit to be a random variable Y with distribution function F. He then proposed the following measures :

$$P_{K2} = F(z) \left[\frac{z - \mu_p}{\mu} \right] \qquad \ldots (1.76)$$

and $$P_{Kf} = \frac{F(z)}{\mu} \left[z - \mu_p\, f(G_p) \right] \qquad \ldots (1.77)$$

where $f(G_p)$ is a monotonic function of G_p, the Gini coefficient of incomes of the poor, such that

Sen's measure P_S corresponds to the special case where $r = 1$. Axiom TS is satisfied by P_{K1} for sufficiently large values of r. However, as pointed out by Clark, Hemming and Ulph (1981), it is inconvenient to search for a particularly large value of r.

Thon's Poverty Measures

Thon (1980) proposed a one-parameter family of relative[52/] poverty indices given by

$$P_T(c) = \sum_{i=1}^{q} (z - y_i) \frac{cn + 1 - 2i}{(c - 1)\, n^2\, z} \qquad \ldots (1.80)$$

where $c \geq 2$.

Continued from previous page:

$0 \leq f(G_p) \leq 1$, $f(G_p) = 1$ if $G_p = 0$ and $f'(G_p) < 0$.

P_{K2} violates axioms M, M' and T. Two special cases of P_{Kf} are interesting :

$$P_{K3} = \frac{F(z)}{\mu} \left[z - (1 - G_p)\, \mu_p \right] \qquad \ldots (1.78)$$

and $$P_{K4} = \frac{F(z)}{\mu} \left[z - \frac{\mu_p}{1 + G_p} \right] \qquad \ldots (1.79)$$

Note that P_{K3} appears to be a transformation of P_{S2} given by (1.72.1). Both P_{K3} and P_{K4} violate axioms M and M', and P_{K3} and P_{K4} may not increase when a transfer from a poorer person enables the recipient to cross the poverty line.

[52/] A poverty index is called a relative index if it satisfies the axiom of scale invariance. Sen's index and Kakwani's indices are also relative indices.

$P_T(c)$ satisfies axioms M and T but violates TS in the same way as Sen's measure P_S.

Anand's Measure of Poverty

Anand's (1977) measure is given by

$$P_A = \frac{z}{\mu} \cdot P_S \qquad .. (1.81)$$

Substituting P_S by P_{S2} (expression (1.72.1)), P_A can be written as :

$$P_A = \frac{z}{\mu} \cdot \frac{q}{n} \left[1 - (1 - G_p) \frac{\mu_p}{z} \right] \qquad ... (1.81.1)$$

Suppose all the poor units enjoy the same positive income equal to μ_p. Then, $G_p = 0$ and

$$P_A = \frac{q}{n} \cdot \frac{z - \mu_p}{\mu} \qquad ... (1.82)$$

which is the proportion of aggregate income that if transferred to the poor would just wipe out poverty. In this sense it measures the society's potential ability to combat poverty. However, by its very dependence on μ, P_A violates axiom M'. It also violates axioms M and TS. As in the case of P_S, a transfer of income from a poor person to a richer person may not increase P_A if the recipient crosses the poverty line.

Measures Based on Censored Income Distribution Proposed by Takayama and Hamada and Takayama

In order to take into account the differences in the deprivation of poor units relative to the non-poor units, Takayama (1979) considered a censored version $\underline{v}$ of the income vector $\underline{y}$ as follows :

$$\underline{v}' = (v_1, v_2, \ldots, v_n), \text{ where}$$

$$v_i = \min (y_i, z) \qquad \ldots (1.83)$$

$i = 1, 2, \ldots, n.$ Takayama then proposed the Gini coefficient of the censored income distribution $\underline{v}$ as a poverty measure for the income vector $\underline{y}$:

$$G_T = \frac{1}{2n^2\mu^*} \sum_{i=1}^{n} \sum_{j=1}^{n} \left| v_i - v_j \right| \qquad \ldots (1.84)$$

where, $$\mu^* = \frac{1}{n} \sum_{i=1}^{n} v_i \qquad \ldots (1.85)$$

is the mean of the censored income distribution.

Hamada and Takayama (1977) applied alternative measures of inequality to the censored income distribution $\underline{v}$ to obtain different measures of poverty for $\underline{y}$.

A serious defect of all these measures is that they violate axiom M. For suppose all n units are poor and enjoy the same positive income. Then these indices take the value zero irrespective of the common level of income of the units.

Again suppose all n units are poor and their incomes are multiplied by a scalar $c > 0$ such that all of them remain poor. Then also these measures remain unchanged. The latter problem can be overcome by multiplying the measures by z/μ^*, but the former remains. The approach based on censored income distributions does not seem to be fruitful.

The Blackorby and Donaldson Indices Based on the Representative Income Approach

Blackorby and Donaldson (1980a) developed a representative income approach in the measurement of poverty. They assumed a continuous, non-decreasing and S-concave social welfare function (swf) W^p defined over the incomes of the poor and defined the representative income of the poor ξ^p as that level of income which if equally shared by the poor units would yield the same level of welfare as the existing income distribution of the poor.

Blackorby and Donaldson defined absolute and relative indices of poverty according as the indices satisfy axioms TI or SI. For axiom SI to be satisfied it is necessary and sufficient that W^p be homothetic. Thus, to every homothetic swf, there corresponds a relative poverty measure

$$P_{BDR} = \frac{q}{n} \left[1 - \frac{\xi^p}{z} \right] \qquad \ldots (1.86)$$

Sen's poverty measure P_S is a special case of P_{BDR}. For, if one considers the following homothetic swf defined over the incomes of the poor,

$$W_S^p = \emptyset \left[\frac{2}{q(q+1)} \sum_{i=1}^{q} y_i \, (q + 1 - i) \right] \quad \ldots (1.87)$$

where $\emptyset$ is increasing in its argument, then P_{BDR} coincides with Sen's measure.

For TI to be satisfied, it is necessary and sufficient that W^p is translatable. Thus, to every translatable swf W^p, there corresponds the following <u>absolute</u> index :

$$P_{BDA} = q \left[z - \xi^p \right] \quad \ldots (1.88)$$

Both P_{BDR} and P_{BDA} suffer from the defect that if a transfer of income from a poorer unit to a richer unit enables the recipient to cross the poverty line, then the two indices may not always increase. Further, P_{BDA} is independent of n and, therefore, fails to capture the incidence of poverty.

<u>Measures of Clark, Hemming and Ulph Based on the Representative Poverty Gap Approach</u>

Clark, Hemming and Ulph (1981) defined their poverty measure in terms of the 'equally distributed equivalent' (ede) or 'representative' poverty gap, which is that income gap which if equally shared by the poor units would yield the same level of social welfare as the existing level and distribution of poverty gaps.

Clark, Hemming and Ulph considered identical individual deprivation functions of the poor units as :

$$d(g_i) = \frac{1}{\alpha} \; g_i^{\alpha} \qquad \dots (1.89)$$

where $g_i = z - y_i$, $i = 1, 2, \dots, q$, and $\alpha \geq 1$ for concavity in income. The swf is assumed to be additively separable, and social welfare of the poor to be separable from that of the non-poor. Then, the swf of the poor can be written as

$$W^p \; (\underline{g}, \alpha) = -\sum_{i=1}^{q} d(g_i) \qquad \dots (1.90)$$

where $$\underline{g}' = (g_1, g_2, \dots, g_q) \qquad \dots (1.91)$$

The ede poverty gap g_p is defined as follows :

$$-\sum_{i=1}^{q} d(g_p) = -\sum_{i=1}^{q} d(g_i)$$

i.e., $$\frac{1}{\alpha} \sum_{i=1}^{q} (g_p)^{\alpha} = \frac{1}{\alpha} \sum_{i=1}^{q} g_i^{\alpha}$$

$$\therefore \; g_p = \left(\frac{1}{q} \sum_{i=1}^{q} g_i^{\alpha} \right)^{1/\alpha} \qquad \dots (1.92)$$

The measure of Clark, Hemming and Ulph is given by

$$P_{CHU} = \frac{q}{n} \cdot \frac{g_p}{z} \qquad \dots (1.93)$$

Whereas Blackorby and Donaldson average incomes, Clark, Hemming and Ulph average poverty gaps. A defect of P_{CHU} is that it may not increase when a transfer of income from a poorer unit to a richer unit enables the recipient to cross the poverty line.

Indices based on Representative Income of the Censored Income Distribution

Clark, Hemming and Ulph (1981) also computed the ede income ξ^* of the censored income distribution $\underline{v}$ given by (1.83) from the swf $W = \frac{1}{\beta} \sum_{i=1}^{n} v_i^{\beta}$, $\beta < 1$, and proposed the following index :

$$P^*_{CHU} = 1 - \frac{\xi^*}{z} \qquad \ldots (1.94)$$

This index satisfies the monotonicity and transfer axioms and also TS. But it does not measure the incidence of poverty. It fails to satisfy axiom PG.

Chakravarty (1983) proposed a class of poverty measures based on the representative income ξ^* of the censored income distribution, of which the measure (1.94) of Clark, Hemming and Ulph is a special case.

Corresponding to any continuous, increasing, strictly S-concave and homothetic swf W^* defined on the censored income distribution $\underline{v}$, there corresponds a relative poverty index

$$P^{*}_{CR} = 1 - \frac{\xi^{*}}{z} \qquad \dots (1.95)$$

where, $$\xi^{*} = v^{*} \mid W^{*}(v^{*} \underline{1}_n) = W^{*}(\underline{v}) \qquad \dots (1.96)$$

When $W^{*}(\underline{v}) = \frac{1}{\beta} \sum_{i=1}^{n} v_i^{\beta}$, $\beta < 1$, then P^{*}_{CR} is the measure (1.94) of Clark, Hemming and Ulph.

Corresponding to any continuous, increasing, strictly S-concave and translatable swf, W^{*}_{1}, defined on the censored income distribution $\underline{v}$, there exists an absolute poverty index

$$P^{*}_{CA} = z - \xi^{*} \qquad \dots (1.97)$$

where, $$\xi^{*} = v^{*} \mid W^{*}_{1}(v^{*}\underline{1}_n) = W^{*}_{1}(\underline{v}) \qquad \dots (1.98)$$

P^{*}_{CA} satisfies the axiom of continuity. It measures per capita poverty.

Additively Decomposable Measures of Poverty

Of the poverty measures discussed so far, only the head-count ratio is additively decomposable over population sub-groups, that is, satisfies axiom AD. This is one of the reasons why it is still widely used in empirical work.

Two normative measures proposed by Foster, Greer and Thorbecke (1984) and Chakravarty (1983a) are additively decomposable over population sub-groups.

Measure Proposed by Foster, Greer and Thorbecke

Foster, Greer and Thorbecke (1984) suggested the following poverty index :

$$P_{FGT}(\alpha) = \frac{1}{n} \sum_{i=1}^{q} \left(\frac{z - y_i}{z} \right)^{\alpha}, \quad \alpha \geq 0. \quad \ldots (1.99)$$

$P_{FGT}(\alpha)$ satisfies axiom M for $\alpha > 0$, the transfer axiom T for $\alpha > 1$, and axiom TS for $\alpha > 2$.

$$\text{For } \alpha = 0, \quad P_{FGT}(0) = H \quad \ldots (1.99.1)$$

$$\text{For } \alpha = 1, \quad P_{FGT}(1) = H\, I_g \quad \ldots (1.99.2)$$

$$\text{For } \alpha = 2, \quad P_{FGT}(2) = H \left[I_g^2 + (1 - I_g)^2 (CV)_p^2 \right] \quad \ldots (1.99.3)$$

$$\text{where } (CV)_p^2 = \frac{\frac{1}{q} \sum_{i=1}^{q} (y_i - \mu_p)^2}{\mu_p^2}$$

= the squared coefficient of variation of the incomes of the poor.

$P_{FGT}(2)$ is a form similar to P_{S1}. It attaches equal weights to transfers at different income levels.

$P_{FGT}(\alpha)$ satisfies AD and can be written as :

$$P_{FGT}(\alpha) = \sum_{j=1}^{K} \frac{n_j}{n} \left[\frac{1}{n_j} \sum_{i=1}^{q_j} \left(\frac{z - y_i^j}{z} \right)^{\alpha} \right] \quad \ldots (1.100)$$

$$= \sum_{j=1}^{K} \frac{n_j}{n} P_{FGT}^{j}(\alpha)$$

where, $\underline{Y}' = (\underline{Y}'_1, \underline{Y}'_2, \ldots, \underline{Y}'_K)$; $\underline{Y}'_j = (y_1^j, y_2^j, \ldots, y_{n_j}^j)$ is the income vector of the jth population sub-group with n_j units; q_j, the number of poor units in sub-group j; and $P_{FGT}^j(\alpha)$, the poverty measure for sub-group j, j = 1, 2,...,K.

Chakravarty's Index

Chakravarty (1983a) considered the normalised sum of the utility gaps of the poor as a poverty measure, which in order to satisfy axioms SI and N, takes the form

$$P_c(e) = \frac{1}{n} \sum_{i=1}^{q} \left[1 - \left(\frac{y_i}{z} \right) \right], \; 0 < e < 1. \qquad \ldots (1.101)$$

$P_c(e)$ satisfies axioms M′, M and T. As the parameter e decreases greater weight is attached to transfers lower down the income scale. However, $P_c(e)$ is insensitive to the number of poor units.

$P_c(e)$ satisfies axiom AD. It can be expressed as

$$P_c(e) = \sum_{j=1}^{K} \frac{n_j}{n} \left[\frac{1}{n_j} \sum_{i=1}^{q_j} \left(1 - \left(\frac{y_i^j}{z} \right)^e \right) \right]$$

$$= \sum_{j=1}^{K} \frac{n_j}{n} \cdot P_c^j(e) \qquad \ldots (1.102)$$

In Chapter 4 of this thesis, both P_c and the head-count ratio are employed to find the contribution of different states, social groups, occupational classes and size classes of household land possessed to overall rural poverty in India.

Chapter 1

SURVEY OF LITERATURE II : EMPIRICAL STUDIES ON INCOME INEQUALITY, LEVEL OF LIVING AND POVERTY WITH SPECIAL REFERENCE TO INDIA

1.2.1 Introduction

Empirical studies on income inequality often examine changes in income distributions in a country over time (time series studies) or differences in income distributions over sub-groups of a population (cross-section studies). Some researchers try to explain disparities in the distribution of income over individuals in terms of social, economic, demographic and other factors. Still other studies try to fit theoretical distributions to sise distributions of income.

Studies which try to explain inequality of incomes may be divided into two broad classes : (1) those which explore the relationship between variation in the income distribution and factors related to the process of economic growth, often through regression techniques, and (2) those that decompose inequality measures in order to find (i) how far the differentials in sub-groupwise average incomes explain overall inequality, or (ii) the contributions of different factor components of income to overall income inequality.

Level of living is a multidimensional concept, but studies on level of living frequently examine absolute levels of consumption and/or inequalities in consumption levels of different sections of a population. While most studies deal with private consumption and its composition, a few examine the availability and/or consumption of public goods. The methodologies followed for studying size distributions of consumption are similar to those mentioned in the preceding paragraphs for income distribution studies.

Coming to studies on poverty, poverty is usually taken in the absolute sense in developing countries. On the other hand, for developed countries, poverty is viewed in the relative sense bringing it close to the concept of inequality.

In this part of the Chapter, some classical studies on other countries are reviewed first before proceeding to a survey of studies on inequality and poverty in India. Thus, Section 1.2.2 gives a brief review of studies on inequality and poverty in other countries. Section 1.2.3 reviews studies on income distribution in India. Section 1.2.4 surveys studies on level of living in India, while Section 1.2.5 gives a review of empirical studies on absolute poverty in rural India. Finally, Section 1.2.6 gives an account of empirical studies on level of living and poverty of two economically weaker sections of the Indian population, namely, the Scheduled Castes and Scheduled Tribes. Some studies on these two groups have been carried out in subsequent Chapters of this thesis.

1.2.2 Studies on Inequality and Poverty in Other Countries

Most of the early studies on income inequality explored the relationship of changes in income distribution over time to the process of economic development. In his pioneering studies in this area, Kuznets (1955, 1963) carried out inter-temporal and inter-spatial comparisons of income distribution and explained the changes in income distribution that occurred in the process of economic development. He showed that in the course of economic growth of a country there was a shift of population from the agricultural sector to the non-agricultural sector, accompanied by an increase in inequality. He examined this shift of population in terms of inter-sectoral differences in average incomes, distribution of income within each sector and the migration of work force from agriculture to the non-agricultural sector. Further, on the basis of data for 18 countries, Kuznets (1963) found that the shares of the upper income groups were distinctly larger in the developing countries than in the developed ones. However, the income share of the lowest quintile groups was about the same in developed and developing countries. He concluded that inequality grew with the transition from a pre-industrialised economy to an industrialised one, then stabilized for a while and finally narrowed down in the later phases of development. This was, however, the experience of developed countries. Kuznets pointed out that an increase in inequality during the early phases of development was not desirable for developing countries where the inequality level was already high.

Studies by Kravis (1960), Oshima (1962), Fishlow (1972), Adelman and Morris(1973), Ahluwalia (1974) and Kakwani (1980a), among others, also examined the relationship between income inequality and economic growth.

Kravis (1960) compared income inequality cross-nationally and tried to explain why income inequality appeared to be higher in most developing countries than in the developed ones. He concluded that the greater inequality in developing countries might be explained by the greater dispersion in the upper part of the income scale.

Oshima (1962) considered a four-fold classification of the stages of economic development — undeveloped, under-developed, semi-developed and fully developed — and suggested that inequality was generally low at the undeveloped stage and that the dispersion of income grew as countries advanced to the next stage. He further suggested that inequality increased during the semi-developed stage but reached its peak there and declined during the next stage. According to him, a major determinant of the dispersion of quintile group shares across countries is the weight of farm or rural sector in the total economy as well as the extent to which the agricultural and urban areas are integrated.

Adelman and Morris (1973) and Fishlow (1972) and Wells (1974) pointed to the increasing inequality accompanying rapid economic growth in Brazil in the late sixties. Chenery *et al.* (1974) also witnessed trends towards greater inequality along with economic growth in many countries.

Adelman and Morris (1973) examined data for 43 developing countries and explored the relationship between patterns of income distribution and 35 indices of economic, social and political factors which could be expected to influence them. They found that at the lowest levels of development, economic growth tended to increase inequality. Broadly speaking, in the poorest countries, economic growth worked against the poorer segments of the population. Adelman and Morris found that inequality could be reduced by improvement of human resources and direct government involvement.

Ahluwalia (1974) compared the growth in income of the poorest 40 per cent of income recipients with the GDP (gross domestic product) growth rate in 18 developing countries and found no clear pattern of relationship. He also carried out a regression analysis on the basis of data for 65 countries where income recipients were divided into three groups — top 20 per cent, middle 40 per cent and lowest 40 per cent — and the income shares of the different groups were used as dependent variables. The growth rate of GDP was found to be positively related to the income share of the lowest 40 per cent of income recipients. However, when the regressions were run again after separating countries by their levels of income, it was found that the share of the poorest 40 per cent did decline with economic growth for countries with annual income level upto $ 400. Above this income level, the share of this group continually increased with growth in GDP and, simultaneously, the share of the top 20 per cent of income recipients moved in the opposite direction; the share of the middle income group, however, remained unaffected. Ahluwalia also found the level and availability of education to be positively related to the income shares of the poorest 80 per cent of income recipients —— primary school enrolment rates significantly explaining the income share of the poorest 40 per cent and the rates of enrolment in secondary schools playing a similar role for the middle 40 per cent of income recipients.

Kakwani (1980a) examined the structures of income distributions for 50 countries at different stages of development in 1970 on the basis of data compiled by Jain (1975). Average income inequality appeared to be the highest for Latin American countries (Gini index = 0.515), followed by that for African countries. For the developed countries the average Gini index was the lowest, and that for the Asian countries was quite close. The shares of the upper income groups were observed to be distinctly larger in developing countries than in developed ones. However, as regards the bottom 40 per cent of income recipients, the difference between the Asian and the developed countries was not significant. But for African and Latin American countries, the share of the bottom 40 per cent of income recipients was appreciably lower.

In a study of inequality in Asian countries, Oshima (1970) found that changes in income distribution over time were not the result of economic growth *per se*. He noted that changes in economic structure as, for example, shifts from a rural to an urban focus of activity as growth proceeds, were more important than growth by itself in explaining changes in income distribution. His main conclusion was that undue policy emphasis on industrialisation would lead to unemployment, excessive urbanisation, regional imbalance and the widening of inequality.

Some researchers have tried to explain variation in individual earnings by factors such as occupation and education. Mincer (1958) and Becker (1964), for example, tried to see how far human capital (education and training) on its own could explain earnings differentials across persons. Weiss (1966) used data on individual earnings from the 1960 Census in the United States to investigate the relationship between earnings, on the one hand, and personal characteristics, measures of union strength and the monopoly position of the employer as measured by the degree of concentration in the industry, on the other.

On the basis of estimates for the United States, Lydall (1968) concluded that not more than a quarter of the total variation in individual earnings could be attributed to the differences in median earnings across occupations.

Routh (1965) studied the average earnings of men in different occupational groups in Britain over the periods 1913-14, 1922-24, 1935-36, 1955-56 and 1960 (see also Atkinson (1975)). He found that unskilled manual labourers received about 80 per cent of average earnings; skilled manual workers earned about 40 per cent more than the unskilled; foremen got 50 per cent more than the average; and higher professional workers, slightly ahead of managers, got three times the average. Also, he found a relative fall over time in the earnings of professional workers, especially between 1935 and 1955.

Atkinson (1974) studied the variation in the Gini coefficient of household incomes by age-groups of the head of household. The Gini coefficient was rather low in age-groups upto the age of 60 years, but above that age, incomes were, if anything, more unequally shared. The findings of Taussig (1973) for the United States showed a similar picture.

As mentioned earlier, many researchers have decomposed income inequality measures in order to identify factors affecting income inequality most (vide the survey paper by Fields (1979)). Inequality measures have been decomposed by sector (rural/urban), income source (e.g., labour, capital, land and transfers) and family characteristics (attributes of workers, their jobs, and regional and other locational considerations).

Thus, within country sector decompositions were carried out using the Gini coefficient by Mehran (1974) for Iranian cities, by Mangahas (1975) for areas and regions of the Philippines, and by Pyatt (1976) for rural and urban areas of Sri Lanka. In all cases, variation within sectors was found to be much greater than variation between sectors.

Coming to source decomposition of income inequality, Fei and Ranis (1974) and Fei, Ranis and Kuo (1978) decomposed income inequality in Taiwan, as measured by the Gini coefficient, by factor components of income. Ayub (1977) decomposed income inequality in Pakistan by income sources. Fields (1979a) decomposed the Gini coefficient of family income for urban Colombia during 1967-68 by functional income source and found labour income to account for almost 70 per cent of total inequality. Fei, Ranis and Kuo (1978) and Ayub (1977) also found labour income to be an important source of overall inequality in Taiwan and Pakistan, respectively.

Kakwani (1980a) also decomposed the Gini coefficient of inequality of total family incomes in Australia by factor components of income. He found income from employment, including wages and salaries, to be responsible for about 83 per cent of total inequality.

Altimir and Piñera (1977), Fields (1979a), Murray (1979), Das and Parikh (1982), Mookherjee and Shorrocks (1982) and Anand (1983) are among those who decomposed inequality measures by determinants of income.

Altimir and Piñera (1977) decomposed the Theil index of income inequality by education, occupation, age, sex, employment status, type of economic activity and time worked for a number of countries, viz., Mexico (1970), Costa Rica (1966-67), Chile (1971), Panama (1972), Peru (1970) and Venezuela (1971). These decompositions showed education to be an important determinant of income inequality.

Fields (1979) decomposed the inequality of family incomes for urban Colombia in 1967-68 by city, education and age, using the method of ANOVA of log-incomes. Nearly 40 per cent of income inequality in urban Colombia was found to be explained by education, age and city, of which about 35 per cent was due to educational differences alone.

Murray (1979) decomposed the Theil and Gini indices into components by sex, age and educational achievements.

His study was based on Australian data on pre-tax incomes for the years 1968-69 and 1973-74. Murray concluded that reduction in inequality between the two years was due to the reduction in differentials between dissimilar persons and inequality between similar persons probably did not change over the five-year period.

Das and Parikh (1982) decomposed the Atkinson index and compared it with decompositions of other inequality measures like the Gini coefficient, variance of log-incomes, the Theil entropy index and the square of the coefficient of variation, on the basis of income distribution data classified by family size for the United States and the United Kingdom.

Mookherjee and Shorrocks (1982) used additively decomposable measures of inequality given by (1.52)-(1.54) for c = 2, 0 and 1, respectively, to analyze the importance of structural changes on the trend in income inequality. They disaggregated total inequality of household income in the United Kingdom during each year from 1965 to 1980 into various components and examined the time paths of these individual contributions. They found that the major disequalising factor over the study period had been the changing age-income profile.

Anand (1983) decomposed the Theil index of inequality in the distribution of individuals/households by per capita household income in Malaysia to find the contributions of between state and between race components to overall income inequality. His study was based on the 1970 post-enumeration survey of households.

Studies on Poverty

In a pioneering study, Rowntree (1901) examined the incidence of absolute poverty in York during 1899. According to him, a family was considered to be living in poverty if its total earnings were 'insufficient to obtain the minimum necessaries for the maintenance of merely physical efficiency'. He used estimates given by the American nutritionist Atwater to calculate the minimum requirements of protein and calories. These requirements were translated into 'a diet containing the necessary nutrients at the lowest cost compatible with a certain amount of variety' (vide Rowntree (1901), p. 129). To the minimum expenditure on food were added certain minimum amounts for clothing, fuel and household sundries and rent paid. This was done for households of different size and composition. Rowntree found that poverty was associated with three stages in a person's life-cycle, namely, (i) childhood, (ii) when the person himself had children and (iii) old age.

Orshansky (1965) studied the incidence of absolute poverty in the United States on the basis of household budget data. Her approach was similar to that of Rowntree (1901). She started with estimates of minimum food expenditures. She then estimated, on the basis of household budget data, the proportion of income spent on food in families of different sizes, and multiplied the cost of the minimum cost diet by the reciprocal of this proportion. Orshansky's work provided the basis for much of the recent research on poverty in the United States.

Abel-Smith and Townsend (1965) studied poverty in Britain on the basis of the Family Expenditure Surveys of 1953-54 and 1960 and estimated the proportion of households below the National Assistance Scale[53].

In developed countries, however, poverty is nowadays viewed more frequently in relative terms than in absolute terms. As mentioned earlier in Section 1.1.4, the relative poverty approach views the relatively deprived sections of the population as poor. For example, in the United States, the Council of Economic Advisers adopted a relative standard of poverty in 1964. There are numerous studies on relative poverty in developed countries. For example, Fuchs (1969) adopted a poverty line as half of the median income.

Thurow (1969) used data from the 1960 census for examining the incidence of poverty in different states of

[53] In 1953-54 this was assessed in terms of expenditure and in 1960 in terms of income.

United States and estimated the contributions of different :ors to the explanation of poverty, measured according to Council of Economic Adviser's definition. He found that ,960, the proportion of white families in poverty was 18.6 cent compared with 47.9 per cent of non-white families. :hen tried to explain this gap of 29.3 per cent in terms of .ous factors.

Kakwani (1980a) adopted a somewhat arbitrary istence income of $ 150 per head in 1970 U.S. dollars as poverty line for the Latin American, African and Asian tries under consideration. The per capita GDP of all the tries were also expressed in terms of U.S. dollars at the hasing power parity rates for different countries. Asian African countries appeared to be poorer, on the average, Latin American countries. The Latin American countries only 12.8 per cent of population living below the poverty , on the average, compared to 35.6 per cent for Asian tries and 35.9 per cent for African countries. Kakwani examined separately the contributions of constituent tries to the total number of poor in Latin American, Asian African countries.

Kakwani (1980a) also measured poverty in Australia in using a poverty line defined for a standard family. le-member families appeared to be the poorest, followed wo-member families. Further, he studied the incidence of poverty in different socio-economic and demographic groups of the population formed, in turn, by sex, marital status, age, educational level, occupation, industry, country of birth and length of residence of the head of household in Australia.

Anand (1983) investigated poverty in Malaysia on the basis of the 1970 post-enumeration survey of households. He decomposed the head-count ratio of poverty for Malaysia separately by race, location (i.e., rural or urban), state (i.e., region), employment status of head of household, education of head, sector of employment of head, occupation of head, sex of head, age of head and household size, using different poverty lines (see also Kakwani (1980a) for a similar study on poverty in Malaysia).

1.2.3 Studies on Income Distribution in India

In India large scale socio-economic surveys of households have been undertaken by three agencies — the National Sample Survey (now the National Sample Survey Organization)(NSS/NSSO), the Reserve Bank of India (RBI) and the National Council of Applied Economic Research (NCAER), apart from the State Statistical Bureaus. However, it is only the NCAER which has systematically collected data on household income besides expenditure and savings. Earlier surveys by the NCAER include the Urban Household Saving Survey conducted during April 1959 - March 1960 and the All-India Rural Household Saving Survey conducted during January-December, 1962.

The NCAER collected data on disposable personal income through the All-India Consumer Expenditure Survey, May 1964 - April 1965 (vide NCAER (1967)). For this survey, personal income was defined as consisting of compensation of employees (wages, salaries, bonus, commission, etc.), income derived from unincorporated business enterprises including agriculture, rent, interest and dividends and current transfers received by households and single persons. Personal income, however, excluded imputed rent of owner occupied houses, employers' contribution to employees' provident fund and accrued but unrealised interest income. This survey showed that the top 20 per cent of the population enjoyed 47.5 per cent of total disposable income, while the bottom 20 per cent had only 7.5 per cent of total income. Income inequality was observed to be larger for households than for individuals. Also, inequality was less in the rural areas than in the urban areas. However, comparisons of the NCAER income data with the Central Statistical Organisation (CSO) estimates of private income, even after suitable adjustments had been made, showed that the NCAER estimate involved an understatement of aggregate income by about 25 per cent (vide Bardhan (1974)).

The next income survey to be carried out by the NCAER was the All-India Household Survey of Income, Saving and Consumer Expenditure (with special reference to middle class households) conducted in the year July 1967-June 1968. In the 1967-68 survey the definition of income was improved by including items like imputed rentals of owner-occupied houses. However, income in this survey referred to 'net income' and 'disposable income', where net income = gross income - depreciation of assets. Disposable income, on the other hand, was given by :

Disposable income = Net income - tax liabilities. The NCAER (1980) data revealed that the bottom 20 per cent of households had 4.9 per cent of total disposable income, while the top 20 per cent of households enjoyed 53.3 per cent of the total disposable income in 1967-68.

The NCAER surveys on Changes in Rural Income in India conducted during July 1968 - June 1969, July 1969 - June 1970 and July 1970 - June 1971 (vide NCAER (1975)) and the survey on Household Income and Its Disposition, undertaken in July 1975 - June 1976 (vide NCAER (1980)), used the gross income concept. The last-mentioned survey was conducted at all-India level.

On the basis of NCAER 1975-76 income data, Bhalla and Vashistha (1988) observed that the bottom 40 per cent of the population had 17.72 per cent of income and the top 20 per cent enjoyed 46.65 per cent. The mean per capita income in the urban areas appeared to be 1.9 times the mean per capita income in rural areas. On comparing the NCAER income data for 1975-76 with corresponding estimates of income from the CSO, Bhalla and Vashistha found the NCAER aggregate income to be underestimated by 28 per cent. They then adjusted the NCAER estimate of income in the light of the CSO estimate by three different methods :

(i) Each component of income was adjusted to the corresponding CSO figure.

(ii) The three components of expenditure, viz., consumption, savings and income taxes, were adjusted.

(iii) This method was similar to (ii) with the difference that rural/urban disparities in consumption were considered.

The examination of income shares of different fractile groups of these adjusted income distributions showed little variation in fractile group shares. Finally, a comparison of fractile group shares of income between 1970-71 and 1975-76 showed no trend in inequality for rural India.

In 1981-82, the NCAER attempted to resurvey the rural households that had been surveyed in 1970-71, in order to make a longitudinal study of the same variables that were covered in the 1970-71 study. The panel sample (that is, households which were common to both the 1970-71 study and the 1981-82 study) consisted of 3,139 households. All 1970-71 incomes were expressed at 1981-82 prices using the overall price index constructed from the survey data, so that all comparisons between the two periods were based on real incomes. The NCAER (1987) study showed that total household income per household rose by 15.11 per cent between 1970-71 and 1981-82. Farm income remained almost stagnant while non-farm income increased by 65.5 per cent. An increase in the share of non-farm income in total income showed that diversification of rural economic activities had taken place between 1970-71 and 1981-82. There was, however, no change in income inequality between these two periods.

The NCAER surveys, however, were somewhat limited in scope and coverage because their sample sizes were rather small for a country of India's size. Also, for practical difficulties, high income households might have been under-represented. Further, due to differences in definition of income used, the income distributions are not fully comparable over all the years.

Apart from income data collected and published by the NCAER, all other household income data for India as a whole have been obtained by combining data from different sources like the NSS, RBI and CSO. In fact, most of the early studies on income distribution in India used income tax data. A few of the important studies on such income distributions are surveyed below.

Lydall (1960) combined income tax data with the consumer expenditure data thrown up by the NSS to estimate the income distribution for India during 1955-56. He assumed for this purpose that the Pareto law of the distribution of incomes applied to India as in other countries. He then compared the pre-and post-tax fractile group shares of income in India with those in the United Kingdom and concluded that the size distribution of real income was much more unequal in India.

Iyengar and Mukherjee (1961) studied the distribution of household income for the years 1951-52, 1953-54 and 1956-57 on the basis of NSS consumption data and RBI savings data. They found that the income shares of the bottom 50 per cent and the top 10 per cent increased over this period, implying that the position of the middle income groups worsened during the same period.

Ojha and Bhatt (1974) deducted estimated direct taxes paid by unincorporated business and household savings data, obtained from RBI, from CSO national income data to get aggregate consumption expenditure. This aggregate was then distributed among different expenditure groups using the NSS pattern of distribution of consumer expenditure. Ojha and Bhatt assumed that the total net savings accrued from the topmost expenditure bracket, the net savings from all other expenditure classes being zero. They then used census data to obtain population projections and their rural-urban distribution. The income distribution so obtained was an average for the years 1963-64 and 1964-65, and was quite similar to the NCAER 1964-65 income distribution. The 1963-65 distributions of personal and disposable income and consumption expenditure were also compared with those for 1953-55 which had been estimated in Ojha and Bhatt (1962, 1964, 1965). However, Ojha and Bhatt's assumption of total net savings coming from the uppermost expenditure bracket, and zero net savings in other expenditure groups has drawn criticism from other researchers.

Ranadive (1971) used more or less the same general method and data sources as Ojha and Bhatt, but modified their assumption on savings. She considered two alternative assumptions : (i) households with annual income less than Rs. 2000 in the urban sector and with annual income less than Rs. 720 in the rural sector were assumed to have zero net savings and all evaded tax payments were assumed to be fully reflected in consumption and/or savings; and (ii) households with annual income less than Rs. 3000 in urban areas and with annual income less than Rs. 1200 in the rural areas were assumed to have negative savings constituting 25 per cent of total urban savings in the case of the former and 14 per cent of the total savings in case of the latter (these dissaving figures were taken roughly on the basis of the urban and rural savings surveys of 1962 and 1965). As for evaded tax payments, they were not reflected at all in consumption and/or savings, so that the estimated amount of tax evasion was added to the disposable income of the tax-paying classes. She also assumed that in the saving groups, total savings were distributed in proportion to consumer expenditure. Both on account of the assumption about savings and tax evasion, case (ii) should show a greater degree of inequality than case (i). For the year 1961-62, Ranadive found the bottom 20 per cent of the population to have between 7.6 and 7.8 per cent of total disposable personal income while the top 20 per cent had between 45.5 and 46.7 per cent of total income.

The study by Ahmed and Bhattacharya (1972) was an extension of earlier work by Lydall (1960) and Ahmed (1965). They combined NSS consumer expenditure data and income tax assessment data to find the size distribution of personal income for India for the years 1956-57, 1960-61 and 1963-64 at current prices. Ahmed and Bhattacharya considered the distribution of population by per capita expenditure as estimated by the NSS for a given year and also the distribution of assessees by size of assessed income before tax during the same period from income tax data, after making suitable adjustments for lags between income and consumption and for the fact that assessed incomes considered in the income tax statistics for a financial year partly relate to the preceding financial years. They assumed that (a) pre-tax income equals consumer expenditure in the lower ranges of the consumer expenditure distribution (covering nearly 75 per cent of total population) and (b) the distribution of per capita pre-tax personal income is asymptotically Paretoan for high values of per capita income and has the same Paretoan slope parameters as the distribution of assessees by size of incomes before tax. For the year 1963-64, Ahmed and Bhattacharya found the bottom 20 per cent of the population to have 7.6 per cent of total personal income and the top 20 per cent to have a share of 45.6 per cent. Further, the income distributions estimated showed a decline in disparities between 1956-57 and 1963-64.

The income distributions estimated by the NCAER for 1964-65, Ojha and Bhatt for 1963-65, Ranadive for 1961-62 and Ahmed and Bhattacharya for 1963-64 were remarkably close (vide Bardhan (1974)). This agreement is certainly encouraging.

1.2.4 Empirical Studies on Level of Living in India

Most of the studies on level of living in India have been based on data thrown up by the various rounds of the NSS. Ever since its inception in 1950, the NSS has been publishing data on various aspects of level of living such as household consumption, housing conditions, availability of public goods and mortality. However, it has hardly collected or published any data on other aspects of level of living like stocks of consumer durables, morbidity, terms and conditions of work, security and recreation. The majority of studies on level of living are concerned with the analysis of NSS household budget data. Of these, a large number of studies examine the size distribution of population by per capita total consumer expenditure per 30 days (PCE).

Mahalanobis (1960, 1962) proposed the method of Fractile Graphical Analysis (FGA) which is useful, among other things, for carrying out inter-temporal and inter-regional comparisons of level of living. Given household budget data, the sample individuals are ranked in ascending order of their PCE and then are divided into equifrequency groups called fractile groups, such as, the poorest 10 per cent of the population, the next poorest 10 per cent, and so on. The average PCE or average per capita consumption of some specific commodity is then estimated for each fractile group, and these estimated averages are plotted against the ordinal number of the fractile group to produce what has been called the fractile graph. If such graphs corresponding to the two half-samples of the given sample are also plotted in the same figure, then the divergence between the half-sample graphs indicates the margin of uncertainty associated with the combined sample graph. Mahalanobis (1960) argued that since PCE is used only for ranking purposes, corresponding fractile groups of different populations can be compared over time or across regions, without any adjustments for inter-temporal and inter-regional variation in prices affecting PCE.

Studies by Roy and Dhar (1960), Bhattacharya and Iyengar (1961) and Iyengar (1967a) have shown that the size distribution of population by classes of PCE estimated from different rounds of the NSS are approximately log-normal for both rural and urban sectors of India as a whole, and also at the state level. Since Lorenz curves of different members of the log-normal family do not intersect, this implies that measures of disparity, such as the Gini coefficient, can be usefully compared to rank the size distributions of PCE by degree of inequality.

The Government of India Committee on Distribution of Income and Levels of Living, also known as the Income Distribution Committee (IDC) (vide Government of India, Planning

Commission, 1969) examined changes in level of living (measured by PCE) in India during the period 1951-1961. The Gini coefficient of <u>nominal</u> PCE declined during this period. However, the IDC was unable to arrive at any definite conclusions regarding changes in <u>real</u> average PCE or in disparities in <u>real</u> PCE, owing to the absence of suitable consumer price index numbers[54]. So it examined changes in the physical consumption of cereals as well as the composition of the cereals basket. It was found that the disparities between the rich and the poor in physical consumption of cereals had increased during the decade under review (1951-61) even while the Gini coefficient of <u>nominal</u> PCE and specific concentration ratio (<u>vide</u> Mahalanobis (1960) and Kakwani (1980a)) for value of cereals consumption had decreased. This suggests that Lorenz curves of <u>nominal</u> PCE may not correctly reflect changes in disparities in <u>real</u> PCE over time. It was evident that there had been differential price movements over time adversely affecting the poor.

Many researchers studied the time trends in inequality in the distribution of PCE. Murti and Pillai (1960), Roy and Dhar (1960), Iyengar and Bhattacharya (1961), Ranadive (1971), Chatterjee and Bhattacharya (1974a), Vaidyanathan (1974),

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[54] Datta Roy Choudhury (1966), on the other hand, examined official estimates (estimates given by the CSO) of consumption at constant prices and found living standards as measured by average PCE to have risen slowly during 1953-54 to 1960-61.

Radhakrishna and Sarma (1976), Ahluwalia (1978) and Dutta (1980), among others, examined the time series of Gini coefficients of PCE. Most of the studies show that the Gini coefficient of nominal PCE for rural India remained stable upto the NSS 14th round (July 1958 - June 1959) after which it declined. Ahluwalia (1978), for example, found a statistically significant trend decline in nominal consumption inequality during the period from 1956-57 to 1973-74 —— the Gini coefficient falling from 0.33 in 1956-57 to 0.28 in 1973-74. Dutta (1980) also arrived at the same conclusion on the basis of a time series of nine annual observations between 1960-61 and 1973-74.

In the urban sector, Gini coefficients of nominal PCE remained stable upto the NSS 12th round period (March-August, 1957) after which it declined. In a detailed study, Radhakrishna and Sarma (1976) found inequality in nominal consumer expenditure to have declined in the urban sector during 1952-53 to 1968-69. In addition, the percentage shares of various fractile groups also showed a clear decline in disparities over time, for both the sectors, in the distribution of population by nominal PCE. In all the studies covering both sectors of the country, disparities in the urban sector were observed to be greater than those in the rural sector.

Such narrowing down of nominal consumption inequality, however, does not necessarily imply a decline in disparity in real consumption. Mahalanobis (1962) and later the IDC (Government of India, Planning Commission, 1969) found that cereals prices rose more sharply for the poor during 1951-61. The IDC and later, Chatterjee and Bhattacharya (1971) examined specific concentration curves (vide Mahalanobis (1960) and Kakwani (1980a)) for consumption of cereals both in physical terms and in value terms, and found that in both rural and urban sectors, the specific concentration ratio for physical consumption of cereals did not show any clear declining trends.

Iyengar and Bhattacharya (1965) examined the problem of unequal price rise for different fractile groups of population from a methodological point of view. They presented some evidence of unequal price rise for the rich and the poor, in both rural and urban areas of West Bengal. They observed price adjusted Gini coefficients to show lesser extent of reduction over time than those based on nominal PCE[55].

Datta Roy Choudhury (1966), Vaidyanathan (1974), Radhakrishna and Sarma (1976), Murty and Murty (1977) and Murty (1985) constructed fractile group specific price indices, taking into account inter-fractile group differences in consumption baskets and changes in relative prices for deflation purposes. Vaidyanathan (1974), Radhakrishna and

55/ Atkinson (1975) observed unequal price rise for different sections of the population in Britain.

Sarma (1976) and Murty and Murty (1977) used wholesale price relatives and NSS based weighting diagrams to construct price indices by decile groups. Radhakrishna and Sarma considered a nine-commodity disaggregation and used linear Engel curves to estimate index weights for different groups of population. They found that while the average nominal PCE for all classes increased for both rural and urban India during 1952-53 to 1968-69, the real average PCE in urban areas fell while that in rural areas increased marginally. And, while inequalities measured in nominal terms narrowed down, those measured after taking price differentials into account widened in the period from 1963-64 onwards[56].

Murty (1985) estimated Atkinson's inequality indices for the rural and urban sectors of India, both at current prices and at constant prices. His estimates showed a statistically significant trend decline in nominal consumption inequality and no significant trend in real consumption inequality in both rural and urban sectors during 1960-61 to 1970-71[57].

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[56] Earlier, Mukherjee and Chatterjee (1967) had employed PCE-classwise price index of cereals as the class specific price index to derive real PCE distributions.

[57] Note that the observed time trend could be partly due to the changes in NSS schedule from 'consumer expenditure schedule' to 'integrated household survey schedule' during NSS rounds 19 (July 1964-June 1965) to 25 (July 1970-June 1971).

Thus, most of the above studies reveal that inequalities in level of living at current prices reduced over time, while inequalities in real living standards remained stable or reduced by a smaller extent. However, the values of inequality measures estimated at constant prices depend on the base year chosen.

In a recent comprehensive study of the subject, Bhattacharya *et al* (1985) examined, among other things, changes in level of living and disparities in consumption in rural India during the period from 1952-53 (NSS 4th and 5th rounds) to 1983 (NSS 38th round). They examined decile groupwise estimates of consumption both nominal and real. Their findings broadly corroborate those of the earlier studies. However, on adjusting the PCE for price differentials using specially constructed consumer price indices for each decile group, the Gini coefficient of the size distribution of real PCE also showed a decline. On the other hand, the level of physical consumption of cereals showed almost starvation levels for the lower decile groups of the population over the NSS rounds but their cereals baskets showed a shift towards superior cereals, namely, rice and wheat. Bhattacharya *et al* repeated this analysis for rural areas of a few selected states. The findings for the states were broadly the same as those for rural India as a whole.

Rural-Urban Disparities

Chatterjee and Bhattacharya (1971, 1972, 1974a) studied rural-urban disparities in level of living on the basis of average nominal PCE. They observed average nominal PCE in the urban sector to be greater than that in the rural sector by about 40 per cent, on the whole. They also examined the ratios of nominal average PCE for the two sectors and found little time trend in the ratio during the period from 1951-52 to 1967-68. Bhattacharya and Chatterjee (1971) and Chatterjee and Bhattacharya (1969) (also see Chatterjee and Bhattacharya (1974a)) also examined rural-urban disparities in real terms utilizing NSS 18th round (February 1963-January 1964) household budget data. They estimated the weighting diagram as well as the average prices for 56 items/item-groups of consumption and computed Laspeyres', Paasche's and Fisher's indices of consumer price differentials between the two sectors, separately for the two half-samples of the NSS sample and the combined sample. While the urban average nominal PCE was 52 per cent above the corresponding rural average during the 18th round period, the gap between the real averages turned out to be about 32 per cent. Such results were also examined for broad groups of items such as cereals and cereals substitutes, total food, etc., separately for different decile groups of the population formed by ranking households in ascending order of PCE.

Inter-sectoral price differentials showed systematic trends over the decile groups.

Swamy (1967) examined the trend in household per capita consumer expenditure inequalities during the first two Five Year Plans, using as measures of inequality, the Kuznet's index, the Gini coefficient, the coefficient of variation and quintile group shares. He found inequality to be higher in the Second Plan period than in the First. He attributed 85 per cent of this increase to structural changes and the rest to inter-sectoral changes.

Dutta (1980) examined rural-urban disparities in real average PCE for nine years between 1960-61 and 1973-74. Inter-temporal adjustments for consumer prices were made employing the Consumer Price Index Numbers for Agricultural Labourers (CPIAL) and Consumer Price Index Numbers for Industrial Workers (CPIIW) for rural and urban sectors of India, respectively. For the rich, that is, for the upper 15 per cent of the population in both the sectors, consumer price index numbers were derived from the decile groupwise price indices constructed by Murty and Murty (1977). Adjustments for rural-urban consumer price differentials were made using the rural-urban price differential indices constructed by Bhattacharya and Chatterjee (1971) together with the CPIAL, CPIIW and Murty and Murty indices for 1963-64. Dutta compared the averages of real PCE for the poor and the rich (the upper 15 per cent of the population) as well as the general population in both sectors.

Inter-state Disparities

Iyenger (1964) was one of the first to study disparities in consumption across states using NSS 13th round (September 1957 - May 1958) data. Bhattacharya and Mahalanobis (1967) attempted to decompose overall inequality in the size distribution of PCE into within-states and between states components. They carried out an ANOVA (analysis of variance) of log PCE of persons on the basis of ungrouped NSS 13th round data. They found that only about 6 per cent of the total sum of squares could be accounted for by the between states component. So, if within states variation could be eliminated, the overall mean square would be about 6 per cent and the overall s.d. (log) about one-fourth of its present value. A similar proportion was observed for the Gini coefficient as well. Both measures showed that between states variation explained about one-fourth of the overall inequality in the rural and urban sectors.

Chatterjee and Bhattacharya (1972) examined inter-state disparities in average PCE at current prices. They expressed the statewise averages of nominal PCE for each sector and sub-sample as indices taking the all-India average for the same sector and sub-sample as base (= 100), and examined the trend of these indices over successive rounds of the NSS (13th (September 1957-May 1958) to 22nd (July 1967-June 1968)). On examining the Kuznet's index, Theil's entropy measure, the Gini coefficient of inequality and equally distributed equivalent measures (for suitably chosen social welfare functions) of <u>between</u> states disparity, Chatterjee and Bhattacharya (1972) found that there had been a clear reduction in overall between states disparity at current prices in the rural sector after the 16th (July 1960-August 1961) and 17th (September 1961-July 1962) rounds of the NSS. No such trend was observed for the urban sector.

Bhattacharya and Chatterjee (1971a) and Chatterjee and Bhattacharya (1974) examined between states variation in <u>real</u> average PCE in the rural sector. They employed NSS 18th round household budget data for constructing Laspeyres', Paasche's and Fisher's indices for inter-state consumer price variation, estimating weights as well as average prices of 56 items from the budget data for different states. Chatterjee and Bhattacharya (1974) constructed these indices for comparing the price level in each state with that in every other state and all-India, separately for five quintile groups of the population as well as for the general population in each region. They then employed the fisher indices to express the average PCEs for different states at all-India rural prices before comparing them. The process of price adjustment seemed to make a substantial difference in the relative positions of some of the states.

Similar studies were carried out by Bhattacharyya et al (1977, 1980) for the NSS 28th round period (October 1973 - June 1974).

Another such study was carried out by Rath (1973) who employed NSS 17th round (September 1961 - July 1962) budget data to construct inter-state price differential indices covering 44 items/item groups. Rath considered (1) cereals and products, (2) pulses and products, (3) edible oils and vanaspati, (4) meat, fish and eggs, (5) tea and coffee, and (6) butter and ghee as single items[58/]. Rath then used Laspeyres-type quantity indices for comparing the real PCEs of different pairs of states, and reached a ranking of states that was strikingly different from that obtained by Chatterjee and Bhattacharya (1974). Rath's approach seemed to have understated the standing of rice- and wheat-consuming states relative to other states.

Bhattacharya et al (1988) compared real average PCE across rural areas of different states of India using NSS 18th (February 1963-January 1964) and NSS 28th (October 1973-June 1974) round household budget data, following the

58/ In Chatterjee and Bhattacharya (1974), however, these groups were represented by 8,5,5,5,3 and 1 item(s), respectively.

method of real income comparisons developed by Sen (1976a). Inter-state consumer price differential indices estimated by Chatterjee and Bhattacharya (1974) for NSS 18th round period and by Bhattacharyya et al (1980) for the 28th round period were used for purposes of price adjustment. Laspeyres-type quantity indices were used for comparing every pair of states, first by ignoring the inequality in the size distributions of PCE and then by taking into account the Gini coefficient of the size distributions of PCE for the states to be compared. If the Laspeyres's type quantity index $L_{21} = \frac{\Sigma q_2 p_1}{\Sigma q_1 p_1}$ for state 2 with state 1 as base is less than 1, then state 1 is better-off than state 2, but if this ratio is greater than 1, then no conclusions can be drawn. Bhattacharya et al (1988) examined L_{21} and L_{12} for each pair of states, and if one of these two indices led to a definite conclusion, they ordered the two states. In this manner, they arrived at partial orderings of states, which they represented in Hasse diagrams. For one set of comparisons, this study treated some groups of items like cereals and products as single items, as was done by Rath (1974), and this treatment affected the ordering of the states considerably. The corresponding analysis for urban India for the NSS 28th round period was carried out by Bhattacharya et al (1986).

Vaidyanathan (1974) studied the pattern of inequalities in the distribution of PCE for rural India as a whole by principal occupational and landholding categories and by household size. He grouped 7416 rural sample households covered in NSS 14th round (1958-59) into four occupational categories. Multiple regression analysis for each category showed a positive correlation between landholding size and PCE, and a negative correlation between household size and PCE. Vaidyanathan also studied the inter-state variation in inequality of PCE and tried to explain this variation through the inequality in the distribution of landholdings and livestock, and found that the inequality in the distribution of landholdings and the proportion of rural income originating in animal husbandry were important determinants of such inter-state variation in consumption inequality.. Vaidyanathan also estimated statewise Gini coefficients of PCE for four NSS rounds (1957-58, 1960-61, 1963-64 and 1967-68) and found no uniform trend in them. Finally, on the basis of a fractile-groupwise deflation of nominal PCE he showed a significant reduction in average real consumption standards during the sixties in rural India. Dutta (1980) also found a trend decline in real average PCE between 1960-61 and 1973-74.

Ahluwalia (1978) examined the trends in inequality in the distribution of nominal PCE for 14 states during the period from 1956-57 to 1973-74. He found a significant trend decline for the states of Andhra Pradesh, Assam, Karnataka, Madhya Pradesh, Tamil Nadu and Uttar Pradesh; non-significant trend decline in Bihar, Gujarat, Maharashtra, Orissa, Rajasthan and West Bengal; and non-significant trend increase in Kerala.

Visaria (1981) studied the relationship between the size of landholding possessed by a household and its PCE for rural areas of Gujarat and Maharashtra during the NSS 27th round (October 1972-September 1973) period. He found that per capita land possessed explained only a small proportion of the variation in PCE.

Other Aspects of Level of Living

Iyengar and Suryanarayana (1985) attempted to decompose the Gini coefficient of inequality in the distribution of consumption expenditure by its constituent items.

There are not many studies on disparities in the distribution of other components of level of living. For different NSS rounds, Bhattacharya, Chakravarty and Chattopadhyay (1985) examined data on private consumption, indicators of housing conditions, distribution of infra-structural facilities like electricity, primary schools, markets, hospitals, etc. over villages in rural India. From this study, it appears that significant improvements in level of living in rural India took place in several aspects of level of living other than private consumption. They also noted the decrease in mortality rates over time.

Maitra, Dey and Bhattacharya (1974)[59] carried out a sample survey in rural and urban areas of West Bengal during 1964-65, with a view to assessing the distribution of public health and education services over different sections of the population. They examined the distribution of students and free students at different stages of education, of visits to outdoor departments of hospitals and of bed-days stayed in hospitals, over different fractile groups of the population. On the whole, it was found that the provision of such services seemed to reduce the disparities in standard of living. And even when the distribution favoured the richer groups, it was more egalitarian than that of PCE. Maitra (1988) carried out a more detailed study of the public distribution of essential commodities, the distribution of public expenditure on health and education and the distribution of different assets and inputs in rural West Bengal during 1976. His study was based on a sample survey similar to that conducted by Maitra *et al* (1974) during 1964-65 in the rural and urban sectors of West Bengal. On comparing the results for rural West Bengal for the two time periods, Maitra found that the percentage increases in the number of students between the two time periods were 20.4, [illegible] and 133.3 for primary,

[59] See also Bhattacharya and Dey (1965).

secondary and college level institutions, respectively. However, the disparities across fractile groups in the distributions of both students and free students appeared to have increased between the two survey periods except for the distribution of students at the secondary level. Maitra observed greater inequality in the public distribution of rice than in the public distribution for wheat. It may be mentioned that, during the NSS 35th round (1980-81) an enquiry on different components of 'social consumption' (i.e., consumption of public goods especially health and education services) was conducted on an all-India scale. Unfortunately, results from the Central Sample have not been published so far, and only the results from the State Sample are available for a few states like Maharashtra and Tamil Nadu (vide, for example, the 'State Sample Report on availability and utilisation of public health and public distribution system in Tamil Nadu, 35th round, Sch. 25.0' and 'NSS 35th round : State Sample Report on availability and utilisation of public health and public distribution services in Maharashtra State'). It may be added that another all-India enquiry on social consumption was recently carried out in the 42nd round of the NSS (1986-87) and the results of this are expected soon.

Gupta et al (1983) combined a set of physical indicators of welfare representing various aspects of level of living such as nutrition, health, transport, housing, education and communication, into a composite index, using a set of weights which were inversely proportional to the standard deviations of the different indicators over regions. They did this for three years (1961, 1971 and 1978) and found inter-state disparities in standard of living to have narrowed down during this period.

Another set of studies, sometimes called micro-studies, undertaken by anthropologists and sociologists by participant-observation and other methods (vide Srinivas (1976), Epstein (1973), Danda and Danda (1976), Chattopadhyay (1982) and Etienne (1982), among others) attempted to examine changes in level of living over time in rural India through intensive studies of purposively selected villages. One important feature of this approach is that the same villages are revisited after the lapse of a number of years in order to examine changes that have taken place in these villages.

In one of these studies, Etienne (1982) attempted to examine rural development at grass root levels and to bring out the diversity and complexity of the rural economy in India. Etienne undertook surveys in practically all the regions of Western and Eastern Uttar Pradesh and of North Bihar. The benchmark surveys were conducted in 1963-64 and 1967, and the revisits were made in 1978-79. This resurvey showed, among other things, that economic and social changes had been occurring in all these regions in rural India, but at different paces. All categories of people in rural areas showed signs of improvement in their living conditions, and labourers' wages increased in real terms wherever the growth and diversification of the local economy had been marked.

Bhattacharya et al (1987, 1987a, 1987b, 1987c and 1987d) carried out a resurvey of villages and households in 1985-86 in three districts of West Bengal - Bardhaman, Birbhum and Purulia — that had been covered in the 27th (1972-73) and 28th (1973-74) rounds of the NSS. Their investigation covered several aspects of level of living such as private consumption, social consumption, housing conditions and stocks of consumer durables. Sample households were also interviewed on their own perceptions of changes in different dimensions of their level of living. They found little rise over time in consumption standards for the food components of household consumption and only a mild improvement in the non-food part. Absolute levels of household consumption remained nearly as dismal in 1985-86 as in 1972-73. However, there appeared to be some improvement in some of the other aspects, especially in the level of social consumption (education, public health, drinking water, etc.).

1.2.5 Empirical Studies on Incidence of Poverty in India

In recent years numerous studies have been carried out on the incidence of poverty in India. Most of these have tried to measure 'absolute poverty' in rural India rather than in the urban sector of the country. As explained in Section 1.1.4, in the 'absolute poverty' approach, individuals living below a normatively defined poverty line are considered to be poor. The different studies on the incidence of absolute poverty mainly differ in respect of the definition of the poverty line, the method of its estimation, the poverty measures used and the data base. Some of the major empirical studies on the incidence of poverty in India will be surveyed here.

In 1962, a distinguished Study Group recommended that a per capita annual consumption of Rs. 240 at 1960-61 prices (excluding expenditure on health and education, which should be provided free according to the Constitution) should be treated as the nationally desirable minimum level of consumption expenditure. This PCE of Rs. 20 per month at 1960-61 prices has been adopted as the poverty line by several researchers ignoring the proviso regarding health and education. Some economists have slightly redrawn the poverty line at Rs. 180 or Rs. 200 (say) per capita per annum at 1960-61 prices, sometimes making a rural-urban distinction.

Minhas (1970) adopted the official (national accounts) averages of per capita consumption at 1960-61 prices estimated by Tewari (1968), and used the NSS rural to urban ratio of average per capita consumption expenditure to estimate the per capita overall consumption in rural India at 1960-61 prices. He then employed the NSS estimates of fractile group shares in total consumer expenditure to derive the average per capita consumption expenditure (at 1960-61 prices) of each fractile group of the population for seven years (1956-57, 1957-58, 1960-61, 1961-62, 1963-64, 1964-65, 1967-68). He finally estimated the number and proportion of persons in rural India with consumption expenditure below Rs. 240 (or Rs. 200) per annum at 1960-61 prices. Minhas found little time trend in the number of persons below the poverty line of Rs. 240 per annum, but the proportion of such people declined steadily over time. This decline was shown to be largely due to rise in average per capita consumption in <u>real</u> terms and only slightly due to the small decrease in the Gini coefficient of the NSS-based size distributions of population by PCE. Minhas' estimates are subject to grave doubts on the ground that Tiwari's estimates appear to exaggerate the growth in <u>real</u> per capita consumption over time. The implicit national income deflator increased from 100 in 1960-61 to only 170 in 1967-68.

Ojha (1970) adopted the norm that a representative Indian requires 2250 Kilo calories per day. He assumed that 66 per cent of this requirement must be met from food-grains, that is, cereals and pulses, in the urban areas as against 80 per cent in the rural areas. The corresponding requirements of foodgrains worked out to 518 gm. and 432 gm. per person per day for rural and urban areas, respectively. Employing NSS 16th round (July 1960-August 1961) household budget data, and correcting the NSS estimates of foodgrains consumption for over-reporting in the light of the official estimates of availability of foodgrains, Ojha found that the average level of foodgrains intake per capita was below the norm specified above for all PCE classes upto Rs. 15-18 per month in the rural areas. These PCE classes accounted for nearly 52 per cent of the population in the rural sector of the country. In the urban sector, the average foodgrain in-take was below 432 gm. per person per day upto PCE class Rs. 8-11 per month, that is, for about 8 per cent of the urban population. For the year 1967-68, Ojha estimated that 70 per cent of the rural population lived below the norm of 518 gm. of foodgrains per person per day, and this meant a rise in the proportion of poor people between 1960-61 and 1967-68.

Dandekar and Rath (1971) assumed that a calorie intake of 2250 Kilo calories per capita per day was adequate under Indian conditions in both rural and urban sectors. They then estimated poverty in both rural and urban India by a method similar to that followed by Ojha (1970), but with two differences. Firstly, they used the NSS estimates of consumption of foodgrains without any correction, and secondly, they assumed that the remaining items of food yield 200 calories per person per day. Dandekar and Rath then found that, for rural areas in 1960-61, an annual per capita consumption expenditure of approximately Rs. 170 was needed to provide a minimum of 2250 Kilo calories per capita per day. The corresponding figure for the urban areas worked out to be about Rs. 271 per person per year. On the basis of these poverty lines, Dandekar and Rath estimated that in 1960-61, about 33 per cent of the rural population and nearly 49 per cent of the urban population lived on diets inadequate even in respect of calories. They also revised the poverty line of Rs. 240 per person per year (at 1960-61 prices) to a poverty line of Rs. 180 per person per year for rural India and Rs. 270 per person per annum for urban India. They then found that about 40 per cent of the rural population and about 50 per cent of the urban population lived below the minimum standards during 1960-61. Dandekar and Rath's estimates of the changes in the incidence of poverty during the sixties depended on some controversial revisions of NSS data on consumer expenditure for 1967-68[60/]. Also their use of the National Income Deflator to convert the current price data into data at constant (1960-61) prices is questionable. Many scholars are of the view that without an intensive study of the discrepancies between the two sources of consumption data, it is not possible to conclude in favour of either. Also, it may be mentioned that from the 19th (1964-65) through the 25th (1970-71) round of the NSS, consumer expenditure data were collected through the 'integrated household survey schedule' instead of the usual 'consumer expenditure schedule'. This change in the enquiry schedule appears to have depressed the estimates of consumer expenditure and thus vitiated the time series comparisons of level of consumption.

[60/] The NSS consumer expenditure estimates for 1967-68 and 1968-69 were based on quick tabulations of unscrutinised data. Dandekar and Rath doubted the reliability of the NSS consumption estimates for 1967-68 for the following reasons :

(i) On using the National Income Deflator (NID)(base 1960-61=100) to express current values in terms of 1960-61 prices, they found the average PCE for rural areas in 1967-68 to be 7 percent below the corresponding NSS estimate for 1960-61. On the other hand, the official (national accounts) estimates of PCE showed the figure for 1967-68 to be 4 per cent above that for 1960-61; and

(ii) again by using the NID, they found the average PCE for the lowest 5 per cent fractile group of population in rural areas in 1967-68 to be 6 per cent below the corresponding figure for 1960-61, and the figure for the top 5 per cent group in 1967-68 to be 27 per cent below the corresponding average for 1960-61. This large differential fall in average PCE led them to suspect the NSS data for 1967-68.

Bardhan (1970, 1971, 1973, 1974) adopted a monthly PCE of Rs. 15 at 1960-61 rural prices as his poverty line for rural India and used the Consumer Price Index Numbers for Agricultural Labourers (CPIAL)(with 1960-61 = 100), to find the poverty lines for the years 1964-65, 1967-68 and 1968-69. He then estimated the proportion of population falling below the poverty line for four years (1960-61, 1964-65, 1967-68 and 1968-69). Bardhan's time series showed a sharp rising trend in the proportion of poor in rural India as opposed to Minhas' estimates showing a declining trend. Bardhan's series of price indices were more appropriate than those used by Minhas (vide Mukherjee et al (1972)). Bardhan also computed several alternative consumer price indices and showed their broad agreement with the CPIAL. Besides the differences in price indices employed, the divergence between NSS and official consumption figures was also partly responsible for the discrepancy between Bardhan's and Minhas' results.

Bardhan (1971, 1974) also computed the cost of the minimum diet recommended for an adult in moderate activity by the Central Government Employees' Pay Commission (1957-59), with slight modification. The cost of this minimum basket worked out to be Rs. 9.61 per month for rural India at 1960-61 prices. This approach also showed that the percentage of rural population below this alternative minimum level of living rose during the sixties, from 38 per cent in 1960-61 to about 54 per cent in 1968-69.

Bardhan (1973, 1974) started from the all-India poverty line of PCE = Rs. 15 per month at 1960-61 rural prices to obtain statewise rural poverty lines at 1960-61 rural prices using the inter-state price differential indices (base : all-India, rural) for the two bottom quintile groups of the rural population, constructed by Chatterjee and Bhattacharya (1974) on the basis of NSS 18th round (February 1963-June 1964) consumption data. The statewise poverty lines so obtained were adjusted using the CPIAL (base : 1960-61 = 100) to derive poverty lines for 1967-68. Bardhan finally estimated the incidence of poverty in the different states for the two years - 1960-61 and 1967-68.

Vaidyanathan (1974) estimated the proportion of rural population with PCE below Rs. 20 per month at 1960-61 prices for three years (1960-61, 1964-65 and 1967-68). He did this in two ways. The first set of estimates, based on NSS consumption data, showed a considerable rise in the incidence of poverty during the sixties, even though the degree of inequality in the size distribution of PCE declined. The second set of estimates were obtained by combining the official figures of per capita consumption and the NSS pattern of disparities in the size distribution of PCE. These estimates showed that the proportion of rural poor remained almost stable in the sixties. In order to take account of differential price rise for different fractile groups of the population, Vaidyanathan constructed separate price indices for different fractile groups of the population, taking weighted averages of official whosesale price relatives for 10 commodity groups, the weights being based on NSS 19th round (1964-65) consumer expenditure data. These price indices were used for both sets of calculations mentioned above.

On the basis of NSS 13th round (September 1957-May 1958) consumption data, Chatterjee et al (1963) found that about 53 per cent of the rural population fell below the norm of 2400 Kilo calories per capita per day.

Vyas (1972) employed NSS consumption data and found that the proportion of rural population below the poverty line of Rs. 240 per capita per annum at 1960-61 prices fell from 45 per cent in 1954-55 to 38 per cent in 1960-61. He attributed this decline to the combined impact of major institutional changes and considerable agricultural growth during the period. However, the period after 1960-61 witnessed neither agricultural growth nor institutional changes, but an increase in poverty.

Bhatty (1974) studied poverty in rural India on the basis of consumption and income data collected through a survey of Effectiveness of Employment conducted by the NCAER during 1968-69. He estimated Sen's index of poverty (Sen, 1974) separately for cultivators, agricultural labourers and non-agricultural workers, both by states and for rural India as a whole, using alternative poverty lines. Bhatty found a statistically significant negative rank correlation between Sen's index and the mean income per capita of the states.

Rajaraman (1975) measured poverty in rural Punjab by estimating the percentage of population below the poverty line. The cost of minimum balanced diet was worked out specifically for the region using linear programming techniques on the basis of NSS consumption data. She found that there was a significant deterioration over the ten year period from 1960-61 to 1970-71, not only in terms of the relative distribution of total consumption, but also in the absolute consumption levels of the poorest 25 per cent of the population.

Lal (1976) found a decline in the incidence of poverty among rural labour households in five states, namely, Maharashtra, Orissa, Rajasthan, the Punjab and Uttar Pradesh, between 1956-57 and 1970-71. He adopted the alternative estimates of the state-level poverty lines of Dandekar and Rath (1971) and Bardhan (1974) and utilized the results of NSS Rural Labour Enquiries for 1956-57 and 1970-71.

Dutta (1978) took a PCE of Rs. 15 per month at 1960-61 prices as the poverty line for rural India. He then estimated the head-count ratio of poverty and also the Sen's index for four years — 1968-69, 1969-70, 1970-71 and 1973-74 — by two different methods. He first calculated expenditure-class specific price indices for rural India using the wholesale price indices for various commodity groups issued by the Office of Economic Adviser, Government of India and commodity weights based on NSS data for each expenditure class, and used the price index of the expenditure class in which the poverty line lay to deflate the poverty line. In the second approach, Dutta used the CPIAL to estimate the poverty lines for the different years. According to Sen's index, the two approaches show a reduction in poverty to the extent of 12.5 per cent and 22.5 per cent, respectively, between 1968-69 and 1973-74. The head-count ratios also showed decline over time.

Ahluwalia (1978) adopted Bardhan's (1973, 1974) methodology and examined the trends in the incidence of rural poverty during the period from 1956-57 to 1973-74, for India as a whole and also for fourteen individual states. Ahluwalia found year-to-year fluctuations in the incidence of poverty in rural India, as measured by the head-count ratio and Sen's index, with no significant time trend except for Assam and West Bengal, where there was a significant trend increase in poverty and for Andhra Pradesh, where there was a significant trend decline. The study showed a significant inverse relationship between the incidence of rural poverty and real agricultural output per head of rural population for India as a whole. This result was found to be true for some individual states, but not for the other states. In several states, there seemed to be other factors at work which tended to increase the incidence of poverty independently of variations in real agricultural output per head.

In a time series analysis of the incidence of poverty in rural India, covering the period from 1956-57 to 1970-71, Desai (1986) examined the effects of agricultural production as well as the prices of commodities consumed by poor rural households (represented by the CPIAL or by the index number of wholesale prices of foodgrains (FPI)) on the incidence of rural poverty. He observed a declining time trend in poverty, and that while increase in agricultural production tended to decrease poverty, an increase in the CPIAL or FPI tended to increase it.

Saith (1981) tried to explain the trend in the incidence of poverty over the period from 1960-61 to 1970-71 in terms of the percentage deviations between the actual and fitted trend values of the index of agricultural production ($DIAP_t$) and CPIAL ($DCPIAL_t$). Saith found an increasing time trend in poverty, and observed that rising prices accentuate poverty more powerfully than production improvements alleviate it.

In a second attack on poverty based on time series data for the years 1956-57 to 1977-78, Ahluwalia (1986) found that rural poverty is inversely related to agricultural performance and the relation is considerably strengthened if lagged agricultural performance is taken into account. But the addition of lagged agricultural performance somewhat weakens the effect of prices but does not negate it entirely.

In another study, Walle (1985) considered population growth as a separate explanatory variable. Pooling both cross-section and time series data on different states of India, he found that population growth had a significant adverse effect on poverty. However, agricultural output and real agricultural wage rates had a favourable effect on poverty.

Among other studies which seek to explain the inter-temporal variation in rural poverty in different states, mention may be made of those carried out by Mundle (1984, 1984a) and Jose (1984, 1984a).

Bhattacharya et al (1985) adopted a PCE of Rs. 15 per 30 days at 1960-61 rural prices as their poverty line for rural India and examined time trends in both head-count ratio and Sen's index for the rural sector of the country as a whole as well as for rural areas of six individual states, namely, Bihar, Haryana, Kerala, the Punjab, Tamil Nadu and West Bengal. Their study covered the period from NSS 12th round (March-August, 1957)(13th round (September 1957-May 1958) for the states) to NSS 38th round (January-December,1983). For rural India as a whole, they found considerable year-to-year fluctuations in the incidence of poverty. The head-count ratio rose rather sharply from about 46 per cent in the 19th round period to 56 per cent in the 21st and 22nd rounds (1966-1968), then fell rapidly and stayed around 45 per cent in rounds 25, 27 and 28 (1970-74). It fell further to 40 per cent in the 32nd round (1977-78) and to 33 per cent in the 38th (1983) round. The findings for the individual states (except Bihar) largely corroborate the pattern of fluctuations in the poverty measures observed at all-India rural level. Bhattacharya et al (1985) also tried to identify and assess the influence of factors which could explain the movements over time in the incidence of poverty in rural India. For this purpose, they set up a macro-econometric model to examine the inter-relationships among the level of poverty of the rural population (as measured by head-count ratio), the per capita quantity of cereals consumed in rural India, the relative price of cereals, current and one-year lagged per capita output of cereals, urban per capita real income, net outflow of cereals from the rural sector (that is, marketed surplus), per capita procurement of cereals, etc. They fitted this model to data covering the period from NSS 14th round (1958-59) to NSS 38th round (1983). They finally observed that the growth in per capita cereals production (both current and one-year lagged) would tend to reduce the incidence of poverty. However, given the cereals output, any growth in per capita non-agricultural real income would tend to deepen rural poverty, while a rise in relative price of cereals would tend to increase it. The Government policy of procurement-cum-distribution tended to reduce the incidence of rural poverty, although by a small extent.

Iyengar and Suryanarayana (1983) characterised poverty by three parameters : X_0 (per capita consumption of the poorest household in a given community); $\bar{X}$ (average per capita consumption of the entire community); and L (overall inequality in the size distribution of PCE). They defined mean poverty gap as $(\bar{X} - X_0)/\bar{X}$. It was assumed that the PCE distribution at and above X_0 is lognormal. Then by fitting a three-parameter lognormal distribution to the published NSS consumer expenditure data for rural and urban India, Iyengar and Suryanarayana estimated the poverty indicators for all the years from 1961-62 through 1973-74. Their study indicated a dip during the mid-sixties and a recovery thereafter in the level of living of the poorest household in both rural and urban India. But while results based on current price data pointed to a general improvement in the level of aggregate welfare, the picture was different when adjustments were made for inflation and implicit differential price effects.

Sanyal (1988) assumed that the distribution of land owned by households arranges the population in decreasing order of poverty, with the landless at the lowest rung followed by very small owners and so on. He then used the Sengupta and Joshi (1979) estimates of the head-count ratios of poverty for states (based on NSS 27th round data) to approximate the size of household ownership holding corresponding to the poverty line of the state during the NSS 26th round period. As the area of land owned is a physical quantity, the poverty line in terms of size of ownership holding would remain unchanged over different NSS rounds. Then, on the basis of the distribution of households by size of ownership holding, Sanyal estimated Sen's index of poverty for the rural areas of individual states as well as for rural India as a whole for NSS rounds 8 (1954-55), 17 (1961-62) and 26 (1971-72). He observed that, of the fifteen states covered in the study, eight registered an increase in poverty while five remained static. Further, of ten states for which landlessness showed a decline, only two showed a decrease in poverty while five showed an increase in poverty. From this, it appeared that there was little association between decline in landlessness and decrease in poverty[61].

A study by the Centre for Development Studies (1975) examined the incidence of poverty and food intake (from the food balance sheets covering a period from 1960-61 to 1970-71) and found from a cross-section analysis across states in India that the average per capita calorie intake for the urban population was directly related to the per capita income and per capita output of foodgrains in the state; however, the per capita calorie intake of the rural population was not explained by per capita income but was directly related to per capita food production in the state and inversely related to the inequality in ownership holdings in the state.

As mentioned earlier in Section 1.2.3, in 1981-82 the NCAER carried out a resurvey of households covered in the 1970-71 survey. On the basis of data collected in these surveys, NCAER (1986a) examined changes in poverty in rural India between 1970-71 and 1981-82. It employed poverty lines representing per capita income corresponding to (1) the nutritionally required calorie intake level as recommended by ICMR, and (2) the minimum calorie requirement level as advocated by Sukhatme. All incomes and consumption figures (including the poverty lines) for 1970-71 were expressed at 1981-82

61/ This approach to measurement of poverty ignores time trends in productivity of land due to green revolution and other changes.

current prices, using the overall consumer price index estimated with the help of survey data. On the basis of the poverty line corresponding to (1) above, the head-count ratio of poverty was found to decrease from 56.9 per cent in 1970-71 to 48.5 per cent in 1981-82. On following through the per capita income decile groups of households in 1970-71 to 1981-82, it was found that in the bottom 5 decile groups the head-count ratio declined from 100 per cent in 1970-71 to 41-64 per cent in 1981-82. In the 4 top decile groups, the head-count ratio rose from 0 in 1970-71 to 30-51 per cent in 1981-82. This shows intertemporal fluctuations in the economic status of individual households. Sen's measure and the head-count ratio were employed to examine changes in the incidence of poverty for different categories of households by size of landholding and by household size. For different landholding categories, the change in poverty status (poor or non-poor) between 1970-71 and 1981-82 was examined. This study also examined changes in the percentage of total consumption expenditure spent on education and health over the per capita income deciles for 1970-71 between 1970-71 and 1981-82. The percentage of expenditure on health increased for all the decile groups of 1970-71. However, while the percentage expenditure on education increased for most of the lower decile groups, it decreased or was stable for the upper 4 decile groups and decreased slightly for the overall rural population.

Coming now to studies on the inter-regional variation in the incidence of poverty, Mukherjee (1969) examined the areal distribution of poverty over 50 NSS regions[62] during the NSS 18th round period (February 1963-January 1964)[63]. Ranking households by PCE he formed the lowest decile group consisting of the poorest 10 per cent of the rural population and the highest decile group comprising the richest 10 per cent of the rural population. The former he called the 'poor' and the latter, the 'rich'. Mukherjee then studied the distribution of the population in these groups over the 50 NSS regions, and prepared maps of India showing clusters of regions that were relatively homogeneous in respect of level of living and poverty. Judging both rural and urban areas of the states as a whole on the basis of the density of the 'poor' ('rich') (population in the region falling in the lowest (highest) decile group of the population on the basis of ranking by PCE, expressed as a percentage of population in the region) and average nominal PCE of the regions, Mukherjee found that Orissa, Kerala, Bihar, Mysore and Andhra Pradesh were the poorer states in 1963-64.

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[62] The NSS regions are formed by grouping together districts within a state that are as homogeneous as possible in respect of soil, climate, etc. No NSS region cuts across the boundary of a state.

[63] Chapter 5 of the present thesis is a follow-up of one part of Mukherjee's (1969) study.

Tewari (1983) examined eight different indices of level of living and poverty like engel ratio for food, percentage of population consuming less than 2400 Kilo calories per day, etc. for the rural areas of 64 NSS regions[64]. He then combined these eight different indices, using four different sets of weights, to obtain four composite indices of development, assuming that the component indices did not change appreciably during the period covered by these NSS rounds.

Sundaram and Tendulkar (1988) sought an empirical explanation of the variation across NSS regions in the incidence of poverty and in the rate of unemployment in rural India during the NSS 27th round period (1972-73). They estimated a recursive system of four equations in which the incidence of poverty in a region is found to be explained by such variables as average PCE, inequality in the distribution of PCE, etc. besides such structural factors as the parameters of the size distribution of physical assets (that is, land and physical capital) over households in that region. Jain *et al* (1989) adopted the model specification developed by Sundaram and Tendulkar (1988) to analyze the inter-regional variations in level of living (as measured by average PCE or median level of PCE) and incidence of poverty (as measured by the head-count

64/ All the indices did not relate to the same NSS round. They were based on data from the 26th (1971-72) to the 32nd (1977-78) rounds of the NSS.

ratio and Sen's index) across 56 NSS regions during NSS 27th round period (1972-73). They estimated a two-equation system that explained such cross-sectional variation substantially. Among other things, they examined the inter-temporal stability of cross-sectionally estimated structural coefficients by an indirect test. This indicated that average PCE or median level of PCE and the Gini coefficient of the distribution of PCE were too crude to predict Sen's intensity-sensitive measure of poverty. The findings also suggested a possible strengthening of the impact of level of living and/or a weakening impact of the Gini coefficient of the distribution of PCE on the incidence of poverty over time. Das (1982) also examined inter-regional variations in the incidence of poverty.

Mukherjee and Kishore (1983) found the districtwise proportions of population in poverty in rural and urban areas of Himachal Pradesh, using data thrown up by a survey carried out by the Directorate of Economics and Statistics, Himachal Pradesh, in consultation with the CSO.

Some researchers have examined the correlates of poverty, that is, the characteristics of the poor in India. For example, Minhas (1970) found that out of the 164 million people below the poverty line in rural India in 1960-61, about 60 million people belonged to rural labour households, and of the remaining, a large proportion of persons were in cultivator households with small operational holdings. He then went on to find the characteristics of rural labour households. Dandekar and Rath (1971) found that in 1956-57 rural poverty at the lowest level was largely accounted for by agricultural labour households. Vaidyanathan (1974) examined the distribution of rural population by classifying them jointly by (i) occupational groups and PCE classes; (ii) size classes of landholding and PCE classes; and (iii) household size and PCE classes[65]. He noted that the bulk of the rural population with a relatively low level of PCE were drawn from agricultural labour households.

Subramanyan (1982) investigated the relationship between poverty, unemployment and participation rates. Reddy and Mitra (1982) also examined the determinants of poverty.

Gaiha (1987) carried out a decomposition of income inequality of the poor, separately for two major occupational groups (viz., cultivating households and casual labour households) in two regions in rural India, based on a classification of sample villages in terms of technological advancement. The analysis was based on a sample of 4118 households interviewed in 1970-71 in the Additional Rural Income Survey (ARIS) carried out by the NCAER (NCAER, 1975) with the purpose of examining the impact of the new technology on incomes in the

[65] See Section 1.2.4.

rural areas. Gaiha adopted a poverty line of Rs. 16 per capita per month at 1960-61 prices and employed the CPIAL to express this as Rs. 370 per person per annum at 1970 prices. He decomposed income inequality into inequality in earnings per worker, inequality in participation rates and covariance between participation rates and earnings per worker. It was found that income inequality varied little between the two regions, while inequality in earnings per worker and in participation rates were higher in the technologically advanced regions. However, in the latter case, the additive effects of the two components mentioned was offset by the high negative covariance between the participation rates and earnings per worker. Among poor cultivating households, the effect of a reduction in inequality in earnings per worker on income inequality was stronger, and this was more so in technologically advanced regions. Among poor casual agricultural labour households, the effect of a reduction in inequality in participation rates was stronger, more so in less advanced regions.

On the basis of ARIS conducted by the NCAER during 1968-69 and 1969-70, Gaiha (1987a) studied impoverishment[66/] among cultivating households in rural India. He showed that both the incidence and severity of impoverishment were higher

[66/] This is the phenomenon of poor becoming poorer and not-poor becoming poor with the passage of time.

among the cultivating not-poor households, and this could largely be accounted for by the new technology in the late 1960s.

Bardhan (1984) employed a binary response model, namely, the logit model, to explain the probability of agricultural labour households falling below the poverty line in rural West Bengal during 1977-78 in terms of household characteristics (such as the number of dependents, number of men in the age-group 15-60 having more than primary education, etc.), and regional characteristics (such as the quantity of fertilizer used per hectare under foodgrains in the district, rate of growth of agricultural output in the district, irrigation level in the village, etc.). Among other things, he found that, other things remaining the same, the probability of an agricultural labour household being poor seemed to be higher if the household was located in a district where agricultural production grew at a faster rate[67].

Gaiha (1988) also carried out a logit analysis of poverty both for rural India as a whole and also separately for cultivating households, casual labour households, permanent wage earning households and business and craft households in rural India, on the basis of the ARIS carried out by the NCAER in 1968-69. He tried to express the probability of a

67/ Bardhan (1987) examined the incidence of poverty in urban West Bengal during the NSS 32nd round period (1977-78).

household being poor in terms of a set of technological variables (such as gross cropped area under HYV in hectares, whether the household used electricity for farming, etc.), village-specific variables (such as distance to the nearest town in kilometres, if cooperative and/or bank exists in the village, etc.) and household demographic and educational variables (such as household size, proportion of children in the household, age of household head, whether the highest educational level of any household member is higher than primary, etc.). He found that village-specific indicators of development and the new agricultural technology tended to decrease poverty and education also appeared to lower the probability of a household being poor. On the other hand, increased dependency burden tended to increase the risk of poverty. Gaiha also computed the percentage changes in the 'reference' probability[68/] of a household being poor with the introduction of subsets of explanatory variables (that is, village specific variables, technological variables, etc.) used, separately for all-India and for the occupational groups mentioned above. It appeared that the probability of a household being poor was reduced more sharply for cultivating households than for casual labour households under the impact of the new technology. Similarly, the availability

68/ The 'reference' probability was computed by assuming that all continuous variables took on their mean values, while all binary explanatory variables were equal to zero.

of credit significantly decreased the probability of a business and craft household being poor, while it had no significant effect on the risk of poverty of a cultivating household.

Paul (1989) defined the poverty line as that level of expenditure at which all calorie and nutrient shortfalls are eliminated, where requirements with respect to these are tailored to the age-sex-occupation characteristics of each household. On the basis of NSS 25th round (1970-71) budget data, Paul thus estimated poverty lines in per equivalent adult terms for rural and urban Punjab. Using these poverty lines the Foster-Greer-Thorbecke (1984) measure of poverty for rural and urban Punjab were decomposed over different occupational groups.

Lastly, Sundaram and Tendulkar (1984, 1984a), Raj Krishna (1983), Gupta and Datta (1984) and Paul (1984) examined the extent of success of the poverty alleviation programmes of the Government during the sixth five-year plan. The literature on this subject is extensive. See, in particular, Rath (1985), Hirway (1985).

1.2.6 Studies on Level of Living and Poverty of Scheduled Castes and Scheduled Tribes

The Scheduled Castes (SC) and Scheduled Tribes (ST) form a major section of the socially and educationally

Backward Classes of India[69]. The Constitution of India provides for protective discrimination favouring these groups of the population. In subsequent Chapters of the present thesis, some studies have been carried out on the level of living and poverty of the SC and ST in rural India. It would, therefore, be desirable to describe the SC and ST of India before going on to survey the studies carried out on thir economic conditions. Thus, Section 1.2.6.1 gives a brief note on the SC and ST and Section 1.2.6.2 surveys the studies on level of living and poverty of the SC and ST.

1.2.6.1 The Scheduled Castes and Scheduled Tribes

Ancient Indian society was divided into caste groups or 'Varnas', formed by occupational grouping. The Brahmins were those who knew Sanskrit and performed religious rites and were the teachers of society. The 'Kshatriyas' were the martial group whose duty was to guard the people against enemies. The king was also a 'Kshatriya'. The 'Vaishyas' looked after cultivation, trade and commerce. The 'Shudras' were engaged in inferior service. A fifth group who performed even lower type of functions like sweeping streets, scavenging, cleaning gutters and dry latrines, tanning, etc. was outside the 'Varna' system. This group of people were

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[69] Besides the SC and ST, there are the other Backward Classes (OBC).

the untouchables or 'Avarnas' or 'Antyajas' (vide Ghurye (1979) and Kamble (1982)). The untouchables had no share in the social, political and judiciary powers. After the passage of centuries 'Varna' came to be decided by birth so that opportunities for inter-group mobility within the caste system were more or less closed to the 'untouchables'. The 'Jati' system which came into existence later dilineates subcastes in each 'Varna'.

The expression 'Scheduled Castes' was first coined by the Simon Commission and embodied in the Government of India Act of 1935. A list of SC was published under the Government of India (SC) Order, 1936, which consisted of 429 'outcaste' communities or subcastes with names such as Mahar, Bhangi, Chamar, etc. After independence, the President of India notified the SC in the orders called Constitution (SC) Order, 1950, the Constitution (SC) part C Status Order 1951 and the SC and ST Lists (Modification) Order 1956. The basis of selection of the SC was primarily 'untouchability' measured by the incidence of social disabilities, but this criterion has been combined in varying degrees with economic, occupational, educational, residential and religious tests (Galanter (1984)). Thus, according to the Act of 1956 mentioned above, only Hindus and Sikhs can report themselves as SC[70].

[70] However, in this thesis, only Hindu SC have been taken to constitute the 'SC' group.

The tribes of India live in hills, forests, and other remote, isolated regions and to this day have retained their customs and regulations. They are variously known as 'Vanyajati' (Castes of forests), 'Vanvasi' (inhabitants of forests), 'Pahari' (hill dwellers), 'Adimjati' (original communities), 'Adivasi' (first settlers), 'Janjati' (folk people), 'Anusuchit Janjati' (Scheduled Tribe) and so on. Except for a few tribes, there is little difference between the economic life of the tribes and that of the surrounding rural people, yet as they have retained their separate social identity, they can be regarded as comparatively isolated and economically backward (vide Basu (1985)). The problem of the ST has been discussed by Ghurye (1959). In 1950, the President of India promulgated the list of Scheduled Tribes. Among the ST, numerically the most important are the Gonds of Madhya Pradesh, Maharashtra and Andhra Pradesh, the Bhils of Rajasthan, Gujarat, Madhya Pradesh and Maharashtra, and the Santhals of Bihar, Orissa and West Bengal. The ST are in a majority in the population of Meghalaya, Nagaland, Arunachal Pradesh, Dadra and Nagar Haveli and Lakshadweep. Tribal development in India has been studied, among others, by Aiyappan (1965), Bose (1969), Vidyarthi (1973, 1974) and Kulkarni (1974).

Historically, Lord Gautama Buddha was the first to revolt against the caste system. During the 19th century individuals like Jyotirao Phule and Dayanand Saraswati tried to help the lower castes, while Christian missionaries proferred conversion as a solution to age old problems. However, it was only at the end of the 19th century that caste hierarchy and inequality were recognised as problems in their own right. Until the early 30's, the SC had no say in the Government. Only after the organised movement of the SC for sharing political power and social justice under the leadership of Dr. Bhimrao Ramji Ambedkar, the British began to consider the problems of the SC. The Constitution then gave the SC population the right to vote. In view of the size of the SC population, it was realized that for winning over their votes, political parties would see that justice was done to them.

Two great national leaders - Mohandas Karamchand Gandhi and Dr. B.R. Ambedkar - took up the cause of the untouchables[71/] [72/]. The Constitution of India provides for special protection of the SC, ST and OBC. Under Article 46 of the Constitution, it is the responsibility of the State 'to promote with special care the educational and economic interests of the weaker sections of the people, and the SC and ST in particular, and to protect them from social injustice

71/ The viewpoints of these two leaders with respect to the SC were different.

72/ Gandhiji referred to the untouchables as 'Harijans' and to the Scheduled Tribes as 'Girijans'.

and all forms of exploitation'. The preferential Schemes organised by the Government of India for the SC, ST and OBC are as follows :

1. Political representation : There is reservation in legislatures.

2. Employment under government : There is reservation of posts in government service.

3. Education : Scholarships, grants and loans are given to students belonging to SC, ST and OBC. Also, places are reserved for them in coveted higher technical and professional colleges, students' hostels, etc.

4. Economic uplift : There are quite a few welfare schemes for the economic uplift of the backward classes. These include allotments of agricultural land, encouragement of cottage industries, provision of tools, seeds and other subsidiaries.

5. Lastly, there are special protections which attempt to remedy the disadvantaged position of the untouchables by regulation rather than redistribution.

Even in the recent anti-poverty programmes, emphasis is laid for ensuring that a good percentage of beneficiaries belong to SC and ST groups.

The Commissioner of SC and ST writes an annual report on the general impact of these welfare schemes. These reports contain information on economic development, and development programmes associated with the SC/ST, educational development, the number of cases of violation of the Untouchability Act, the number of bonded labour freed, the number of cases of atrocities and harassment brought to the notice of the authorities etc. The Report of the Commissioner of the SC and ST comments that the SC suffer at the hands of vested interests on 'account of social inhibitions and inadequate work done to bring about the required social change'. The Commissioners' reports repeatedly stress the inadequacy of facilities and the lack of imagination in the implementation of policies.

Other sources of information on the SC and ST include the population census reports. These give a wealth of data on the demographic and economic characteristics of the SC/ST. Occasionally, the census reports also publish a bibliography of ethnic studies on the SC/ST.

Apart from these reports, there are several reports on special plans (viz., the special component plan, the tribal development plan, etc.). The reports study the impact of specific development plans, based on the census and other secondary data sources.

In December 1978, the Central Government appointed a Backward Classes Commission under the chairmanship of B.P. Mandal, a Member of Parliament.[73] The purpose of this Commission was to determine the criteria for defining the socially and educationally backward classes. The Mandal Commission submitted its report in 1980. The Commission accepted 'caste' as the unit for identifying the socially and educationally backward classes. The criteria for identifying the OBC in other religious groups were : (i) all untouchables converted to any non-Hindu religion and (ii) such occupational communities which are known by the name of their traditional hereditary occupations and whose Hindu counterparts have been listed among the Hindu OBCs (e.g., Dhobi, Teli, Dheevar, etc.). This report has been criticised on the grounds that the Commission in its report has confused classes and castes and that some of the other Backward Castes - mostly landowning middle peasantry -- have come up and oppressed the untouchables and that there are many Brahmins who are poor so that preferential treatment should be class based and not caste based (vide Radhakrishnan (1982)). However, inspite of all the criticisms levelled at the Report of the Mandal Commission, Radhakrishnan (1982) pointed out that the village studies have

[73] The report of the earlier Kalelkar Commission set up in 1953 to formulate uniform standards to determine the backward classes and to prepare a central master list of backward classes was not accepted by the Government of India.

brought out the close correlation between caste and class and though protective reservation has done little, without reservation nothing could be done.

1.2.6.2 Studies on the Level of Living and Poverty of SC/ST

Studies about the SC are mostly based on secondary data or on micro-level data. These studies cover various aspects of the life of the SC like the occupational distribution, the opportunities for education, their living conditions, their dwelling, their religious beliefs and social customs, their politicization and the impact of change on the psyche of the SC. There are also several reports and studies looking at the problem of untouchability (*vide* Raghuprasad (1986) for a detailed review of these studies).

The rest of this sub-section surveys studies on level of living and poverty of the SC and ST. Most of these studies were carried out at the micro-level.

Saradamoni (1981) studied two *panchayats*[74] in Kerala. She stratified the population in the two *panchayats* into caste-occupation categories and examined the level of living and assets of these categories. This study contains, among other things, some estimates of (i) per capita daily consumption of rice and rice purchased in the open market,

[74] Panchayat = cluster of villages recognized as areal unit for local self-government.

(ii) average household expenditure on selected items for Onam in 1976, and (iii) average household expenditure on some non-food items. Saradamoni concluded that inspite of the favourable political and social climate in the State of Kerala, a large section of the SC as well as the poor of other communities were outside the pale of development and its benefits. In the two village panchayats under consideration, Harijan disabilities were basically economic and only growth and involvement of the Harijans themselves in economic development would improve their lot.

Kurien (1982) investigated the economic factors responsible for the poverty of the SC in India on the basis of 1971 Census data, the 'Rural Labour Enquiry 1974-75 : Final Report on Wages and Earnings of Rural Labour Households' and the 'Report of the Commissioner of Scheduled Castes and Scheduled Tribes, 1977-78'. Kurien found that among the working population of SC, almost 52 per cent were agricultural labourers compared to 26 per cent among the total working population. The economic situation of the SC was intimately related to the problems of agricultural labourers in general. Kurien stressed the need for more adequate educational opportunities and facilities for SC and a radical reorganisation of the socio-economic system.

Papola and Ashraf (1983) examined the socio-economic development of SC in Uttar Pradesh and found that the development programmes had helped those who already had some assets. A large section of the SC were agricultural labourers and their low wage rates contributed to their plight. Job opportunities in non-traditional sectors had helped the SC more than participation with some assistance in their traditional occupations.

Agarwal and Ashray (1977) studied the effect of special privileges granted to the SC in Haryana. Their analysis suggested that lasting change could be brought about only by making the Harijans economically and politically stronger.

Srivastava and Lal (1983) studied poverty in the five gram sabhas of Sohaon Block of district Ballia in Uttar Pradesh, using the demoscopic approach[75/]. The minimum consumption need as desired by the households was examined against their actual consumption expenditure in order to identify the classes below the minimum desired needs or poverty lines. Three classes, namely, the SC cultivators, SC landless households and non-SC landless households emerged as poor.

[75/] See Section 1.1.4.

On the basis of NSS 32nd round (1977-78) consumer expenditure data, Gupta et al (1983) examined the incidence of poverty among the weaker sections of the population, viz., the SC and ST. They did this for four groups of states (grouped with respect to per capita state domestic product) and at all-India level. For each category of states and for all-India, they studied the percentage of population in SC, ST, and in the general population, that were below the poverty line, and the SC poor and ST poor as percentage of total poor. The poverty line employed was based on the average minimum calorie requirement approach. In general, backward states were found to have a larger percentage of SC and ST in their population.

On the basis of a sample survey carried out in West Bengal in 1976, Maitra (1988) estimated the percentage of SC, ST and others among the poorest 20 per cent and the poorest 55 per cent of the rural population in West Bengal. Further, he found the percentage of population in each caste belonging to these fractile groups. He also did this for different occupation groups in rural West Bengal.

Raghuprasad (1986)[76] examined the levels of living of the SC and ST and the non-SC/ST groups of population in rural and urban Karnataka during 1973-74 and 1977-78 on the basis of

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[76] See also Nayak and Prasad (1984).

NSS household budget data. The SC/ST were found to have a lower level of living in <u>real</u> terms compared to the non-SC/ST and, in general, their level of living improved between 1973-74 and 1977-78. The inequality in the distribution of consumption expenditure increased for both SC/ST and non-SC/ST groups, but this increase was larger for the SC/ST. During 1977-78, the SC/ST had much lower literacy levels compared to the rest of the population. The occupation structure showed that the SC/ST were concentrated in low paying occupations -- most of them being agricultural labourers or production and related workers. However, this position improved slightly for the urban sector. The incidence of poverty was higher among the SC/ST. Raghuprasad also decomposed the Theil indices of inequality and log-variance of PCE to find inter-social group (both within different occupations and NSS regions and for the total population) and inter-regional (within occupations, within social groups and for the general population) and inter-occupational (within SC/ST and non-SC/ST and within regions and for the total population) contributions to the total inequality in the distribution of PCE. Within group inequalities were mainly responsible for overall inequality. Inter-regional disparities among the SC/ST were found to be stronger than inter-regional disparities among the non-SC/ST in both the sectors of Karnataka.

Chapter 2

THE DATA ANALYZED

2.1 Introduction

The present study on disparities in level of living and incidence of poverty in rural India is mainly based on a retabulation of the disaggregated household budget data of the Central Sample of the 28th round of the Indian National Sample Survey (NSS) relating to the period from October 1973 to June 1974. A copy of these data on an updated Honeywell tape was provided by the authorities of the NSS Organisation, Government of India. Following the usual procedure of the NSS Organisation, the 28th round household budget data were collected by the interview method from a countrywise probability sample of households through canvassing a 'Consumption Expenditure Schedule' (Schedule 1.0). The data made available by the NSS Organisation contained information on such household classificatory variables as the state, sector (rural or urban), district, etc. to which a household belonged, its size and composition[1/], its principal occupation, etc. along with the information on household expenditure on various items of domestic consumption. However, some of the useful details of household demographic information (viz., the information collected in the block 4 of the consumer expenditure schedule)

[1/] To be precise, household composition means the number of household members falling under the three categories — adult males, adult females and children (i.e., persons who have not completed 15 years of age).

were not available for the present study. Also, the level of education and occupations of the individual members of the household were not available, not even the number of earners in a household.

A broad summary of the consumer expenditure data collected in the NSS 28th round consumer expenditure enquiry is available, separately for the rural and urban sectors of individual states as well as India as a whole, in 'Report No. 240 : Tables with Notes on Consumer Expenditure : Twenty-eighth Round', published by the National Sample Survey Organisation, Government of India (1978). The NSS Report No. 240 does not utilize information on household group (that is, Scheduled Caste, Scheduled Tribe or others) or religion or principal occupation or land possessed. However, the use of disaggregated household level data allowed a more detailed analysis of level of living and poverty which cannot be carried out on the basis of Report No. 240[2/]. Thus, household characteristics such as household group and religion, household principal occupation, area of land possessed by the household, could be brought into the present analysis of level of living and poverty only because of the availability

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[2/] For example, disaggregated data made possible the decomposition of Atkinson-Kolm-Sen measure of relative inequality in the distribution of per capita expenditure in Chapter 3. They also allowed the (NSS) region-level studies carried out in Chapter 5.

of the disaggregated household level consumption expenditure data. In the present Chapter, a brief discussion will be made of the nature of the disaggregated NSS 28th round household budget data and other related data that have been used in this dissertation[3].

This Chapter is organised as follows : Section 2.2 describes the scope, coverage and design of the NSS 28th round survey and outlines the method of estimation of population characteristics. Section 2.3 gives the number of sample households for different states, and compares the statewise mean per capita expenditures obtained in this special tabulation with the corresponding results published in NSS Report No. 240. Section 2.4 gives the definitions of the variables used in the present study. The reliability and validity of NSS data in general is discussed in Section 2.5. And lastly, Section 2.6 describes the consumer price indices used for making price adjustments in various parts of the study.

2.2 Scope, Coverage and Design of the NSS 28th Round Enquiry on Consumer Expenditure

This Section begins with a description of the geographical area and population covered in the NSS 28th

[3] A description of the scope and coverage and design of the 28th round enquiry on consumer expenditure, together with concepts and definitions of the variaoles on which data were collected are given in 'National Sample Survey 28th Round : Instructions to Field Staff- Vol. I' (National Sample Survey, Government of India (1973)).

round survey and goes on to describe the sampling design followed for the selection of households for the enquiry on consumer expenditure. Next, the method of estimation of population characteristics such as total consumption expenditure and total population is briefly described.

The 28th round enquiry on consumer expenditure covered the population living in the rural and urban areas of practically the whole of India[4]. However, institutional population living in hospitals, jails, cantonments and other such Government institutions were excluded from the scope of the enquiry. Inmates of hostels, messes, etc. were, on the other hand, included; each such inmate together with his dependents and guests was taken to constitute a household.

The sampling design for the survey was stratified with a two stage selection of units within each stratum. Since the present dissertation deals mainly with rural India, only the sampling design for the rural sector of the country is described here[5]. For the rural sector of the country

[4] Only a few areas, viz., Ladakh district of Jammu & Kashmir, some areas of Madhya Pradesh and Maharashtra, rural areas of Nagaland, disturbed villages of Tripura, rural areas of Chandigarh, the Union Territories of Andaman and Nicobar Islands, Mizoram, Laccadive, Minicoy and Amindive Islands, Dadra and Nagar Haveli and districts Siang, Lohit and Tirap of Arunachal Pradesh, were excluded from the scope of the survey.

[5] The sampling design for urban India may be found in 'Instructions to Field Staff - Vol. I' (NSS Organisation, Government of India, 1973) or NSS Report No. 240.

villages were the first stage units (fsu's) and households constituted the second stage units (ssu's). The design of the survey made provision for two independent and inter-penetrating half-samples, each of which provided an equally valid estimate of population characteristics.

The sampling frame for the selection of fsu's in rural areas was the list of villages considered in 1971 population census of India. The whole country was divided into a number of basic strata (none of which cut across district boundaries). This was done by grouping contiguous tehsils having similar density of rural population and cropping pattern under the same stratum. Further, the strata were so formed that the 1971 census population in each stratum was less than 1.5 million. Thus, districts with population less than 1.5 million according to 1971 census each constituted one basic stratum[6/]. The all-India sample size of 8730 villages was allocated to the states on a joint consideration of their rural population, area under cereal crops and available investigator strength. Within each state and Union Territory, the allocated villages were distributed over the constituent basic strata in proportion to their rural population. In general, these allocations were rounded to multiples of 6 to ensure sub-sample (2 half

[6/] In Gujarat, some districts with population less than 1.5 million were divided into two basic strata.

samples) and sub-round (3 sub-rounds or seasons) representation in each basic stratum.

In the rural sector, within each basic stratum, the sample villages were selected with probability proportional to the size (PPS) of population (according to 1971 census) and with replacement in the form of two independent half-samples. Next, all households in a sample village were listed by investigators and arranged into six relatively homogeneous classes judged by their means of livelihood and depending on whether any member of the household had visited a health centre or not during the last 365 days preceding the date of enquiry. It may be mentioned that large villages were split into hamlets and one hamlet was selected for listing and subsequent operations. From the frame thus arranged within a village, a sample of households was selected in a linear systematic manner, using suitable sampling intervals and random starts specified for the purpose.

In the consumer expenditure enquiry, among other things, the quantities and values of different items consumed by a sample household during the 'last 30 days' preceding the date of interview was noted. As the 28th round survey period extended from October 1973 to June 1974, such a moving reference period could lead to the distortion of overall estimates of consumer expenditure[7]. Thus, with a view to eliminating possible effects of seasonality on final estimates of consumption, the period of survey was divided into three sub-rounds each of a duration of three-months (that is, October to December, 1973; January to March, 1974; and April to June, 1974), and the number of households to be interviewed was evenly distributed over the three sub-rounds within each stratum/sub-stratum by alloting different subsamples to the three subrounds.

The survey design was also made self-weighting at state-level, that is, each sample household in a state represented a fixed number of households in the population[8] of that state[9]. This number was, however, different for rural and urban sectors of a state.

Estimation Procedure

The procedure of estimating the population totals over households of characteristics like household size and consumer expenditure on items/item-groups was as follows :

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[7] For example, the consumption expenditure of households tend to be higher during festival seasons, for at such times, households purchase semi-durables such as clothing and footwear, and also incur expenditure on feasts and ceremonials.

[8] Here population refers to population of households.

[9] This number is commonly referred to as the 'multiplier' or raising factor for a state. These multipliers were needed in the present study only when computing all-India results.

For a given sector (rural or urban), let

s = subscript for the sth state,

i = subscript for ith household,

y_{is} = value of the characteristic y for the ith household of the sth state,

$\hat{Y}_s$ = estimate of the total for the characteristic y for the sth state,

n_s = number of households selected from the sth state,

$\hat{Y}$ = estimate of the all-India (rural or urban) total for the characteristic y,

h_{is} = size of household i in state s,

and M_s = multiplier for state s (different for rural and urban sectors)

Thus, the totals over households are estimated as :

$$\hat{Y}_s = M_s \sum_{i=1}^{n_s} y_{is} \qquad \ldots (2.1)$$

and
$$\hat{Y} = \sum_{s=1}^{k} M_s \sum_{i=1}^{n_s} y_{is} \qquad \ldots (2.2a)$$

$$= \sum_{s=1}^{k} \hat{Y}_s \qquad \ldots (2.2b)$$

where k is the number of states. For estimates of total population, y_{is} in expressions (2.1) and (2.2a), (2.2b) is replaced by h_{is}. If y_{is} is a characteristic which is equal for all members of the (i, s)th sample household (for example, the per capita expenditure of the household), then totals over the population of the characteristic y are given by

$$\hat{Y}_s = M_s \sum_{i=1}^{n_s} y_{is} h_{is} \qquad \ldots (2.3)$$

and $$\hat{Y} = \sum_{s=1}^{k} M_s \sum_{i=1}^{n_s} y_{is} h_{is} \qquad \ldots (2.4)$$

2.3 Sample Size and Mean Per Capita Expenditure (PCE)

The present study is, as mentioned earlier, based on a special re-tabulation of NSS 28th round household level data on consumer expenditure based on an updated Honeywell tape containing the data supplied by the authorities of the NSS Organisation. Results based on these data were found to be slightly different from those presented in NSS Report No. 240. These discrepancies need to be examined at the outset. It will be seen that, on the whole, the discrepancies are fairly small and do not raise serious doubts about the usefulness of the results reported in the present study.

Table 2.1 compares the sample sizes (number of households) and mean PCE for NSS 28th round enquiry as published by the NSS Organisation in Report No. 240 with the corresponding figures obtained in the present study, for rural areas of different states and the country as a whole. Cols. (2) and (3) of the table show that according to the published

Table 2.1 : Statewise sample sizes and estimated averages of monthly per capita consumer expenditure in rural India based on Central Sample of the NSS 28th round (October 1973-June 1974) enquiry on consumer expenditure

State	number of sample households		average monthly per capita consumer expenditure (Rs.)		$\frac{X_i - Y_i}{X_i} \times 100$ (per cent)
	NSS Report No. 240	present study	NSS report No. 240 (X_i)	present study (Y_i)	
(1)	(2)	(3)	(4)	(5)	(6)
Rajasthan	613	613	64.01	63.98	0.05
Punjab	670	670	75.51	76.68	-1.55
Jammu and Kashmir*	1327	657	52.24	54.14	-3.64
Haryana	603	603	72.45	73.01	-0.77
Himachal Pradesh	394	394	70.62	71.85	-1.74
Uttar Pradesh	1784	1784	51.32	51.58	-0.51
Madhya Pradesh	1320	1320	50.39	50.84	-0.89
Bihar	1300	1288	56.01	56.31	-0.54
Orissa	672	671	42.66	42.61	0.12
West Bengal	1030	1030	47.50	47.47	0.06
Assam	600	600	52.03	52.01	0.04
Manipur	222	222	52.92	52.88	0.08
Tripura	187	187	50.21	50.15	0.12
Nagaland	-	-	-	-	-
Meghalaya	226	225	58.85	58.89	-0.07
Andhra Pradesh	1236	1236	50.67	50.69	-0.04
Tamil Nadu	911	910	47.74	47.68	0.13
Kerala	645	645	55.35	55.32	0.05
Gujarat	530	530	54.49	54.54	-0.09
Maharashtra	1135	1135	52.27	52.91	-1.22
Karnataka	621	621	52.32	52.29	0.06
Delhi	17	17	60.99	61.43	-0.72
Chandigarh	-	-	-	-	-
Pondicherry	52	52	55.56	55.48	0.14
Goa, Daman and Diu	42	42	66.25	66.01	0.45
India	15467**	15452	53.01	53.24	-0.43

*For Jammu and Kashmir, the results presented in Report No. 240 are based on Central and State Samples combined.

**Excludes 670 State Sample households of Jammu & Kashmir.

NSS Report, the Central Sample for India for the NSS 28th round enquiry consisted of 15,467 rural households, while the tabulations carried out for the present dissertation show this figure to be 15,452. The sample sizes were found to agree for the rural areas of most states with a few exceptions. Thus, for the present study, the sample sizes for rural areas of Bihar, Orissa, Meghalaya and Tamil Nadu were smaller by 12, 1, 1 and 1 household(s), respectively.

The statewise (and all-India, rural) estimated average monthly per capita expenditures obtained in the present study (vide col. (5) of Table 2.1) were found to differ to some extent from the corresponding figures published in Report No. 240 (vide col. (4) of Table 2.1). The two sets of estimates differ to some extent for most of the states (and all-India). While this difference is less than a rupee in most cases, it exceeds a rupee for rural areas of the Punjab, Jammu & Kashmir and Himachal Pradesh. However, broadly speaking, the differences are small in the relative sense (vide the percentage differences in col. (6)) and indicate that the data set supplied by NSS Organisation for this study were very nearly the same as that used for NSS Report No. 240.

2.4 Definitions of the Items/Variables Used for the Present Study

As already mentioned, the definitions of the items/ variables on which data were collected in course of the NSS 28th round consumer expenditure survey are given in 'Instructions to Field Staff — Vol. I' (NSS Organisation, Government of India, 1973). However, for the sake of convenience, the definitions of the variables used in the present dissertation are reproduced below :

1. Household : A group of persons normally living together and taking food from a common kitchen. In case of hostels, hotels, etc., each boarder with his dependents and guests (if any) was considered to constitute a separate household. The normally resident members include temporary stay-aways but exclude temporary visitors or guests. If a person lives in one place and takes food from another, then he is considered to be a resident of the place where he lives.

2. Household Consumption : Household consumption consisted of domestic consumption of goods and services out of (i) monetary purchases, (ii) receipts in exchange of goods and services, (iii) home-grown stock, and (iv) (a) transfer receipts like gifts, loans, etc., (b) free collections. Consumption out of home-grown produce was imputed at ex-factory or ex-farm prices. Values of consumption under (ii) and (iv)(a) were imputed at the average local retail prices. And,

lastly, the value of consumption under (iv)(b) was imputed on the basis of average retail prices from a market (rural and urban) nearest to the sample village. Imputed rental of owner-occupied houses or of free accomodation provided by employers was, however, not included in the total value of household consumption.

3. Household Per Capita Consumption Expenditure (PCE) : It is the total household expenditure per capita on all items/item-groups of domestic consumption during the last 30 days preceding the date of interview.

4. Household Size and Composition : Household size gives the total number of persons normally residing in the household. Composition is indicated by a breakdown of household size -- the number of adult males, the number of adult females and the number of children.

5. Household Land Possessed : The area of land possessed by a household on the date of interview is recorded in acres. It is defined as follows :

area of land possessed = area of land owned + area of land leased in — area of land leased out.

6. <u>Household Industry - Occupation</u> : For each household there is a six-digited code number of which the first three digits from the left refer to the appropriate principal 'Industry Group' and the next three digits to the relevant principal 'Occupation Family' of the Industrial and Occupational Classification, respectively. For industry and occupation codes, the National Industrial Classification (NIC, Central Statistical Organisation, Government of India, 1962) and National Classification of Occupations (NCO, Central Statistical Organisation, Government of India, 1968) were used. Principal household occupation was that occupation which brought the maximum earnings to the household in the year preceding the date of enquiry. The industry in which the principal occupation was pursued was considered to be the principal industry group of the household. In case there were two or more industries in which the principal occupation was followed, that from which greater earnings accrued was taken to be the household industry group. In the event of there being two occupations or two industry-occupations with maximum earnings, that of the senior-most among the participating members was taken.

It may be mentioned here that not all households could be classified by industry and occupation. There were some non-worker households and households who failed to respond to the query about their occupation.

7. Household Group : A one-digited code number gives the group to which a household belonged —— 1 - Scheduled Castes, 2 - Scheduled Tribes and 3 - Others.

8. Household Religion : A one-digited code number gives the religion followed by a household during the NSS 28th round period. For example, 1 - Hinduism, 2 - Islam, etc.

It may be mentioned that in subsequent chapters the household group and religion codes were used together to form 'social groups' of households.

2.5 Reliability and Validity of NSS Consumer Expenditure Data

Since its inception in 1950, the NSS has been conducting countrywide multipurpose socio-economic enquiries in the form of successive rounds. Consumer expenditure data were collected from probability samples of households during all the rounds starting from the 1st (October 1950 - March 1951) to the 28th (October 1973 - June 1974), and thereafter at intervals of four or five years. Recently, however, NSSO has revived its annual enquiries on consumer expenditure.

As in the case of the NSS 28th round, the household budget data for any NSS round was collected by the interview method from a probability sample of households selected from the whole country. The sampling design for each round was stratified, multi-stage, with provision for two (or more) independent and inter-penetrating half-samples (or sub samples). The divergence between (among) half-sample (or sub-sample) estimates is expected to indicate the margin of uncertainty associated with the combined sample estimate. During the early rounds, the reference period for collection of data varied to some extent, but from the seventh round onwards, the reference period was 'last month' for all item-groups, including durables[10].

The NSS consumer expenditure data is the single most important body of data on consumer expenditure available in India and have been used extensively for studies on consumer behaviour, level of living and poverty in India, and have produced sensible results in most of these studies (Government of India, Planning Commission (1969); Bhattacharya (1978, 1978a)). However, questions are frequently raised on the reliability and validity of such data, especially when results based on these data are found to be at variance with *a priori* expectations or with results based on aggregate consumption data of National Accounts Statistics (also referred to as official estimates of consumption) thrown up by the Central Statistical Organisation, Government of India[11].

[10] From the 32nd round onwards, both 'last month' and 'last year' were used for durables and for clothing and footwear.

[11] For example, the NSS estimate of rural average PCE in 1967-68 (deflated by the National Income deflator with 1960-61 as base) was observed by Dandekar and Rath (1971) to be about 7 per cent below the corresponding NSS estimate in 1960-61 and about 11 per cent below the corresponding estimate for 1967-68 obtained from national accounts data. This led them to suspect the reliability of NSS 1967-68 estimates.

The main points of doubt raised about the NSS consumer expenditure data are :

(i) The data, by virtue of being collected by the interview method may be subject to recall biases and also to deliberate misreporting by respondents.

(ii) There is a feeling that the estimates of consumption of cereals as obtained through the NSS enquiries are somewhat biased upwards, resulting from over-reporting of consumption of foodgrains, particularly by households in the upper income classes. One possible source of such over-reporting could be that cereals consumed in connection with ceremonials during the reference period or cereals consumed by agricultural labourers employed by the household get double counted. It is also possible that cereals consumed by domestic animals other than pets get wrongly included in household consumption. However, lower income households are clearly found to report almost starvation levels of consumption (Chatterjee and Bhattacharya (1975); Vaidyanathan (1986)).

(iii) It is sometimes contended that the sampling design of the NSS enquiries which generally does not include any stratification by income, results in an under-representation of 'rich' households in the NSS consumer expenditure enquiries. As a result, the standard error of estimates relating to the upper income or consumption classes tend to be large (Dandekar and Rath (1971); Rudra (1972); Bhattacharya and Chatterjee (1975); Murthy (1977); Vaidyanathan (1986)). There is an apprehension that an increasing proportion of the rich households had become casualties, but there is no evidence to support this. What is important, these households may deliberately under-report consumption and stocks of consumer durables to a greater extent than others. This, if true, might distort the size distributions of consumption and related estimates thrown up by the NSS enquiries (Dandekar and Rath (1971); Rudra (1972)).

(iv) There are systematic changes over time in the degree of non-sampling errors in NSS data on consumption, owing to identifiable changes in the design of schedules and in concepts (Vaidyanathan (1986)).

(v) The use of NSS data in any study on inter-temporal movements in levels of household consumption might not be appropriate. Mukherjee (1986) claimed that NSS is unable to provide useful information on annual changes in household final consumption and its major constituents mainly because of changes in definitions, lengths of survey periods and gaps between two surveys. He suggested the use of overlapping samples in successive rounds as recommended by the Fisher Committee of 1957, in which some part of the sample is common among the rounds, while the other part changes.

However, in spite of all these objections that are frequently raised about the reliability and validity of NSS data, the fact remains that they are the only major source of information on private consumption available at household level and possess a fair measure of validity as is shown by sensible results of a wide variety of analyses based on such data. Only the NSS can give the distribution of the national total of consumption over sectors (rural and urban), regions (that is, states) and socio-economic classes of households (e.g., decile groups based on ranking by PCE), which is necessary for carrying out studies on level of living and poverty in India.

In order to validate NSS consumer expenditure data, many researchers compared NSS-based consumer expenditure data with corresponding estimates derived from national accounts data (that is, official estimates) thrown up by the CSO over different years (vide Mahalanobis (1960), Kansal (1965), Dandekar and Rath (1971), Rudra (1972), Mukherjee and Chatterjee (1974), Srinivasan et al (1974), Chatterjee and Bhattacharya (1975), Mukherjee and Saha (1981), Roy (1985), Vaidyanathan (1986), Suryanarayana and Iyenger (1986), Mukherjee (1986), Minhas et al (1986) and Minhas (1988)).

It may be noted that the NSS budget data are completely independent of the national accounts data, for, while the NSS budget data are collected directly by the interview method from a nationwide probability sample of households, the corresponding official estimates of total private consumption are computed indirectly by adjusting the production and income flows of different consumer goods and services for import, export, intermediate uses, government consumption and the change in stocks.

The studies mentioned above indicate systematic patterns in the divergences between the two sets of estimates of aggregate consumer expenditure over time. To be more specific, these studies indicate the following :

(i) The NSS estimates of aggregate household consumption expenditure were generally higher than the correspon-ding official estimates upto early sixties. There-after, the former were always lower (vide Mukherjee and Chatterjee (1974); Mukherjee and Saha (1981); Roy (1985); Vaidyanathan (1986)). The extent of divergence between the two series of estimated aggre-gate consumption expenditure is presented in Table 2.2 which is taken from Mukherjee and Saha (1981).

Table 2.2 : Discrepancies between NSS estimates of household consumption expenditure and official estimates of private consumption expenditure in India

(estimates in Rs. 10^9 at current prices)

Financial year	NSS estimate of household consumption expenditure	Official estimate of private consumption expenditure	$\frac{\text{NSS-Official}}{\text{Official}} \times 100$	Remarks
(1)	(2)	(3)	(4)	(5)
1954-55	81.3	81.1	0.25	NSS home consumption imputed at retail prices.
1955-56	85.6	82.2	4.26	
1956-57	93.0	95.2	(-)2.31	
1957-58	99.0	98.4	0.61	
1958-59	109.6	109.5	0.09	
1959-60	113.8	110.2	3.27	
1960-61	121.6	119.5	1.76	
1961-62	128.0	124.8	2.56	
1962-63	134.1	131.3	2.13	
1963-64	142.0	146.3	(-)2.94	
1964-65	163.0	174.6	(-)6.53	Integrated household Schedule used by NSS
1965-66	175.5	184.4	(-)4.83	- do -
1966-67	193.8	216.5	(-)10.48	- do -
1967-68	219.3	261.5	(-)16.14	- do -
1968-69	229.2	261.9	(-)12.49	- do -
1969-70	-	-	-	
1970-71	265.5	296.8	(-)10.53	- do -
1971-72	-	-	-	
1972-73	343.5	351.9	(-)2.39	
1973-74	411.2	430.4	(-)4.47	
1977-78	579.6*	626.0	(-)7.42	

*The NSS estimate does not relate to the financial year 1977-78 but to the period July 1977-June 1978; it was computed by S. Saha.

Source : Mukherjee and Saha (1981).

(ii) The NSS estimates of per capita foodgrain consumption have been appreciably higher than the official estimates through the sixties upto mid-seventies (Kansal (1965); Chatterjee and Bhattacharya (1975), Vaidyanathan (1986))

(iii) The per capita expenditure on non-food items as computed by CSO was always greater than the corresponding estimates thrown up by the NSS through the mid-sixties to early seventies (Vaidyanathan (1986))

(iv) The CSO estimates of per capita consumption of clothing were lower than the corresponding NSS estimates during the early sixties, but thereafter the latter was always lower (Roy (1985); Vaidyanathan (1986)).

Srinivasan et al (1974) discussed about the margins of error of the CSO and NSS estimates. They concluded that NSS estimates and CSO estimates may diverge because of the margins of error in both estimates, and therefore, neither does close agreement between the two series prove absence of bias, nor does divergence indicate bias in either of the series. Further, while for estimating incidence of poverty, it is sufficient to know the direction of bias in consumption of individuals near the poverty line, for estimating the amount of transfers of income required to reduce the incidence of poverty, it is essential to know both the direction and magnitude of bias over the entire range of consumption.

The question of comparability of the CSO and NSS estimates of consumer expenditure has also drawn attention. For example, Suryanarayana and Iyengar (1986) concluded that the NSS and CSO estimates are incomparable due to conceptual and methodological differences in their computation. Further, they noted that NSS data cannot be assessed as there exist no alternative estimates of the same population characteristics which would enable one to judge the reliability of the NSS estimates. In a detailed study, Minhas et al (1986) identified a large number of important factors which are responsible for differences between the NSS and official estimates of consumption. Among these factors are the differences in reference periods of the two series, differences in the recorded implicit prices of various consumer goods under the two series, differences in coverage and in the methods of data collection and estimation procedures (also see Minhas (1988)).

Finally, as stated earlier, this dissertation is mainly a cross-sectional study based on NSS 28th round consumer expenditure data. While it is quite possible that NSS budget data at the household level are affected by a variety of non-sampling biases like under-reporting of expenditure on tobacco and alcohol, such biases may be more or less uniform in cross-section data over regions, social groups, etc. To the extent such biases are in fact uniform across groups of households compared in the various analyses based on cross-section data, the results of the present dissertation will not be vitiated by them.

2.6 Consumer Price Indices Employed in the Study

In the present dissertation on variation in levels of living and poverty in rural India, different consumer price indices have been employed to adjust for inter-regional or inter-temporal variation in prices. Thus, to estimate the incidence of absolute poverty in rural areas of different states (and all-India) in Chapter 4, statewise (and all-India) poverty lines at NSS 28th round period rural prices were required. These poverty lines were estimated using Bardhan's (1973) methodology. Bardhan (1973) adopted PCE = Rs. 15 at 1960-61 all-India rural prices as the poverty line for rural India and derived separate poverty lines for rural areas of different states utilizing the average of the Fisher-type indices of inter-state consumer price differentials for the two lower quintile groups of the rural population of the states (with the prices for the corresponding quintile groups for rural India as base = 100) constructed by Chatterjee and

Bhattacharya (1974)[12]. For the present study, these statewise poverty lines estimated by Bardhan for the year 1960-61 were expressed at NSS 28th round period prices using the monthly averages of the Consumer Price Index Numbers for Agricultural Labourers (base : 1960-61). For rural India as a whole and for different socio-economic groups, poverty was estimated once using nominal PCE and again after expressing all PCE's in terms of all-India rural prices of the poor. For the latter purpose, all PCEs were adjusted using the same statewise Fisher-type consumer price indices constructed by Chatterjee and Bhattacharya (1974) as were used by Bardhan (1973) to derive his poverty lines for 1960-61.

Similarly, in Chapter 5, in order to study variation in level of living and poverty across NSS regions in rural India, all PCEs were expressed at all-India rural prices using the statewise Paasche-type price indices constructed by Bhattacharyya et al (1980) for the NSS 28th round period. In the same Chapter, some comparisons of level of living were carried out between NSS 18th and 28th round periods. For this purpose, the average PCEs of states and selected NSS

[12] These indices relate to the NSS 18th round period (February 1963 - January 1964); Bardhan assumed that the pattern of consumer price variation across states was the same in 1960-61. This is risky because inter-state price differentials may vary from year to year, as can be seen from the results of Rath (1973) for NSS 17th round, Chatterjee and Bhattacharya (1974) for NSS 18th round and Bhattacharyya et al (1980) for NSS 28th round.

regions for the NSS 18th round period were expressed at all-India rural prices for the same period utilizing the statewise Paasche-type consumer price indices constructed by Chatterjee and Bhattacharya (1974). Similarly, as mentioned earlier, the corresponding figures for NSS 28th round were expressed at all-India rural prices using the Paasche-type consumer price indices constructed by Bhattacharyya *et al* (1980). These price indices are briefly discussed below.

(a) The Consumer Price Index Numbers of Agricultural Labourers (CPIAL)

The monthly Consumer Price Index Numbers of Agricultural Labourers (base : 1960-61) are published in the 'Indian Labour Journal' brought out by the Labour Bureau, Ministry of Labour, Government of India. One index is constructed for each state. In the absence of a consumer price index number being specially designed for the poor, the CPIAL have been most commonly used to adjust poverty lines at 1960-61 prices for different years on the ground that the pattern of consumption of the rural poor is close to that of agricultural labourers.

The CPIAL are constructed by the Labour Bureau. The weights assigned to the different commodities in constructing the CPIAL were taken from the consumer expenditure pattern of agricultural labourers as estimated from the second Agricultural Labour Enquiry (ALE), which was conducted along with the NSS 11th and 12th rounds covering the period from August 1956 to July 1957. The index covers 65 items selected from the categories of (i) food, (ii) fuel and light, (iii) clothing, bedding and footwear, and (iv) miscellaneous. However, items under ceremonials, taxes and cess, and items like furniture, musical instruments, domestic utensils, ornaments, etc. were excluded. The expenditure on house rent, being negligible, was also excluded from the family budget of agricultural labourers. The retail prices for the base year (1960-61) were collected from a fixed set of 422 villages spread over 39 zones during the 16th round of the NSS. Current prices are being collected by the NSS. These are used to construct the CPIAL (vide Saluja (1972)).

The CPIAL, however, have some limitations in reflecting accurately the price changes for the poor. As already mentioned, the weights assigned to the different items in constructing the CPIAL relate to the second ALE (1956-57), even though the base year for these indices is 1960-61. Since then, the consumption pattern of agricultural labourers must have undergone considerable changes due to changes in the pattern of production and availability of foodgrains and other items, and therefore, the CPIAL might not reflect the actual changes in prices for agricultural labourers decades after 1960-61.

(b) <u>Consumer Price Indices Constructed by Chatterjee and Bhattacharya (1974)</u>

On the basis of NSS 18th round (February 1963 - January 1964) household budget data at the disaggregated household level, Chatterjee and Bhattacharya (1974) constructed indices of consumer price differentials between the rural areas of different states (and all-India). The budget data were employed to estimate average prices and weights of 56 items covering food, pan, tobacco and intoxicants, fuel and light, and clothing groups which made up about 82 per cent of the household budget. These average prices and weights were than used to compute Laspeyres', Paasche's and Fisher's indices for comparison of the price level in each state with that in every other state and all-India. The indices were also computed separately for the five quintile groups based on ranking of rural population by PCE in each of the fifteen states taking the corresponding quintile groups for rural India as a whole as base (= 100).

(c) <u>Price Indices Constructed by Bhattacharyya, Roy Choudhury and Joshi (1980)</u>

Bhattacharyya <u>et al</u> (1980) derived consumer price indices separately for the rural and urban areas of different states and all-India from household budget data collected during the NSS 28th round survey (October 1973 - June 1974). Considering 94 items of consumption covering about

85.15 (75.20) per cent of the budget for rural (urban) India as a whole, they constructed Laspeyres', Paasche's and Fisher's price indices for each of twenty states with every other state and all-India as base (= 100). The methodology followed was parallel to that of Chatterjee and Bhattacharya (1974) with the difference that Bhattacharyya et al seemed to do nothing to redistribute the weights of items within a group or sub-group excluded from the index computation. While computing their consumer price indices Chatterjee and Bhattacharya (1974) assumed that price differentials for the excluded item-groups were the same as the price differentials for the included item-groups.

Chapter 3

VARIATION IN LEVEL OF LIVING ACROSS SOCIAL GROUPS IN RURAL INDIA[1]

3.1 Introduction

There have been a large number of investigations on disparities in level of living in India, mainly based on the data on household consumption expenditure thrown up by NSS household budget enquiries (see, for example, the survey article by Bhattacharya (1978)). Various factors contributing to disparities in PCE have been mentioned, but there have not been many studies assessing the contributions of these factors to the variation in PCE across households. The present dissertation mainly aims at filling this gap, utilizing NSS 28th round budget data for rural India, and draws pointed attention to several factors which are of great importance.

Rural-urban and inter-state differentials in average PCE have been widely studied (*vide* Bhattacharya and Mahalanobis (1967); Bhattacharya and Chatterjee (1971a, 1971b); Chatterjee and Bhattacharya (1969, 1971, 1972, 1974a); Rath (1973); Bhattacharyya *et al* (1980); Bhattacharya *et al* (1988)).

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[1] Some results presented in this Chapter were reported in Bhattacharya, Chatterjee and Pal (1988) and in Bhattacharya and Pal (1986). The corresponding results for urban India were reported in Bhattacharya, Chatterjee and Pal (1986) and Bhattacharya and Pal (1986).

Some researchers have also examined variation in the levels of PCE by occupational classes (vide Mukherjee (1969) and Vaidyanathan (1974)); by size classes of household landholdings (vide Minhas (1974); Vaidyanathan (1974); Visaria (1981)), by household size (vide Vaidyanathan (1974)), by asset distribution (vide Sundaram and Tendulkar (1988)), and by regions within states (vide Mukherjee (1969)).

The NSS has at times collected and published consumer expenditure data separately for some of the weaker sections of the population such as agricultural labour households[2], rural labour households[3], and small cultivators and non-cultivating wage earner households[4]. But one important factor seems to have been completely ignored upto the mid-eighties, that is, for thirty years since the NSS data began to be available. This is the effect of the social group (Scheduled Caste (SC), Scheduled Tribe (ST), etc.) to which a household belongs[5]. Even though sample households were

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[2] The Second Agricultural Labour Enquiry (ALE) was conducted during the 11th and 12th rounds of the NSS, covering the period from August 1956 to July 1957.

[3] The NSS conducted the First Rural Labour Enquiry in 1963-65 and the Second in 1974-75.

[4] Theseerelate to the 'Survey of Economic Condition of the Weaker Sections - NSS 25th round, 1970-71'. See, in this connection, 'Consumer Expenditure of the Weaker Section of the Rural Population of India, NSS 25th round', NSS report No. 231.

[5] As mentioned in Section 1.2.6 of Chapter 1, some castes and tribes in India are recognised as depressed sections of the population by the Government of India and are listed in the Indian Constitution as SC and ST, respectively. These SC and ST are given special privileges in matters of education, employment, etc.

questioned about the social groups (that is, SC, ST or others) to which they belonged in course of the NSS consumer expenditure surveys in various rounds, separate estimates of consumer expenditure data were not published for social groups like the SC and ST until the 38th round (January-December, 1983). The only exception was NSS Report No. 158 : 'Tables with notes on consumer expenditure of Scheduled Tribe Households in Manipur and Tripura States', covering two small states in the north-eastern part of India. This report relates to NSS 18th round consumer expenditure enquiry.

The SC and ST form major sections of the backward classes of India[6/]. For centuries, the SC have been subjected to economic and social exploitation and deprivation by the rest of society. The ST, on the other hand, lived mostly in hilly or forest areas with hunting, fishing, gathering or shifting cultivation as their principal means of livelihood. Since independence, the uplift of the SC and ST have been given considerable importance in planning for economic development of the country.

The special provisions made for the SC and ST categories are of great social and political significance in India. In fact, there have been considerable tension and unrest over these issues, for instance, in the state of Gujarat. It

[6/] The historical backgrounds of the SC and ST are described in Section 1.2.6 of Chapter 1.

appears unfortunate, therefore, that social scientists have not kept continual watch over the disparities in level of living across social groups in the country. From Section 1.2.6 of Chapter 1, it appears that some aspects like education, occupational structure, untouchability, living conditions, religious beliefs and customs, and politicization of SC and ST have received the attention of several researchers. However, the few studies on the economic conditions of the SC and ST are mostly at the regional level. To recapitulate, Saradamoni (1981) studied the asset holdings, levels of living and consumer expenditure of the population of two panchayats in Kerala, stratified into caste-occupation categories. Kurien (1982) tried to identify the economic factors responsible for the poverty of the SC in India on the basis of 1971 Census data, the 'Report of the Commissioner of Scheduled Castes and Scheduled Tribes, 1977-78', and the 'Final Report on Wages and Earning of Rural Labour Households', based on Rural Labour Enquiry, 1974-75, and published by Labour Bureau, Ministry of Labour, Government of India (1979). He found that the problems of the SC were closely linked to those of the agricultural labourers. Papola and Ashraf (1983) examined the socio-economic development of SC in Uttar Pradesh and found a large proportion of them to be agricultural labourers. Aggarwal and Ashray (1977) studied the effects of the special privileges granted to the SC in Haryana. In a more detailed study, Raghuprasad (1986) examined different aspects of level of living and patterns of consumer expenditure of SC and ST in Karnataka, employing NSS 28th round (1973-74) and NSS 32nd round (1977-78) household budget data. Gupta et al (1983) also used NSS 32nd round budget data to examine the incidence of poverty among the SC and ST in four groups of states, classified according to their levels of per capita State Domestic Product, and also at all-India level. They did this separately for the rural and urban sectors, and for both sectors combined.

The present study differs from the studies referred to above in scope and coverage. It aims at examining and comparing levels of living of the SC and ST and other social groups for rural India as a whole, as well as for rural areas of individual states on the basis of NSS 28th round disaggregated household budget data.

Level of living has many dimensions of which domestic consumption measured by PCE is only one, though an important one. While PCE measures the absolute level of living of a household, factors such as occupation, education, and the area of land possessed by a household, etc., which determine the earning power of a household, also reflect the economic status of the household. The distributions of SC, ST and non-SC/ST populations by occupational groups, size classes of household land possessed and household size are examined in the present Chapter. But the main emphasis is on disparities in level of living of these groups based on nominal PCE. For this study on disparities, a more detailed classification of households by household social group is considered. The analyses are carried out for rural India on the basis of NSS 28th round disaggregated or household level budget data.

For the studies based on PCE, rural households covered in the NSS 28th round consumer expenditure enquiry were divided into social groups on joint consideration of religion and household group (that is, caste/tribe status). The households were first classified into three groups by religion : (I) Hindus, (II) Muslims and (III) 'other religious groups' (Jains, Buddhists, Christians, Sikhs, Parsis, etc.). Within each of groups (I), (II) and (III) households were further classified according to their caste/tribe status in the following manner :

(a) Hindu households were divided into Scheduled Castes (SC), Scheduled Tribes (ST), and 'other Hindu' groups.

(b) Muslim households were grouped into ST and non-ST, that is, 'other Muslim' groups.

(c) Households belonging to 'other religious groups' were similarly divided into ST and non-ST, that is, 'others' groups.

For the present study, only Hindu SC households have been taken to form the 'SC' category[7]. Among ST households, it may be mentioned, a majority reported themselves as Hindus, while quite a sizeable number of them claimed to follow religions other than Hinduism or Islam.

The averages of <u>nominal</u> PCE were first compared across different social groups in rural areas, both within individual states and at the all-India level. Next, the inequality in the size distributions of PCE - as measured by the Gini coefficient and the Atkinson-Kolm-Sen (AKS) relative indices - within these social groups were examined. Finally, in an attempt to measure the contribution of social group as a factor influencing the degree of inequality, the AKS inequality index was decomposed into intra-social group and inter-social group components. This was done, first for rural India as a whole and then for rural areas of individual states. These decompositions should indicate the relative importance of inequality within social groups <u>or</u> inequality between social groups as components of overall inequality.

However, while comparing levels of living of different social groups on the basis of PCE, one should bear in mind the limitations of PCE as an indicator of welfare of a

[7] Actually, according to instructions given to the field staff, even a Sikh household could report that it belonged to the SC category, but in the special tabulations carried out for this study, the SC category was formed only for Hindus.

household. For, in using PCE, the age-sex composition of a household, and the nature of occupation (heavy or sedentary) of individual earners of the household are ignored. One also has to ignore the variation in consumer prices across social groups if the comparison is made at the all-India level.

The study of disparities in level of living across social groups within individual states of India was done for twenty states, rural areas of which were covered in the NSS 28th round survey. The Union Territories, namely, Delhi, Chandigarh, Pondicherry and Goa, Daman and Diu had to be left out in these comparisons because of inadequate sample size; however, they were included when computing the results for rural India as a whole.

The structure of the present Chapter is as follows : The distribution of SC, ST and non-SC/ST populations in rural India by several determinants of level of living are examined in Section 3.2. Section 3.3 compares the averages of nominal PCE across social groups both for rural India as a whole and also separately for the rural areas of individual states. This Section also reports on the inequalities in the distribution of PCE within each social group at the all-India level. In Section 3.4, the AKS inequality indices for rural India as a whole as well as for individual states are decomposed into intra-and inter-social group indices. Finally, Section 3.5 concludes the Chapter with some observations.

3.2 Occupation, Land Possessed and Household Size : A Comparative Study of SC, ST and non-SC/ST Populations

The level of living of households is influenced by factors like number of earners, their occupation and educational status. But as already mentioned in Chapter 2, such information was not available and, therefore, the distribution of population by these factors could not be examined.

This Section examines the distributions of SC, ST and non-SC/ST populations in rural India by occupation, household land possessed and household size with a view to throwing light on the variation in level of living across these social groups.

Data on social group affiliation of sample households were collected in the NSS 28th round enquiry on consumer expenditure without any special probes. Therefore, before embarking on the present exercise, it would be worthwhile to check the reliability of NSS data on household group and religion. For this purpose, the statewise percentages of population falling in SC, ST, Hindu and Muslim groups as estimated from NSS 28th round budget data were compared with the corresponding figures obtained from the 1971 population census.

The statewise and sectorwise percentages of total population belonging to SC and ST as estimated from NSS 28th round household budget data are presented in Table 3.1.1. Separate estimates for the rural and urban sectors are not

Table 3.1.1 : State and sectorwise percentages of total population belonging to different social groups based on NSS 28th round enquiry on consumer expenditure (October 1973 - June 1974)

State/Union territory	no. of sample households		percentages of population							
			Scheduled Castes			Scheduled Tribes			Hindus	Muslims
	rural	urban	rural	urban	combined	rural	urban	combined	combined	combined
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Rajasthan	613	323	18.1	14.3	17.4	14.6	4.9	12.9	90.6	5.4
Punjab	670	263	14.9	11.1	14.0	0.6	0.5	0.5	35.9	1.2
Jammu and Kashmir	657	249	9.1	3.0	7.9	0.7	1.4	0.8	32.6	64.1
Haryana	603	239	21.1	13.7	19.8	0.4	1.2	0.6	89.2	2.0
Himachal Pradesh	394	60	23.6	16.3	23.3	3.0	1.0	2.9	95.5	0.9
Delhi	17	167	38.1	10.1	12.4	-	0.4	0.4	89.5	5.5
Uttar Pradesh	1784	867	21.9	11.0	20.5	1.0	0.7	1.0	81.6	15.4
Madhya Pradesh	1320	451	15.4	11.2	14.7	26.8	3.0	22.8	92.6	4.5
Bihar	1288	491	16.6	12.3	16.1	9.7	3.6	9.0	86.4	11.4
Orissa	671	227	14.8	8.8	14.2	26.0	8.4	24.3	93.8	2.5
West Bengal	1030	740	29.3	12.4	25.4	7.8	0.5	6.1	77.1	20.9
Assam (excl. Mizoram)	600	229	15.5	14.8	15.4	15.6	2.1	14.4	69.8	26.0
Manipur	222	53	1.6	3.0	1.8	26.0	1.2	22.2	63.4	11.8
Tripura	187	42	18.3	3.0	16.8	30.4	2.5	28.2	86.9	7.4
Meghalaya	225	51	0.3	4.8	0.7	83.1	24.7	76.9	28.4	5.1
Andhra Pradesh	1236	664	17.0	8.3	15.2	4.1	1.0	3.4	85.9	8.1
Tamil Nadu	910	744	23.4	9.2	18.8	0.2	0.2	0.2	88.3	5.7
Kerala	645	245	10.4	5.7	9.5	1.0	-	0.9	60.5	18.3
Pondicherry	52	31	22.6	15.6	19.7	-	-	-	88.4	7.3
Karnataka	621	369	13.9	9.4	12.8	3.1	0.5	2.5	87.3	9.3
Gujarat	530	364	6.0	4.3	5.5	20.0	4.0	15.8	89.0	8.3
Maharashtra	1135	953	6.6	4.8	6.1	14.3	3.0	11.2	84.3	7.3
Goa, Daman, Diu	42	23	2.9	2.6	2.8	-	-	-	70.8	2.7
India	15452	7898*	17.3	9.4	15.7	9.4	1.8	7.9	82.9	10.7

* This total includes the number of sample households for Chandigarh and Nagaland.

Table 3.1.2 : State and sectorwise percentages of total population belonging to different social groups based on the census of India, 1971

State/Union territory	Scheduled Castes			Scheduled Tribes			Hindus	Muslims
	rural	urban	combined	rural	urban	combined	combined	combined
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Rajasthan	16.5	12.8	15.8	14.4	1.5	12.1	89.6	6.9
Punjab	27.6	15.3	24.7	-	-	-	37.5	0.8
Jammu and Kashmir	9.3	3.7	8.3	-	-	-	30.4	65.9
Haryana	20.6	11.1	18.9	-	-	-	89.2	4.0
Himachal Pradesh	22.8	14.7	22.2	4.4	0.2	4.1	96.1	1.5
Delhi	25.1	14.6	15.6	-	-	-	83.8	6.5
Uttar Pradesh	22.6	11.3	21.0	0.2	0.1	0.2	83.8	15.5
Madhya Pradesh	13.7	10.1	13.1	23.6	2.1	20.1	93.7	4.4
Bihar	14.7	9.1	14.1	9.3	3.7	8.8	83.5	13.5
Orissa	15.4	11.2	15.1	24.5	8.0	23.1	96.3	1.5
West Bengal	24.3	6.6	19.9	7.4	0.5	5.7	78.1	20.5
Assam (incl. Mizoram)	6.1	6.5	6.1	13.7	3.7	12.8	71.0	24.0
Manipur	1.7	0.4	1.5	34.3	10.6	31.2	59.0	6.6
Tripura	13.1	6.3	12.4	31.9	3.4	29.0	89.6	6.7
Meghalaya	0.2	1.5	0.4	86.4	45.6	80.5	18.5	2.6
Andhra Pradesh	14.5	8.1	13.3	4.5	1.0	3.8	87.6	8.1
Tamil Nadu	21.1	10.2	17.8	1.0	0.1	0.8	89.0	5.1
Kerala	9.0	5.0	8.3	1.4	0.3	1.3	59.4	19.5
Pondicherry	21.1	7.7	15.5	-	-	-	85.0	6.2
Karnataka	14.4	9.1	13.1	0.9	0.4	0.8	86.5	10.6
Gujarat	6.9	6.6	6.8	18.3	3.0	14.0	89.3	8.4
Maharashtra	6.6	4.8	6.0	8.1	0.8	5.9	81.9	8.4
Goa, Daman, Diu	1.7	2.5	1.9	0.9	0.8	0.9	64.2	3.8
India	16.1	8.8	14.6	8.4	1.2	6.9	82.7	11.2

presented for Hindus and Muslims. The corresponding census figures are given in Table 3.1.2. While the census-based percentages of SC population include Sikhs reporting themselves as SC, the corresponding NSS-based estimates relate only to the Hindu SC population[8]. The two sets of percentages of population falling in different social groups appear to agree fairly well. Even though the census enumeration may be far from perfect, this agreement validates the NSS data on social groups to a large extent and allows one to proceed with some degree of confidence with comparisons of level of living across social groups, employing NSS data on social groups and PCE.

First, the social groupwise distributions of population by occupation are examined for rural India as a whole.

3.2.1 <u>Occupation</u>

The rural households were divided into broad occupational classes using the codes given as per the National Classification of Occupations (NCO) (1968). The occupational classes considered for the study, together with their NCO codes and estimated percentages of households in these classes for rural India as a whole, according to NSS 28th round enquiry on consumer expenditure, are set out in the table below :

[8] See footnote 7 of this Chapter.

	occupational class	NCO codes	percentage of rural households
I.	professional, technical and related, administrative, executive and managerial workers, clerical and related workers.	000-399	3.40
II.	sales workers	400-499	2.91
III.	service workers	500-599	2.02
IV.	cultivators (owners)	610	47.52
V.	cultivators (tenants)	611	1.59
VI.	agricultural labourers	630	29.02
VII.	other agriculture, fishermen, hunters, loggers and related workers.	600-699, excluding 610, 611 and 630	2.33
VIII.	production and related workers, transport equipment operators and labourers	700-999	8.23
IX.	non-response or non-workers	NCO code 000 and National Industrial Classification (NIC) code 000	2.98

The distributions of rural SC, ST and non-SC/ST population over these nine occupational classes are presented in Table 3.2. It appears that about half the rural SC population belonged to agricultural labour households. In all, about 84 per cent of the SC were in the agricultural sector. Coming now to the ST, about 93 per cent of the population were

Table 3.2 : Distribution of the all-India rural population in different social groups by household occupation, NSS 28th round (October 1973 - June 1974) consumer expenditure enquiry

household principal occupation	percentage of population in			
	SC	ST	non-SC/ST	all groups
(1)	(2)	(3)	(4)	(5)
I. professional, technical and related, administrative, executive and managerial, clerical and related workers	1.80	1.23	3.62	3.08
II. sales workers	1.30	0.70	3.42	2.80
III. service workers	1.98	0.73	1.74	1.68
IV. cultivators (owners)	27.48	59.75	57.94	52.86
V. cultivators (tenants)	2.65	0.93	1.55	1.68
VI. agricultural labourers	50.90	29.77	19.45	25.84
VII. other agriculture, fishermen, hunters, loggers and related workers	2.61	2.38	2.14	2.24
VIII. production and related workers, transport equipment operators and labourers	9.66	4.08	8.08	7.98
IX. non-response or non-workers	1.62	0.43	2.05	1.83
all occupations	100.00	100.00	100.00	100.00
no. of sample households	2691	1614	11147	15452

in households mainly engaged in agricultural occupations. Of these, nearly 60 per cent were in 'owner cultivator' households. Among the rural non-SC/ST population, about 81 per cent got their major share of income from agriculture. The percentage of rural population belonging to agricultural labour households was appreciably lower (about 19 per cent) for this group. Also, the percentage of population dependent on white collar occupations (class I) was a little higher for the non-SC/ST group compared to the SC and ST, and the same is true of occupational class II as well. Another noteworthy finding from Table 3.2 is the lower percentage share of class VIII for the ST population.

Thus, one finds appreciable differences in occupational structure across the SC, ST and non-SC/ST groups. A much higher proportion of the SC were dependent on agricultural labour. While a large proportion of the ST were 'owner cultivators', it is also true that they mostly inhabited hilly or forest areas and, therefore, the quality of land owned by them tended to be inferior. Also the ST shows lower percentages for occupational classes I and VIII. Thus, on the basis of occupational structure, the non-SC/ST may be considered to be better-off than the SC or ST.

3.2.2 Size Classes of Household Land Possessed

As agriculture is the major source of livelihood of a large proportion of households in rural areas, an examination of the distributions of SC, ST and non-SC/ST populations by size classes of land possessed by households might throw some light on differences in level of living across these groups.

In course of the NSS 28th round consumer expenditure survey, the area of land (in acres) possessed by each sample household was recorded among the classificatory characteristics of the household. Land possessed by a household was defined as :

land possessed = land owned + land leased in - land leased out.

Here again, it would be necessary to examine the validity of NSS 28th round data on land possessed, which, like the data on social group were collected through a single question without any probe. For this purpose, estimates relating to household land possessed thrown up by the NSS 28th round survey are compared with estimates thrown up by the elaborate 26th round (July 1971-September 1972) enquiry on landholdings.

Data from the NSS 26th round survey on landholdings, published in Report No. 215 : 'Tables on landholdings : All-India' and _Sarvekshana_, Vol. V, Nos. 3 and 4 (January-April, 1982), give estimates relating to area owned[9] and area operated by households. A household operational holding is a land-holding possessed and managed by a single household, and used wholly or partly for agricultural production, plus any share of it in a joint operational holding (operated by several households). The reference period for land operated was the agricultural year 1970-71. Cooperative farms and land put to non-agricultural uses were excluded from the scope of the survey.

The statewise averages of land possessed per household based on the 28th round consumer expenditure enquiry were compared with the corresponding averages of land operated per household, based on the 26th round survey of landholdings. The estimates for the two rounds are presented separately for two half-samples of the NSS sample and also for the combined sample in appendix Table A.1. A comparison of the two sets of estimates should indicate the reliability and validity of the 28th round figures collected through a single question item. In general, divergence between the two sets of estimates is large for states/U.T.s with small sample sizes during the NSS 28th round. However, somewhat large divergence is also observed for Haryana.

The all-India distributions of rural households over size classes of household land operated/possessed during the

[9] Any area of land taken on long-term lease was also treated as land owned.

NSS 26th and 28th rounds are also compared. The relevant figures are set out in Appendix Table A.2. The percentages of households in the first two size classes varied considerably between the two rounds. This can be largely explained by the difference between the concepts of land possessed and land operated. During the 26th round, the first size class referred to landless households or households operating no land, whereas for the 28th round, this covered households possessing no land. In the remaining size classes, the percentages of households and those of area operated/possessed agree quite well. This is evident, from the ogives (vide Fig. A.1) and Lorenz Curves (vide Fig. A.2) based on the size distributions of landholdings for the two periods.

On the whole, Tables A.1 and A.2 and Figs. A.1 and A.2 point to satisfactory agreement between NSS 26th and 28th round estimates of landholdings and validates NSS 28th round data on land possessed by sample households.

After some experimentation, the fifteen size classes of land possessed (shown in Table A.2) were reduced to seven for purposes of a comparative study of SC, ST and non-SC/ST groups. These are shown in Table 3.3. Each class interval includes its lower limit but excludes its upper limit. The distributions of the rural SC, ST and non-SC/ST populations over these seven size classes of land possessed are set out in Table 3.3. About 58 per cent of the rural SC population

Table 3.3 : Distribution of the all-India rural population in different social groups by size classes of household land possessed, NSS 28th round (October 1973 - June 1974) consumer expenditure enquiry

household land possessed (in acres)	percentage of population in			
	SC	ST	non-SC/ST	all groups
(1)	(2)	(3)	(4)	(5)
< 0.005	4.71	5.29	3.22	3.67
0.005 - 1.0	52.89	21.44	28.21	31.83
1.0 - 2.5	18.26	14.55	16.45	16.58
2.5 - 5.0	12.04	21.04	18.35	17.51
5.0 - 7.5	5.91	15.55	11.40	10.85
7.5 - 15.0	3.77	13.22	12.70	11.21
15.0 -	2.42	8.91	9.67	8.35
all classes	100.00	100.00	100.00	100.00
number of sample households	2691	1614	11147	15452

Table 3.4 : Distribution of all-India rural population in different social groups by household size, NSS 28th round (October 1973 - June 1974) consumer expenditure enquiry

household size (no. of persons)	percentage of population in			
	SC	ST	non-SC/ST	all groups
(1)	(2)	(3)	(4)	(5)
1	0.97	0.81	1.19	1.11
2	4.04	3.49	3.17	3.35
3	8.82	7.23	6.46	6.94
4	12.30	11.35	10.28	10.73
5	17.62	15.16	14.79	15.32
6	18.22	18.37	15.09	15.94
7	13.42	13.85	14.24	14.06
8	9.41	10.06	10.60	10.34
9	5.57	5.93	7.15	6.76
10 and above	9.63	13.75	17.02	15.44
all sizes	100.00	100.00	100.00	100.00
number of sample households	2691	1614	11147	15452

were in households possessing less than 1 acre of land. The corresponding percentages of population for ST and non-SC/ST groups were about 27 and 31 per cent, respectively. On the other hand, households possessing 5 acres or more of land constituted about 12 per cent, 38 per cent and 34 per cent of the population in SC, ST and non-SC/ST groups, respectively.

Clearly, then, as in the case of household principal occupation, here also, the distribution by size classes of household land possessed show the non-SC/ST group to be better-off than the SC. From Tables 3.2 and 3.3, the ST might appear to have been better-off than the SC and nearly as well-off as non-SC/ST, but as already mentioned, the ST mostly lived in hilly/forest areas where the quality of land tends to be lower and opportunity for non-agricultural occupations tends to be limited.

3.2.3 Household Size

The percentages of the rural population of SC, ST and non-SC/ST in households of different sizes are presented in Table 3.4. The percentage of population in large sized (≥7 members) households seemed to be greatest for the non-SC/ST group (49 per cent), followed by ST (43.6 per cent) and then SC (38 per cent). For households consisting of 2 to 5 members, the opposite pattern is observed - the percentage of SC population (42.8 per cent) in these groups was greater than those in ST (37.2 per cent) or non-SC/ST (34.7 per cent) groups. So, on the whole, household size was largest for non-SC/ST and smallest for SC (vide Table 3.5 below).

One may now examine the household compositions of these groups. The average household size and the average number of adult males, adult females and children per household in these groups are set out in Table 3.5. The average number of adult males, adult females and children, and therefore the average household size of the SC were smaller than the corresponding figures for ST and non-SC/ST groups. The values for ST which were close to the averages for all rural households, were a little lower than those for the non-SC/ST group.

Table 3.5 : Average size and composition of households in different social groups in rural India based on NSS 28th round household budget data

social group	average number per household of			
	adult males	adult females	children	persons
(1)	(2)	(3)	(4)	(5)
SC	1.44 (28.9)	1.40 (28.1)	2.14 (43.0)	4.98 (100.0)
ST	1.52 (28.9)	1.48 (28.1)	2.26 (43.0)	5.26 (100.0)
non-SC/ST	1.56 (28.9)	1.53 (28.4)	2.30 (42.7)	5.39 (100.0)
all groups	1.54 (29.0)	1.50 (28.2)	2.27 (48.2)	5.31 (100.0)

Note : Figures in parentheses give percentages of population.

Household composition is shown by the percentages within parentheses, and these are very similar for the three groups.

3.3 Comparison of Nominal PCE across Social Groups

A detailed examination of disparities in level of living across social groups is now carried out. The averages of nominal PCE are compared across social groups, first for rural India as a whole. The exercise is then repeated for rural areas of individual states.

3.3.1 Variation across Social Groups at All-India (Rural) Level

The mean PCE for each social group expressed as an index, taking the mean PCE for rural India as base (= 100), is presented in Table 3.6. Col. (2) of the Table shows that most of the indices presented are based on fairly large samples, and small divergences between the half-sample estimates indicate the reliability of these indices. However, the half-sample divergence for ST belonging to 'other religious groups' is quite large.

The average PCE for the Hindus was found to be almost level with that of the general rural population. The SC and ST among the Hindus were about 20 or 21 per cent below the general rural population. The 'other Hindus', on

Table 3.6 : Averages of PCE for different social groups expressed as percentage of the average PCE for the general population, based on NSS 28th round enquiry on consumer expenditure, all-India, rural

social groups compared	no. of sample house-holds	average PCE as percentage (general population = 100)		
		hs1	hs2	combined
(1)	(2)	(3)	(4)	(5)
I. Hindus				
ST	1319	81.5	76.1	78.9
SC	2691	80.9	78.9	79.9
'other Hindus'	8379	107.4	109.0	108.2
SC + 'other Hindus'	11070	101.4	102.1	101.7
all Hindus	12389	99.2	99.5	99.4
II. Muslims				
ST	4	-	-	-
'other Muslims'	1674	95.3	93.7	94.5
all Muslims	1678	95.4	93.7	94.5
III. 'other religious groups'				
ST	291	81.1	97.2	88.0
'others'	1094	122.6	117.9	120.2
all	1385	117.5	115.9	116.7
IV. all religious groups				
ST	1614	81.5	77.5	79.6

Note : '—' indicates that the estimates are too unreliable to be prêsented.

the other hand, were about 8 per cent above the all-India rural average. However, on combining the SC and 'other Hindu' categories, the average PCE came close to that for the overall rural population.

The 'other Muslims' (and all Muslims) were found to be about 5 per cent below the overall rural average.

Households in the 'other religious groups' appeared to be the most well-off, their average PCE being roughly 17 per cent above that for the entire rural population. The average PCE for the ST population in this category was observed to be about 88 per cent of that of the overall rural population; but as the divergence between the half-sample estimates for this group is rather large, not much reliance can be placed on this estimate. The non-ST, that is, the 'others' in the same category were roughly about 20 per cent above the all-India rural average.

Thus, it appears that among 'Hindus' and among 'other religious groups' categories, the ST population were appreciably worse-off compared to the 'other Hindus' and 'others', respectively. The average PCE of all ST households (that is, irrespective of their religious affiliations) seemed to be about 80 per cent of the average PCE of the general rural population.

If the average PCE of the ST population is taken as base (= 100), the average PCE indices of ST households reporting themselves as Hindus, Muslims, or as belonging to 'other religious groups' can be seen to be as follows :

within ST population	no. of sample households	average PCE as percentage (average for ST population=100)		
		hs1	hs 2	combined
(1)	(2)	(3)	(4)	(5)
Hindus	1319	100.0	98.2	99.1
Muslims	4	-	-	-
'other religious groups'	291	99.5	125.4	110.7

Note : See note below Table 3.6.

Coming now to non-SC/ST households, from the above discussion one finds considerable variation in the levels of average PCE of 'other Hindus', 'other Muslims' and 'others'. It, therefore, appears meaningful to compare the levels of living of the following five social groups : (i) The Scheduled Castes (among Hindus)(SC), (ii) the Scheduled Tribes (ST), (iii) the 'other Hindus' (OH), (iv) the 'other Muslims' (OM) and (v) the 'others'. It may be observed that these five groups are mutually exclusive and collectively exhaustive in that they cover the entire rural population. For most of the remaining analyses, these five social groups will be considered for purposes of comparisons[10/].

[10/] The use of these five groups has only one disadvantage : it masks the differentials between Hindus and 'other religious groups' among the ST population.

This all-India picture of differentials in levels of living, measured by average nominal PCE is over-simplified for the following reasons :

(i) It ignores inter-regional differences in consumer prices.

(ii) It also ignores the differences in regional distribution of population belonging to different social groups.

(iii) The indices presented in Table 3.6 show only the relative positions of different social groups in terms of average nominal PCE. As is well-known, average PCE alone cannot reflect fully the welfare of a group, for the within group distribution of PCE should also be taken into account in the measurement of welfare. The comparison of levels of living across social groups should be based on some measure of 'equally distributed equivalent'[11] PCE.

To meet the criticism made in (i) and (ii) above, the relative positions of the five social groups are now examined, separately for rural areas of individual states.

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[11] Let $\underline{y}' = (y_1, y_2, \ldots, y_n)$ be a vector representing the PCE's of n persons forming a group. Then, the 'equally distributed equivalent' PCE of the group would be that level of PCE which when equally enjoyed by all n individuals would yield the same level of social welfare as $\underline{y}$.

3.3.2 Variation in Average PCE across Social Groups within Rural Areas of Individual States

In Table 3.7, as in Table 3.6, the average nominal PCE of each social group within a state is expressed as a percentage of the average nominal PCE of the general population in the rural areas of the same state.

The pattern of variation in the index of average PCE across the five social groups observed at all-India level is roughly repeated in most of the states with some exceptions. For example, in the Punjab, the average PCE for 'other Hindus' was below the average PCE for rural Punjab as a whole. In rural Maharashtra, the 'others' were a little better-off than the ST, but were significantly worse-off than 'other Hindus'. Similarly, in rural Andhra Pradesh, the 'other Hindus' were appreciably better-off than the 'others'.

These average PCE indices were used for a series of sign tests (vide Siegel (1956), pp. 68-75) which were performed in order to compare the indices for each pair of social groups within the rural sector of the same state, assuming that the estimated PCE, has a continuous distribution. In each of these tests, the indices for different states were treated as the primary observations, and the tests were carried out in the following manner :

Let $x_1, x_2, \ldots, x_k$ be the average PCE indices for social group A for states 1, 2, ..., k and $y_1, y_2, \ldots, y_k$

Table 3.7 : Averages of PCE for different social groups expressed as percentage of the average PCE for the general population, by States, based on NSS 28th round enquiry on consumer expenditure : rural sector

State/Union territory	Scheduled Tribes			Scheduled Castes			Other Hindus			Other Muslims			Others		
	hs 1	hs 2	com-bined	hs 1	hs 2	com-bined	hs 1	hs 2	com-bined	hs 1	hs 2	com-bined	hs 1	hs 2	com-bined
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Rajasthan	78.3	74.1	76.2	81.9	79.6	80.7	108.1	110.0	109.4	—	—	—	—	—	—
Punjab	—	—	—	71.4	75.4	73.2	98.8	76.6	87.0	—	—	—	106.1	109.5	107.8
Jammu & Kashmir	—	—	—	76.4	78.4	77.4	92.1	105.8	99.4	105.4	100.3	102.8	—	—	—
Haryana	—	—	—	72.5	69.0	70.6	103.5	109.3	106.2	—	—	—	—	—	—
Himachal Pradesh	—	—	—	94.6	69.9	83.0	98.1	108.5	103.3	—	—	—	—	—	—
Uttar Pradesh	—	—	—	85.7	81.3	83.7	105.0	107.9	106.4	98.6	97.2	97.9	—	—	—
Madhya Pradesh	79.1	73.2	76.3	92.0	93.9	92.3	114.5	111.5	112.9	—	—	—	—	—	—
Bihar	85.2	78.4	81.1	68.3	78.0	72.8	111.8	109.6	110.7	90.2	99.4	94.4	—	—	—
Orissa	76.8	77.2	77.0	87.6	82.9	84.8	112.3	116.5	114.3	—	—	—	—	—	—
West Bengal	84.3	81.8	83.0	82.7	82.1	82.5	120.8	119.5	120.1	92.0	97.2	94.5	—	—	—
Assam	109.6	98.8	105.3	90.8	87.0	88.9	95.9	105.2	100.7	103.2	99.9	101.6	—	—	—
Manipur	85.0	102.3	92.5	—	—	—	106.4	104.3	106.0	—	—	—	—	—	—
Tripura	85.3	79.2	82.2	—	—	—	119.2	109.9	114.2	—	—	—	—	—	—
Meghalaya	98.5	97.7	98.1	—	—	—	—	—	—	—	—	—	—	—	—
Andhra Pradesh	68.4	68.1	68.4	75.9	69.7	72.7	108.7	111.2	109.9	96.0	88.4	91.2	96.6	91.4	93.8
Tamil Nadu	—	—	—	85.7	79.4	81.8	103.1	110.3	106.7	—	—	—	—	—	—
Kerala	—	—	—	75.9	71.9	73.8	107.2	107.6	107.6	83.1	82.7	82.9	112.4	112.7	112.3
Karnataka	—	—	—	75.5	79.4	76.1	106.9	105.8	106.4	—	—	—	—	—	—
Gujarat	81.0	77.3	79.1	—	—	—	106.7	107.6	107.2	—	—	—	—	—	—
Maharashtra	89.4	81.5	85.3	78.0	84.5	80.8	104.9	107.8	106.4	—	—	—	94.0	82.0	87.6
INDIA	81.5	77.5	79.6	80.9	78.9	79.9	107.4	109.0	108.2	95.3	93.7	94.5	122.6	117.9	120.2

Notes : Results are presented for social groups with sample size ≥ 50.

be the corresponding indices for social group B. The differences $(x_i - y_i)$, $i = 1, 2, \ldots, k$ were computed for each state and the signs of these differences were considered to examine the validity of the null hypothesis :

H_0 : median (average PCE of group A in a state – average PCE of group B in the same state) = 0.

Under H_0, one would expect that the number of pairs (x_i, y_i) with $x_i > y_i$ would tend to equal the number of pairs (x_i, y_i) with $x_i < y_i$. In other words, if the hypothesis H_0 were true, then about half the differences would be negative and half of them positive. Of the k pairs of indices, if r show positive differences $(x_i - y_i)$ and s negative, then $r + s \leq k$. Let $t = \min(r, s)$. If t is the number of positive signs, then one is to judge how likely are at most t successes to occur in $(r + s)$ trials from a binomial distribution with probability of success $p = \frac{1}{2}$. If $Z = \sum_{j=0}^{t} \binom{r+s}{j} \left(\frac{1}{2}\right)^{r+s} < \alpha$,

then H_0 is rejected in favour of the appropriate alternative (H_1 : median of differences < 0) at 100 α per cent level of significance. If t is the number of negative differences, then one uses Z defined in the same way to test the one-sided alternative H_2 : median of the differences > 0. In order to reject H_0 for the two-sided alternative H_3 : median of differences $\neq 0$ at 100 α per cent level of significance, it is required that $2 \sum_{j=0}^{t} \binom{r+s}{j} (\frac{1}{2})^{r+s} < \alpha$.

The results of the tests carried out for different pairs of social groups are summarised in Table 3.8 below.

Table 3.8 : Results of sign tests performed to compare indices of average PCE within rural areas of the same state, separately for different pairs of social groups, NSS 28th round enquiry on consumer expenditure

social groups compared		no. of observed pairs (states utilized)	test statistic Z*	conclusion
group A	group B			
SC	ST	8	0.623	H_0 accepted at 5 per cent level
SC	OH	16	$(\frac{1}{2})^{16}$	H_0 rejected at 1 per cent level in favour of H_1
SC	OM	7	0.008	- do -
ST	OH	11	0.006	- do -
OM	OH	7	0.227	H_0 accepted at 5 per cent level

* See text for definition.

Note : H_0 : median (average PCE index of group A in a state — average PCE index of group B in the same state) = 0.

H_1 : median (average PCE index of group A in a state — average PCE index of group B in the same state) < 0.

The 'others' could not be compared with the remaining social groups because of the paucity of the number of states with reliable estimates for 'others'. For the same reason, the ST could not be compared with 'other Muslims'.

The results of the sign test largely corroborate the main conclusions drawn from Table 3.6. The average PCE for 'other Hindus' was significantly above that for SC within the same state in the rural sector of India. In the same way, 'other Muslims' showed higher average PCE than SC within the same state. The average for 'other Muslims' was not significantly lower than that for 'other Hindus' in the rural areas of the same state, but this comparison was based on 7 states only. It appears that the ST group was not significantly different from the SC group, but was significantly worse-off, on the whole, compared to 'other Hindus' in the rural areas of the same state.

3.3.3 <u>Variation in Inequality of PCE across Social Groups</u>

One may now attempt to study the degree of inequality in the distribution of PCE within these social groups at the all-India level. The Gini coefficients and the AKS relative inequality indices of the size distribution of <u>nominal</u> PCE within each of the five social groups for the rural areas of the country are presented in Table 3.9.

Let $\underline{y}' = (y_1, y_2, \ldots, y_n)$ ... (3.1) be a vector representing the PCE's of n persons constituting the rural population in a group. Let μ be the mean PCE of this population, that is,

$$\mu = \frac{1}{n} \sum_{i=1}^{n} y_i \qquad \ldots (3.2)$$

and ξ be its equally distributed equivalent (ede) PCE. Then, ξ is obtained by solving the equation

$$W(\xi \cdot \underline{1}_n) = W(\underline{y}) \qquad \ldots (3.3)$$

where W is a social welfare function and $\underline{1}'_n = (1, 1, \ldots, 1)_{1xn}$. W is assumed to be continuous, increasing, S-concave, additively separable and homothetic.

Then, the AKS relative inequality index is of the form (See Chapter 1, Section 1.1.3.

$$I(\underline{y}) = 1 - \frac{\xi}{\mu}$$

$$= \begin{cases} 1 - \dfrac{\left(\frac{1}{n} \sum\limits_{i=1}^{n} y_i^r\right)^{1/r}}{\mu}, & r \neq 0,\ r \leq 1, \\ 1 - \dfrac{\left(\prod\limits_{i=1}^{n} y_i\right)^{1/n}}{\mu}, & r = 0 \end{cases} \qquad \ldots (3.4).$$

It is clear that $I(\underline{y})$ gives the fraction of total consumer expenditure saved in moving from the actual PCE distribution to a perfectly egalitarian distribution which is equivalent from the point of view of social welfare. The parameter r is called the inequality anersion parameter. As r decreases, the index I attaches greater weight to transfers of PCE at the lower end of the PCE distribution, and lower weights to those at the top. In Table 3.9, the AKS relative indices are presented for three different values of r, namely, r = 0, -2 and -5.

The Gini coefficient is given by the expression

$$G = \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} \left| y_i - y_j \right|}{2\mu}$$

$$= 1 + \frac{1}{n} - \frac{2}{n^2 \mu} \sum_{i=1}^{n} (n + 1 - i)\, y_i \qquad \ldots (3.5)$$

where $y_1 \leq y_2 \leq \ldots . \leq y_n$. The indices of average PCE discussed earlier are also presented in this table for the five social groups to facilitate the drawing of conclusions.

In general, the Gini coefficients and AKS indices for r = 0, -2 showed the distribution of PCE to be relatively egalitarian for the poorer social groups, namely, the SC and ST, and most unequal for the 'others' — the most prosperous social group. The Gini coefficient for 'other Hindus' was very close to that for the general rural population. On comparing the figures in cols. (3), (4) and (5) with those in col. (7), a positive rank correlation is observed between the inequality measures and the averages of <u>nominal</u> PCE of social groups. However, on examining the figures in

Table 3.9 : Measures of inequality of the size distributions of population by PCE within selected social groups, based on NSS 28th round enquiry on consumer expenditure, all-India, rural

social group	half-sample	Gini coefficient	AKS relative index			index of average PCE (nominal) (all-India rural=100)
			r = 0	r= -2	r= -5	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
ST	1	0.237	0.094	0.243	0.457	81.5
	2	0.254	0.106	0.275	0.482	77.5
	combined	0.245	0.100	0.259	0.471	79.6
SC	1	0.236	0.091	0.240	0.413	80.9
	2	0.245	0.102	0.295	0.647	78.9
	combined	0.241	0.097	0.270	0.602	79.9
'other Hindus'	1	0.266	0.113	0.276	0.478	107.4
	2	0.284	0.127	0.309	0.771	109.0
	combined	0.275	0.121	0.293	0.734	108.2
'other Muslims'	1	0.270	0.117	0.294	0.509	95.3
	2	0.240	0.096	0.285	0.779	93.7
	combined	0.256	0.106	0.290	0.746	94.5
'others'	1	0.299	0.139	0.383	0.776	122.6
	2	0.315	0.152	0.363	0.553	117.9
	combined	0.307	0.146	0.373	0.742	120.2
all groups	1	0.270	0.117	0.289	0.564	100.0
	2	0.284	0.130	0.324	0.747	100.0
	combined	0.277	0.125	0.307	0.711	100.0

col. (6) one finds a different pattern —— so the ranking of groups by inequality changes as r decreases from -2 to -5. This implies that the Lorenz curves of some of the social groups must be intersecting, and therefore, the five social groups cannot be ranked uniquely in terms of degree of PCE inequality.

The Gini coefficients for 'Hindus', 'Muslims' and 'other religious groups' were also computed. These results are set out below together with the combined sample indices of average <u>nominal</u> PCE for the groups :

social group	Gini coefficient			average PCE index (all-India, rural = 100)
	hs 1	hs 2	combined	
(1)	(2)	(3)	(4)	(5)
Hindus	0.266	0.285	0.276	99.4
Muslims	0.270	0.240	0.256	94.5
'other religious groups'	0.302	0.312	0.307	116.7
all groups	0.270	0.284	0.277	100.0

The Gini coefficient for Hindus was close to that for the overall rural population. Here also, as above, there is positive rank correlation between the Gini coefficient of PCE and the index of average PCE.

3.4 Decomposition of Inequality of Nominal PCE

In Section 3.3, considerable variation was observed in the levels of average nominal PCE and in inequality of nominal PCE across social groups in rural India. Here, an attempt is made to measure to what extent the variation within social groups or between social groups contribute to total inequality of PCE in rural India. For this purpose, an inequality index which can be decomposed into within-group and between-group components would be necessary. As mentioned in Section 3.1, the AKS index of inequality, which admits decomposability in this sense, is used to find the intra-social group and inter-social group components of inequality of nominal PCE for rural India.

The methodology of decomposition of the AKS index is described in Section 1.1.3 of Chapter 1. To recapitulate, the decomposition procedure is briefly described below.

Let the population with PCE vector $\underline{y}$ (*vide* exp.(3.1) above) and mean PCE μ (*vide* exp. (3.2) above) be divided into k groups with $n^1, n^2, \ldots, n^k$ persons and PCE vectors $\underline{y}^{1'} = (y_1, y_2, \ldots, y_{n^1})$, $\underline{y}^{2'} = (y_{n^1+1}, \ldots, y_{n^1+n^2})$ and so on upto $\underline{y}^{k'}$. Then $\underline{y}'$ can be expressed as

$$\underline{y}' = (\underline{y}^{1'}, \underline{y}^{2'}, \ldots, \underline{y}^{k'}) \qquad \ldots (3.6).$$

Let $\xi^1, \xi^2, \ldots, \xi^k$ represent the ede PCE of these k groups. Now consider the three PCE-vectors :

(1) $\underline{y}' = (\underline{y}^{1'}, \underline{y}^{2'}, \ldots, \underline{y}^{k'})$,

(2) $(\xi^1 \underline{1}'_{n^1}, \xi^2 \underline{1}'_{n^2}, \ldots, \xi^k \underline{1}'_{n^k})$,

and

(3) $(\xi \underline{1}'_n)$,

where ξ is obtained from expression (3.3), all of which correspond to the same level of social **welfare**.

Following Blackorby <u>et al</u> (1981), a measure of <u>intra-group inequality</u> is the proportion of aggregate consumer expenditure saved in moving from (1) to (2), that is,

$$I_n(\underline{y}) = 1 - \frac{\sum_{j=1}^{k} n^j \xi^j}{n\mu} \qquad \ldots (3.7).$$

The <u>inter-group inequality</u> is the proportion of expenditure saved in moving from (2) to (3), that is,

$$I_R(\underline{y}) = 1 - \frac{n\xi}{\sum_{j=1}^{k} n^j \xi^j} \qquad \ldots (3.8)$$

From (3.4), (3.7) and (3.8), it follows that

$$(1 - I_A(\underline{y}))\,(1 - I_R(\underline{y})) = 1 - I(\underline{y}) \qquad \ldots (3.9).$$

In the present exercise, the AKS index is decomposed into inter- and intra-social group indices for three different values of r, namely, r = 0, -2 and -5, in order to see the extent to which the results of decomposition are sensitive to the value of r chosen. The AKS relative inequality indices and their decompositions for rural India as a whole are presented in Table 3.10.

Table 3.10 : Decomposition of AKS index of relative inequality of PCE into inter-social group and intra-social group indices based on NSS 28th round data on nominal PCE for rural India

value of r	half-sample	intra-social group index I_A	inter-social group index I_R	overall index I
(1)	(2)	(3)	(4)	(5)
	1	0.110	0.008	0.117
0	2	0.121	0.009	0.130
	combined	0.116	0.009	0.125
	1	0.278	0.016	0.289
-2	2	0.307	0.026	0.324
	combined	0.293	0.021	0.307
	1	0.491	0.144	0.564
-5	2	0.720	0.096	0.747
	combined	0.698	0.043	0.711

The set of indices given in cols. (3) - (5) of Table 3.10 show the effect of disparities among the five social groups. It shows that intra-social group inequality of PCE was much higher than the corresponding inter-social group inequality. Even for r = -2, the inter-group component was quite small. It, however, appeared to be larger for r = -5.

As in the case of Table 3.6, here too, calculations were based on nominal PCE and take no account of regional (or social group-wise) variation in consumer prices in rural India. Also, no account is taken of regional variations in the distribution of population belonging to different social groups. To overcome these limitations, the AKS relative index was decomposed into intra- and inter-social group indices separately for the rural areas of each individual state. The results of these decompositions are presented in Table 3.11 for the three values of r, namely, r = 0, -2 and -5.

From this table, it appears that there was considerable variation in the overall index I across states, and part of this variation seems to be statistically significant. The same may be said of the two components I_A and I_R. The findings in Table 3.11 agree broadly with those of Table 3.10 in that, in most of the states, intra-social group inequality was much larger than inter-social group inequality for all three values of r.

Table 3.11 : Decomposition of AKS index of relative inequality into intra-social-group and inter-social-group indices[a] for rural India, based on NSS 28th round data on nominal PCE

State	half sample	r = 0			r = -2.0			r = -5.0		
		I_A	I_R	I	I_A	I_R	I	I_A	I_R	I
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Rajasthan	1	0.100	0.010	0.109	0.246	0.024	0.264	0.372	0.049	0.403
	2	0.122	0.013	0.133	0.292	0.043	0.322	0.436	0.104	0.494
	combined	0.111	0.011	0.121	0.271	0.031	0.294	0.416	0.069	0.456
Punjab	1	0.108	0.009	0.116	0.264	0.016	0.276	0.427	0.022	0.440
	2	0.104	0.012	0.114	0.254	0.017	0.267	0.411	0.005	0.414
	combined	0.108	0.009	0.116	0.265	0.012	0.273	0.430	0.004	0.433
Jammu & Kashmir	1	0.077	0.006	0.083	0.209	0.023	0.227	0.346	0.055	0.382
	2	0.084	0.003	0.087	0.200	0.013	0.211	0.329	0.032	0.350
	combined	0.082	0.004	0.085	0.207	0.015	0.219	0.342	0.037	0.367
Haryana	1	0.128	0.019	0.144	0.312	0.042	0.341	0.472	0.101	0.525
	2	0.113	0.013	0.124	0.265	0.027	0.284	0.400	0.043	0.426
	combined	0.122	0.014	0.135	0.291	0.033	0.315	0.442	0.075	0.484
Himachal Pradesh	1	0.097	0.009	0.105	0.226	0.012	0.236	0.341	0.013	0.350
	2	0.079	0.018	0.096	0.213	0.107	0.297	0.356	0.347	0.580
	combined	0.094	0.008	0.101	0.242	0.095	0.268	0.394	0.223	0.529
Uttar Pradesh	1	0.079	0.003	0.082	0.204	0.010	0.211	0.340	0.037	0.365
	2	0.098	0.005	0.103	0.239	0.014	0.249	0.401	0.117	0.471
	combined	0.089	0.004	0.093	0.222	0.011	0.230	0.375	0.084	0.428
Madhya Pradesh	1	0.122	0.010	0.131	0.287	0.028	0.307	0.462	0.137	0.535
	2	0.121	0.013	0.132	0.282	0.036	0.308	0.435	0.092	0.487
	combined	0.122	0.011	0.131	0.285	0.032	0.308	0.451	0.117	0.515
Bihar	1	0.112	0.017	0.127	0.277	0.053	0.315	0.465	0.107	0.522
	2	0.107	0.009	0.115	0.291	0.031	0.313	0.502	0.223	0.613
	combined	0.111	0.012	0.122	0.286	0.040	0.315	0.496	0.179	0.586

Table 3.11 (Continued)

State	half sample	r = 0			r = -2.0			r = -5.0		
		I_A	I_R	I	I_A	I_R	I	I_A	I_R	I
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Orissa	1	0.097	0.012	0.108	0.252	0.021	0.268	0.409	0.019	0.421
	2	0.095	0.017	0.110	0.244	0.045	0.278	0.409	0.087	0.461
	combined	0.097	0.013	0.109	0.251	0.030	0.273	0.414	0.050	0.443
West Bengal	1	0.112	0.012	0.123	0.311	0.015	0.321	0.522	0.017	0.530
	2	0.150	0.010	0.158	0.367	0.046	0.396	0.577	0.353	0.726
	combined	0.131	0.010	0.140	0.343	0.026	0.360	0.581	0.242	0.683
Assam	1	0.070	0.004	0.073	0.189	0.023	0.207	0.332	0.091	0.393
	2	0.066	0.002	0.068	0.081	0.005	0.186	0.310	0.021	0.325
	combined	0.069	0.002	0.071	0.188	0.011	0.197	0.335	0.048	0.367
Manipur	1	0.042	0.006	0.048	0.119	0.031	0.146	0.201	0.104	0.284
	2	0.049	0.009	0.058	0.133	0.035	0.163	0.227	0.071	0.281
	combined	0.052	0.005	0.057	0.139	0.028	0.163	0.231	0.090	0.300
Tripura	1	0.076	0.006	0.082	0.204	0.005	0.209	0.337	0.027	0.355
	2	0.055	0.011	0.065	0.151	0.039	0.183	0.271	0.079	0.329
	combined	0.066	0.008	0.074	0.184	0.018	0.198	0.328	0.027	0.346
Meghalaya	1	0.068	0.001	0.069	0.181	0.007	0.187	0.332	0.014	0.341
	2	0.053	0.028	0.018	0.138	0.679	0.723	0.225	0.889	0.914
	combined	0.063	0.012	0.075	0.176	0.541	0.621	0.315	0.852	0.899
Andhra Pradesh	1	0.114	0.009	0.122	0.270	0.017	0.282	0.513	0.017	0.522
	2	0.138	0.013	0.149	0.361	0.231	0.381	0.749	0.275	0.818
	combined	0.127	0.011	0.136	0.325	0.024	0.341	0.736	0.248	0.797

Table 3.11 (Concluded)

State	half sample	r = 0			r = -2.0			r = -5.0		
		I_A	I_R	I	I_A	I_R	I	I_A	I_R	I
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	1	0.115	0.003	0.118	0.270	0.010	0.278	0.404	0.025	0.419
Tamil Nadu	2	0.101	0.011	0.112	0.249	0.031	0.272	0.396	0.072	0.440
	combined	0.109	0.006	0.115	0.264	0.016	0.275	0.409	0.038	0.431
	1	0.141	0.009	0.149	0.335	0.026	0.353	0.511	0.024	0.523
Kerala	2	0.151	0.007	0.156	0.346	0.013	0.354	0.515	0.036	0.532
	combined	0.146	0.008	0.153	0.344	0.015	0.354	0.511	0.022	0.528
	1	0.092	0.007	0.098	0.244	0.073	0.299	0.388	0.534	0.715
Karnataka	2	0.144	0.005	0.148	0.311	0.014	0.320	0.459	0.034	0.077
	combined	0.120	0.006	0.125	0.286	0.036	0.311	0.438	0.449	0.690
	1	0.077	0.006	0.083	0.191	0.015	0.203	0.314	0.013	0.323
Gujarat	2	0.086	0.009	0.094	0.224	0.035	0.252	0.378	0.136	0.463
	combined	0.082	0.007	0.089	0.209	0.023	0.227	0.354	0.018	0.406
	1	0.107	0.003	0.110	0.258	0.006	0.263	0.406	0.008	0.411
Maharashtra	2	0.110	0.006	0.116	0.272	0.018	0.285	0.431	0.041	0.454
	combined	0.109	0.005	0.113	0.266	0.011	0.274	0.421	0.021	0.433
	1	0.110	0.008	0.117	0.278	0.016	0.289	0.491	0.144	0.564
India	2	0.121	0.009	0.130	0.307	0.026	0.324	0.720	0.096	0.747
	combined	0.116	0.009	0.125	0.293	0.021	0.307	0.698	0.043	0.711

[a] I_A = intragroup index, I_R = intergroup index, I = overall index.

Even though the between social groups variation in average PCE appeared to be small, judging by its contribution to overall inequality of PCE, it has been found to be sufficiently wide to explain the anxiety and social tension in some states of India.

3.5 Concluding Observations

The SC and ST are recognised to be among the socially and economically backward sections of the population by the Government of India. The findings based on NSS 28th round household budget data for rural India appear to support this fact. The distributions of SC, ST and non-SC/ST rural population by principal household occupations and by size classes of household land possessed showed the SC to be at a distinct disadvantage with respect to their earning capacity compared to ST and non-SC/ST groups. While the same distributions for the ST and the non-SC/ST population were not so different, it may again be remembered that the ST mostly inhabited forest or hilly areas which are economically backward.

The SC and ST were found to be the poorest social groups, while 'others' were most prosperous, according to their average nominal PCEs. Similarly, the level of living of the Hindus was found to be nearly at par with that of the general rural population. Muslims, however, were a lit e below the general mean. While drawing these broad inferences, it should be borne in mind that the results for all-India rural ignored regional variation in consumer prices and also the differences in the regional distribution of population in different social groups. For these reasons, comparisons of average nominal PCE were carried out separately for individual states. Statewise findings broadly corroborate the conclusions for rural India as a whole, based on nominal PCE. In general, the Gini coefficient of PCE was higher for social groups with higher averages of PCE.

The decomposition of AKS relative inequality indices showed that inequality within social groups contributed much more to overall inequality of PCE than inequality between social groups, both at all-India rural level and in rural areas of individual states. Many factors, like education, land possessed, occupation, household size and composition besides regional variation, etc. are responsible for both within group and between group inequality. The following Chapters investigate the contribution of these factors. In the next Chapter, the incidence of rural poverty is examined separately for different states, social groups, occupational classes, size classes of household land possessed and household size. A decomposition analysis of poverty is carried out to assess the contributions of these factors (taken one at a time) to total poverty in rural India. In Chapter 5, the importance of NSS regions, which are typically smaller than the states, in determining levels of living and incidence of poverty is examined. Finally, in Chapters 6 and 7, all these factors, that is, social group, occupational class, household land possessed, household size and composition and NSS region, are brought together to explain variations in PCE and poverty through a multiple regression analysis of PCE and a logit analysis of poverty, respectively.

Chapter 4

INCIDENCE OF ABSOLUTE POVERTY IN RURAL INDIA : VARIATIONS ACROSS STATES AND SOCIO-ECONOMIC GROUPS[1/]

4.1 Introduction

In Chapter 3, it was observed that there were large disparities in level of living, as measured by PCE, across social groups in rural India during the NSS 28th round period (October 1973 - June 1974). This Chapter seeks to study the variation in the incidence of absolute poverty in rural India across states and across different socio-economic groups of the population during the same period. In a sense, measuring overall poverty of a country's population is only the beginning of an analysis of poverty. In order to frame effective policies and programmes for ameliorating poverty, among other things, it is essential to identify the poverty groups in a population by their geographical location (that is, place of residence) and socio-economic characteristics. In the present Chapter, such an analysis is attempted for the Indian rural population on the basis of NSS 28th round disaggregated household budget data.

For the present analysis, the rural households of the country were divided into sub-groups, separately by

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[1/] This Chapter is a revised version of Pal, Chakravarty and Bhattacharya (1986).

(1) States, (2) social groups (SC, ST, etc.), (3) size classes of household land possessed, (4) occupational classes, and (5) household size.

The incidence of absolute poverty in the sub-groups formed in (1), (2), (3) and (4) is estimated, taking one factor at a time, employing the head-count ratio measure of poverty, Sen's index and Chakravarty's indices[2/]. Some analysis is also carried out for sub-groups (2), (3) and (4) separately for each state. The association between poverty and household size for different occupational classes and for different size classes of household land possessed is also examined here. As already mentioned, since information on the number of earners in a sample household, their individual occupations, ages and levels of education were not available, these possible concomitants of poverty could not be included in the present analysis.

In what follows, the incidence of poverty in the different sub-groups is measured first to identify the poorer sub-groups of the population. Next, the overall incidence of poverty for the rural population is decomposed into components due to different sub-groups to find the contributions of different sub-groups to the total poverty. For this analysis of decomposition of the overall poverty,

[2/] These indices are discussed at length in Section 1.1.4 of Chapter 1.

some additively decomposable poverty measures, viz., the head-count ratio and Chakravarty's indices for three values of e are used.

The Chapter is organised as follows : In Section 4.2 the socio-economic groups selected for the purpose of the study are briefly described. Section 4.3 describes the statewise poverty lines and the methodology followed in the analysis. Sections 4.4 and 4.5 then report on the estimated incidence of poverty in the different states and in the different socio-economic groups, respectively. Section 4.6 carries out the decomposition analysis of the incidence of poverty and presents the contributions of different states and different socio-economic groups to overall poverty in rural India. Finally, Section 4.7 concludes the Chapter with some observations on the main findings.

4.2 The Socio-economic Groups

All sample households in rural India covered in the NSS 28th round (October 1973 - June 1974) household budget enquiry were divided into the following five social groups : (i) the Scheduled Castes (SC), (ii) the Scheduled Tribes (ST), (iii) 'other Hindus', (iv) 'other Muslims' and (v) 'others'. As in Chapter 3, the SC category consisted only of Hindu Scheduled Caste households. All Scheduled

Tribe households were included in the ST category irrespective of their religious affiliations. The 'other Hindu' group consisted of non-SC and non-ST Hindu households, while the 'other Muslim' group was made up of non-ST Muslims. The last social group, 'others', consisted of non-ST households belonging to the remaining religious communities such as Jains, Christians, Sikhs, etc.

In a separate grouping, the households were classified by the size of land possessed by them. The seven size classes of household land possessed formed here were the same as those considered in Section 3.2.2 of Chapter 3. These classes were defined as follows : land possessed (in acres): < 0.005 (landless), 0.005 - 1.00, 1.00 - 2.50, 2.50 - 5.00, 5.00 - 7.50, 7.50 - 15.00, 15.00 - , each interval including its lower limit but excluding its upper limit.

Coming to the occupationwise classification of the households, all rural households were divided into nine occupational classes on the basis of their codes for household principal occupation and industry, given according to the National Classification of Occupations (NCO) and National Industrial Classification (NIC) for India, respectively, exactly as in the previous Chapter. These occupational classes were :

I. Professional, technical and related, administrative, executive and managerial workers, clerical and related workers;

II. sales workers;

III. service workers;

IV. cultivators (owners);

V. cultivators (tenants);

VI. agricultural labourers;

VII. other agricultural workers, fishermen, hunters, loggers and related workers;

VIII. production and related workers, transport equipment operators and labourers; and

IX. non-response or non-worker households.

4.3 Choice of the Poverty Lines and the Methodology

Bardhan (1973) chose the poverty line for rural India to be : PCE = Rs. 15 at 1960-61 rural prices. To obtain separate poverty lines for rural areas of different states at 1960-61 prices, he employed the inter-state consumer price differential indices estimated by Chatterjee and Bhattacharya (1974) (on the basis of NSS 18th round (February 1963 - January 1964) household budget data) in the following manner. First, he averaged the Fisher price indices for the two bottom quintile groups of the rural population of each state, where the index for a group was computed by taking the prices faced by corresponding quintile groups of rural India as base (= 100). He then adjusted the all-India rural poverty line of PCE = Rs. 15, using these average price indices as measures of inter-state consumer price differentials for 1960-61, to obtain poverty lines for rural areas of different states[3/].

It may be mentioned here that it would have been more appropriate to use the corresponding Paasche-type inter-state consumer price differential indices for deriving the statewise poverty lines, as such adjustment would have yielded Laspeyres-type quantity indices for the poorest 40 per cent of the rural population in states, with the corresponding group for rural India as base (= 100). However, in the present study, Bardhan's methodology, as described above, has been adopted in choosing the statewise (and all-India) poverty lines for the NSS 28th round period. More specifically, for the present analysis, the statewise (and

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3/ Studies by Rath (1973) (based on NSS 17th round budget data) and Chatterjee and Bhattacharya (1974) (based on NSS 18th round data) revealed that the patterns of inter-state consumer price differentials were somewhat different for the two consecutive rounds. A similar result relating to the pattern of interstate consumer price variation during the NSS 18th and 28th rounds is reported in the next Chapter. In view of these findings, it appears that the use of inter-state consumer price differential indices pertaining to one round (1963-64) for a different round (1960-61) might be inappropriate.

all-India, rural) poverty lines at 1960-61 prices derived by Bardhan (1973) were expressed in NSS 28th round (October 1973 - June 1974) prices using the average monthly values of the Consumer Price Index Numbers of Agricultural Labourers (CPIAL) (base : 1960-61) for the respective states (and all-India) during the NSS 28th round period.

It should be stated here that the statewise poverty lines described above were used only for those analyses in which 'state' was taken as a classificatory variable (vide Tables 4.1, 4.2C to 4.4C and 4.7(a))[4/]. However, for estimating poverty in different socio-economic groups at the all-India level, the all-India rural poverty line was used. This was done in two ways :

(i) the inter-state consumer price variations were ignored and the incidence of poverty was estimated on the basis of nominal PCE using a single poverty line for rural India;

(ii) next, all PCEs were expressed at all-India rural prices of the poor using the statewise averages of Fisher indices of consumer price differentials for the two lowest

[4/] There is one composite CPIAL for the states of Assam, Manipur, Tripura and Meghalaya. The same is true for the Punjab, Haryana, Himachal Pradesh and Delhi. In each of these cases, therefore, the same poverty line was used for all the states covered by a single composite index.

quintile groups of the rural population with the corresponding groups for rural India as base, constructed by Chatterjee and Bhattacharya (1974)[5/][6/]. Then the incidence of absolute poverty in different socio-economic groups of the rural population was estimated in the same manner as in (i)[7/]. Here it would have been more appropriate to use Paasche-type price indices instead of Fisher indices. But to make such price adjustments consistent with the method of construction of statewise poverty lines, Fisher indices were used.

It may be mentioned that as separate consumer price indices were not available for the rural areas of different Union Territories, they were excluded while estimating the incidence of poverty on the basis of adjusted PCE (that is, PCE expressed at all-India prices for the rural poor). However, the estimates based on nominal PCE cover all these Union Territories.

[5/] See footnote 3. Also, one might argue that the consumer price indices for rural areas of different states with rural India as base (= 100) constructed by Bhattacharyya et al (1980) on the basis of NSS 28th round data should have been used for making such price adjustments. But these indices were not used as they reflect consumer price variation across states for the total rural population rather than for the poorer groups of the population.

[6/] The same index was used for (i) Assam, Manipur, Tripura and Meghalaya; and for (ii) the Pubjab, Haryana and Himachal Pradesh.

[7/] Among other things, it was necessary to estimate poverty on the basis of adjusted PCE in order to carry out poverty decompositions over population sub-groups using Chakravarty's indices.

After fixing the poverty lines to be used, the next step was to choose indices for the measurement of poverty. Let $\underline{y}' = (y_1, y_2, \ldots, y_n)$ represent the PCE-vector of a group of n persons, where $y_1 \leq y_2 \leq \ldots \leq y_q < z \leq \ldots \leq y_n$, z being the poverty line. As already mentioned in Section 4.1, the indices selected were :

(i) The <u>head-count ratio</u> given by

$$H = q/n \qquad \ldots (4.1)$$

where q is the number of individuals in households for which the PCE lies below the poverty line z;

(ii) <u>Sen's index</u>,

$$P_{S2} = H \left[1 - (1 - G_p) \frac{\mu_p}{z} \right] \qquad \ldots (4.2)$$

where G_p = Gini coefficient of the distribution of PCE of individuals in poor households,

$$= 1 + \frac{1}{q} - \frac{2}{q^2 \mu_p} \sum_{i=1}^{q} (q + 1 - i)\, y_i \qquad \ldots (4.3)$$

μ_p = mean PCE of the poor

$$= \frac{1}{q} \sum_{i=1}^{q} y_i \qquad \ldots (4.4)$$

and H is the head-count ratio given by (4.1); and

(iii) Chakravarty's indices,

$$P_c(e) = \frac{1}{n} \sum_{i=1}^{q} \left[1 - \left(\frac{y_i}{z}\right)^e \right], \quad 0 < e < 1 \quad \ldots(4.5)$$

where the parameter 'e' determines the degree of sensitivity of the measure $P_c(e)$ to transfers of PCE from one person to another. As e decreases, the index $P_c(e)$ attaches greater weight to transfers lower down the PCE scale.

When $e \longrightarrow 0$, $P_c(e) \longrightarrow 0$ and when

$e \longrightarrow 1$, $P_c(e) \longrightarrow H\, I_g$,

where I_g is the PCE-gap ratio defined as

$$I_g = 1 - \frac{\mu_p}{z} \quad \ldots (4.6).$$

For this reason, Chakravarty's indices were computed for three different values of e, namely e = 0.2, 0.5 and 0.9, with a view to examining the sensitivity of the poverty measure to the value of e chosen.

As already mentioned, Sen's index and Chakravarty's indices are based on welfare theoretic considerations[8], that is, they take into account the phenomenon of deprivation of the poor. But Sen's index is not additively decomposable over population sub-groups, while the head-count ratio and Chakravarty's indices are, and this property enables one to

[8] The properties of Sen's and Chakravarty's indices are discussed in Section 1.1.4 of Chapter 1.

employ the two latter indices for measuring the relative contributions of different states and different socio-economic groups to overall rural poverty in the country.

From the point of view of decomposition of poverty, the head-count ratio and Chakravarty's indices can be written as :

$$H = \sum_{i=1}^{k} \frac{n_i}{n} H_i \qquad \ldots (4.1.1)$$

where H_i = head-count ratio for sub-group i,

n_i = number of individuals in sub-group i of the rural population, $i = 1, 2, \ldots, k$,

and $\sum_{i=1}^{k} n_i = n$;

and

$$P_c(e) = \sum_{i=1}^{k} \frac{n_i}{n} P_{c_i}(e) \qquad \ldots (4.5.1)$$

where $P_{c_i}(e)$ is the poverty index (4.5) for sub-group i, $i = 1, 2, \ldots, k$.

As stated earlier, Sen's index, not being additively decomposable over population sub-groups, could not be used for finding the contributions of different sections of the population to overall rural poverty in India. However, this index was computed for the different sub-groups of the population purely for the sake of interest.

It should be pointed out that equations (4.5) and (4.5.1), when employed to decompose poverty over a specific set of socio-economic groups, uses a single poverty line z for all persons irrespective of the group (for example, state) to which they belong. For this reason, Chakravarty's measures based on adjusted PCE were employed to find the contributions of the different socio-economic groups, described in Section 4.2, to overall rural poverty in the country. However, to find the contributions of different states to total poverty in India using nominal PCE, state-wise poverty lines were used on the ground that, in doing so, one is correcting the y_i's for price variation across states. The head-count ratio can also be modified in a similar manner to take account of variations in poverty lines across groups (for example, states). Thus, to find the contributions of different states and different socio-economic groups to overall rural poverty in India, head-count ratios estimated by employing statewise poverty lines were used.

4.4 Variation in the Incidence of Absolute Poverty across States

For the present exercise, poverty is estimated separately for the rural areas of all the states covered in the NSS 28th round household budget enquiry. The Union Territories, namely, Delhi, Chandigarh, Pondicherry and

Goa, Daman and Diu had to be left out because of small sample size and the non-availability of appropriate consumer price indices for these regions.

Table 4.1 shows the half-samplewise and combined sample estimates of the head-count ratio, Sen's index and Chakravarty's indices for e = 0.2, 0.5 and 0.9 for the rural areas of different states. The estimated means and Gini coefficients of the PCE of the population below poverty lines of the states are also presented in this table, separately for different states.

For most of the states, it is observed that the half-sample estimates of the poverty indices are fairly close, and the ranking of states by any index is nearly the same for the two half-samples and the combined sample. Such rankings are, however, markedly different for Manipur and Tripura, where small sample size probably led to large divergences between the half-sample estimates. Thus, it appears that the estimated poverty measures were fairly reliable for most of the states.

The results presented in Table 4.1 suggest that the three eastern states, viz., West Bengal, Orissa and Bihar were the poorest during the NSS 28th round period. Of these, West Bengal was the poorest with a head-count ratio of nearly 70 per cent. Madhya Pradesh, Uttar Pradesh, Kerala, Tamil Nadu and Karnataka were also rather badly off

Table 4.1 : Measures of poverty for the rural population in India, by States, based on National Sample Survey 28th round household budget enquiry (October 1973 – June 1974)

State (poverty line)	half-sample	no. of sample households	head-count ratio (H)	mean PCE of the poor (in Rs.)	Gini coefficient of PCE of the poor	Sen's index	Chakravarty's index e=0.2	Chakravarty's index e=0.5	Chakravarty's index e=0.9
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Rajasthan (Rs. 42.68)	1	303	0.301	33.70	0.091	0.085	0.015	0.035	0.058
	2	310	0.278	32.06	0.111	0.093	0.017	0.039	0.064
	combined	613	0.289	32.91	0.101	0.089	0.016	0.037	0.061
Punjab (Rs. 44.52)	1	340	0.189	35.67	0.070	0.048	0.009	0.020	0.034
	2	330	0.170	38.26	0.040	0.030	0.005	0.013	0.022
	combined	670	0.179	36.89	0.059	0.040	0.007	0.017	0.028
Jammu & Kashmir (Rs. 40.68)	1	332	0.302	31.68	0.105	0.092	0.016	0.037	0.061
	2	325	0.369	34.02	0.076	0.084	0.014	0.033	0.055
	combined	657	0.336	33.00	0.091	0.088	0.015	0.035	0.058
Haryana (Rs. 44.52)	1	314	0.267	34.64	0.097	0.079	0.014	0.033	0.054
	2	289	0.284	36.41	0.070	0.068	0.012	0.028	0.047
	combined	603	0.275	35.52	0.085	0.074	0.013	0.031	0.051
Himachal Pradesh (Rs. 44.52)	1	192	0.188	37.58	0.046	0.037	0.007	0.016	0.027
	2	202	0.177	35.19	0.116	0.054	0.009	0.021	0.034
	combined	394	0.183	36.44	0.080	0.045	0.008	0.018	0.030
Uttar Pradesh (Rs. 45.61)	1	892	0.505	34.63	0.093	0.158	0.029	0.067	0.112
	2	892	0.507	34.27	0.103	0.165	0.030	0.070	0.116
	combined	1784	0.506	34.46	0.098	0.161	0.029	0.069	0.114
Madhya Pradesh (Rs. 45.14)	1	653	0.572	32.05	0.121	0.215	0.041	0.094	0.153
	2	667	0.552	32.17	0.130	0.209	0.039	0.090	0.146
	combined	1320	0.561	32.11	0.126	0.212	0.040	0.092	0.149
Bihar (Rs. 55.28)	1	647	0.615	39.07	0.141	0.241	0.045	0.103	0.167
	2	641	0.590	37.00	0.151	0.255	0.049	0.113	0.180
	combined	1288	0.603	38.09	0.147	0.248	0.047	0.108	0.173

Table 4.1 (Continued)

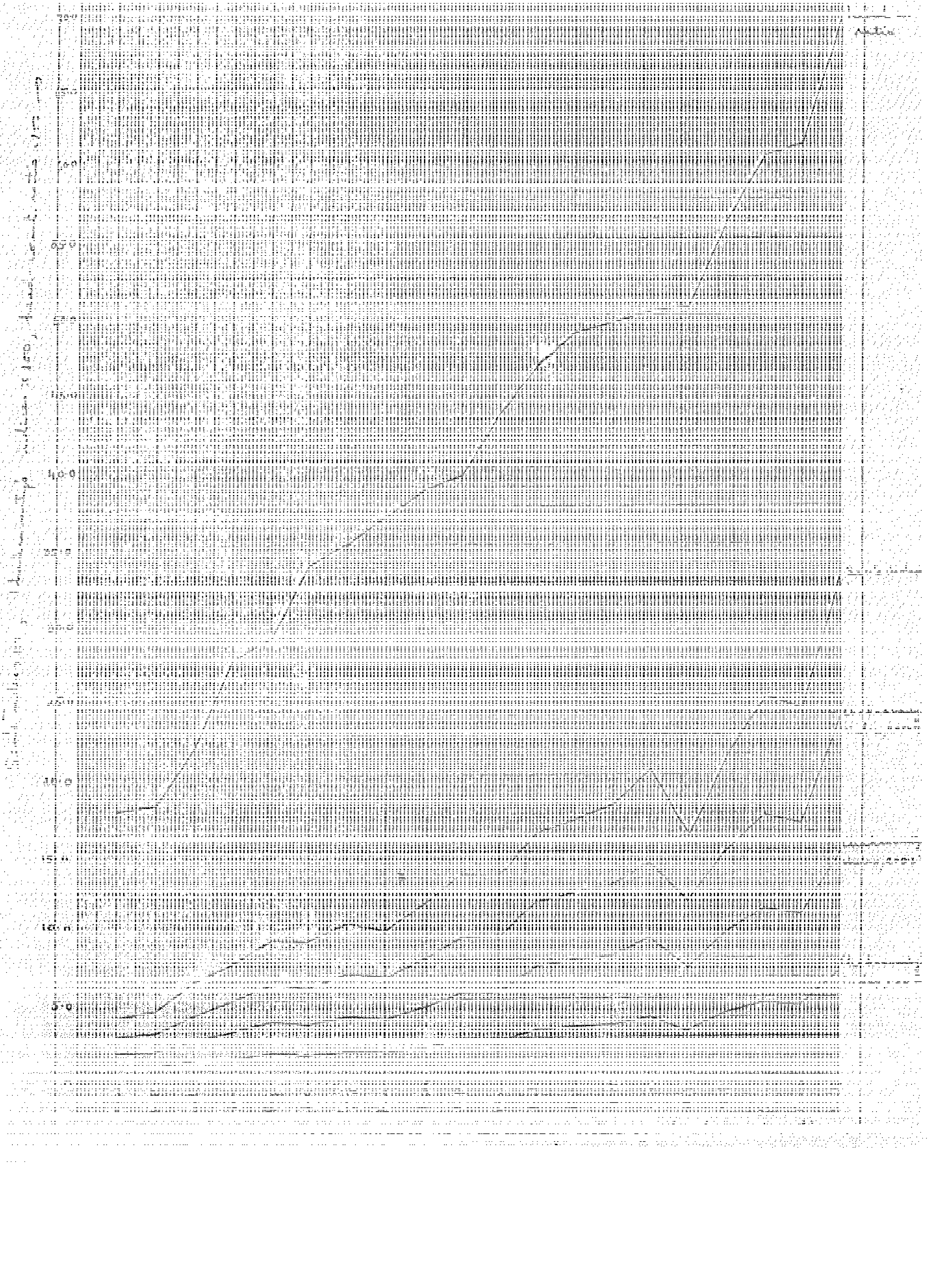
State (poverty line)	half sample	no. of sample households	head-count ratio (H)	mean PCE of the poor (in Rs.)	Gini coefficient of PCE of the poor	Sen's index	Chakravarty's index		
							e = 0.2	e = 0.5	e = 0.9
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Orissa (Rs. 41.57)	1	341	0.602	29.12	0.135	0.237	0.044	0.102	0.166
	2	330	0.621	29.24	0.138	0.244	0.046	0.105	0.170
	combined	671	0.611	29.17	0.137	0.241	0.045	0.104	0.168
West Bengal (Rs. 52.01)	1	521	0.685	32.90	0.168	0.324	0.065	0.147	0.233
	2	509	0.705	33.24	0.172	0.332	0.066	0.149	0.236
	combined	1030	0.695	33.07	0.170	0.328	0.066	0.148	0.235
Assam (Rs. 43.83)	1	311	0.391	34.33	0.107	0.118	0.020	0.047	0.078
	2	289	0.381	34.79	0.094	0.107	0.018	0.043	0.072
	combined	600	0.386	34.55	0.101	0.113	0.019	0.045	0.075
Manipur (Rs. 43.83)	1	110	0.445	35.71	0.095	0.117	0.019	0.045	0.076
	2	112	0.281	35.27	0.064	0.070	0.012	0.030	0.050
	combined	222	0.369	35.55	0.085	0.095	0.016	0.038	0.064
Tripura (Rs. 43.83)	1	91	0.542	34.45	0.095	0.156	0.027	0.064	0.106
	2	96	0.331	33.19	0.112	0.108	0.019	0.045	0.074
	combined	187	0.435	33.97	0.103	0.133	0.023	0.054	0.090
Meghalaya (Rs. 43.83)	1	118	0.253	34.80	0.098	0.072	0.012	0.029	0.048
	2	107	0.184	35.31	0.110	0.052	0.012	0.024	0.034
	combined	225	0.219	35.01	0.108	0.063	0.012	0.026	0.041
Andhra Pradesh (Rs. 37.82)	1	609	0.366	29.68	0.105	0.109	0.019	0.044	0.072
	2	627	0.422	27.71	0.140	0.156	0.028	0.064	0.104
	combined	1236	0.395	28.60	0.126	0.134	0.023	0.054	0.089
Tamil Nadu (Rs. 41.27)	1	436	0.501	29.98	0.119	0.180	0.033	0.077	0.126
	2	474	0.490	29.80	0.129	0.182	0.033	0.077	0.125
	combined	910	0.495	29.89	0.125	0.181	0.033	0.077	0.126

Table 4.1 (Concluded)

State (poverty line)	half-sample	no. of sample households	head-count ratio (H)	mean PCE of the poor (in Rs.)	Gini coefficient of PCE of the poor	Sen's index	Chakravarty's index e = 0.2	e = 0.5	e = 0.9
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Kerala (Rs. 45.79)	1	316	0.513	31.60	0.147	0.211	0.040	0.091	0.147
	2	329	0.493	32.02	0.138	0.196	0.033	0.085	0.125
	combined	645	0.503	31.81	0.142	0.204	0.038	0.088	0.142
Gujarat (Rs. 42.11)	1	262	0.375	33.64	0.089	0.102	0.017	0.041	0.069
	2	268	0.326	33.07	0.104	0.097	0.017	0.039	0.064
	combined	530	0.351	33.38	0.096	0.100	0.017	0.040	0.067
Maharashtra (Rs. 44.39)	1	574	0.506	32.62	0.108	0.175	0.032	0.075	0.123
	2	561	0.426	32.50	0.122	0.152	0.028	0.064	0.105
	combined	1135	0.466	32.56	0.115	0.163	0.030	0.070	0.114
Karnataka (Rs. 43.56)	1	312	0.472	31.41	0.117	0.171	0.032	0.074	0.121
	2	309	0.502	32.17	0.111	0.173	0.032	0.074	0.121
	combined	621	0.488	31.80	0.114	0.172	0.032	0.074	0.121
all-India rural (Rs. 43.57)	1	7729	(0.462) 0.494	(32.19)-	(0.123)-	(0.162) 0.173	0.033	0.077	0.128
	2	7723	(0.460) 0.486	(31.85)-	(0.131)-	(0.168) 0.174	0.035	0.078	0.127
	combined	15452	(0.461) 0.491	(32.00)-	(0.127)-	(0.165) 0.173	0.034	0.077	0.127

Note : Figures in parentheses presented for all-India rural indicate the values of the measures of poverty when one poverty line is used for the entire country. These estimates are based on nominal PCE, and take into account the Union Territories of Chandigarh, Delhi, Pondicherry and Goa, Daman and Diu. For all other figures statewise poverty lines were used.

Fig. 4.1 : POVERTY MEASURES FOR STATES RANKED BY HEAD-COUNT RATIO



with about half their rural populations falling below the poverty line. The north-western region of India was relatively prosperous, the Punjab and Himachal Pradesh each having a head-count ratio of about 18 per cent, followed by Meghalaya having a head-count ratio of 22 per cent and by Rajasthan and Haryana with a little less than 30 per cent of their rural populations falling below the poverty line.

In Fig. 4.1, the head-count ratio, Sen's index and Chakravarty's indices (for e = 0.2, 0.5 and 0.9) are plotted against the states arranged in ascending order of the values of head-count ratio. It can be seen that the ranking of states by the five indices agreed very well. Spearman's rank correlation coefficient (based on the combined sample estimates) between the head-count ratio and Sen's index or Chakravarty's indices (for the three values of e) for different states is 0.98. The corresponding coefficient between Sen's and Chakravarty's indices is nearly 1.0.

4.5 Variation in the Incidence of Absolute Poverty across Socio-economic Groups

The poverty indices, namely, the head-count ratio, Sen's index and Chakravarty's indices computed for different socio-economic groups of the all-India rural population, mentioned in Section 4.2, are set out in Tables 4.2A to 4.4A, 4.5 and 4.6. All these are based on nominal PCE. The same indices based on adjusted PCE (that is, PCE expressed at all-India prices for the rural poor) for different social groups, size classes of household land possessed and occupational classes are shown in Tables 4.2B to 4.4B, respectively. As already mentioned, the all-India poverty indices reported in these tables are based on a single poverty line for rural India, that is, a PCE of Rs. 43.57 at NSS 28th round rural prices. Statewise head-count ratios for different socio-economic groups, estimated using statewise poverty lines, are reported in Tables 4.2C to 4.4C. It should be pointed out that an alternative set of head-count ratios for rural India as a whole was computed on the basis of the statewise estimates like those given in Tables 4.2C to 4.4C. These are slightly different from those presented in Tables 4.2A to 4.4A and 4.2B to 4.4B. The estimates in Tables 4.2C to 4.4C may be considered to be superior. For, in deriving the statewise poverty lines underlying these estimates the inter-state price differentials during the NSS 28th round period have been indirectly taken into account through the use of inter-state consumer price indices for the 18th round constructed by Chatterjee and Bhattacharya (1974), together with the CPIAL (base : 1960-61).

In most cases, head-count ratios based on nominal PCE (vide Tables 4.2A to 4.4A) are smaller than the corresponding estimates that take into account inter-state consumer price variations (vide Tables 4.2B to 4.4B and 4.2C to 4.4C). The head-count ratio for rural India as a whole based on nominal PCE is 46.1 per cent, while the corresponding values reported in Tables 4.2B to 4.4B and 4.2C to 4.4C are about 49 per cent. In fact, the head-count ratios presented in Tables 4.2B to 4.4B are, by and large, relatively close to the corresponding values shown in Tables 4.2C to 4.4C. But the rankings of different socio-economic groups by these two sets of estimates are slightly different. However, greater weight should naturally be attached to estimates of poverty based on PCE adjusted for inter-state consumer price differentials of the poor. These estimates of poverty levels can be compared across socio-economic groups with greater confidence, because in obtaining these estimates, PCE levels were made comparable across states through such price adjustment.

4.5.1 Incidence of Poverty by Social Groups

Poverty indices for the five social groups in rural India based on nominal PCE are presented in Table 4.2A. The corresponding results based on adjusted PCE are shown in Table 4.2B. From Table 4.2B, it appears that the ST

Table 4.2A : Measures of poverty for the rural population in India, by social groups, based on <u>nominal</u> PCE : National Sample Survey 28th round household budget enquiry (October 1973 - June 1974)

social group	half-sample	no. of sample house-holds	head-count ratio	mean PCE of the poor (in Rs.)	Gini coef-ficient of PCE of the poor	Sen's index	Chakravarty's index		
							e=0.2	e=0.5	e=0.9
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Scheduled Castes	1	1348	0.614	30.68	0.132	0.239	0.045	0.103	0.167
	2	1343	0.645	30.82	0.145	0.255	0.047	0.108	0.174
	combined	2691	0.629	30.76	0.138	0.247	0.046	0.105	0.171
Scheduled Tribes	1	843	0.616	30.98	0.129	0.234	0.044	0.100	0.164
	2	771	0.629	29.37	0.148	0.267	0.051	0.117	0.189
	combined	1614	0.622	30.22	0.139	0.250	0.047	0.108	0.176
Other Hindus	1	4147	0.397	33.33	0.112	0.127	0.022	0.052	0.086
	2	4232	0.387	32.74	0.118	0.130	0.023	0.054	0.088
	combined	8379	0.392	33.04	0.115	0.129	0.023	0.053	0.087
Other Muslims	1	841	0.493	31.32	0.133	0.186	0.034	0.078	0.128
	2	833	0.468	33.03	0.124	0.157	0.028	0.064	0.104
	combined	1674	0.481	32.14	0.130	0.172	0.031	0.071	0.116
Others	1	550	0.338	32.73	0.120	0.115	0.020	0.047	0.077
	2	544	0.363	32.68	0.135	0.135	0.024	0.056	0.091
	combined	1094	0.350	32.19	0.128	0.125	0.022	0.052	0.084
all-groups	1	7729	0.462	32.19	0.123	0.162	0.029	0.068	0.111
	2	7723	0.460	31.85	0.131	0.168	0.030	0.070	0.114
	combined	15452	0.461	32.00	0.127	0.165	0.030	0.069	0.113

Table 4.2B : Measures of poverty for the rural population in India, by social groups, based on adjusted PCE : National Sample Survey 28th round household budget enquiry (October 1973 - June 1974)

social group	half-sample	no. of sample households	head-count ratio	mean PCE of the poor (in Rs.)	Gini coefficient of PCE of the poor	Sen's index	Chakravarty's index		
							e=0.2	e=0.5	e=0.9
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Scheduled Castes	1	1335	0.650	30.13	0.143	0.265	0.050	0.115	0.185
	2	1334	0.661	29.89	0.152	0.276	0.052	0.119	0.192
	combined	2669	0.656	30.01	0.147	0.271	0.051	0.117	0.189
Scheduled Tribes	1	843	0.647	30.88	0.129	0.248	0.046	0.106	0.174
	2	771	0.652	29.24	0.150	0.280	0.054	0.123	0.198
	combined	1614	0.649	30.11	0.140	0.264	0.050	0.114	0.185
Other Hindus	1	4116	0.429	33.05	0.118	0.142	0.025	0.058	0.095
	2	4195	0.414	32.48	0.123	0.143	0.025	0.059	0.097
	combined	8311	0.422	32.77	0.120	0.143	0.025	0.059	0.096
Other Muslims	1	838	0.541	30.45	0.148	0.219	0.041	0.093	0.151
	2	832	0.522	32.05	0.134	0.189	0.034	0.078	0.127
	combined	1670	0.532	31.22	0.142	0.205	0.037	0.086	0.139
Others	1	542	0.373	32.29	0.127	0.132	0.024	0.055	0.089
	2	535	0.400	31.15	0.145	0.155	0.028	0.065	0.105
	combined	1077	0.387	31.70	0.137	0.144	0.026	0.060	0.097
all groups	1	7674	0.496	31.81	0.130	0.181	0.033	0.076	0.123
	2	7667	0.488	31.38	0.137	0.185	0.034	0.077	0.126
	combined	15341	0.492	31.59	0.134	0.183	0.033	0.077	0.125

Note : The U.T.s, viz., Delhi, Chandigarh, Pondicherry and Goa, Daman and Diu were excluded when computing the figures for this Table.

Table 4.2C : Head-count ratio measures of poverty for the rural population in different states of India, by social groups, based on NSS 28th round household budget enquiry (October 1973 – June 1974)

States	social groups					
	Scheduled Castes	Scheduled Tribes	other Hindus	other Muslims	others	all groups
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Rajasthan	0.421 (107)	0.467 (96)	0.213 (369)	-	-	0.290 (613)
Punjab	0.355 (106)	-	0.214 (90)	-	0.133 (463)	0.179 (670)
Jammu and Kashmir	0.571 (66)	-	0.414 (167)	0.274 (406)	-	0.336 (657)
Haryana	0.458 (138)	-	0.225 (398)	-	-	0.275 (603)
Himachal Pradesh	0.255 (88)	-	0.162 (284)	-	-	0.183 (394)
Uttar Pradesh	0.683 (419)	-	0.446 (1067)	0.481 (232)	-	0.506 (1784)
Madhya Pradesh	0.581 (217)	0.729 (350)	0.477 (704)	-	-	0.561 (1320)
Bihar	0.801 (241)	0.753 (134)	0.515 (756)	0.678 (149)	-	0.603 (1288)
Orissa	0.692 (113)	0.842 (184)	0.483 (345)	-	-	0.611 (671)
West Bengal	0.808 (317)	0.800 (83)	0.547 (374)	0.762 (244)	-	0.695 (1030)
Assam	0.476 (108)	0.295 (87)	0.405 (227)	0.370 (164)	-	0.386 (600)
Manipur	-	0.493 (64)	0.281 (123)	-	-	0.368 (222)
Tripura	-	0.639 (53)	0.303 (76)	-	-	0.435 (187)
Meghalaya	-	0.204 (181)	-	-	-	0.219 (225)
Andhra Pradesh	0.642 (207)	0.665 (52)	0.315 (831)	0.421 (71)	0.390 (75)	0.395 (1236)
Tamil Nadu	0.643 (216)	-	0.441 (612)	-	-	0.495 (910)
Kerala	0.660 (70)	-	0.465 (312)	0.606 (121)	0.418 (135)	0.503 (645)
Gujarat	-	0.638 (101)	0.260 (349)	-	-	0.351 (530)
Maharashtra	0.568 (86)	0.583 (157)	0.414 (744)	-	0.574 (102)	0.466 (1135)
Karnataka	0.712 (91)	-	0.439 (455)	-	-	0.488 (621)
all-India	0.656 (2669)	0.661 (1614)	0.417 (8311)	0.550 (1670)	0.362 (1077)	0.491 (15341)

Notes : 1) Figures in parentheses indicate the number of sample households.

2) No estimate is presented in a cell if the no. of sample households is below 50.

3) The all-India estimate ignores the U.T.s of Delhi, Chandigarh, Pondicherry, and Goa, Daman and Diu.

and SC were the poorest social groups with 65 to 66 percent of their population falling below the poverty line. They were followed by 'other Muslims' with a head-count ratio of about 53 per cent. The 'other Hindus' had a head-count ratio of 42 per cent. Thus, the 'other Muslims' appeared to be slightly worse-off than the general population for whom the head-count ratio was 49 per cent. Finally, the 'others' group, with nearly 39 per cent of its population falling below the poverty line, turned out to be close to the 'other Hindus'.

The head-count ratios based on nominal PCE rank the social groups in a similar manner. However, as already mentioned, the estimates for the different social groups (and all-India) are smaller than the corresponding head-count ratios based on adjusted PCE.

The third set of all-India results for different social groups based on the corresponding statewise estimates, reported in Table 4.2C, show the following head-count ratios: about 66 per cent for SC or ST, 55 per cent for 'other Muslims', 42 per cent for 'other Hindus' and 36 per cent for 'others'.

On merging the SC and 'other Hindu' categories, the head-count ratio is obtained to be about 44.6 per cent from Table 4.2A, 47.6 per cent from Table 4.2B, and about 47.2 per cent from Table 4.2C. It appears that if Hindu ST households were also added to this group, the head-count ratio of the entire Hindu population (including SC and ST) would be close to that of the overall rural population[9].

The ranking of the social groups by Sen's or Chakravarty's indices agree very well for estimates based on <u>nominal</u> PCE and for those based on <u>adjusted</u> PCE. The ranking by the head-count ratio index is also very similar. Further, the rankings obtained for the two half-samples are quite consistent with that observed for the combined sample pointing to the reliability of the estimates.

The statewise results presented in Table 4.2C on variation of poverty across social groups may now be summarised briefly. The pattern of the incidence of absolute poverty over social groups observed at the all-India level seemed to be repeated in a broad manner in the states. But there were some notable exceptions. For example, in Assam, the ST appeared to be the least poor, and 'other Muslims' were slightly better-off than 'other Hindus'. For Madhya Pradesh, the ST were much poorer than the SC who were relatively close to the 'other Hindus'. In Orissa, too, the ST were considerably poorer than the SC. In Maharashtra, the 'others' group appeared to be as poor as the SC and ST. Similarly, in Andhra Pradesh, the 'other Hindus' were above

[9] See in this connection similar attempts to examine average PCE for the entire Hindu population in Chapter 3.

the 'others' group. In West Bengal, the 'other Muslims' were nearly as poor as the SC and ST. In contrast, the 'other Muslims' were the most prosperous group in the state of Jammu and Kashmir.

4.5.2 Incidence of Poverty by Size Classes of Household Land Possessed

Table 4.3A (4.3B) presents the estimates of different poverty measures, viz., the head-count ratio, Sen's index and Chakravarty's indices for e = 0.2, 0.5 and 0.9, based on nominal (adjusted) PCE separately for the different size classes of household land possessed. The estimated means and Gini coefficients of PCE of the poor are also shown in these tables.

Table 4.3B shows that households possessing 0.005-1.0 acre of land were the poorest group, with about 62 per cent of the population in this group falling below the poverty line. Even the landless households, with a head-count ratio of about 56 per cent, appeared to be slightly better-off than households in the 0.005-1.0 acre range. For landed households, the incidence of poverty is observed to decrease as one moves to higher size classes of land possessed, the head-count ratio for the highest size class, that is, for households possessing 15 acres or more of land, being nearly 26 per cent.

Table 4.3A : Measures of poverty for the rural population in India, by size classes of land possessed, based on nominal PCE : National Sample Survey 28th round household budget enquiry (October 1973 - June 1974)

household land possessed (in acres)	half-sample	no. of sample households	head-count ratio	mean PCE of the poor (in Rs.)	Gini coefficient of PCE of the poor	Sen's index	Chakravarty's index e = 0.2	Chakravarty's index e = 0.5	Chakravarty's index e = 0.9	average household size
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
landless (< 0.005)	1	333	0.557	31.20	0.134	0.212	0.039	0.090	0.146	4.10
	2	352	0.504	31.04	0.153	0.200	0.036	0.083	0.134	4.07
	combined	685	0.529	31.12	0.144	0.206	0.038	0.086	0.140	4.09
0.005 - 1.00	1	2766	0.583	30.67	0.135	0.228	0.043	0.098	0.159	4.60
	2	2784	0.585	30.36	0.146	0.237	0.044	0.102	0.164	4.52
	combined	5550	0.584	30.52	0.140	0.232	0.044	0.100	0.162	4.56
1.00 - 2.50	1	1345	0.506	32.66	0.119	0.172	0.030	0.071	0.116	5.09
	2	1375	0.515	32.61	0.122	0.177	0.031	0.073	0.119	5.04
	combined	2720	0.510	32.64	0.120	0.174	0.031	0.072	0.118	5.06
2.50 - 5.00	1	1421	0.411	34.19	0.101	0.121	0.021	0.049	0.081	5.52
	2	1315	0.426	32.79	0.112	0.141	0.025	0.059	0.097	5.61
	combined	2736	0.419	33.49	0.107	0.131	0.023	0.054	0.089	5.56
5.00 - 7.50	1	720	0.366	33.70	0.102	0.112	0.019	0.046	0.076	6.17
	2	753	0.347	32.52	0.125	0.121	0.021	0.049	0.081	6.10
	combined	1473	0.357	33.11	0.114	0.117	0.020	0.048	0.079	6.13
7.50 - 15.00	1	698	0.341	32.90	0.109	0.111	0.020	0.046	0.077	6.68
	2	704	0.333	33.79	0.099	0.100	0.018	0.041	0.069	6.55
	combined	1402	0.337	33.34	0.104	0.106	0.019	0.044	0.073	6.61
15.00 -	1	446	0.262	33.51	0.119	0.084	0.014	0.034	0.056	7.82
	2	440	0.235	34.81	0.106	0.067	0.011	0.026	0.043	7.47
	combined	886	0.249	34.11	0.114	0.076	0.013	0.030	0.050	7.64
all classes	1	7729	0.462	32.19	0.123	0.162	0.029	0.068	0.111	5.34
	2	7723	0.460	31.85	0.131	0.168	0.030	0.070	0.114	5.27
	combined	15452	0.461	32.00	0.127	0.165	0.030	0.069	0.113	5.30

Table 4.3B : Measures of poverty for the rural population in India, by size classes of land possessed, based on adjusted PCE : National Sample Survey 28th round household budget enquiry (October 1973 - June 1974)

household land possessed (in acres)	half-sample	no. of sample households	head-count ratio	mean PCE of the poor (in Rs.)	Gini coefficient of PCE of the poor	Sen's index	Chakravarty's index e = 0.2	Chakravarty's index e = 0.5	Chakravarty's index e = 0.9
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
landless (< 0.005)	1	333	0.590	30.06	0.144	0.242	0.046	0.104	0.169
	2	348	0.535	30.20	0.160	0.223	0.042	0.095	0.152
	combined	681	0.562	30.13	0.152	0.232	0.044	0.099	0.160
0.005 - 1.00	1	2731	0.623	29.92	0.147	0.258	0.049	0.112	0.180
	2	2746	0.623	29.68	0.157	0.265	0.050	0.115	0.184
	combined	5477	0.623	29.80	0.152	0.262	0.050	0.113	0.182
1.00 - 2.50	1	1335	0.540	32.40	0.126	0.189	0.034	0.078	0.127
	2	1370	0.548	32.07	0.127	0.196	0.035	0.081	0.133
	combined	2705	0.544	32.24	0.126	0.192	0.034	0.080	0.130
2.50 - 5.00	1	1415	0.446	34.00	0.102	0.134	0.023	0.054	0.090
	2	1312	0.466	32.68	0.113	0.156	0.028	0.065	0.107
	combined	2727	0.455	33.34	0.108	0.145	0.025	0.059	0.098
5.00 - 7.50	1	718	0.398	33.75	0.106	0.122	0.021	0.050	0.082
	2	749	0.377	32.51	0.121	0.129	0.023	0.053	0.088
	combined	1467	0.387	33.13	0.114	0.126	0.022	0.052	0.085
7.50 - 15.00	1	696	0.368	33.02	0.107	0.119	0.021	0.049	0.082
	2	703	0.345	33.96	0.099	0.103	0.018	0.042	0.070
	combined	1399	0.356	33.47	0.103	0.111	0.019	0.046	0.076
15.00 -	1	446	0.295	33.88	0.114	0.092	0.016	0.036	0.060
	2	439	0.217	33.87	0.106	0.066	0.011	0.027	0.044
	combined	885	0.257	33.88	0.111	0.079	0.014	0.032	0.052
all classes	1	7674	0.496	31.81	0.130	0.181	0.033	0.076	0.123
	2	7667	0.488	31.38	0.137	0.185	0.034	0.077	0.126
	combined	15341	0.492	31.59	0.134	0.183	0.033	0.077	0.125

Note : See note below Table 4.2B.

Table 4.3C : Head-count ratio measures of poverty for the rural population in different states of India, by size classes of household land possessed, based on NSS 28th round household budget enquiry (October 1973 - June 1974)

State	household land possessed (in acres)							
	landless (<0.005)	0.005-1.00	1.00-2.50	2.50-5.00	5.00-7.50	7.50-15.00	15.00-	all classes
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Rajasthan	-	0.429 (78)	0.484 (62)	0.388 (113)	0.266 (99)	0.255 (93)	0.176 (138)	0.290 (613)
Punjab	-	0.297 (344)	-	0.123 (51)	0.054 (62)	0.103 (107)	0.017 (57)	0.179 (670)
Jammu and Kashmir	-	0.279 (140)	0.255 (193)	0.373 (195)	0.418 (93)	-	-	0.336 (657)
Haryana	-	0.471 (234)	-	-	0.314 (73)	0.168 (120)	0.032 (72)	0.275 (603)
Himachal Pradesh	-	0.248 (84)	0.181 (159)	0.170 (98)	-	-	-	0.183 (394)
Uttar Pradesh	-	0.624 (608)	0.583 (457)	0.522 (353)	0.318 (179)	0.311 (121)	-	0.506 (1784)
Madhya Pradesh	0.568 (71)	0.615 (264)	0.621 (149)	0.619 (207)	0.545 (207)	0.525 (262)	0.487 (160)	0.561 (1320)
Bihar	0.712 (78)	0.748 (541)	0.631 (238)	0.548 (216)	0.497 (113)	0.371 (69)	-	0.603 (1288)
Orissa	-	0.750 (249)	0.633 (128)	0.550 (141)	0.509 (86)	-	-	0.611 (671)
West Bengal	-	0.873 (523)	0.665 (193)	0.481 (193)	0.626 (54)	-	-	0.695 (1030)
Assam	-	0.571 (184)	0.464 (139)	0.284 (188)	-	-	-	0.386 (600)
Manipur	-	-	0.412 (60)	0.332 (91)	-	-	-	0.369 (222)
Tripura	-	0.523 (84)	-	-	-	-	-	0.435 (187)
Meghalaya	-	-	0.254 (54)	0.191 (110)	-	-	-	0.219 (225)
Andhra Pradesh	-	0.435 (590)	0.509 (202)	0.393 (187)	0.279 (84)	0.267 (87)	0.194 (68)	0.395 (1236)
Tamil Nadu	-	0.575 (508)	0.519 (164)	0.378 (133)	-	-	-	0.495 (910)
Kerala	-	0.593 (412)	0.423 (120)	-	-	-	-	0.503 (645)
Gujarat	0.513 (113)	0.505 (90)	0.505 (53)	0.277 (50)	0.282 (74)	0.232 (83)	0.169 (67)	0.351 (530)
Maharashtra	0.553 (141)	0.557 (254)	0.549 (144)	0.503 (168)	0.387 (108)	0.449 (181)	0.298 (139)	0.466 (1135)
Karnataka	-	0.606 (215)	0.437 (77)	0.437 (92)	0.453 (66)	0.443 (83)	0.433 (61)	0.488 (621)
all-India	0.546 (681)	0.617 (5477)	0.549 (2705)	0.460 (2727)	0.396 (1467)	0.351 (1399)	0.242 (885)	0.491 (15341)

Notes : 1) Figures in parentheses indicate the number of sample households.

2) No estimate is presented in a cell if the no. of sample households is below 50.

3) The all-India estimate ignores the U.T.s of Delhi, Chandigarh, Pondicherry, and Goa, Daman and Diu.

The head-count ratios estimated from nominal PCE (*vide* Table 4.3A) are slightly smaller than the corresponding results based on adjusted PCE, but they show the same pattern of variation in the incidence of absolute poverty across size classes of household land possessed as the estimates based on adjusted PCE. Chakravarty's indices and Sen's index (*vide* Tables 4.3A and 4.3B) also corroborate this pattern. Actually, the ranking of the size classes by the combined sample estimates of poverty is found to be about the same no matter which index is used. In general, the half-sample estimates of poverty also agree fairly well and give similar rankings.

The pattern of poverty across size classes of household land possessed observed at the all-India level was seen to be roughly repeated in most of the states (*vide* Table 4.3C), with some notable exceptions. For example, in Jammu and Kashmir, populations in the two size classes of land possessed, namely, 2.5 - 5.0 acres and 5.0 - 7.5 acres appeared to have been poorer than those in the two lower size classes. In Karnataka, there was hardly any decline in the head-count ratio from the size class 1.0 - 2.5 acres onwards. For Maharashtra and Gujarat, the index remained almost stable at about 55 per cent and 51 per cent, respectively, for the three lowest size classes of land possessed. In Madhya Pradesh, even the population in the size classes

1.0 - 2.5 acres and 2.5 - 5.0 acres appeared to be poorer than the landless households. Finally, in Andhra Pradesh, population in the size class 1.0 - 2.5 acres seemed to be worse-off than those in the class 0.005 - 1.0 acre.

Thus, the pattern of variation of poverty across size classes of household land possessed seem to suggest some inter-state differences. The fact that household land possessed rather than per capita land possessed has been used as the classificatory factor might have contributed to such variation. Household size interacts with household land possessed in affecting the level of living of a household. Further, a rising trend in the average size of households with increasing size of household land possessed is clearly observed at the level of rural India (vide col. (11) of Table 4.3A). The possible interaction effects of these two factors, viz., household size and household land possessed, are examined in detail in Section 4.5.4 below.

4.5.3 Variation of Poverty across Household Occupational Classes

The poverty indices for different occupational groups estimated on the basis of nominal PCE and adjusted PCE are shown in Tables 4.4A and 4.4B, respectively. Both tables give a similar picture of variation in the incidence of absolute poverty across occupational classes. In Table 4.4B, which deserves greater attention, the agricultural

Table 4.4A : Measures of poverty for the rural population in India, by occupational classes, based on nominal PCE : National Sample Survey 28th round household budget enquiry (October 1973 - June 1974)

household occupation	half-sample	no. of sample households	head-count ratio	mean PCE of the poor (in Rs.)	Gini coefficient of PCE of the poor	Sen's index	Chakravarty's index e = 0.2	Chakravarty's index e = 0.5	Chakravarty's index e = 0.9
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
I. professional, technical and related, administrative, executive and managerial workers, clerical and related workers	1	275	0.234	33.93	0.102	0.070	0.012	0.029	0.047
	2	288	0.290	33.41	0.109	0.092	0.016	0.037	0.062
	combined	563	0.261	33.64	0.106	0.081	0.014	0.033	0.055
II. sales workers	1	235	0.360	33.33	0.117	0.117	0.021	0.048	0.078
	2	224	0.400	32.73	0.112	0.133	0.024	0.055	0.091
	combined	459	0.379	33.03	0.115	0.125	0.022	0.051	0.084
III. service workers	1	149	0.539	32.46	0.108	0.181	0.033	0.077	0.126
	2	149	0.501	31.54	0.135	0.188	0.035	0.079	0.128
	combined	298	0.520	32.03	0.122	0.184	0.034	0.078	0.127
IV. cultivators (owners)	1	3863	0.369	33.73	0.107	0.114	0.020	0.046	0.077
	2	3743	0.356	33.31	0.112	0.114	0.020	0.047	0.077
	combined	7606	0.363	33.53	0.109	0.114	0.020	0.046	0.077
V. cultivators (tenants)	1	126	0.453	33.56	0.119	0.146	0.025	0.058	0.096
	2	133	0.577	33.12	0.130	0.196	0.034	0.078	0.128
	combined	259	0.521	33.30	0.126	0.173	0.030	0.069	0.113
VI. agricultural labourers	1	1977	0.673	30.30	0.137	0.269	0.051	0.117	0.189
	2	2083	0.672	30.09	0.146	0.276	0.052	0.119	0.192
	combined	4060	0.673	30.19	0.142	0.273	0.051	0.118	0.191
VII. other agriculture, fishermen, hunters, loggers and related workers	1	198	0.615	31.08	0.116	0.227	0.043	0.099	0.162
	2	192	0.520	31.94	0.140	0.192	0.034	0.079	0.128
	combined	390	0.569	31.46	0.128	0.211	0.039	0.089	0.146
VIII. production and related workers, transport equipment operators and labourers	1	669	0.484	32.17	0.122	0.171	0.031	0.071	0.117
	2	669	0.462	32.35	0.127	0.163	0.029	0.067	0.110
	combined	1338	0.473	32.25	0.125	0.167	0.030	0.069	0.113
IX. non-response or non-workers	1	237	0.486	31.46	0.133	0.181	0.033	0.076	0.124
	2	242	0.431	30.60	0.163	0.178	0.033	0.075	0.119
	combined	479	0.459	31.07	0.147	0.180	0.033	0.076	0.122
all-occupations	1	7729	0.462	32.19	0.123	0.162	0.029	0.068	0.111
	2	7723	0.460	31.85	0.131	0.168	0.030	0.070	0.114
	combined	15452	0.461	32.00	0.127	0.165	0.030	0.069	0.113

Table 4.4B : Measures of poverty for the rural population in India, by occupational classes, based on adjusted PCE : National Sample Survey 28th round household budget enquiry (October 1973 - June 1974)

household occupation	half-sample	no. of sample households	head-count ratio	mean PCE of the poor (in Rs.)	Gini coefficient of PCE of the poor	Sen's index	Chakravarty's index		
							e = 0.2	e = 0.5	e = 0.9
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
I. professional, technical and related, administrative, executive and managerial workers, clerical and related workers	1	273	0.274	33.42	0.116	0.088	0.015	0.035	0.059
	2	282	0.311	32.67	0.121	0.106	0.019	0.043	0.071
	combined	555	0.292	33.03	0.119	0.097	0.017	0.039	0.065
II. sales workers	1	233	0.395	32.66	0.136	0.139	0.024	0.056	0.091
	2	222	0.471	32.55	0.123	0.162	0.029	0.067	0.110
	combined	455	0.431	32.60	0.129	0.150	0.027	0.061	0.100
III. service workers	1	148	0.576	31.72	0.119	0.207	0.038	0.088	0.144
	2	148	0.540	31.49	0.147	0.207	0.038	0.087	0.139
	combined	296	0.558	31.61	0.133	0.207	0.038	0.087	0.141
IV. cultivators (owners)	1	3848	0.399	33.80	0.107	0.123	0.021	0.050	0.082
	2	3732	0.375	33.14	0.112	0.122	0.021	0.050	0.082
	combined	7580	0.387	33.49	0.109	0.122	0.021	0.050	0.082
V. cultivators (tenants)	1	123	0.495	31.47	0.125	0.182	0.033	0.077	0.127
	2	132	0.622	31.97	0.138	0.229	0.041	0.094	0.153
	combined	255	0.564	31.77	0.134	0.208	0.037	0.086	0.140
VI. agricultural labourers	1	1962	0.708	29.55	0.147	0.298	0.057	0.131	0.210
	2	2063	0.707	29.33	0.155	0.305	0.059	0.133	0.214
	combined	4025	0.707	29.43	0.151	0.302	0.058	0.132	0.212
VII. other agriculture, fishermen, hunters, loggers and related workers	1	192	0.649	29.55	0.134	0.268	0.052	0.119	0.193
	2	191	0.555	30.49	0.150	0.225	0.042	0.095	0.154
	combined	383	0.604	29.97	0.142	0.248	0.047	0.108	0.174
VIII. production and related workers, transport equipment operators and labourers	1	658	0.539	31.64	0.132	0.199	0.036	0.083	0.136
	2	661	0.514	32.19	0.133	0.185	0.033	0.076	0.124
	combined	1319	0.526	31.91	0.133	0.192	0.035	0.080	0.130
IX. non-response or non-workers	1	237	0.532	31.23	0.148	0.207	0.038	0.086	0.139
	2	236	0.455	29.51	0.165	0.198	0.038	0.086	0.136
	combined	473	0.495	30.47	0.157	0.203	0.038	0.086	0.138
all-occupations	1	7674	0.496	31.81	0.130	0.181	0.033	0.076	0.123
	2	7667	0.488	31.38	0.137	0.185	0.034	0.077	0.126
	combined	15341	0.492	31.59	0.134	0.183	0.033	0.077	0.125

Note : See note below Table 4.2B.

labourers appeared to be the poorest with a head-count ratio of about 71 per cent. They were followed by 'other agricultural workers' (60 per cent), 'tenant cultivators' (56 per cent) and 'service workers' (56 per cent) in the order stated. On the other hand, households belonging to occupational class I ('professional, technical, etc.') had the smallest incidence of poverty (29 per cent), followed by 'owner cultivators' (39 per cent) and 'sales workers' (43 per cent).

Half-sample estimates are seen to agree fairly well except for occupational classes like 'tenant cultivators' and 'other agricultural workers', possibly because the number of sample households for these classes was small. Taking rural India as a whole, there was marked variation of the poverty indices across the major occupational classes.

Sen's index (vide col. (7) of Tables 4.4A and 4.4B) and Chakravarty's indices (vide cols. (8), (9) and (10) of Tables 4.4A and 4.4B) are seen to rank the different occupational classes more or less in the same manner as the corresponding head-count ratio measure of absolute poverty. The Spearman rank correlation coefficient between the combined sample estimates of Sen's index and the head-count ratio, based on adjusted PCE is 0.98, while that between the head-count ratio and Chakravarty's indices is 0.90 for $e = 0.2$, 0.95 for $e = 0.5$ and 0.97 for $e = 0.9$. The Spearman's

Table 4.4C : Head-count ratio measures of poverty for the rural population in different states of India by household occupational classes, based on NSS 28th round household budget enquiry (October 1973 - June 1974)

State	household occupation									
	professional, technical, executive, managerial, administrative, clerical and related workers	sales workers	service workers	cultivators (owners)	cultivators (tenants)	agricultural labourers	other agricultural workers	production, transport and related workers	non-response or non-workers	all occupations
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Rajasthan	-	-	-	0.272 (470)	-	-	-	0.374 (53)	-	0.290 (613)
Punjab	-	-	-	0.073 (269)	-	0.338 (194)	-	0.296 (69)	-	0.179 (670)
Jammu and Kashmir	-	-	-	0.348 (500)	-	-	-	0.349 (79)	-	0.336 (657)
Haryana	-	-	-	0.171 (301)	-	0.576 (88)	-	0.400 (81)	-	0.275 (603)
Himachal Pradesh	-	-	-	0.195 (283)	-	-	-	-	-	0.183 (394)
Uttar Pradesh	0.406 (50)	0.573 (51)	-	0.441 (1091)	-	0.699 (319)	-	0.618 (140)	-	0.506 (1784)
Madhya Pradesh	-	-	-	0.540 (799)	-	0.669 (361)	-	0.470 (63)	-	0.561 (1320)
Bihar	-	-	-	0.469 (579)	-	0.804 (443)	-	0.691 (84)	-	0.603 (1288)
Orissa	-	-	-	0.532 (303)	-	0.803 (260)	-	-	-	0.611 (671)
West Bengal	-	-	-	0.513 (342)	-	0.926 (361)	-	0.706 (99)	-	0.695 (1030)
Assam	-	-	-	0.304 (349)	-	0.605 (50)	0.797 (71)	0.481 (51)	-	0.386 (600)
Manipur	-	-	-	0.364 (162)	-	-	-	-	-	0.369 (222)
Tripura	-	-	-	0.340 (72)	-	-	-	-	-	0.435 (187)
Meghalaya	-	-	-	0.197 (167)	-	-	-	-	-	0.219 (225)
Andhra Pradesh	0.406 (77)	-	-	0.287 (429)	-	0.536 (513)	-	0.367 (95)	-	0.395 (1236)
Tamil Nadu	-	-	-	0.369 (276)	-	0.646 (387)	-	0.456 (89)	-	0.495 (910)
Kerala	0.281 (62)	-	-	0.330 (143)	-	0.712 (173)	-	0.591 (126)	-	0.503 (645)
Gujarat	-	-	-	0.219 (273)	-	0.656 (145)	-	-	-	0.351 (530)
Maharashtra	0.332 (52)	-	-	0.352 (472)	-	0.653 (425)	-	0.493 (98)	-	0.466 (1135)
Karnataka	-	-	-	0.407 (300)	-	0.701 (215)	-	-	-	0.488 (621)
all-India rural	0.284 (555)	0.425 (455)	0.548 (296)	0.395 (7580)	0.545 (255)	0.696 (4025)	0.570 (383)	0.518 (1319)	0.463 (473)	0.491 (15341)

Notes : 1) Figures in parentheses indicate the number of sample households.

2) No estimate is presented in a cell if the number of sample households is below 50.

3) The all-India estimate ignores the U.T.s of Delhi, Chandigarh, Pondicherry, and Goa, Daman and Diu.

coefficient between Sen's and Chakravarty's indices is 0.95 for e = 0.2, 0.97 for e = 0.5 and 0.98 for e = 0.9. The marginal disagreements of the ranking of occupations by the different indices are possibly due to the sensitivity of the Sen's and Chakravarty's indices to the nature of distribution of PCE below the poverty line. For example, in the ranking by the head-count ratio, the difference between the ranks of 'service workers' and workers in the 'production, transport, etc.' class was slightly narrower than that in the ranking by Sen's or Chakravarty's indices. In the ranking by the latter two indices, workers in the 'production, transport, etc.' class were relatively less poor because the average PCE of the poor for this class was a little higher than that for the 'service workers'.

Coming to the statewise results presented in Table 4.4C on the variation in the incidence of poverty across occupational classes, note that the head-count ratios for some occupational classes for some states are not presented in view of inadequate sample sizes (which were less than 50 households). However, the estimates of poverty for the major occupational classes, viz., 'owner cultivators' (class IV), 'agricultural labourers' (class VI), and 'production, transport and related workers' (class VIII) are shown for most of the states. These show broadly the same pattern of variation of the incidence of absolute poverty across occupational classes as observed for rural India as a whole. However, there were some notable exceptions. Thus, in Madhya Pradesh, 'production, transport and related workers' appeared to have been more prosperous than 'owner cultivators' who were not much better-off than the 'agricultural labourers'. Also, in Jammu and Kashmir, 'owner cultivators' were seen to be almost at par with 'production, transport and related workers'.

4.5.4 Poverty and Household Size

The association between the head-count ratio measure of poverty and household size is studied through Tables 4.5 and 4.6, which present the head-count ratio by classes of household size cross-classified by household occupation (Table 4.5) or household land possessed (Table 4.6) for rural India as a whole. Note that these head-count ratios were estimated from nominal PCEs using the all-India rural poverty line of PCE = Rs. 43.57 (per 30 days).

The head-count ratios for households with sizes varying from 1 to 10 or more for all occupational classes taken together are presented in col. (6) of Table 4.5. It appears that the incidence of poverty steadily increased with household size upto households of size 6, after which it declined, although by a smaller amount. In order to investigate the possible reasons underlying this trend, in

Table 4.5 : Head-count ratio measures of poverty for the population in rural India, by household occupation and household size, based on NSS 28th round household budget enquiry (October 1973-June 1974)[a]

household size	household occupation: professional, tech. and reltd., executive, managerial, adm. and all clerical and related workers	owner cultivators	agricultural labourers	production and related workers, transport equipment workers and labourers	all occupations[b]
(1)	(2)	(3)	(4)	(5)	(6)
1	0.043 (101)	0.068 (211)	0.212 (213)	0.033 (89)	0.147 (895)
2	-	0.142 (550)	0.356 (455)	0.168 (122)	0.228 (1330)
3	0.118 (50)	0.263 (773)	0.492 (627)	0.216 (150)	0.347 (1836)
4	0.160 (68)	0.349 (984)	0.625 (684)	0.317 (180)	0.447 (2159)
5	0.231 (74)	0.357 (1207)	0.686 (697)	0.445 (206)	0.473 (2485)
6	0.235 (75)	0.418 (1114)	0.737 (554)	0.567 (203)	0.533 (2172)
7	0.283 (62)	0.403 (928)	0.758 (378)	0.543 (162)	0.513 (1696)
8	-	0.391 (624)	0.755 (212)	0.637 (107)	0.510 (1104)
9	-	0.391 (417)	0.796 (106)	0.512 (58)	0.482 (666)
10 and above	-	0.338 (798)	0.772 (134)	0.513 (61)	0.416 (1109)
all sizes	0.261 (563)	0.362 (7606)	0.673 (4060)	0.473 (1338)	0.461 (15452)

[a] Figures in parenthesis indicate number of sample households.

[b] Including those not covered in cols. (2) to (5).

Fig. 4.2. VARIATION IN HEAD-COUNT RATIO WITH HOUSEHOLD SIZE FOR DIFFERENT OCCUPATIONS

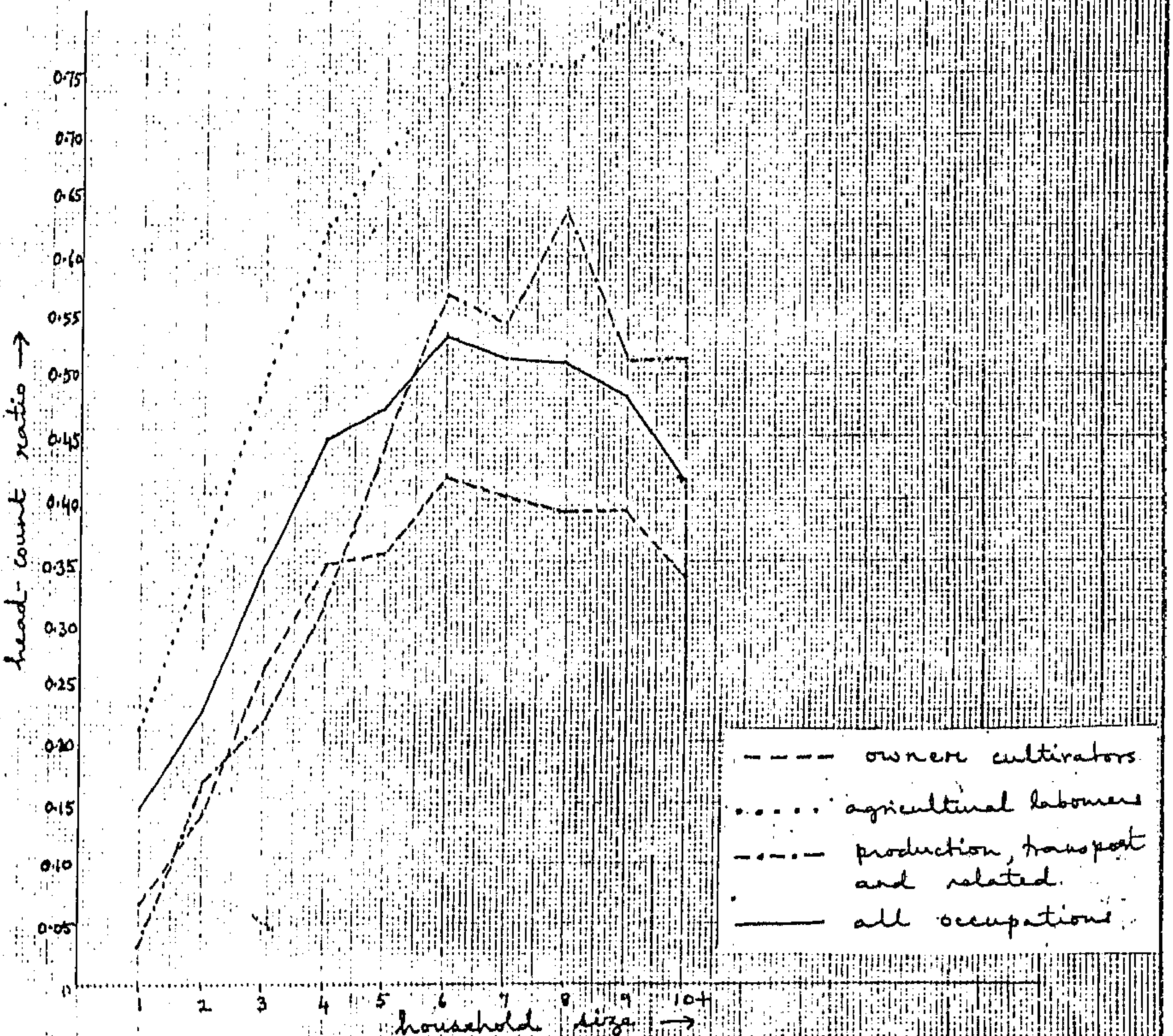


Fig 4.2

particular the decline in head-count ratio over large household sizes, the association between poverty and household size was studied separately for major occupational classes (vide Table 4.5) and size classes of household land possessed (vide Table 4.6).

Table 4.5 actually shows the pattern for four major occupational classes. The remaining occupational classes had to be left out in this exercise because of their inadequate sample size. The head-count ratios for households of different sizes are plotted in Fig. 4.2 for 'all occupational classes' and classes IV, VI and VIII. It may be seen that within any of these occupational classes (IV, VI and VIII), the head-count ratio rose with household size upto households with about six members after which it became roughly stable. (Only for the 'owner cultivator' class, the head-count ratio fell rather sharply after size = 9 for the households.) The general pattern of decrease in head-count ratio for large-sized households for all occupations taken together (vide col. (6)) could largely be accounted for by the increasing proportion of 'owner cultivators' (and decreasing proportion of 'agricultural labourers') with increasing household size and the lower level of head-count ratio for 'owner cultivator' households compared to that for 'agricultural labourers'.

Table 4.6 : Head-count ratio measures of poverty for the population in rural India, by household land possessed and household size, based on NSS 28th round household budget enquiry (October 1973 - June 1974)[a]

household size	household land possessed (in acres)							
	landless household	0.005-1	1-2.5	2.5-5.0	5.0-7.5	7.5-15.0	15.0-	all classes
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	0.104 (147)	0.194 (509)	0.067 (118)	0.068 (53)	-	-	-	0.147 (895)
2	0.308 (86)	0.300 (608)	0.189 (250)	0.119 (198)	0.088 (93)	0.138 (61)	-	0.228 (1330)
3	0.350 (84)	0.405 (825)	0.375 (353)	0.261 (301)	0.245 (127)	0.174 (96)	0.236 (50)	0.347 (1836)
4	0.436 (92)	0.552 (871)	0.439 (416)	0.378 (388)	0.276 (173)	0.321 (156)	0.221 (63)	0.447 (2159)
5	0.633 (79)	0.621 (892)	0.438 (509)	0.404 (452)	0.343 (233)	0.280 (215)	0.154 (105)	0.473 (2485)
6	0.623 (78)	0.678 (710)	0.538 (422)	0.464 (450)	0.403 (195)	0.388 (217)	0.260 (100)	0.533 (2172)
7	0.505 (52)	0.641 (507)	0.608 (279)	0.510 (348)	0.427 (203)	0.290 (180)	0.247 (127)	0.513 (1696)
8	-	0.667 (301)	0.621 (162)	0.461 (242)	0.384 (138)	0.329 (130)	0.298 (92)	0.510 (1104)
9	-	0.711 (159)	0.648 (88)	0.412 (116)	0.338 (89)	0.399 (111)	0.230 (88)	0.482 (666)
10 and above	-	0.593 (168)	0.627 (123)	0.400 (188)	0.363 (188)	0.373 (212)	0.266 (217)	0.416 (1109)
all sizes	0.530 (685)	0.584 (5550)	0.510 (2720)	0.418 (2736)	0.356 (1473)	0.337 (1402)	0.249 (886)	0.461 (15452)

[a] Figures in parentheses indicate number of sample households.

Table 4.6 examines the effect of household size on head-count ratio for different size classes of household land possessed. As in Table 4.5, it is observed that for almost any given size class of household land possessed, the head-count ratio rose somewhat steadily upto household size 5, 6 or a little more, but thereafter showed no clear trend. These observations are quite consistent with those based on Table 4.5.

4.6 Contributions of States and Different Socio-economic Groups to Overall Rural Poverty in India

In the foregoing analysis the incidence of poverty in rural India has been examined for households grouped, in turn, by state, social group, occupational class, size of household land possessed and finally household size. The results reported so far in Sections 4.4 and 4.5 would help in identifying the states and socio-economic groups having relatively larger incidence of absolute poverty. An attempt is made in this Section to decompose the overall (total) incidence of poverty in rural India by state and socio-economic groups. Needless to mention, such a decomposition analysis should bring out clearly the contributions and the relative importance of various segments of the population in determining the overall incidence of poverty. As already mentioned, the head-count ratio and Chakravarty's indices have been employed in this decomposition analysis. In terms of equations (4.1.1) and (4.5.1), the contributions of the i-th group to overall poverty are measured by $\frac{n_i}{n} H_i$ and $\frac{n_i}{n} P_{C_i}(e)$ in case of the head-count ratio and Chakravarty's indices, respectively.

The contributions of different states to overall poverty in rural India are presented in Table 4.7(a). The corresponding decompositions by social groups, by size classes of household land possessed and by household occupational classes are presented in Tables 4.7(b) - (d), respectively. In all these tables, the results obtained on the basis of head-count ratio (estimated using statewise poverty lines) and Chakravarty's index for e = 0.2, 0.5 and 0.9 are shown separately. It may be mentioned again that in finding the contributions of states to overall rural poverty, statewise estimates of Chakravarty's indices were used. The contributions of socio-economic groups were derived from corresponding Chakravarty's indices, based on adjusted PCE, presented in Tables 4.2B to 4.4B. Some of the salient results of this decomposition analysis are reported below.

Two general remarks on the results presented in Tables 4.7(a) - (d) are in order. First, it may be noted that the percentage contributions to overall poverty, based on Chakravarty's indices, are rather insensitive to the value of e. Note also that the percentage contributions to overall poverty based on the head-count ratio presented in Tables 4.7(a) - (d) are nothing but the percentages of all-India (rural) poor belonging to the different states or socio-economic groups.

4.6.1 Contributions of States to Overall Rural Poverty

From Table 4.7(a), it can be seen that the three poorest states of the eastern region, viz., West Bengal, Orissa and Bihar, constituted 24 per cent of the total rural population and 31 per cent of the poor population in rural India according to the head-count ratio. By Chakravarty's indices, their share in overall poverty was somewhat higher, viz., 37 to 38 per cent. The higher contribution of these three states according to Chakravarty's indices compared to the head-count ratio was partly due to higher than average poverty gaps (vide cols. (1) and (5) of Table 4.1) and Gini coefficients of PCE of the poor (vide col. (6) of Table 4.1) for these three states. Madhya Pradesh and Uttar Pradesh were the next poorest states in the ranking of the states by the head-count ratio. The five states mentioned made up about half of the rural population, and accounted for about 59 per cent of the total rural poverty according to the head-count ratio and for about 62 to 63 per cent of total poverty by Chakravarty's indices.

Table 4.7(a) : Contribution of different States to overall rural poverty in India, based on NSS 28th round household budget enquiry (October 1973 - June 1974)

States	percentage of all-India rural population	head-count ratio	percentage contributions to total poverty based on			
			head-count ratio	Chakravarty's index		
				e=0.2	e=0.5	e=0.9
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Rajasthan	4.9	0.289	2.9	2.3	2.3	2.4
Punjab	2.5	0.179	0.9	0.5	0.5	0.6
Jammu & Kashmir	0.4	0.336	0.3	0.2	0.2	0.2
Haryana	1.9	0.275	1.1	0.7	0.7	0.8
Himachal Pradesh	0.8	0.183	0.3	0.2	0.2	0.2
Uttar Pradesh	17.7	0.506	18.2	15.4	15.7	16.0
Madhya Pradesh	8.2	0.561	9.4	9.7	9.8	9.8
Bihar	11.1	0.603	13.7	15.7	15.5	15.3
Orissa	4.7	0.611	5.9	6.4	6.3	6.3
West Bengal	8.2	0.695	11.6	16.1	15.8	15.3
Assam	2.9	0.386	2.3	1.7	1.7	1.7
Manipur	0.2	0.369	0.2	0.1	0.1	0.1
Tripura	0.3	0.435	0.3	0.2	0.2	0.2
Meghalaya	0.2	0.219	0.1	0.1	0.1	0.1
Andhra Pradesh	7.9	0.395	6.3	5.5	5.5	5.5
Tamil Nadu	6.4	0.495	6.4	6.3	6.3	6.3
Kerala	4.3	0.503	4.4	4.9	4.9	4.9
Gujarat	4.4	0.351	3.1	2.2	2.3	2.3
Maharashtra	7.9	0.466	7.5	7.0	7.1	7.2
Karnataka	5.1	0.488	5.1	4.8	4.8	4.8
INDIA*	100.0	0.491	100.0	100.0	100.0	100.0

*Does not include the Union Territories of Pondicherry, Delhi, Chandigarh, and Goa, Daman and Diu.

Table 4.7(b) : Contribution of different social groups to overall rural poverty in India, based on NSS 28th round household budget enquiry (October 1973 - June 1974)

Social group	percentage of all-India rural population	head-count ratio	percentage contributions to total poverty based on			
			head-count ratio	Chakravarty's index		
				e=0.2	e=0.5	e=0.9
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Scheduled Castes	17.3	0.656	23.1	26.6	26.3	26.1
Scheduled Tribes	9.4	0.661	12.7	14.1	14.1	14.0
Other Hindus	58.2	0.417	49.4	44.1	44.5	44.9
Other Muslims	9.5	0.550	10.7	10.8	10.7	10.6
Others	5.6	0.362	4.1	4.4	4.4	4.4
all groups	100.0	0.491	100.0	100.0	100.0	100.0

Note (i) : The head-count ratios presented in col. (3) are taken from Table 4.2C.

(ii) : The contributions based on Chakravarty's indices were computed from the figures in cols. (8)-(10) of Table 4.2B.

(iii) : The Union Territories, viz., Delhi, Chandigarh, Pondicherry and Goa, Daman and Diu were excluded while computing the results for this table.

4.6.2 Contributions of Social Groups to Overall Rural Poverty

According to Table 4.7(b), the Scheduled Castes who formed 17.3 per cent of the rural population accounted for 23.1 per cent of the rural poor in India. The SC and ST, taken together, formed 26.7 per cent of the rural population and included 35.8 per cent of the rural poor. The corresponding figures for 'other Muslims' were relatively close — 9.5 per cent of the rural population and 10.7 per cent of the rural poor.

According to Chakravarty's indices, the SC and ST, taken together accounted for about 40-41 per cent of the total poverty in rural India.

In contrast, 'other Hindus' who comprised 58 per cent of the rural population included 49 per cent of the rural poor. According to Chakravarty's indices, their contribution to rural poverty in India was 44 to 45 per cent.

4.6.3 Contributions of Size Classes of Household Land Possessed to Overall Rural Poverty

From Table 4.7(c), it may be seen that households possessing small areas of land (0.005 - 1.0 acre) accounted for 32 per cent of the total rural population of the country and contributed 40 per cent to total poverty going by the head-count ratio and about 46 to 47 per cent of the same

Table 4.7(c) : Contribution of different size classes of household land possessed to overall rural poverty in India, based on NSS 28th round household budget enquiry (October 1973 - June 1974)

land possessed (in acres)	percentage of all-India rural population	head-count ratio	percentage contributions to total poverty based on			
			head-count ratio	Chakravarty's index		
				e=0.2	e=0.5	e=0.9
(1)	(2)	(3)	(4)	(5)	(6)	(7)
< 0.005	3.7	0.546	4.1	4.8	4.8	4.7
0.005 - 1.0	31.8	0.617	40.0	47.4	46.9	46.5
1.0 - 2.5	16.6	0.549	18.6	17.2	17.2	17.3
2.5 - 5.0	17.5	0.460	16.4	13.4	13.6	13.8
5.0 - 7.5	10.8	0.396	8.8	7.2	7.3	7.4
7.5 - 15.0	11.2	0.351	8.0	6.6	6.7	6.8
15.0 -	8.4	0.242	4.1	3.4	3.5	3.5
all classes	100.0	0.491	100.0	100.0	100.0	100.0

Note (i) : The head-count ratios presented in col. (3) are taken from Table 4.3C.

(ii) : The contributions based on Chakravarty's indices were computed from the figures shown in cols. (8)-(10) of Table 4.3B.

(iii) : See note (iii) below Table 4.7(b).

judging by the Chakravarty indices. In fact, the three poorest size classes, namely, the 'landless households' and households possessing less than 2.5 acres of land constituted 52 per cent of the rural population of India and contributed 68 to 69 per cent to overall poverty by Chakravarty's indices and 63 per cent by the head-count ratio. The contribution of 'landless households' by themselves, however, was quite small, essentially because they covered a meagre 3.7 per cent of the total rural population.

4.6.4 Contributions of Occupational Classes to Overall Rural Poverty

Table 4.7(d) shows that the poorest occupational class of households, namely, the 'agricultural labourers' accounted for about 26 per cent of the rural population and 37 per cent of the rural poor. According to Chakravarty's indices, their contribution to rural poverty was about 44 to 45 per cent. 'Owner cultivators', who made up about 53 per cent of the rural population, included 43 per cent of the rural poor in India. Going by Chakravarty's indices, their contribution to overall poverty was 34 to 35 per cent. The contributions of the other occupational classes in the total rural poverty were much smaller because of their comparatively small shares in the total rural population.

Table 4.7(d) : Contribution of different occupational classes to overall rural poverty in India based on NSS 28th round budget data (October 1973 - June 1974)

household occupation	percentage of all-India rural population	head-count ratio	percentage contributions to total rural poverty based on			
			head-count ratio	Chakravarty's index		
				e=0.2	e=0.5	e=0.9
(1)	(2)	(3)	(4)	(5)	(6)	(7)
I. professional, technical and related, administrative, executive, managerial, clerical and related workers	3.1	0.284	1.8	1.6	1.6	1.6
II. Sales workers	2.8	0.425	2.4	2.2	2.2	2.2
III. Service workers	1.7	0.548	1.9	1.9	1.9	1.9
IV. cultivators (owners)	52.9	0.395	42.6	33.9	34.4	35.0
V. cultivators (tenants)	1.7	0.545	1.9	1.9	1.9	1.9
VI. agricultural labourers	25.9	0.696	36.7	45.0	44.6	44.0
VII. other agriculture, hunters, loggers, fishermen and related workers	2.2	0.570	2.6	3.1	3.1	3.1
VIII. production and related workers, transport equipment operators and labourers	7.9	0.518	8.4	8.3	8.3	8.3
IX. non response	1.8	0.463	1.7	2.0	2.0	2.0
all occupations	100.0	0.491	100.0	100.0	100.0	100.0

Note (i) : The head-count ratios presented in col. (3) are taken from Table 4.4C.

(ii) : The contributions based on Chakravarty's indices were computed from the figures in cols. (8)-(10) of Table 4.4B.

(iii) : See note (iii) below Table 4.7(b).

4.7 Concluding Remarks

The analysis of rural poverty in India presented in this Chapter was carried out in two parts. In the first part, the sample households of rural India covered in the NSS 28th round (October 1973 - June 1974) were divided, separately, into sub-groups by state and socio-economic characteristics such as social group, size classes of household land possessed and occupational class. The incidence of absolute poverty in each individual state and in each socio-economic group, at the all-India level, was estimated using the head-count measure, Sen's index and Chakravarty's index of poverty for three values of e. For different socio-economic groups, poverty was estimated both in nominal terms and after expressing all PCE at all-India rural prices of the poor, using a single poverty line for rural India. Poverty in the individual socio-economic groups as mentioned above was also estimated at the state level using the head-count measure of absolute poverty and statewise poverty lines.

It may be mentioned that for each classificatory factor used for formation of sub-groups, the different poverty indices used gave, in general, similar rankings of the sub-groups. Marginal differences in the rankings of sub-groups by head-count ratio and Sen's or Chakravarty's indices were observed in some cases, largely due to differences in the degree of deprivation of the poor (as measured by, for example, relative differences between averages of PCE and poverty lines used or the PCE-gap ratio, and the Gini coefficient of PCE of the poor) in different sub-groups, which the latter indices take account of but the head-count ratio does not.

Among the states, West Bengal, Bihar and Orissa were found to be the poorest with head-count ratios above 60 per cent. On the other hand, the north-western states of the Punjab and Himachal Pradesh were the least poor, and were closely followed by Meghalaya.

On examining the incidence of poverty across social groups at the all-India level, the SC and ST were found to be the poorest social groups with nearly two-thirds of the populations in these groups falling below the poverty line. The 'others' group (covering Jains, Christians, Sikhs, etc.) was found to have the lowest incidence of absolute poverty. This pattern in the variation of poverty across social groups was observed in most of the states, but there were some exceptions. For example, in Assam, the ST were less poor than 'other Hindus', and in Maharashtra, the 'others' group was almost as poor as the SC and ST.

Coming to the incidence of poverty in different size classes of household land possessed at the level of rural India, households possessing 0.005 - 1.0 acre of land were found to be the poorest — in fact, they turned out to be poorer than even the 'landless households'. Among landed households, poverty tended to decrease with the increase in the size classes of land possessed. This pattern of variation in the incidence of poverty was broadly repeated in most of the states, again with some variations. For example, in Jammu and Kashmir, a higher head-count ratio was observed for the size classes 2.5 - 5.0 acres and 5.0 - 7.5 acres than for 0.005 - 1.0 acre or 1.0 - 2.5 acres.

Finally, among the occupational classes, at the all-India level, the 'agricultural labourers' were found to be the poorest. The 'professional, technical, etc.' class was the least poor, followed by the 'owner cultivators'. In this case also, the pattern of variation in the incidence of poverty observed at the all-India level was more or less repeated in most of the states with some exceptions. Thus, in Madhya Pradesh, workers in 'production, transport, etc.' were found to be less poor than 'owner cultivators', who were not very much better-off than the 'agricultural labourers'.

The association between the incidence of poverty and household size was also examined in this Chapter. For the general rural population, the estimated head-count ratio was found to increase steadily upto households of size 6, after which it declined to some extent. This declining trend in poverty over large household sizes was, at least partly, due to the increasing proportion of population in 'owner cultivator' households (and the decreasing proportion of population in 'agricultural labour' households) as household size increased and lower head-count ratios of poverty for 'owner cultivator' households compared to those for 'agricultural labourers'.

Thus, the first part of the analysis aimed at identifying the poorer states and socio-economic groups. In the second part of the study, a decomposition analysis of poverty was carried out to find the relative contributions of different states and different socio-economic groups (taking one factor at a time) to overall poverty in rural India. This decomposition analysis was based on two additively decomposable measures of poverty, viz., the head-count ratio and Chakravarty's indices for three values of e.

Briefly, the results of the decomposition analysis revealed the following. The three poorest states, namely, West Bengal, Orissa and Bihar, which had 24 per cent of the total rural population of the country had 31.2 per cent of the poor population in rural India according to the head-count ratio.

As regards the contribution of different social groups to the overall rural poverty in India, the two poorest groups, viz., the SC and ST together accounted for 26.7 per cent of the rural population and included 35.8

per cent of the rural poor. Coming to the size classes of household land possessed, the poorest size class of households, viz., those with 0.005 - 1.0 acre of land accounted for 32 per cent and 40 per cent of the total rural population and total number of rural poor, respectively. Finally, among the occupational classes, the 'agricultural labourers', observed to be the poorest occupational class, accounted for about 26 per cent of the rural population and covered about 37 per cent of the rural poor.

It may be mentioned that, in most of the cases, Chakravarty's measures (for all three values of e) and the head-count ratio gave similar ordering of the contributions of individual groups to overall measure of poverty. However, in most cases, the contribution of the poorer groups to the overall measure of poverty were greater for Chakravarty's indices compared to those for the head-count ratio presumably because Chakravarty's indices took into account the distribution of PCE of the poor which the head-count ratio did not.

The measurement of poverty by states and socio-economic groups as done here gives some idea about the characteristics and geographical distribution of the poor in rural India. However, some of the states like Uttar Pradesh, Madhya Pradesh and Maharashtra cover large areas and consist of regions that are heterogenous in respect of type of soil, rainfall and other climatic conditions —— regions that are not equally prosperous or developed. One would thus normally expect the incidence of poverty to vary considerably across rural regions within the larger states. A more detailed study of the regionwise level of living and geographical location of the poor would, therefore, be worthwhile, so that one might be able to identify the regions — pockets or concentrations of poverty or relative affluence — with relatively lower/higher level of living and high/low densities of poor population. In the next Chapter, such a detailed regionwise study of level of living and the areal distribution of poverty in rural India has been undertaken.

Chapter 5

THE AREAL PATTERN OF LEVEL OF LIVING AND POVERTY IN RURAL INDIA : INTER-REGIONAL VARIATION WITHIN STATES[1]

5.1 Introduction

The incidence of absolute poverty in rural areas of different states, and the statewise distribution of the rural poor in India were examined, among other things, in the previous Chapter. This study, however, may be regarded to be somewhat inadequate for bringing out fully the regional distribution of poverty in rural India, since within any state there may be significant regional differences in type of soil, rainfall, cropping intensity, irrigation facilities, man-land ratio, other endowments like cattle, etc., which may result in variation in the incidence of poverty across regions even within a state. For example, the variation between east Uttar Pradesh and west Uttar Pradesh is well-known. In recent years, increasing emphasis is being given on economic planning at smaller regional levels, such as districts within a state, in order to ensure a balanced regional development of different parts of the country. In fact, there are increasing demands for statistical data for smaller regional levels even below the level of district, such as community development (CD)

[1] This Chapter is an extended version of the paper 'On Areal Distribution of Poverty in Rural India during 1973-74' by Padmaja Pal and Nikhilesh Bhattacharya, which is forthcoming in Sankhyā.

blocks, from planning and policy making agencies at national and state levels. These data are used, inter alia, for framing poverty alleviation programmes. Keeping this in mind, an attempt is made in this Chapter to study the incidence of poverty as also of relative affluence in the rural areas of 61 NSS regions[2/] (the definitions of the NSS regions are given in Appendix B), which are typically smaller than the states, during the NSS 28th round period (October 1973 - June 1974). It may be mentioned that the NSS regions are made up of districts within a state that are homogeneous in respect of soil, climate, etc., and these regions do not cut across the boundaries of states.

The analysis presented in this Chapter is, to a large extent, a follow-up of one part of a pioneering study by Mukherjee (1969), mentioned in Section 1.2.5 of Chapter 1, with some extensions and refinements. Employing NSS 18th round (February 1963 - January 1964) household budget data, Mukherjee studied the spatial distribution of the (relatively) poor and (relatively) rich persons in India over 50 NSS regions used in the 18th round, separately for the rural and urban sectors of the country. To do this, Mukherjee arranged the sample

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2/ In studies based on PCE adjusted for inter-state consumer price differentials, rural areas of the Union Territories of (i) Delhi, (ii) Pondicherry and (iii) Goa, Daman and Diu were left out as appropriate consumer price indices were not available for these three regions, and results are reported for 61 NSS regions. However, for defining the fractile groups in terms of nominal PCE, these Union Territories were included, and estimates are presented for rural areas of 64 NSS regions.

households in each sector in ascending order of their PCE's and formed the lowest decile group consisting of the poorest 10 per cent of the country's population, and the highest decile group comprising the richest 10 per cent of the population. The former were called the 'poor' and the latter the 'rich'. For each of the two sectors, Mukherjee studied (i) the percentage shares of the different NSS regions in the all-India (rural or urban) population of the 'poor' (or the 'rich') defined in relative sense as described above, and (ii) the percentage of the population of each region that was 'poor' or 'rich'. These latter percentages were called the 'densities'. Mukherjee then tried to form clusters of regions having similar densities of the 'poor' (or 'rich') or similar values of mean PCE and to present these clusters through maps (vide his Maps (2) and (3)).

Mukherjee's study covered only the lowest and the highest decile groups of the size distribution of population by PCE. Also, the phenomenon of inter-regional variation in consumer prices was ignored in that study. In the present exercise, the spatial distribution of (i) the poorest 10 per cent, (ii) the poorest 20 per cent, (iii) the richest 10 per cent and (iv) the richest 20 per cent of the rural population of the country during NSS 28th round have been examined. Further, the inter-state variation in consumer prices has also been taken care of in this study to some extent. While

Mukherjee presented only combined sample estimates, both half samplewise and combined sample estimates are reported here to give some idea about the reliability of the results. In addition, the regionwise distribution of the poor (defined in terms of poverty lines, in the usual manner) has been studied here. However, unlike Mukherjee's study which covers both the rural and urban sectors of the country separately, only the rural sector is covered here.

As stated earlier, Mukherjee's areal units were 50 NSS regions considered in the NSS 18th round consumer expenditure enquiry, while the number of NSS regions considered for this study (that is, for the 28th round) is 61[3/]. Since the boundaries of most states remained unchanged during the ten years intervening between the 18th and 28th round periods, some comparisons of the statewise results obtained by Mukherjee with those obtained in the present exercise were carried out. On the other hand, most of the regional boundaries changed between the two survey periods due to (i) formation of new states, (ii) transfer of areas from one state to another, (iii) formation of new regions within some states, (iv) transfer of areas between regions, and (v) transfer of areas from the urban sector to the rural sector or vice versa. For this reason, it is rather risky to carry out comparisons of regionwise results for the 18th and 28th round periods. However,

[3/] See footnote 2 above.

for the sake of interest, the regionwise figures estimated in the present study were compared with Mukherjee's estimates only for a small number of NSS regions, the boundaries of which apparently remained unchanged between the 18th and 28th rounds of the NSS.

The findings in Chapters 3 and 4 indicated that, on the whole, the Scheduled Castes (SC) and the Scheduled Tribes (ST) had a lower level of living compared to other social groups. This was true for rural India as a whole, as well as for rural areas of most individual states. One might, therefore, expect that regions with a larger percentage of SC/ST in their population were more prone to poverty than regions with a smaller percentage of SC/ST. An attempt has been made here to study the relationship between level of living and the incidence of absolute poverty and the percentage of SC/ST (taken together) population in regions on the basis of NSS 28th round household budget data.

The present Chapter is organised as follows : The methodology of analysis is described in Section 5.2. Section 5.3 describes the Tables and Maps containing the main empirical results of the present exercise. The findings based on NSS 28th round budget data are discussed in Section 5.4, while some of these results are compared with those of Mukherjee (1969) in Section 5.5. The results of Sections 5.3 and 5.4 underscore the existence of large intra-state inter-regional variation in average PCE and head-count ratio of absolute poverty in a number of states and hence the need of publishing and analyzing survey data at the level of NSS regions within the states. This practice is seldom followed at present in India[4/]. Section 5.6 is devoted to a discussion on the sample size required for reliable region-level estimates. Finally, the Chapter is concluded in Section 5.7. The definitions of the NSS regions used in the 28th round enquiry are given in Appendix B.

5.2 The Methodology

Following Mukherjee (1969), the rural households covered in the NSS 28th round consumer expenditure survey were arranged in ascending order of their PCEs. Four fractile groups, namely, the bottom 10 per cent of the population, the bottom 20 per cent of the population, the top 10 per cent of the population, and the top 20 per cent of the population of rural India were then formed. This was done, first, by ignoring inter-regional consumer price variations and estimates parallel to those of Mukherjee (1969) were obtained. Next, all PCE's were expressed at all-India rural prices, employing the Paasche-type consumer price indices constructed by Bhattacharyya et al (1980) for rural areas of different

[4/] However, see Sarvekshana, Vol. VI, Nos. 3-4, 1983, for some (NSS) regionwise results relating to NSS 27th round period (1972-73). These results were noticed at a very late stage of the preparation of this thesis and could not be utilized for extending the analysis.

states with rural India as base (= 100) from NSS 28th round budget data[5/, 6/]. The same price index was, however, used for all the regions within any state. Households were then ranked in ascending order of their PCE's adjusted for inter-state consumer price differentials, and as before, the four fractile groups of population were formed. The regional distribution of the population in rural India belonging to each of the four fractile groups was then studied, as in Mukherjee (1969), through percentage shares of regions and the densities.

As mentioned in Section 5.1, the regional distribution of the population falling below the poverty line was also examined here. Since regionwise consumer price indices were not available, the poverty line for a state was used for all the NSS regions within the state. The statewise poverty lines employed here were those used in Chapter 4 for measuring the incidence of absolute poverty. These poverty lines, it may be reiterated, were derived from Bardhan's (1973) statewise poverty lines for 1960-61, using the average monthly values of the Consumer Price Index Numbers for Agricultural

5/ These indices are briefly described in Section 2.6 of Chapter 2.

6/ As already mentioned, the rural areas of the Union Territories of (i) Delhi, (ii) Pondicherry and (iii) Goa, Daman and Diu were excluded in this step as suitable consumer price indices were not available for these regions in the Bhattacharyya *et al* paper.

Labourers (base : 1960-61) for different states during the NSS 28th round period. As there is a single CPI for Agricultural Labourers for (i) Assam, Manipur, Tripura and Meghalaya; and (ii) the Punjab, Haryana, Himachal Pradesh and Delhi, the same poverty line was used for all the states covered in a composite CPI number.

As done by Mukherjee (1969), the spatial variation of average PCE and of the densities of the 'rich' (top 10 per cent group) and the 'poor' (bottom 10 per cent of the rural population) are presented diagramatically through maps of India showing NSS regions. The same is done for the head-count ratio of absolute poverty. However, while Mukherjee's maps were based on nominal PCE, the maps presented here are based on adjusted PCE, that is, PCE expressed at all-India rural prices. No attempt has been made to apply formal techniques for clustering the regions.

5.3 The Results

The basic results of the present exercise based on NSS 28th round household budget data are presented in Tables 5.1 to 5.4.

The average nominal PCE for all the rural regions of India in different states are presented by half-samples as also for the combined sample in cols. (3) to (5) of Table 5.1. The corresponding adjusted values of average PCE (that is, average PCE expressed at all-India rural prices) are given in cols. (6) to (8). The regionwise head-count ratios of poverty are also set out in the same Table, in cols. (9) to (11). As stated earlier, these ratios were obtained by allowing for inter-state variation in consumer prices.

The sample size (that is, the number of sample households) for the rural areas of each NSS region in the NSS 28th round enquiry is reported in col. (2) of Table 5.1. The sample size for some regions appear to be quite small, even less than 100, and the divergence between half-sample estimates tend to be large for such regions. However, rather large divergences are also observed for some regions with fairly large sample size. For example, the divergences between the half-sample estimates of average PCE are somewhat large for region 6 in Punjab (sample size 283) and region 40 in Andhra Pradesh (sample size 441).

In Table 5.2, cols. (2) to (4) give the regional distribution of the rural population of India, by half-samples and for the combined sample as estimated from NSS 28th round household budget data. The 'densities' of the type considered by Mukherjee (1969) are set out in cols. (5) to (16) of this table. These results are based on nominal PCE and ignore inter-state and inter-regional variation in consumer prices.

Table 5.3 gives the corresponding results based on estimated adjusted PCE (that is, PCE expressed at all-India rural prices). The regional 'densities' of population in the four ordinal groups formed on the basis of a ranking by adjusted PCE are set out in cols. (2) to (13) of this table.

Cols. (2) to (4) of Table 5.4 give the percentage shares of the different regions in the total count of the poor, that is, the total number of persons falling below the statewise poverty lines in rural India. Cols. (5) to (8) of the same table give the shares of the different regions in the population of rural India, separately for the four ordinal groups based on a ranking by adjusted PCE. For consideration of space, only the combined sample estimates of these shares are presented here. All the results presented in Table 5.4 were obtained by taking into account the inter-state variation in consumer prices.

Table 5.5 gives the joint distribution of 61 regions of rural India by head-count ratio of absolute poverty and the percentage of SC and ST in the population of regions.

The diagrams presented in this Chapter may be described briefly. The average adjusted PCEs for the 61 regions of rural India, rounded off to the nearest Indian rupee are shown in Map (1). The areal distribution of absolute poverty as measured by the head-count ratio (taking into account the inter-state variation in consumer prices), presented in col. (11) of Table 5.1, is illustrated in Map (2). The regions of rural India are classified into four levels of the head-count ratio, and the four classes are distinguished by adopting a scheme of hatching/shading.

Following the procedure adopted by Mukherjee for his Map (2), the densities of the 'poor' (the bottom 10 per cent of the rural population) and the relatively 'rich' (the top 10 per cent of the rural population) are shown in Map (3). Note that, while Mukherjee's densities were based on nominal PCE, Map (3) here is based on estimates of PCE adjusted for inter-state consumer price variations.

Tables 5.6A and 5.6B compare the results based on NSS 28th round (October 1973 - June 1974) data with those obtained by Mukherjee (1969) for NSS 18th round (February 1963 - January 1964) data. The results in Table 5.6A relate to the states of India, while those in Table 5.6B relate to 13 NSS regions which were, at least approximately, the same in the two periods. Both tables present a number of measures of level of living and poverty or relative affluence of the rural population. The 28th round results are given in nominal terms as well as by taking into account the inter-state variations in consumer prices, while Mukherjee's results, as already stated, are based only on nominal PCE. However, in col. (4) of each of Tables 5.6A and 5.6B, Mukherjee's averages of PCE are expressed at all-India rural prices, employing the statewise Paasche-type indices of consumer prices (base : all-India, rural) estimated by Chatterjee and Bhattacharyya (1974) on the basis of NSS 18th round budget data[7].

The range of regionwise densities of the 'poor' (that is, the bottom 10 per cent of the rural population) in the rural areas of individual states for the 18th and 28th round periods are set out in columns (4) to (6) of Table 5.7. Cols. (2) and (3) of the same table give the number of NSS regions within each state during the 18th round period and the 28th round period, respectively. While figures based on both nominal PCE and PCE adjusted for inter-state consumer price differentials are presented for the 28th round (*vide* cols. (5) and (6) of Table 5.7), the results for the 18th round period relate to nominal PCE only (*vide* col. (4) of the same table).

The following sections are devoted to discussions of the major findings on regional variations in level of living and the incidence of poverty in rural India as revealed by the empirical results presented in these tables and maps.

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[7] The same index was used (i) for the Punjab, Haryana and Himachal Pradesh; and (ii) for Assam, Manipur and Tripura. In Table 5.6B, the index used for a region was the index for the state to which the region belonged.

Table 5.1 : Regionwise average of PCE and head-count ratio indices of poverty for rural India : NSS 28th round*

state/region	no. of sample households	average PCE (Rs.)			average PCE (Rs.) (adjusted*)			head count ratio*		
		hs 1	hs 2	combined	hs 1	hs 2	combined	hs 1	hs 2	combined
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Rajasthan										
1	159	61.36	62.30	61.84	67.01	69.04	67.53	0.245	0.238	0.242
2	274	73.35	75.55	74.50	80.11	82.50	81.36	0.185	0.222	0.204
3	96	45.22	41.04	43.39	49.38	44.82	47.38	0.587	0.595	0.590
4	84	52.91	59.16	55.91	57.78	64.61	61.05	0.418	0.256	0.341
total/average	613	62.59	65.37	63.98	68.36	71.40	69.88	0.301	0.278	0.289
Punjab										
5	387	77.02	77.80	77.40	82.23	83.06	82.64	0.180	0.143	0.162
6	283	69.90	81.70	75.79	74.63	87.22	80.92	0.199	0.203	0.201
total/average	670	73.87	79.55	76.68	78.87	84.93	81.87	0.189	0.170	0.179
Jammu and Kashmir										
7	44	49.83	66.28	58.91	64.91	86.34	76.74	0.380	0.094	0.222
8	290	44.99	46.02	45.54	58.61	59.95	59.32	0.523	0.580	0.553
9	323	62.43	57.89	60.20	81.33	75.41	78.43	0.132	0.234	0.182
total/average	657	54.73	53.57	54.14	71.30	69.79	70.52	0.302	0.369	0.336
Haryana										
10	350	68.47	65.82	67.19	70.00	67.29	68.69	0.357	0.352	0.355
11	253	84.61	76.15	80.56	86.50	77.85	82.36	0.151	0.195	0.172
total/average	603	75.54	70.29	73.01	77.23	71.86	74.64	0.267	0.284	0.275
Himachal Pradesh										
12	394	72.42	71.25	71.85	65.31	64.25	64.79	0.188	0.177	0.183
Uttar Pradesh										
13	87	50.57	49.07	49.77	56.96	55.27	56.06	0.542	0.589	0.567
14	581	52.21	56.26	54.25	58.81	63.37	61.11	0.473	0.429	0.451
15	297	46.70	50.71	48.61	52.60	57.13	54.75	0.605	0.519	0.564
16	724	50.69	50.82	50.75	57.10	57.25	57.17	0.489	0.543	0.515
17	95	55.89	47.32	51.19	62.96	53.31	57.66	0.512	0.621	0.571
total/average	1784	50.78	52.40	51.58	57.20	59.02	58.10	0.505	0.507	0.506

Table 5.1 (Continued)

state/region	no. of sample households	average PCE (Rs.)			average PCE (Rs.) (adjusted*)			head count ratio*		
		hs 1	hs 2	combined	hs 1	hs 2	combined	hs 1	hs 2	combined
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Madhya Pradesh										
18	432	47.21	46.38	46.80	52.05	51.14	51.60	0.628	0.540	0.584
19	251	41.68	41.32	41.50	45.95	45.55	45.75	0.700	0.748	0.724
20	219	55.33	58.98	57.40	61.00	65.03	63.28	0.447	0.549	0.505
21	242	58.33	54.85	56.43	64.31	60.47	62.22	0.500	0.491	0.495
22	176	53.12	59.76	56.38	58.56	65.88	62.15	0.497	0.410	0.454
total/average	1320	50.34	51.30	50.84	55.49	56.56	56.04	0.572	0.552	0.561
Bihar										
23	316	50.03	45.88	47.98	44.49	40.80	42.66	0.705	0.728	0.716
24	592	61.10	58.41	59.81	54.33	51.94	53.18	0.593	0.541	0.568
25	380	58.78	56.63	57.72	52.27	50.35	51.33	0.579	0.551	0.565
total/average	1288	57.76	54.79	56.31	51.36	48.72	50.07	0.615	0.590	0.603
Orissa										
26	301	50.95	49.80	50.39	63.58	62.15	62.88	0.407	0.453	0.430
27	141	33.45	31.14	32.37	41.74	38.86	40.40	0.842	0.929	0.883
28	229	36.82	38.13	37.47	45.95	47.59	46.77	0.736	0.688	0.712
total/average	671	42.81	42.39	42.61	53.43	52.90	53.17	0.602	0.621	0.611
West Bengal										
29	124	47.41	39.76	43.84	44.88	37.64	41.50	0.762	0.787	0.774
30	289	38.44	43.12	40.72	36.39	40.82	38.55	0.824	0.780	0.802
31	359	49.90	55.16	52.48	47.24	52.22	49.69	0.613	0.647	0.630
32	258	50.51	49.15	49.83	47.82	46.53	47.18	0.586	0.666	0.626
total/average	1030	46.46	48.54	47.47	43.98	45.95	44.94	0.685	0.705	0.695
Assam										
33	581	51.64	52.41	52.02	53.55	54.35	53.94	0.394	0.383	0.389
34	19	50.46	55.56	51.64	52.33	57.61	53.56	0.302	0.211	0.280
total/average	600	51.59	52.45	52.01	53.50	54.39	53.93	0.391	0.381	0.386
Manipur										
35	116	52.37	60.07	56.19	52.69	60.44	56.53	0.316	0.178	0.248
36	106	44.19	55.08	48.91	44.46	55.42	49.21	0.583	0.423	0.514
total/average	222	48.42	57.97	52.88	48.71	58.33	53.21	0.445	0.281	0.369

Table 5.1 (Continued)

state/region	no. of sample households	average PCE (Rs.)			average PCE (Rs.) (adjusted*)			head count ratio*		
		hs 1	hs 2	combined	hs 1	hs 2	combined	hs 1	hs 2	combined
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Tripura										
37	187	48.65	51.61	50.15	57.03	60.50	58.78	0.542	0.331	0.435
Meghalaya										
38	225	57.46	60.35	58.89	56.11	58.93	57.51	0.253	0.184	0.219
Andhra Pradesh										
39	591	50.94	57.36	54.21	61.20	68.91	65.12	0.316	0.317	0.317
40	441	49.91	39.00	44.25	59.96	46.85	53.16	0.443	0.570	0.509
41	204	57.74	51.46	54.54	69.36	61.83	65.53	0.343	0.387	0.365
total/average	1236	51.83	49.61	50.69	62.26	59.60	60.90	0.366	0.422	0.395
Tamil Nadu										
42	248	43.05	43.71	43.39	51.56	52.36	51.97	0.568	0.554	0.561
43	275	49.70	45.32	47.39	59.53	54.29	56.76	0.546	0.485	0.514
44	387	51.05	50.59	50.80	61.14	60.59	60.85	0.419	0.451	0.436
total/average	910	48.34	47.07	47.68	57.90	56.39	57.11	0.501	0.490	0.495
Kerala										
45	234	52.31	52.25	52.28	53.37	53.31	53.34	0.600	0.474	0.537
46	411	55.67	58.49	57.09	56.80	59.68	58.25	0.462	0.504	0.483
total/average	645	54.43	56.22	55.32	55.53	57.36	56.44	0.513	0.493	0.503
Gujarat										
47	100	50.24	53.79	52.11	47.67	51.03	49.44	0.614	0.483	0.545
48	151	48.03	47.61	47.83	45.57	45.17	45.38	0.398	0.486	0.440
49	90	60.05	60.79	60.41	56.97	57.68	57.32	0.374	0.127	0.255
50	79	58.23	58.27	58.25	55.24	55.28	55.26	0.137	0.158	0.148
51	110	52.53	64.42	57.63	49.84	61.12	54.68	0.329	0.261	0.300
total/average	530	52.98	56.21	54.54	50.26	53.33	51.74	0.375	0.326	0.351

Table 5.1 (Concluded)

state/region	no. of sample households	average PCE (Rs.)			average PCE (Rs.) (adjusted*)			head count ratio*		
		hs 1	hs 2	combined	hs 1	hs 2	combined	hs 1	hs 2	combined
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Maharashtra										
52	156	58.99	55.58	57.29	55.12	51.93	53.52	0.373	0.415	0.394
53	300	58.09	58.44	58.27	54.28	54.60	54.44	0.408	0.331	0.368
54	150	44.96	52.14	48.22	42.01	48.71	45.05	0.612	0.506	0.564
55	226	42.54	50.99	46.63	39.75	47.64	43.56	0.635	0.462	0.551
56	213	53.76	53.82	53.79	50.23	50.29	50.26	0.433	0.500	0.466
57	90	46.75	53.21	50.42	43.69	49.71	47.11	0.688	0.394	0.521
total/average	1135	51.33	54.50	52.91	47.96	50.92	49.43	0.506	0.426	0.466
Karnataka										
58	61	61.02	63.29	62.13	58.84	61.03	59.91	0.127	0.244	0.184
59	81	48.68	58.26	53.43	46.94	56.17	51.52	0.523	0.414	0.469
60	190	56.44	61.18	58.83	54.42	58.99	56.73	0.315	0.410	0.363
61	289	42.66	48.13	45.47	41.13	46.41	43.84	0.640	0.642	0.641
total/average	621	49.60	54.92	52.29	47.82	52.96	50.42	0.472	0.502	0.488
others (Union Territories)	111	50.82	73.47	62.19	**	**	**	**	**	**
India	15452	52.80	53.69	53.24	55.42a	56.38a	55.90a	0.495a	0.486a	0.491a

* The average PCEs and the head-count ratios were adjusted for inter-state consumer price differentials. Thus, statewise poverty lines were used for computing the head-count ratios.

** Price indices and hence poverty lines were not available for the U.T.'s of Delhi, Pondicherry, Goa, Daman and Diu.

[a] Excludes the U.T.'s mentioned in (**).

Table 5.2 : Regionwise 'densities' of the 'poor' and the 'rich' in rural India based on nominal PCE : NSS 28th round

state/union territory/region	percentage of all-India rural population			percentage of regional population in all-India rural fractile group (%)											
				0 - 10			0 - 20			90 - 100			80 - 100		
	hs 1	hs 2	combined	hs 1	hs 2	combined	hs 1	hs 2	combined	hs 1	hs 2	combined	hs 1	hs 2	combined
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Rajasthan															
1	1.26	1.31	1.29	3.31	3.86	5.22	7.28	10.73	9.03	15.67	16.52	15.56	38.19	26.82	31.66
2	2.08	2.29	2.18	0.94	1.60	0.83	6.57	5.77	5.45	28.55	30.55	29.28	36.19	44.05	40.87
3	0.79	0.62	0.70	9.54	21.82	13.32	17.67	40.45	27.63	3.53	3.64	3.58	14.34	8.18	11.93
4	0.73	0.68	0.71	11.03	5.37	9.31	14.83	9.09	12.08	8.75	13.64	11.09	17.11	28.51	22.18
total/average	4.86	4.90	4.88	4.47	5.28	5.02	9.80	11.93	10.55	18.17	21.06	19.32	30.37	32.76	31.57
Punjab															
5	1.38	1.34	1.36	0.09	0.76	0.42	1.56	0.76	1.16	28.57	29.29	28.74	46.15	43.32	45.27
6	1.09	1.10	1.10	2.08	0.46	1.27	7.86	2.32	3.88	22.43	33.29	27.56	38.03	46.98	42.15
total/average	2.47	2.44	2.46	0.97	0.63	0.80	4.34	1.46	2.37	25.86	31.09	28.21	42.57	44.97	43.88
Jammu and Kashmir															
7	0.03	0.04	0.03	3.10	0.0	1.39	16.28	0.0	7.29	0.0	13.84	7.64	22.48	25.79	25.35
8	0.16	0.19	0.17	15.58	6.34	10.66	27.90	18.76	23.23	5.95	4.10	4.96	12.61	8.70	10.52
9	0.22	0.22	0.22	0.0	0.0	0.0	1.64	2.34	2.51	11.69	10.21	10.08	33.85	22.55	28.25
total/average	0.41	0.45	0.43	6.30	2.68	4.44	12.93	9.09	11.31	8.62	7.93	7.81	24.75	16.96	20.81
Haryana															
10	1.09	1.04	1.06	1.52	1.23	1.38	12.04	8.07	9.75	21.86	17.09	19.69	35.77	29.53	32.89
11	0.85	0.79	0.82	4.46	1.50	3.16	6.41	3.37	4.95	34.55	25.81	31.50	56.98	47.63	52.33
total/average	1.94	1.82	1.88	2.81	1.35	2.16	9.57	6.04	7.66	27.42	20.86	24.83	45.06	37.36	41.35
Himachal Pradesh															
12	0.77	0.75	0.76	0.0	2.56	1.26	1.48	3.69	2.56	21.58	25.00	23.71	37.24	41.70	40.28
Delhi															
13	0.08	0.06	0.07	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.33	3.57	12.50	41.67	25.00
Uttar Pradesh															
14	0.74	0.86	0.80	8.87	9.52	10.14	24.14	15.15	19.35	5.42	4.76	5.07	24.14	12.99	18.20
15	5.83	5.98	5.90	6.35	4.33	5.21	15.84	12.68	14.25	7.92	11.50	9.91	18.54	23.01	20.29
16	2.81	2.57	2.69	7.43	6.33	6.91	26.60	22.88	24.76	7.17	6.19	6.70	12.65	15.54	14.84
17	7.68	7.01	7.34	4.01	7.27	5.71	11.51	18.56	14.56	5.11	4.59	4.84	16.57	17.24	16.66
18	0.79	0.96	0.88	0.0	5.36	4.62	10.70	21.84	16.81	18.88	4.98	9.87	28.37	11.88	19.33
total/average	17.85	17.38	17.61	5.34	6.13	5.87	15.79	17.19	16.34	6.80	7.23	7.08	17.43	18.46	17.80

Table 5.2 (Continued)

state/union territory/region	percentage of all-India rural population			percentage of regional population in all-India rural fractile group (%)											
				0 - 10			0 - 20			90 - 100			80 - 100		
	hs 1	hs 2	combined	hs 1	hs 2	combined	hs 1	hs 2	combined	hs 1	hs 2	combined	hs 1	hs 2	combined
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Madhya Pradesh															
19	2.53	2.51	2.52	12.58	15.17	13.87	29.08	26.18	27.46	8.66	5.27	6.98	13.58	11.34	12.72
20	1.56	1.53	1.54	24.33	18.29	21.27	38.36	43.75	40.57	4.48	6.55	5.51	8.96	9.91	9.13
21	1.15	1.52	1.34	7.98	6.12	7.71	13.77	18.65	16.54	11.13	15.29	13.42	21.76	22.22	22.77
22	1.55	1.87	1.71	7.91	12.22	10.19	22.84	18.70	20.58	16.57	8.60	12.43	29.40	20.32	24.39
23	1.13	1.10	1.12	9.98	5.29	8.61	18.13	14.59	16.49	15.27	16.91	16.08	20.98	31.71	26.24
total/average	7.92	8.53	8.23	12.92	12.19	12.77	25.87	24.85	25.21	10.70	9.52	10.12	18.02	17.73	17.94
Bihar															
24	2.68	2.64	2.66	10.59	8.17	10.11	19.53	26.56	23.42	7.53	2.88	5.23	16.35	10.34	14.45
25	5.11	4.72	4.91	8.70	8.15	8.44	14.14	14.68	14.17	15.25	12.46	14.11	25.62	25.05	25.25
26	3.55	3.49	3.52	6.83	8.83	7.82	14.37	14.48	14.43	15.26	11.75	13.21	26.89	23.50	26.43
total/average	11.34	10.95	11.09	8.56	8.37	8.64	15.49	17.51	16.47	13.43	9.90	11.69	23.83	20.97	23.03
Orissa															
27	2.28	2.20	2.24	13.78	7.11	10.19	19.72	17.13	18.45	6.45	5.67	6.06	16.31	13.93	15.23
28	0.97	0.85	0.91	31.25	29.93	28.41	64.88	56.46	60.95	0.30	0.68	0.48	2.98	1.02	2.06
29	1.58	1.58	1.58	31.33	30.88	28.45	46.81	50.37	48.58	1.28	3.86	2.56	3.64	7.90	5.76
total/average	4.83	4.63	4.73	23.03	19.41	19.80	37.65	35.69	36.69	3.52	4.13	3.82	9.49	9.46	9.53
West Bengal															
30	0.99	0.87	0.93	6.10	24.92	14.88	13.95	39.20	25.74	4.94	1.33	3.26	11.34	10.30	10.85
31	2.40	2.30	2.35	26.59	17.76	20.99	45.15	31.99	39.35	2.75	3.90	3.81	10.30	9.32	9.58
32	2.92	2.85	2.88	18.70	12.41	16.31	27.46	25.74	26.61	10.83	13.02	11.91	22.34	20.96	21.06
33	2.04	2.03	2.04	13.36	21.11	17.99	28.41	33.10	30.74	9.42	9.84	9.63	19.83	18.12	18.98
total/average	8.35	8.05	8.20	18.17	17.49	17.91	31.18	30.84	31.19	7.47	8.35	8.04	16.96	15.76	16.09
Assam															
34	2.88	2.80	2.84	7.81	4.04	5.65	14.42	12.31	13.39	6.31	5.35	5.68	17.61	16.42	16.53
35	0.11	0.03	0.07	0.0	21.05	4.88	0.0	21.05	4.88	1.59	5.26	2.44	11.11	26.32	14.63
total/average	2.99	2.83	2.91	7.53	4.24	5.64	13.90	12.42	13.18	6.14	5.34	5.61	17.37	16.53	16.49
Manipur															
36	0.12	0.12	0.12	0.0	0.0	0.0	1.41	6.61	3.99	2.26	5.75	2.99	18.08	28.16	23.50
37	0.11	0.09	0.10	8.16	0.0	4.62	24.77	7.11	15.58	0.60	8.30	3.94	6.65	17.79	11.30
total/average	0.23	0.21	0.22	3.94	0.0	2.10	12.70	6.82	9.25	1.46	6.82	3.42	12.55	23.79	17.96

Table 5.2 (Continued)

state/union territory/region	percentage of all-India rural population			percentage of regional population in all-India rural fractile group (%)											
				0 - 10			0 - 20			90 - 100			80 - 100		
	hs 1	hs 2	combined	hs 1	hs 2	combined	hs 1	hs 2	combined	hs 1	hs 2	combined	hs 1	hs 2	combined
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Tripura															
38	0.29	0.30	0.30	7.74	6.42	7.07	16.47	14.20	15.32	5.95	4.09	5.01	14.88	12.26	12.77
Meghalaya															
39	0.20	0.20	0.20	3.90	1.72	2.82	7.13	3.44	5.29	7.13	12.03	9.22	24.96	25.26	25.02
Andhra Pradesh															
40	3.51	3.67	3.59	10.42	10.88	10.54	17.92	17.73	17.82	6.95	12.52	10.13	16.99	22.13	19.83
41	2.71	2.94	2.82	12.93	23.84	18.00	22.75	38.18	30.74	6.11	3.07	4.54	13.33	8.29	10.57
42	1.41	1.47	1.44	10.98	5.20	9.46	20.81	17.29	20.06	13.87	6.88	9.74	22.16	15.80	17.88
total/average	7.63	8.03	7.85	11.42	14.56	13.02	20.16	25.08	22.88	7.93	8.06	8.05	16.64	15.94	16.15
Tamil Nadu															
43	1.72	1.79	1.75	17.40	17.52	16.38	35.53	31.50	34.11	4.95	4.42	4.68	10.44	13.27	11.88
44	1.88	2.12	2.00	12.35	10.00	11.11	29.88	20.75	25.53	11.19	3.58	7.17	18.53	7.31	12.92
45	2.41	2.77	2.59	13.95	17.26	15.90	22.69	28.46	25.64	7.43	7.31	7.37	18.90	19.43	18.82
total/average	6.01	6.68	6.34	14.44	15.02	14.52	28.61	26.82	27.95	7.90	5.36	6.56	16.37	13.93	15.04
Kerala															
46	1.57	1.56	1.57	15.54	13.37	14.46	23.75	18.28	21.62	12.32	7.43	9.59	20.67	17.09	18.89
47	2.67	2.73	2.70	14.43	13.54	13.69	24.46	24.96	24.24	14.43	16.78	15.19	22.30	25.72	24.20
total/average	4.24	4.29	4.27	14.85	13.48	13.97	24.20	22.52	23.28	13.65	13.37	13.13	21.70	22.58	22.25
Pondicherry															
48	0.09	0.06	0.07	0.0	4.35	1.69	11.60	4.35	8.78	1.66	26.96	11.49	7.73	39.13	19.93
Gujarat															
49	0.77	0.87	0.82	10.81	0.0	5.12	23.17	6.60	14.44	6.56	5.90	6.22	11.97	23.26	19.20
50	1.22	1.11	1.17	7.32	17.57	12.18	18.05	25.68	22.05	3.66	6.49	5.00	13.66	18.92	16.15
51	0.73	0.69	0.71	0.0	0.0	0.0	2.88	0.0	1.49	23.87	8.33	15.50	28.40	25.44	26.96
52	0.67	0.74	0.71	3.10	0.0	1.48	6.19	7.29	6.77	5.75	10.12	8.03	28.76	14.57	20.93
53	1.13	0.85	0.99	3.18	0.0	1.82	15.65	5.30	11.21	10.08	14.84	13.03	13.00	30.74	20.61
total/average	4.52	4.26	4.40	5.08	4.59	4.84	14.13	10.38	12.42	9.31	8.97	9.21	17.82	22.46	20.23

Table 5.? (Concluded)

state/union territory/region	percentage of all-India rural population			percentage of regional population in all-India rural fractile group (%)											
				0 - 10			0 - 20			90 - 100			80 - 100		
	hs 1	hs 2	combined	hs 1	hs 2	combined	hs 1	hs 2	combined	hs 1	hs 2	combined	hs 1	hs 2	combined
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Maharashtra															
54	0.95	0.95	0.95	11.44	10.38	10.10	19.89	16.94	18.42	11.99	12.02	12.01	28.34	21.31	24.83
55	2.04	2.23	2.14	8.62	6.67	7.97	20.41	14.50	17.34	16.48	12.05	13.87	25.77	33.89	27.98
56	1.13	0.94	1.04	5.28	10.22	7.52	20.18	16.30	18.43	2.52	11.05	6.39	10.78	15.19	11.03
57	1.72	1.63	1.67	14.44	5.78	10.17	28.42	16.85	23.29	3.76	6.58	5.12	7.52	11.56	10.71
58	1.49	1.45	1.47	8.52	11.37	10.81	14.26	23.10	18.60	8.87	9.21	9.21	22.43	17.87	20.28
59	0.53	0.70	0.62	4.39	10.78	6.75	15.61	14.50	14.98	5.85	6.69	7.59	8.78	15.99	12.87
total/average	7.86	7.90	7.89	9.45	8.58	9.07	20.58	17.07	18.93	8.99	9.81	9.45	18.93	19.61	19.09
Karnataka															
60	0.50	0.48	0.49	0.0	0.0	0.0	2.89	4.88	3.86	5.20	14.63	9.79	27.75	24.39	25.52
61	0.71	0.70	0.70	9.47	2.93	7.05	25.51	14.23	19.92	6.58	12.97	9.75	21.40	29.71	24.69
62	1.54	1.58	1.56	3.39	14.05	8.02	6.40	21.63	14.37	9.60	13.31	11.47	26.37	24.58	25.84
63	2.25	2.40	2.32	17.78	13.69	16.12	34.66	24.57	29.49	5.28	8.80	6.71	10.95	14.91	12.99
total/average	5.00	5.15	5.07	10.39	11.07	10.82	21.47	20.43	21.03	6.79	11.29	8.90	18.86	20.77	19.77
Goa, Daman and Diu															
64	0.12	0.17	0.14	0.0	9.60	5.74	0.0	19.20	11.48	10.71	24.80	19.14	15.48	54.40	41.63
India	100.00	100.00	100.00	10.02	10.02	10.00	20.01	20.02	20.01	9.99	9.99	9.99	20.00	19.99	20.00

Table 5.3 : Regionwise 'densities' of the 'poor' and the 'rich' in rural India based on PCE adjusted for inter-state consumer price differentials : NSS 28th round

state/region	percentage of regional population in all-India rural fractile group (%)											
	0 - 10			0 - 20			90 - 100			80 - 100		
	hs 1	hs 2	combined	hs 1	hs 2	combined	hs 1	hs 2	combined	hs 1	hs 2	combined
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Rajasthan												
1	3.31	1.29	2.29	4.19	10.73	7.51	15.67	17.17	16.43	44.59	30.04	37.76
2	0.0	1.60	0.83	4.29	2.82	3.91	29.09	31.29	31.13	43.03	48.96	46.44
3	6.71	20.00	12.52	13.78	37.27	24.06	3.53	5.00	4.17	14.84	8.18	11.93
4	9.89	5.37	7.72	12.17	9.09	10.69	8.75	13.64	11.09	20.91	29.34	24.95
average	3.44	4.36	3.90	6.99	10.15	8.74	18.40	21.74	20.47	35.53	36.03	36.07
Punjab												
5	0.09	0.76	0.42	1.56	0.76	1.16	28.57	29.29	29.16	47.89	45.88	46.02
6	2.08	0.46	1.27	5.43	2.32	3.88	23.01	33.29	27.85	38.50	49.38	44.24
average	0.97	0.63	0.80	3.27	1.46	2.37	26.11	31.09	28.58	43.74	47.68	45.22
Jammu and Kashmir												
7	0.0	0.0	0.0	3.10	0.0	1.39	22.48	25.79	22.57	34.11	72.96	55.56
8	4.96	3.85	4.04	15.01	5.59	9.86	12.61	7.58	10.46	22.80	21.37	22.50
9	0.0	0.0	0.0	0.0	0.0	0.0	30.56	21.81	25.22	55.08	41.91	48.62
average	1.93	1.63	1.64	6.08	2.36	4.12	22.98	16.12	19.01	40.99	35.82	38.53
Haryana												
10	2.14	1.23	1.38	13.83	8.74	11.50	21.86	17.00	19.50	34.52	28.02	31.19
11	4.46	2.62	3.58	6.75	3.37	5.61	33.98	24.94	29.33	51.95	45.14	48.15
average	3.16	1.83	2.34	10.73	6.42	8.94	27.17	20.43	24.00	42.16	35.42	38.57
Himachal Pradesh												
12	1.48	3.69	2.56	6.40	7.27	6.83	11.63	12.91	12.15	26.70	31.86	28.98
Uttar Pradesh												
13	5.42	5.19	5.30	15.27	15.15	15.21	6.90	4.76	5.76	29.06	12.99	20.51
14	4.59	3.96	4.15	10.12	9.40	9.82	10.37	13.61	12.28	24.01	27.21	25.56
15	5.61	6.33	5.68	17.86	15.11	16.21	7.95	9.50	8.69	13.04	20.86	16.76
16	2.10	3.00	2.73	6.73	14.07	10.47	7.64	9.01	8.44	19.91	20.03	20.12
17	0.0	0.0	0.0	10.70	16.09	13.66	21.40	8.43	14.29	28.37	15.33	21.22
average	3.51	3.77	3.64	10.12	12.78	11.50	9.16	10.42	9.94	20.92	22.02	21.50

Table 5.3 (Continued)

state/region	percentage of regional population in all-India rural fractile group (%)											
	0 - 10			0 - 20			90 - 100			80 - 100		
	hs 1	hs 2	combined	hs 1	hs 2	combined	hs 1	hs 2	combined	hs 1	hs 2	combined
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Madhya Pradesh												
18	8.66	13.41	11.02	23.43	22.85	22.65	8.75	6.57	7.76	15.50	14.43	14.83
19	19.10	13.72	16.59	31.19	36.59	34.16	4.93	7.01	5.96	9.85	9.91	9.88
20	6.59	3.82	5.63	11.78	17.28	14.39	11.58	16.06	13.94	23.15	26.15	24.85
21	6.57	10.22	8.56	17.31	17.21	17.26	16.57	13.34	14.81	30.00	22.82	26.56
22	9.98	1.27	5.71	14.66	13.53	14.11	16.09	17.12	16.60	24.44	36.79	30.50
average	10.18	9.49	9.95	20.79	21.86	21.27	10.99	11.18	11.09	19.63	20.43	20.10
Bihar												
23	15.53	22.72	19.38	30.12	41.95	35.97	1.41	2.04	1.72	8.94	3.85	6.60
24	13.33	13.33	13.53	25.00	25.05	24.54	11.17	6.53	8.76	16.79	15.22	16.30
25	13.04	12.48	13.48	20.50	24.95	23.06	9.76	4.01	6.79	19.52	16.03	17.53
average	13.76	15.34	14.92	24.80	29.14	26.81	8.42	4.63	6.45	15.79	12.71	14.36
Orissa												
26	7.59	6.32	6.65	14.54	7.11	10.52	13.78	10.41	12.45	32.11	25.96	29.10
27	9.52	10.88	11.27	31.25	29.93	30.63	1.79	0.68	1.27	7.44	3.06	5.40
28	14.57	14.89	14.46	32.97	31.99	30.83	3.10	6.80	4.94	13.48	16.73	14.46
average	10.26	10.08	10.14	23.93	19.79	21.17	7.88	7.39	7.79	21.06	18.60	19.65
West Bengal												
29	8.43	34.55	20.62	27.03	42.19	32.25	4.07	0.66	2.48	6.40	5.65	6.05
30	35.93	24.06	29.71	58.92	38.41	49.17	1.20	2.52	1.84	7.90	6.80	7.37
31	22.05	17.09	20.06	33.76	32.45	32.97	7.48	7.82	6.80	15.06	15.56	15.31
32	20.53	27.39	23.30	35.02	38.66	37.04	5.20	8.27	6.30	15.33	13.55	14.45
average	24.05	23.57	23.69	40.50	36.78	38.54	4.71	5.65	4.77	12.04	11.48	11.77
Assam												
33	7.81	5.16	5.81	14.54	12.31	13.39	5.65	4.48	4.98	15.81	15.49	16.01
34	0.0	21.05	4.85	0.0	21.05	4.86	1.59	5.26	2.44	11.11	26.32	14.63
average	7.53	5.35	5.78	14.01	12.42	13.18	5.50	4.49	4.92	15.63	15.61	15.98
Manipur												
35	1.41	0.0	0.71	1.41	6.61	3.99	0.0	4.89	2.85	10.45	20.11	15.24
36	10.27	3.95	6.34	28.10	9.49	19.01	0.60	7.51	3.60	3.32	15.81	8.73
average	5.69	1.66	3.27	14.31	7.82	10.81	0.29	5.99	3.19	7.01	18.30	12.29

Table 5.3 (Continued)

state/region	percentage of regional population in all-India rural fractile group (%)											
	0 – 10			0 – 20			90 – 100			80 – 100		
	hs 1	hs 2	combined	hs 1	hs 2	combined	hs 1	hs 2	combined	hs 1	hs 2	combined
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Tripura												
37	3.77	1.17	2.46	9.72	8.75	9.23	9.13	5.25	7.07	19.25	19.46	19.84
Meghalaya												
38	4.92	1.72	3.33	10.02	3.44	6.75	5.60	5.84	5.98	12.73	22.51	17.59
Andhra Pradesh												
39	4.48	8.20	6.37	11.27	12.67	12.59	13.13	16.24	14.68	26.95	30.77	28.78
40	6.41	16.85	12.02	14.13	26.35	20.27	8.72	4.93	6.85	18.04	12.48	15.15
41	4.05	2.42	3.22	10.98	12.08	11.54	17.92	13.57	15.33	37.19	19.19	28.29
average	5.09	10.29	7.82	12.23	17.54	15.16	12.45	11.65	11.98	25.68	22.11	23.79
Tamil Nadu												
42	11.17	11.33	11.25	19.96	20.18	20.25	8.61	7.61	8.10	13.74	14.51	14.67
43	8.51	2.39	5.28	13.36	14.03	13.71	15.53	4.63	9.22	22.70	15.22	18.44
44	8.21	10.29	9.32	16.43	22.86	19.61	13.82	13.14	13.64	23.73	24.23	24.00
average	9.15	8.06	8.58	16.47	19.34	17.93	12.87	8.96	10.72	20.55	18.77	19.67
Kerala												
45	16.42	13.37	14.91	25.95	19.47	22.58	11.73	6.39	9.08	19.94	16.34	18.52
46	16.51	14.05	14.89	25.84	25.38	25.23	13.57	15.25	14.80	21.52	25.55	23.55
average	16.48	13.81	14.89	25.88	23.23	24.25	12.89	12.02	12.70	20.94	22.20	21.70
Gujarat												
47	17.76	2.43	9.69	32.05	19.10	25.23	6.56	5.90	6.22	8.11	15.97	12.25
48	14.15	22.43	18.08	23.66	31.35	27.31	2.20	4.05	3.08	7.32	12.70	9.87
49	0.0	0.0	0.0	12.35	0.0	6.58	15.64	3.51	10.83	25.10	19.74	22.51
50	3.10	4.86	4.02	6.19	7.29	6.77	5.75	7.69	6.55	18.14	12.55	15.22
51	6.10	2.47	4.55	16.98	15.55	16.36	3.71	10.25	6.52	10.34	19.08	14.09
average	8.84	7.70	8.29	19.01	16.45	17.81	6.01	6.21	6.24	12.67	15.75	14.16

Table 5.3 (Concluded)

state/region	percentage of regional population in all-India rural fractile group (%)											
	0 - 10			0 - 20			90 - 100			80 - 100		
	hs 1	hs 2	combined	hs 1	hs 2	combined	hs 1	hs 2	combined	hs 1	hs 2	combined
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Maharashtra												
52	14.99	12.30	13.92	26.16	26.50	26.33	10.08	9.29	9.69	17.98	14.48	16.23
53	13.69	11.70	12.29	29.28	18.83	23.84	12.17	9.36	10.71	21.93	16.61	18.80
54	16.51	12.71	14.16	36.47	25.41	31.45	2.29	8.56	6.02	2.52	13.54	7.52
55	21.50	11.56	16.69	40.75	27.45	33.85	1.95	5.46	3.65	5.26	9.15	7.14
56	9.91	17.33	14.26	27.83	31.95	30.47	5.04	6.50	5.76	12.52	14.98	13.73
57	13.17	12.27	12.66	32.20	20.07	26.58	3.41	4.09	3.80	7.20	13.01	10.76
average	15.21	12.94	14.06	32.37	24.83	28.72	6.32	7.46	7.01	12.28	13.83	12.96
Karnataka												
58	2.89	0.0	1.48	2.89	8.54	5.64	2.31	9.15	5.64	15.03	21.34	18.10
59	12.35	8.37	10.37	37.86	21.76	29.88	4.53	9.21	4.98	6.58	20.08	13.28
60	3.77	16.08	9.98	17.14	28.84	23.51	7.16	12.01	9.61	20.53	19.78	20.15
61	25.00	16.99	21.08	43.30	29.34	36.89	3.74	6.97	5.27	9.41	13.20	11.36
average	14.45	13.96	14.29	30.41	26.22	28.78	4.76	9.02	6.60	13.00	16.91	14.98
India	10.01	10.01	10.03	20.01	20.02	20.01	9.99	10.00	10.00	20.00	19.97	20.00

5.4 Areal Variation in Level of Living during the NSS 28th Round Period

The patterns of areal variation in level of living and poverty in rural India are examined here in two stages. In the first stage, the region-level estimates for the 61 regions in rural India are examined disregarding the states altogether. For this purpose, the results based on adjusted PCE are considered. In the next stage, an attempt is made to study inter-regional variation within the rural areas of individual states and stress the existence of marked inter-regional disparities within some of the states.

5.4.1 Inter-regional Variation in Rural India

Different indicators of level of living based on PCE adjusted for inter-state variation in consumer prices, such as the adjusted average PCE, the head-count ratio and the densities of the poor and the rich are shown in Tables 5.1 and 5.3. These exhibit wide variation across the 61 regions of rural India.

Thus, the adjusted averages of PCE varied from Rs. 39 for region 30 (*vide* Appendix B for geographical boundaries of regions) in West Bengal to Rs. 83 for region 5 in the Punjab[8].

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[8] The corresponding range of adjusted average PCE for the states was slightly smaller : from Rs. 45 for West Bengal to Rs. 82 for the Punjab.

The densities

The densities of the 'poor' (bottom 20 per cent group, shown in cols. (5)-(7) of Table 5.3) ranged from 0 (region 9 in Jammu and Kashmir) to 49 per cent across the 61 regions, the highest density (49 per cent) of 'poor' being observed for region 30 in West Bengal. The frequency distribution of these densities is presented below :

density (per cent)	:	0 -10	10-20	20-30	30-40	40-50
no. of regions	:	17	17	15	11	1

The corresponding density of the 'rich' (top 20 per cent group, based on adjusted PCE) was seen to be distributed over the 61 regions as follows[9/] :

density (per cent)	:	0 -10	10-20	20-30	30-40	40-50	50-60
no. of regions	:	9	27	16	3	5	1

[9/] Note that the highest density (56 per cent) of the 'rich' was observed for region 7 in Jammu and Kashmir, which had a sample size of 44 households only. The next highest densities observed for region 9 of Jammu and Kashmir and region 11 of Haryana were based on somewhat larger samples.

Next, the joint distribution of 61 regions by the density of 'poor' (the bottom 20 per cent group) and the density of 'rich' (top 20 per cent group) is shown below :

density of 'poor'	density of 'rich'	
	below 20 per cent	above 20 per cent
below 20 per cent	11	23
above 20 per cent	25	2

Only two regions — region 46 in Kerala and region 60 in Karnataka —— showed densities above 20 per cent for both the 'rich' and the 'poor'. Both these regions had somewhat large sample sizes. The estimates for region 46 were based on data for 411 sample households, and those for region 60 on 190 sample households.

The head-count ratio

The head-count ratio of absolute poverty also varied widely across regions. It ranged from about 15 per cent (Gujarat, region 50) to 88 per cent (Orissa, region 27)[10]. The distribution of the 61 regions by head-count ratio is presented below :

[10] The corresponding statewise ratios varied between 18 per cent for the Punjab and 70 per cent for West Bengal.

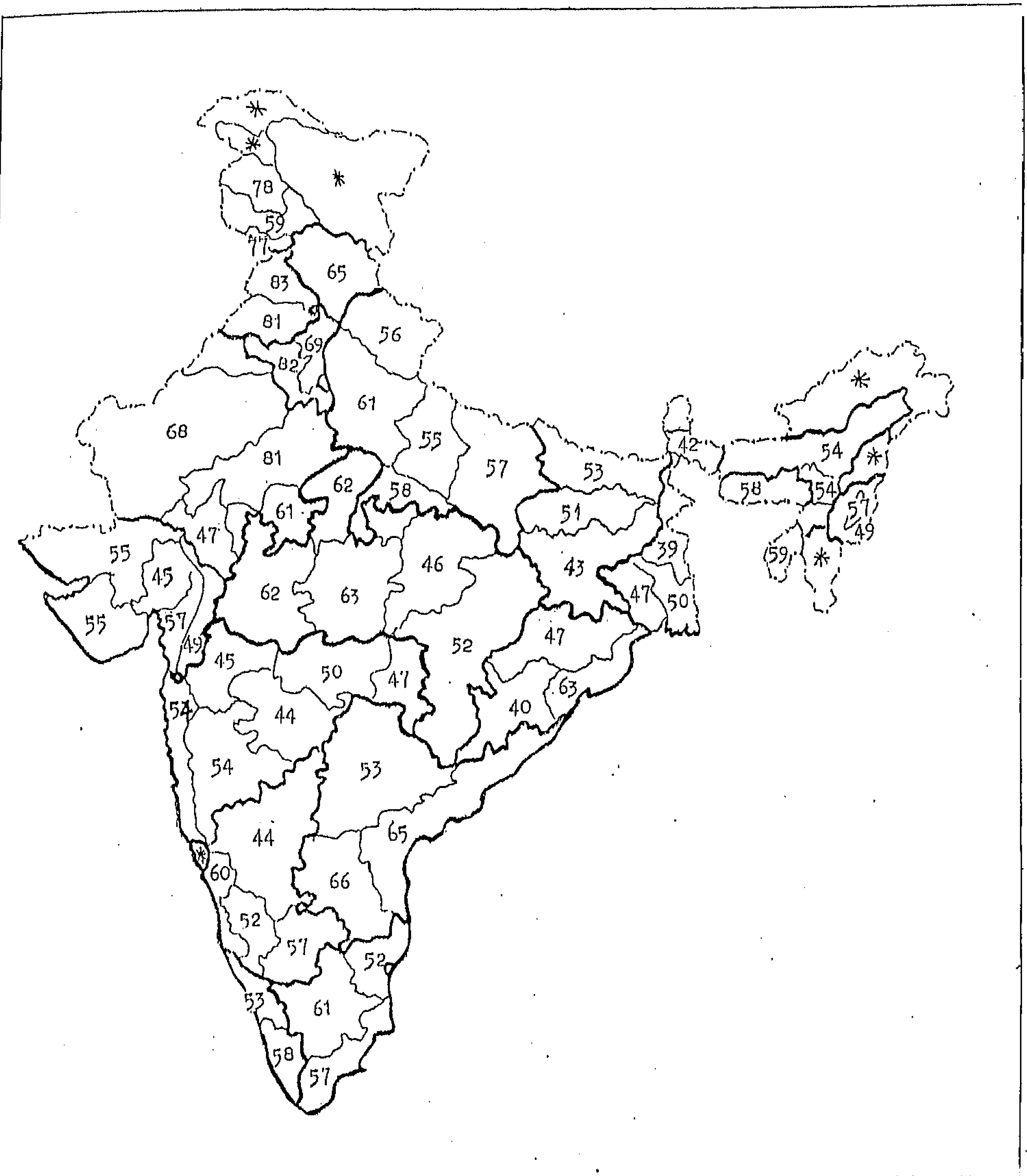
head-count ratio (per cent)*	no. of regions	regions (codes)
10 - 20	6	5, 9, 11, 12, 50, 58.
20 - 30	8	1, 2, 6, 7, 34, 35, 38, 49.
30 - 40	9	4, 10, 33, 39, 41, 51, 52, 53, 60.
40 - 50	10	14, 21, 22, 26, 37, 44, 46, 48, 56, 59.
50 - 60	19	3, 8, 13, 15, 16, 17, 18, 20, 24, 25, 36, 40, 42, 43, 45, 47, 54, 55, 57.
60 - 70	3	31, 32, 61.
70 - 80	4	19, 23, 28, 29.
80 -	2	27, 30.

* Each interval excludes its upper limit.

As stated earlier, the spatial pattern of inter-regional variation in poverty and level of living summarised above are depicted in Maps (1) to (3). These maps reveal large clusters of contiguous regions falling in different ranges of levels of living and poverty.

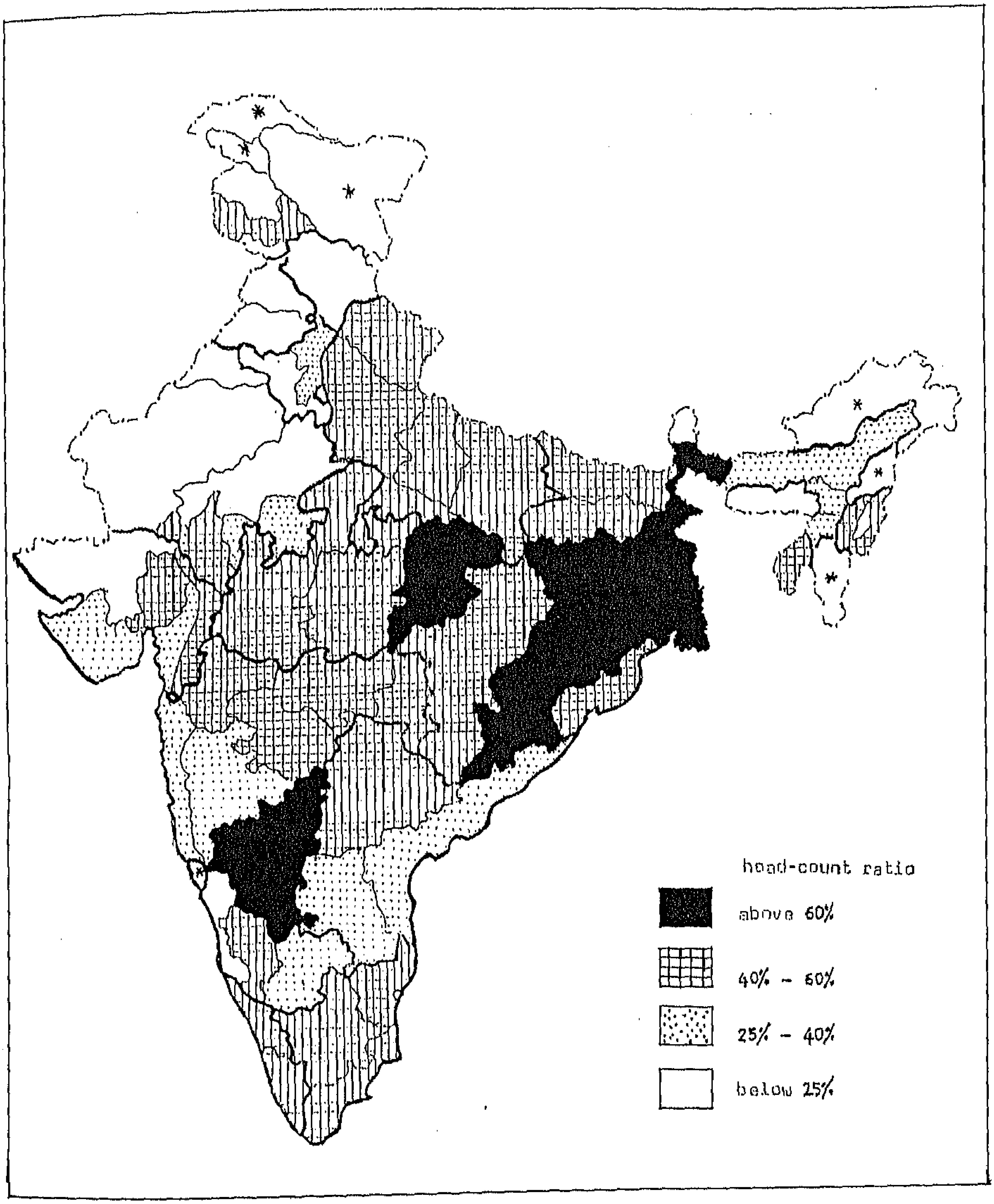
Maps (1), (2) and (3) present a picture of level of living and incidence of poverty in rural regions of India during the NSS 28th round period (October 1973 - June 1974). Map (2) shows that the poorest regions (with head-count ratio above 60 per cent) formed one cluster covering West Bengal, southern Bihar, and northern and western parts of Orissa.

Map I : Regionwise averages of PCE (in Rs.) for rural areas at all-India rural prices : NSS 28th round (October 1973-June 1974).



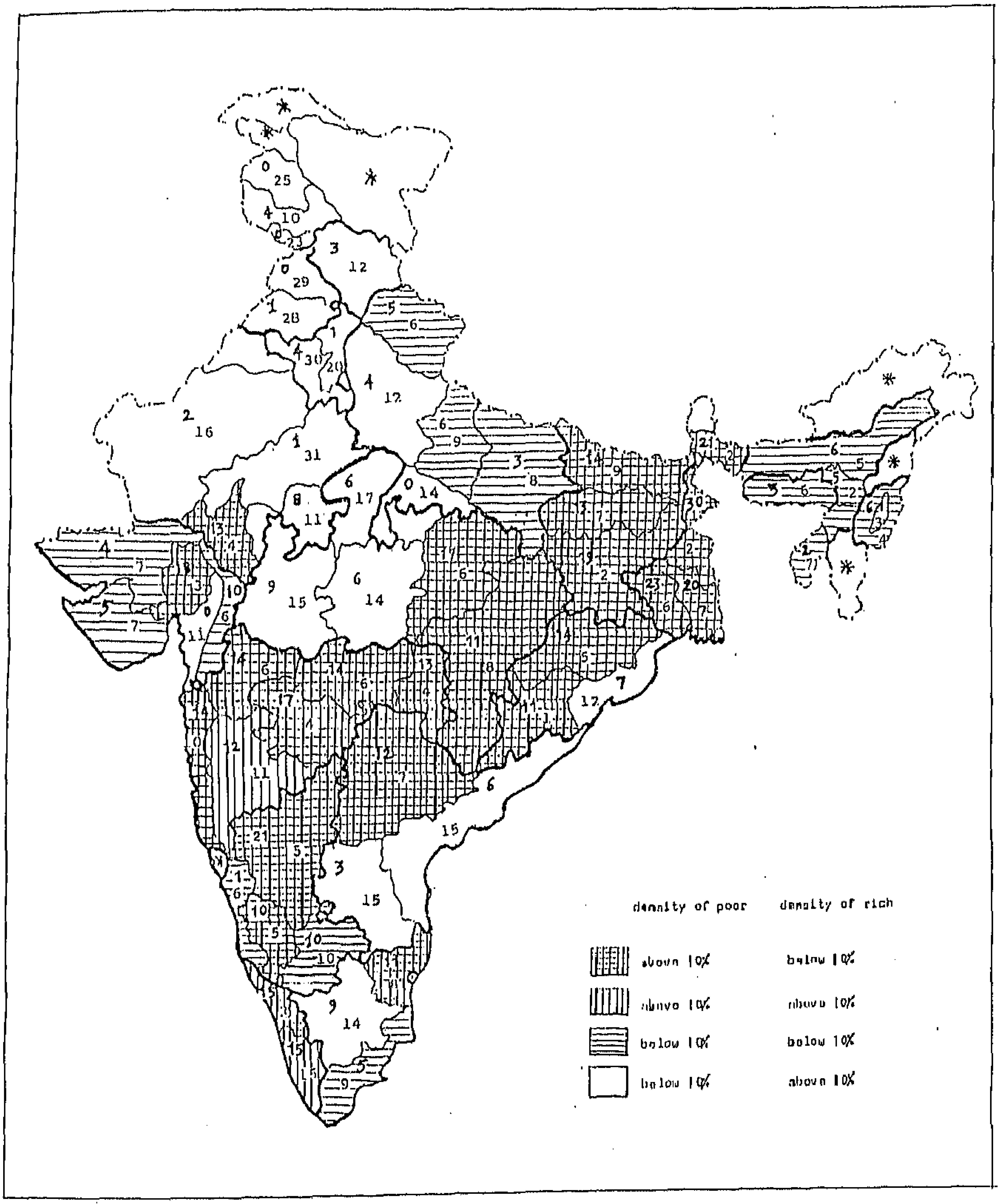
* Reliable estimates are not available because of inadequate sample size.

Map 2 : Classification of regions in rural India by head-count ratio index of poverty (vide col.(11) of Table 5.1) : NSS 28th round (October 1973-June 1974).



* Reliable estimates are not available because of inadequate sample size.

Map 3 : Classification of regions in rural India by densities of ''poor'' and ''rich'' (vide cols.(4) and (10) of Table53) : NSS 28th round (October 1973-June 1974)**.



* Reliable estimates are not available because of inadequate sample size.

** Density of poor in solid and that of rich in ordinary type.

Table 5.4 : Regional distribution of selected groups of the population of rural India : NSS 28th round

state/region	region's share (%) in all-India count of rural population						
	below poverty line			in fractile group based on adjusted* PCE (%)			
	hs 1	hs 2	combined	0-10	0-20	90-100	80-100
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rajasthan							
1	0.6	0.6	0.6	0.29	0.48	2.12	2.43
2	0.8	1.0	0.9	0.18	0.43	6.82	5.10
3	0.9	0.8	0.9	0.88	0.84	0.29	0.42
4	0.6	0.4	0.5	0.55	0.38	0.79	0.88
total	2.9	2.8	2.9	1.90	2.13	10.02	8.83
Punjab							
5	0.5	0.4	0.5	0.06	0.08	3.98	3.14
6	0.4	0.5	0.4	0.14	0.21	3.06	2.43
total	0.9	0.9	0.9	0.20	0.29	7.04	5.57
Jammu and Kashmir							
7	0.0	0.0	0.0	0.0	0.0	0.08	0.09
8	0.2	0.2	0.2	0.07	0.09	0.18	0.20
9	0.1	0.1	0.1	0.0	0.0	0.56	0.54
total	0.3	0.3	0.3	0.07	0.09	0.82	0.83
Haryana							
10	0.8	0.8	0.8	0.15	0.61	2.08	1.66
11	0.3	0.3	0.3	0.29	0.23	2.45	1.98
total	1.1	1.1	1.1	0.44	0.84	4.53	3.64
Himachal Pradesh							
12	0.3	0.3	0.3	0.19	0.26	0.93	1.10
Uttar Pradesh							
13	0.8	1.0	0.9	0.42	0.61	0.46	0.82
14	5.6	5.3	5.5	2.45	2.91	7.26	7.58
15	3.4	2.8	3.1	1.53	2.19	2.34	2.26
16	7.6	7.9	7.7	2.01	3.86	6.22	7.41
17	0.8	1.2	1.0	0.0	0.60	1.26	0.93
total	18.2	18.2	18.2	6.41	10.17	17.54	19.00
Madhya Pradesh							
18	3.3	2.8	3.0	2.78	2.87	1.96	1.88
19	2.2	2.4	2.3	2.55	2.63	0.92	0.76
20	1.0	1.7	1.4	0.75	1.00	1.87	1.67
21	1.6	1.9	1.7	1.46	1.47	2.53	2.27
22	1.1	0.9	1.0	0.64	0.79	1.86	1.71
total	9.2	9.7	9.4	8.18	8.76	9.14	8.29
Bihar							
23	3.8	4.0	3.9	5.16	4.80	0.46	0.88
24	6.1	5.3	5.7	6.65	6.04	4.32	4.01
25	4.2	4.0	4.1	4.75	4.07	2.40	3.09
total	14.1	13.3	13.7	16.56	14.91	7.18	7.98
Orissa							
26	1.9	2.1	2.0	1.49	1.18	2.80	3.27
27	1.6	1.6	1.6	1.03	1.40	0.12	0.25
28	2.4	2.2	2.3	2.29	2.44	0.78	1.15
total	5.9	5.9	5.9	4.81	5.02	3.70	4.67

Table 5.4 (Concluded)

state/region	region's share (%) in all-India count of rural population						
	below poverty line			in fractile group based on adjusted* PCE (%)			
	hs 1	hs 2	combined	0-10	0-20	90-100	80-100
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
West Bengal							
29	1.5	1.4	1.5	1.92	1.50	0.23	0.28
30	4.0	3.7	3.8	6.98	5.78	0.43	0.87
31	3.6	3.8	3.7	5.79	4.77	1.97	2.21
32	2.4	2.8	2.6	4.76	3.78	1.29	1.48
total	11.5	11.7	11.6	19.45	15.83	3.92	4.84
Assam							
33	2.3	2.2	2.3	1.65	1.91	1.42	2.28
34	0.1	0.0	0.0	0.03	0.02	0.02	0.05
total	2.4	2.2	2.3	1.68	1.93	1.44	2.33
Manipur							
35	0.1	0.0	0.1	0.01	0.02	0.03	0.09
36	0.1	0.1	0.1	0.06	0.10	0.04	0.04
total	0.2	0.1	0.2	0.07	0.12	0.07	0.13
Tripura							
37	0.3	0.2	0.3	0.07	0.14	0.21	0.29
Meghalaya							
38	0.1	0.1	0.1	0.07	0.07	0.12	0.18
Andhra Pradesh							
39	2.2	2.4	2.3	2.29	2.27	5.29	5.19
40	2.4	3.5	2.9	3.39	2.87	1.94	2.14
41	1.0	1.2	1.1	0.46	0.83	2.21	2.04
total	5.6	7.1	6.3	6.14	5.97	9.44	9.37
Tamil Nadu							
42	2.0	2.0	2.0	1.97	1.78	1.42	1.29
43	2.1	2.1	2.1	1.06	1.38	1.85	1.85
44	2.0	2.6	2.3	2.41	2.54	3.54	3.12
total	6.1	6.7	6.4	5.44	5.70	6.81	6.26
Kerala							
45	1.9	1.5	1.7	2.34	1.77	1.43	1.46
46	2.5	2.8	2.7	4.02	3.41	4.00	3.18
total	4.4	4.3	4.4	6.36	5.18	5.43	4.64
Gujarat							
47	1.0	0.9	0.9	0.79	1.04	0.51	0.50
48	1.0	1.1	1.0	2.11	1.60	0.36	0.58
49	0.6	0.2	0.4	0.0	0.23	0.77	0.80
50	0.2	0.2	0.2	0.28	0.24	0.47	0.54
51	0.7	0.5	0.6	0.45	0.81	0.65	0.70
total	3.5	2.9	3.1	3.63	3.92	2.76	3.12
Maharashtra							
52	0.7	0.8	0.8	1.32	1.26	0.92	0.77
53	1.7	1.5	1.6	2.62	2.55	2.29	2.01
54	1.4	1.0	1.2	1.47	1.63	0.63	0.39
55	2.2	1.5	1.9	2.79	2.84	0.61	0.60
56	1.3	1.5	1.4	2.09	2.24	0.85	1.01
57	0.7	0.6	0.6	0.78	0.82	0.23	0.33
total	8.0	6.9	7.5	11.07	11.34	5.53	5.11
Karnataka							
58	0.1	0.2	0.2	0.07	0.14	0.28	0.45
59	0.7	0.6	0.7	0.73	1.05	0.35	0.47
60	1.0	1.3	1.2	1.56	1.84	1.51	1.58
61	2.9	3.2	3.0	4.90	4.30	1.23	1.32
total	4.7	5.3	5.1	7.26	7.33	3.37	3.82
India	100.0	100.0	100.0	100.00	100.00	100.00	100.00

* Adjusted PCE means PCE expressed at all-India rural prices to eliminate the effects of inter-state consumer price differentials.

Two other pockets of extreme poverty appeared to be in Madhya Pradesh and Karnataka. It is observed that most of the regions with head-count ratios above 40 per cent were connected and together they covered much of the country's geographical area. While the most affluent areas were in the Punjab and Haryana, many regions in the north-western and western states, in the north-eastern region and along the eastern coast also appeared to be relatively affluent. As could be expected, the areal patterns in Maps (1) and (2) agree quite well, because the averages and head-count ratios based on adjusted PCE are negatively correlated to a marked extent. The 28th round figures for the 20 states are presented in cols. (5) and (12) of Table 5.6A. The correlation coefficient r between the two measures (average PCE and head-count ratio) is -0.729. The corresponding regionwise figures for the 61 regions shown in cols. (8) and (11) of Table 5.1 show that r = -0.771.

Map (3) appears to largely corroborate the findings from Map (2). Regions with high density (above 10 per cent) of the 'poor' (here, the bottom 10 per cent group) and low density (below 10 per cent) of the 'rich' (here, the top 10 per cent group) formed one large cluster covering West Bengal, Bihar, northern and western parts of Orissa, eastern Madhya Pradesh, the northern region of Andhra Pradesh, large parts of Maharashtra and Karnataka, and northern Kerala. Jammu and

Kashmir, the Punjab, Haryana, Himachal Pradesh, some regions of Rajasthan, Madhya Pradesh and western Uttar Pradesh, on the other hand, constituted a large cluster of regions having low density (below 10 per cent) of the 'poor' and high density (above 10 per cent) of the 'rich'. Another such cluster was formed by the coastal regions of Orissa and Andhra Pradesh, south-western Andhra Pradesh and the inland region of Tamil Nadu.

The figures in Table 5.4 may be examined in conjunction with the percentages of population presented in cols. (2) to (4) of Table 5.2[11/]. On ranking the regions in descending order of head-count ratio (shown in Table 5.1) and accumulating the regional shares in the population of rural India starting from the poorest region (region 27 in Orissa), one finds that 26 regions from the bottom, taken together, accounted for about 50 per cent of the population in rural India and for 62 per cent of the rural poor in the country.

[11/] While computing the results presented in Table 5.4, the Union Territories of Delhi, Pondicherry and Goa, Daman and Diu were excluded as suitable consumer price indices were not available for these regions. However, while estimating the population shares of regions given in Table 5.2, the rural regions of these Union Territories were taken into account. These three regions contained only 0.28 per cent of the rural population, of the country according to NSS 28th round budget data.

5.4.2 Intra-state Variation across Regions

Table 5.1 shows very clearly how the average of nominal PCE varied across regions within some of the states[12]. Such variation is marked for a number of states like Rajasthan, Madhya Pradesh and Orissa. For Rajasthan, the average nominal PCE varied from about Rs. 43 to about Rs. 74 across the regions of the state. As half-sample divergences for these results are not very large, there is very little doubt about the statistical significance of such intra-state regional variation. For states like the Punjab, on the other hand, the variation across regions was small and non-significant. Uttar Pradesh, surprisingly, appeared to fall in this category. It may be mentioned here that variation between east Uttar Pradesh and west Uttar Pradesh is rather well-known and Mukherjee (1969) found appreciable inter-regional variation within Uttar Pradesh based on NSS 18th round budget data. Such inter-temporal fluctuations in the relative positions of different regions could very well be the result of gentle trends and/or fluctuations in the agricultural economies of these rural regions from year to year due to variation in weather and other relevant factors.

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[12] The averages of adjusted PCE, shown in cols. (6) to (8) of Table 5.1 naturally corroborate the conclusions drawn on the basis of corresponding nominal figures because the deflator used for adjustment was the same for all regions within a state.

The head-count ratios also show marked variation across regions within a number of states. For example, for Rajasthan, they varied from 20 per cent to 59 per cent, for Gujarat from 15 per cent to 54 per cent, for Orissa from 43 per cent to 88 per cent and for Karnataka from 18 per cent to 64 per cent. Considerable variation is also observed for other states like Jammu and Kashmir, Haryana and Madhya Pradesh.

As expected, Table 5.2 shows that the densities of population in the bottom fractile groups, 0-10 per cent and 0-20 per cent, varied considerably and significantly across regions in a number of states like Rajasthan, Jammu and Kashmir, Madhya Pradesh, Karnataka, Gujarat and Orissa. Thus, in Orissa, the regional densities for the bottom 20 per cent group varied from 18 per cent to 61 per cent over the regions. In contrast, a few states like Maharashtra appeared to be relatively homogeneous in respect of these densities of the 'poor'.

As regards the density of the 'rich', the regional variation appeared to be large for some states like Rajasthan and Haryana, but not for states like the Punjab.

On examining Table 5.3, one gets more or less the same picture as in Table 5.2, but here the comparisons across states can be made with some degree of confidence. The densities for the bottom 20 per cent group varied from 6 per cent to 37 per cent for the different regions in Karnataka. Other states having large variation in the same density were Rajasthan, Madhya Pradesh, Orissa and Gujarat. States like the Punjab, Uttar Pradesh and Maharashtra appeared to present a pattern of relative homogeneity.

The densities of the 'rich' (top 20 per cent or the top 10 per cent groups), on the other hand, varied markedly within many states like Rajasthan, Jammu and Kashmir and Orissa.

Cols. (5) and (6) of Table 5.7 show the statewise ranges of the densities of the 'poor' (bottom 10 per cent group) measured in terms of nominal and adjusted PCE, respectively. It is observed that nominal and adjusted figures based on NSS 28th round data showed noticeable divergence in only a few cases. Thus, the range of regionwise densities of the poor for Orissa dropped from 18.26 per cent to 7.81 per cent when adjusted PCE was used to measure the density in place of nominal PCE.

5.4.3 Effect of Density[13/] of SC and ST Population on the Level of Living and Incidence of Poverty

As already mentioned, in the previous Chapter the SC and ST were found to be the poorest among the social groups

[13/] The percentage of SC/ST persons in the population of a region is here called the density of SC/ST population.

in rural India. The purpose here is to examine whether rural regions with a higher density of SC/ST in their population were poorer than regions with a smaller percentage of persons in these groups during the NSS 28th round period. The joint distribution of 61 regions by percentage of SC/ST population and head-count ratios of absolute poverty, as estimated from NSS 28th round budget data, is presented in Table 5.5.

Table 5.5 : Distribution of 61 rural regions in India by head-count ratio of absolute poverty and 'density' of SC/ST population based on NSS 28th round household budget data

percentage of SC/ST in rural areas of regions	head-count ratio (per cent)							
	10-20	20-30	30-40	40-50	50-60	60-70	70-	total
0 - 10	3	2	1	0	1	0	0	7
10 - 20	0	0	5	4	4	1	0	14
20 - 30	3	3	2	3	6	0	0	17
30 - 40	0	1	1	1	4	2	1	10
40 - 50	0	0	0	2	1	0	1	4
50 - 60	0	0	0	0	2	0	3	5
60 -	0	2	0	0	1	0	1	4
total	6	8	9	10	19	3	6	61

From Table 5.5, it appears that, on the whole, regions with a higher density of SC/ST have a higher incidence of poverty. However, many regions with a low (high) density of the SC/ST also show high (low) incidence of poverty. The correlation coefficient between the density of SC/ST and head-count ratio is found to be 0.352. The density of SC/ST is found to be negatively correlated with the adjusted average PCE. The correlation coefficient between these two variables for the 61 regions is found to be -0.355.

5.5 Comparative Study of Results of NSS 18th (February 1963 - January 1964) and NSS 28th (October 1973 - June 1974) Rounds

Tables 5.6A and 5.6B compare the findings of the present study on inter-state and inter-regional variation in levels of PCE, based on NSS 28th round (October 1973 - June 1974) data with those of Mukherjee (1969), relating to NSS 18th round period (February 1963 - January 1964). They should throw light on the stability or otherwise of the pattern of inter-state or inter-regional variation in level of living over time.

For the purpose of comparison, correlations between state- or region-wise average PCE's during the two rounds of NSS were computed[14/]. These correlations are presented below :

[14/] In computing correlation coefficients from statewise data, Assam and Meghalaya were excluded. The estimates for the Punjab and Haryana for the 28th round period were pooled.

Table 5.6A : Comparative study of level of living in rural areas of different states : NSS rounds 18 (1963-64) and 28 (1973-74)

State	average PCE (nominal)(Rs.)		average PCE adjusted*		density of poor (0-10%)			density of rich (90-100%)			head-count ratio (adjusted*) 28th round
	18th round	28th round	18th round	28th round	18th round	28th round nominal	28th round adjusted*	18th round	28th round nominal	28th round adjusted*	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Andhra Pradesh	20.91	50.69	20.89	60.90	11.39	13.02	7.82	7.16	8.05	11.98	0.395
Assam**	26.28	52.01	25.46	53.93	1.36	5.64	5.78	14.25	5.61	4.92	0.386
Bihar	21.24	56.31	21.09	50.07	10.79	8.64	14.92	8.46	11.69	6.45	0.603
Gujarat	22.69	54.54	20.49	51.74	8.63	4.84	8.29	9.38	9.21	6.64	0.351
Haryana	-	73.01	-	74.64	-	2.16	2.34	-	24.83	24.00	0.275
Himachal Pradesh	25.75	71.85	25.18	64.79	0.00	1.26	2.56	9.84	23.71	12.15	0.183
Jammu and Kashmir	27.99	54.14	28.27	70.52	0.92	4.44	1.64	18.52	7.81	19.01	0.336
Karnataka	20.35	52.29	21.04	50.42	10.90	10.82	14.29	6.67	8.90	6.60	0.488
Kerala	20.45	55.32	20.77	56.44	13.92	13.97	14.89	8.10	13.13	12.70	0.503
Madhya Pradesh	23.21	50.84	24.73	56.04	13.53	12.77	9.95	12.09	10.12	11.09	0.561
Maharashtra	21.75	52.91	20.54	49.43	8.61	9.07	14.06	8.54	9.45	7.01	0.466
Manipur**	22.20	52.88	21.51	53.21	1.36	2.10	3.27	7.59	3.42	3.19	0.369
Meghalaya	-	58.89	-	57.51	-	2.82	3.33	-	9.22	5.98	0.219
Orissa	19.47	42.61	20.79	53.17	14.86	19.80	10.14	5.95	3.82	7.79	0.611
Punjab (incl. Haryana)	29.11	75.09	28.46	78.73	3.44	1.39	1.47	22.58	26.74	26.59	0.221
Rajasthan	23.27	63.98	24.10	69.88	10.35	5.02	3.90	13.93	19.32	20.47	0.289
Tamil Nadu	23.52	47.68	22.26	57.11	9.07	14.52	8.58	11.28	6.56	10.72	0.495
Tripura**	23.66	50.15	22.92	58.78	0.20	7.07	2.46	8.35	5.01	7.07	0.435
Uttar Pradesh	21.37	51.58	22.93	58.10	12.45	5.87	3.64	8.50	7.08	9.94	0.506
West Bengal	23.83	47.47	20.74	44.94	3.97	17.91	23.69	10.43	8.04	4.77	0.695
Punjab (excl. Haryana)	-	76.68	-	81.87	-	0.80	0.80	-	28.21	28.58	0.179
India	22.38	55.90[a]	22.38	55.90[a]	10.00	10.00	10.03	10.00	9.99	10.00	0.461

Note : The 18th round results are reproduced from Mukherjee (1969).

* The adjustment consisted in expressing PCE at all-India rural prices.

** A single Paasche type consumer price index has been used separately for Assam, Manipur and Tripura to obtain <u>adjusted</u> average PCE for 18th round.

[a] U.T.'s have not been considered.

Table 5.6B : Comparative study of level of living in rural areas of selected NSS regions : NSS rounds 18 (1963-64) and 28 (1973-74)

region (only those remaining same over 18th and 28th rounds)	average PCE (Rs.)(nominal)		average PCE (Rs.)(adjusted*)		density of poor (0-10 per cent)			density of rich (90-100 per cent)			head-count ratio 28th round
	18th round	28th round	18th round	28th round	18th round	28th round nominal	28th round adjusted*	18th round	28th round nominal	28th round adjusted*	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Assam**											
Plains (33,30)	26.97	52.02	26.13	53.94	0.00	5.65	5.81	15.23	5.68	4.98	0.389
Jammu and Kashmir											
Mountainous (7,7)	25.75	58.91	26.01	76.74	1.19	1.39	0.00	15.77	7.64	22.57	0.222
Outer Hills (8,8)	21.98	45.54	22.20	59.32	2.84	10.66	4.04	10.34	4.96	10.46	0.553
Jhelum Valley (9,9)	31.44	60.20	31.75	78.43	0.00	0.00	0.00	23.10	10.08	25.22	0.182
Kerala											
Northern (45,39)	19.57	52.28	19.88	53.34	15.04	14.46	14.91	6.86	9.59	9.08	0.537
Southern (46,40)	21.06	57.09	21.39	58.25	13.12	13.69	14.89	8.98	15.19	14.80	0.483
Maharashtra											
Inland, Central (55, 46)	21.64	46.63	20.43	43.56	9.99	10.17	16.69	8.57	5.12	3.65	0.551
Orissa											
Coastal (26,23)	22.48	50.39	24.01	62.88	4.79	10.19	6.65	7.90	6.06	12.25	0.430
Southern (27,24)	15.59	32.37	16.65	40.40	25.82	22.41	11.27	1.92	0.48	1.27	0.883
Uttar Pradesh											
Himalayan (13,11)	26.82	49.77	28.78	56.06	1.70	10.14	5.30	15.52	5.07	5.76	0.567
Western (14,12)	23.18	54.25	24.87	61.11	5.58	5.21	4.15	10.65	9.91	12.28	0.451
Central (15,13)	20.86	48.61	22.38	54.75	17.43	6.91	5.68	8.55	6.70	8.69	0.564
West Bengal											
Himalayan (29,27)	29.80	43.84	25.94	41.50	0.00	14.88	20.62	16.31	3.26	2.48	0.774

*Note : See note below Table 5.6A.

Figures in parentheses in col. (1) indicate the serial number of the region in Table 5.1 of the present chapter followed by its serial number in Table 6 of Mukherjee (1969).

		correlation coefficient(r)	Spearman's coefficient(r_s)
statewise	nominal averages of PCE (17 States) (18th Vs. 28th rounds)	0.63	0.26
- do -	adjusted averages	0.86	0.65
regionwise	nominal averages of PCE (13 regions) (18th Vs. 28th rounds)	0.51	0.31
- do -	adjusted averages	0.62	0.53

It may be readily seen that the rank correlations in the above table are small or moderate compared to the corresponding ordinary correlations. However, the latter should be given greater importance as actual values of average PCE are more important than the ordinal rankings based on these.

For the statewise adjusted averages of PCE, r = 0.86, which is quite high considering the ten-year gap between the two time periods. This suggests that there is a fairly stable pattern of inter-state differentials in adjusted average PCE.

The correlations are higher for the statewise figures than for the regionwise figures. This could be partly because the regionwise estimates are more affected by sampling errors. It is, however, likely that the inter-temporal variation of the underlying true values was also greater at the regional level than at the state level. What is more important is that the correlations tend to be appreciably higher for the adjusted averages than for the nominal ones. This may be partly due to the fact that the relative price levels in different states varied to a large extent between the two time periods considered here. To examine this, one may compare the patterns of inter-state consumer price differentials in rural India observed during these two time periods. Paasche-type consumer price indices (base : all-India, rural) for some of the states that are found to be the most discordant ones are presented below :

State	Paasche price index (base : rural India)	
	18th round period	28th round period
Andhra Pradesh	100.1	83.2
Bihar	100.7	112.4
Jammu and Kashmir	99.0	76.8
Orissa	93.6	80.1
Tamil Nadu	105.6	83.5
West Bengal	114.9	105.6

Note : The indices for the 18th round period are compiled from Chatterjee and Bhattacharya (1974) and those for 28th round from Bhattacharyya et al (1980).

In fact, if one examines these price indices for all the states one finds poor correlation between the two sets of indices for the two time periods. This probably reflects an important aspect of the inter-temporal variation in the rural sector of the Indian economy. Much of it is due to year-to-year fluctuations in weather and agricultural production. It thus emphasizes the necessity of constructing consumer price differential indices from NSS budget data for as many rounds as possible. It also appears that it is risky to use indices of inter-state consumer price differentials obtained from one NSS round (year) for a different NSS round (year)[15/] [16/].

For the sake of interest, the correlation coefficients (r) between the nominal and adjusted average PCEs for each of the two NSS rounds are presented below :

		18th round		28th round	
		no. of states/ regions	r	no. of states/ regions	r
statewise averages of PCE :	adjusted vs. nominal	18	0.71	20	0.77
regionwise averages of PCE :	-do-	50	0.92	61	0.82

Since results in Table 5.2 are based on nominal PCE, they may be compared with those of Mukherjee (1969). The

[15/] For example, Bardhan (1973) assumed inter-state price differential indices constructed by Chatterjee and Bhattacharya (1974) for the 18th round (1963-64) to hold for the year 1960-61 in order to estimate statewise poverty lines from a single poverty line for rural India at 1960-61 prices.

[16/] The same point should be discernible in the official series of CPI Numbers for Agricultural Labourers (base : 1960-61), available for different states of India.

Table 5.7 : Range of regionwise densities of poor (0-10% group) based on NSS 18th and 28th rounds

state	no. of regions		range of regionwise densities of poor (0-10%)		
	18th round	28th round	18th round nominal	28th round nominal	28th round adjusted
(1)	(2)	(3)	(4)	(5)	(6)
Rajasthan	4	4	29.72	12.49	11.69
Punjab	2	2	1.34	0.85	0.85
Jammu and Kashmir	3	3	2.84	10.66	4.04
Haryana	-	2	-	1.78	2.20
Uttar Pradesh	5	5	15.73	5.52	5.68
Madhya Pradesh	4	5	7.31	13.56	10.96
Bihar	3	3	15.40	2.29	5.90
Orissa	4	3	29.22	18.26	7.81
West Bengal	3	4	4.98	6.11	9.65
Assam	2	2	10.61	0.77	0.93
Manipur	1	2	-	4.62	5.63
Andhra Pradesh	3	3	5.60	8.54	8.80
Tamil Nadu	2	3	0.90	5.27	5.97
Kerala	2	2	1.92	0.77	0.02
Gujarat	3	5	9.31	12.18	18.08
Maharashtra	4	6	6.71	4.06	4.40
Karnataka	3	4	9.99	16.12	19.60

range of densities of the 'poor' (bottom 10 per cent group) over the regions of each state during the 18th round period estimated in terms of nominal PCE are shown in col. (4) of Table 5.7. These may be compared with the corresponding figures for the 28th round obtained from Table 5.2 and presented in col. (5) of Table 5.7. The two sets of figures show interesting similarities and divergences between NSS 18th round and NSS 28th round results. Thus, regions in Uttar Pradesh were markedly different in their density of the 'poor' during the 18th round but fairly homogenous during the 28th round. Rajasthan also showed a similar shift towards homogeneity, going by the density of the 'poor'.

Comparisons with Mukherjee's maps show that the areal distributions of poverty/level of living differed to some extent between the two time periods. This can be explained by differentials in economic growth of different regions, by year-to-year fluctuations in the economy, by sampling errors affecting NSS data and by the fact that Mukherjee worked with nominal PCE, while the maps presented here are based on adjusted PCE.

In any case, the moderate correlations between regionwise adjusted averages of PCE based on 18th and 28th round results ($r = 0.62$, $r_s = 0.53$) point to considerable geographical shifts in relative poverty or affluence between the two time periods. Investigations like the present one covering many time periods would probably reveal that some regions are chronically poor or relatively prosperious, while others occupy shifting positions in the ranking from year-to-year. Region-level studies should be more rewarding from this point of view than studies conducted at the state level because state-level figures tend to mark interesting inter-regional variations.

5.6 Sample Size Needed for Region-level Estimates

Wide variation in level of living and the incidence of absolute poverty observed across the regions within many of the states stresses the importance of analyzing and releasing household budget data at the regional level. It appears that the policy of the NSSO and of most other statistical agencies in India is to present state-level estimates but very little data for areas smaller than states. As already mentioned in Section 5.1, this is undesirable in view of increasing demands for data for smaller areas like districts or even community development (CD) blocks for purposes of planning and anti-poverty programmes. The survey organisations have been expressing their inability on grounds of inadequacy of sample size for areas smaller than states[17/]. This policy requires

[17/] In the NSSO, the view taken on this is that when the states sample results have become available and have been compared and reconciled with the Central Sample results, the pooled data will be used for throwing up regional level estimates. Unfortunately, progress in this direction has been very poor, presumably due to lack of resources. The present study is based on the Central Sample of the NSS 28th round consumer expenditure enquiry.

careful scrutiny. The reliability of some of the region level estimates presented here, based on the Central Sample of the 28th round enquiry, is examined below, utilizing the half-samplewise estimates for estimation of standard errors.

Standard error (s.e.) of the head-count ratios presented in col. (11) of Table 5.1 were computed from the corresponding half-samplewise estimates using the formula

$$SE(t_c) = \frac{|t_1 - t_2|}{2} \qquad \ldots (5.1)$$

where t_1, t_2 and t_c denote half-sample 1, half-sample 2 and combined sample estimates of the true head-count ratio. Although extremely rough (each estimated s.e. being based on only 1 d.f.), these estimates led to some important observations.

As expected, the s.e.'s were generally smaller for a region/state for which the sample size was larger. Taking the regionwise results first, a summary picture of the relationship between the sample sizes and the corresponding s.e.'s is presented below :

Sample size (no. of house-holds) :	upto 100	101-200	201-300	301-400	401-500	501-600
No. of regions :	12	12	20	9	3	5
average s.e. of head-count ratio :	0.068	0.046	0.030	0.018	0.043	0.016

Thus, the s.e. of the head-count ratio was about 2 per cent, on an average, for regions with sample size 300 or more[18].

The corresponding picture for the statewise s.e.'s is shown below :

sample size : (no. of sample households)	below 500	501-1000	1001 -
no. of states :	4	10	6
average s.e. of head-count : ratio	0.057	0.013	0.017

Considering the pattern and extent of variability of the head-count ratio across regions (or over time), a s.e. of 2 per cent should be considered sufficiently small for purposes of spatial and inter-temporal comparisons. One might, therefore, release the regionwise results for all the regions with sample size 300 or more. One may even go farther and release head-count ratios of regions with sample size 200 or more, thus allowing the average s.e. to go up to 3 per cent. Statewise estimates, on the other hand, appear to be fairly dependable when the sample size is 500 or more.

[18] The unusually high average s.e. (0.043) for the interval 401-500 of sample size is based on only 3 regions and is believed to be affected by large sampling errors. The statement made here is based on a smoothing of the average s.e.'s for the different class-intervals with a view to obtaining a plausible pattern.

Out of the 61 regions, as many as 37 had sample size greater than 200. On adding up the shortfall of the sample sizes of the remaining 24 regions from 200, one gets the figure 2108. This means that one might have attained a sample size of 200 for all the regions with a total sample size of 20,000 households for rural India. Thus, by pooling of State and Central Samples or by raising the sample size of the smaller regions to a minimum of 200 (say), one can obtain fairly reliable region-level estimates of the head-count ratio of absolute poverty[19/] [20/].

5.7 Concluding Remarks

The results presented in this Chapter show wide variation in the level of living, as measured by PCE, and in the incidence of absolute poverty across 61 NSS regions in rural India during the NSS 28th round period (October 1973 - June 1974). For example, the head-count ratio of absolute

[19/] It may also be possible to reallocate sample size among the regions to some extent and in that case, total sample size need not increase by 2108 households.

[20/] For the 32nd round enquiry on consumer expenditure the size of the Central Sample was 99,766 households for rural India, which is more than six times that for the corresponding 28th round enquiry. None of the region level estimates was published even though many of the rural regions had sample size above 1000 households in the 32nd round enquiry.

poverty varied from about 15 per cent for region 50 in Gujarat to 88 per cent for region 27 in Orissa. The average adjusted PCE's, and the density of the 'poor' (bottom 10 per cent or bottom 20 per cent of the population, based on adjusted PCE) also showed considerable variation over these NSS regions. The corresponding variation across states was somewhat narrower.

What is most important, inter-regional variation was found to be marked within many of the states. Thus, according to any of the indicators of level of living, such inter-regional variation was large for the states of Rajasthan, Orissa, Karnataka and Madhya Pradesh. States like the Punjab, Maharashtra and Uttar Pradesh, on the other hand, appeared to be relatively homogeneous in this respect.

Comparisons of NSS 28th round (October 1973 - June 1974) results with those of Mukherjee (1969), which relate to the NSS 18th round period (February 1963 - January 1964), show that the pattern of variation in average adjusted PCE across states, and across the 13 NSS regions compared, was somewhat similar during the two time periods. The correlation coefficients between the values of adjusted average PCE's for the two rounds was appreciably higher (0.86 for statewise figures and 0.62 for regionwise figures) than those based on average nominal PCE's (0.63 for statewise figures and 0.51 for regionwise figures). This finding could largely be attributed to the difference in the pattern of inter-state consumer price differentials during the two time periods[21]. The ranges of regionwise densities of the 'poor' (bottom 10 per cent group) within states showed a few differences between the two NSS rounds. For example, while the regions in Uttar Pradesh were markedly different in respect of the density of the poor during the 18th round, they were somewhat homogeneous during the 28th round. Rajasthan, too, showed a shift towards homogeneity.

The regional patterns in the incidence of poverty and level of living in rural India have been compared here for only two rounds, namely, the 18th (1963-64) and 28th (1973-74). This does not give a complete picture of the regional pattern of level of living and incidence of poverty in rural India. Only a similar study covering many time periods would succeed in identifying regions which are chronically poor (or relatively rich).

The findings mentioned above underline most emphatically the need of publishing regionwise NSS results based on household budget data. The NSSO releases only the statewise estimates and seldom the regionwise results although the sample size for states like Manipur, Tripura and Meghalaya

21/ This stresses the need of estimating consumer price differentials separately for each year or NSS round, as such differentials vary a good deal across years.

are typically smaller than those of many regions of the larger states. This Chapter makes out a case for the publication of (NSS) regionwise results based on NSS consumer expenditure data, by showing that fairly dependable regionwise estimates can be obtained by ensuring a minimum sample size of 200 households (say) for each region.

Thus far, in Chapters 4 and 5, large variations in the incidence of absolute poverty were observed, in turn, across states, NSS regions within states, social groups, size classes of household land possessed, occupational classes and household size. It would naturally be of interest to examine how these household characteristics, when taken together, explain the level of living and poverty of a household in rural India. As absolute poverty is explained in terms of PCE, it would seem logical to examine how these factors, taken together, explain the PCE of a household. Thus, in the next Chapter, a multiple linear regression model is developed for the rural areas of a few selected states, to examine how the PCE of a household was affected by such household characteristics as the area of land possessed by it, its size and composition, and the social group, occupational class and NSS region to which it belonged during the NSS 28th round period. And, in the Chapter following the next, these household characteristics are employed to explain the poverty status (that is, poor or non-poor) of rural households in the states covered in the next Chapter, that is, Chapter 6.

Chapter 6

REGRESSION ANALYSIS OF PCE

6.1 Introduction

In Chapters 3, 4 and 5, the variation in the distribution of PCE and in the incidence of poverty in rural India was studied separately over states, NSS regions and different socio-economic groups, on the basis of NSS 28th round (October 1973-June 1974) household budget data. These studies indicate that there existed wide differences in level of living (as measured by PCE) and poverty across geographical areas and socio-economic groups during the NSS 28th round period. Actually, it was found that the incidence of poverty was appreciably higher in some social groups like Scheduled Castes and Scheduled Tribes, occupational classes such as agricultural labourers, some size classes of household land possessed (especially households possessing 0.005-1.00 acre of land) and in certain states and NSS regions[1/]. The pattern of variation in the incidence of absolute poverty across different socio-economic groups, observed at the all-India (rural) level was seen to be more or less repeated in rural areas of most of the states. Also for rural India as a whole, the incidence of poverty was seen to rise with household size

[1/] As average PCE shows high negative correlation with the head-count ratio of absolute poverty, one may expect that groups having a high incidence of absolute poverty also have low average PCE.

upto households with about 6 members, after which it declined though by a smaller extent.

One limitation of the above analyses is that they sought to explain differences in PCE (or level of poverty) in terms of one or two explanatory variables or factors taken at a time. An attempt is now made to explain PCE of a rural household in terms of several household characteristics considered together. These characteristics are : land possessed by the household, its size and composition (that is, the number of adult males, number of adult females and number of children), its principal occupation, and the social group and (NSS) region to which it belonged. The analysis is carried out by setting up a multiple linear regression model to explain PCE, utilizing NSS 28th round disaggregated household budget data. This analysis is done separately for the rural areas of each of nine selected states because otherwise too many variables would be needed to take account of possible interactions between state and other factors[2/]. Also, this approach eliminates the need of using multipliers, thanks to the self-weighting nature of the NSS sampling design for the rural sector of each state.

As mentioned earlier, NSS 28th round household budget data analyzed here were collected by interview method using

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[2/] For example, the same size of landholding possessed means very different things in different states.

'last 30 days' as reference period. As the interviews were evenly spread over the survey period from October 1973 to June 1974, it is likely that reported household consumption relating to the reference period of 'last 30 days' was affected by seasonality. Therefore, in order to get better estimates of the other effects, the season (or sub-round)[3/] to which the household was allotted for interview was introduced as an additional explanatory variable.

Actually, the multiple linear regression models set up include only a subset of the variables that determine ln PCE[4/]. In case of occupation, only the principal occupation of the household was used as an explanatory variable. It was not possible to include such determinants of PCE as the number of earners in the household, their different occupations and their education as explanatory variables because of non-availability of data. Also, detailed information on age-distribution of members of the household was not available. Omission of these factors in the present study may be regarded as a limitation of this study, as these

[3/] As already mentioned in Chapter 2, the entire survey period from October 1973 to June 1974 was divided into three sub-rounds, namely, October to December, 1973, January to March, 1974 and April to June, 1974, and three independent samples of households were allotted for the interviews during these sub-rounds.

[4/] The logarithmic transformation was applied in the hope that this would stabilize the variance of the disturbance terms and also make the disturbance term nearly normal.

factors are likely to be important determinants of a household's level of living.

Another possible limitation of this study is that interaction effects of the factors considered were not incorporated in the model. This was done for two reasons : (i) if interaction terms were included, then the number of explanatory variables would become too large and unmanageable from the point of view of estimation; and (ii) the number of sample households might be small for some of the cells creating difficulties in the estimation process.

This Chapter is organised as follows : Section 6.2 describes the criteria of selection of nine states chosen for the study. Section 6.3 describes the variables used in the regression analysis, while Section 6.4 outlines the method of selection of regressors and estimation of the multiple linear regression model. Section 6.5 reports on the results of the regression analysis of PCE. Finally, Section 6.6 concludes the Chapter.

6.2 Selection of States

As already mentioned, a multiple linear regression model was developed for the rural areas of each of nine selected states. These were Rajasthan, the Punjab, Uttar Pradesh, Orissa, West Bengal, Tamil Nadu, Kerala, Gujarat and Maharashtra. The criteria on which the selection of states was based were :

(i) The number of rural sample households in a state for the NSS 28th round consumer expenditure enquiry;

(ii) the average adjusted PCE (that is, PCE expressed at all-India rural prices) for a state;

(iii) the level of absolute poverty in a state as measured by head-count ratio index; and

(iv) the variation of average PCE over NSS regions within a state as measured by

$$RA = \frac{\text{Range of average PCE over NSS regions in the state}}{\text{Average PCE for the state}} \times 100$$

Indices (ii), (iii) and (iv) were also based on NSS 28th round household budget data.

The number of sample households, and estimates of average adjusted PCE, head-count ratio and RA for rural areas of different states are shown in Table 6.1. From this table it can be seen that states with relatively high or low average PCE (hence low or high head-count ratio) or large or small extent of variation (RA) in average PCE across regions

Table 6.1 : Criteria for selection of nine states for the multiple regression analysis of PCE and logit analysis of poverty status

State	criteria for selection			
	sample size	adjusted average PCE (in Rs.)	head-count ratios	RA** (in percent)
(1)	(2)	(3)	(4)	(5)
Rajasthan*	613	69.88	0.289	49 (4)
Punjab*	670	81.87	0.179	2 (2)
Jammu & Kashmir	657	70.52	0.336	27 (3)
Haryana	603	74.64	0.275	18 (2)
Himachal Pradesh	394	64.79	0.183	- (1)
Uttar Pradesh*	1784	58.10	0.506	11 (5)
Madhya Pradesh	1320	56.04	0.561	31 (5)
Bihar	1288	50.07	0.603	21 (3)
Orissa*	671	53.17	0.611	42 (3)
West Bengal*	1030	44.94	0.695	19 (4)
Assam	600	53.93	0.386	1 (2)
Manipur	222	53.21	0.369	14 (2)
Tripura	187	58.78	0.435	- (1)
Meghalaya	225	57.51	0.219	- (1)
Andhra Pradesh	1236	60.90	0.395	20 (3)
Tamil Nadu*	910	57.11	0.495	16 (3)
Kerala*	645	56.44	0.503	9 (2)
Gujarat*	530	51.74	0.351	23 (5)
Maharashtra*	1135	49.43	0.466	22 (6)
Karnataka	621	50.42	0.488	32 (4)

Source : Table 5.1 of Chapter 5 of the present dissertation.

* States selected for the regression analysis and logit analysis.
** Figures in parentheses in col. (5) give the number of NSS regions in the state.

were selected for the present study. The sample size was at least 500 for each selected state.

The explanatory variables considered for the study are now described.

6.3 Description of Variables

The dependent variable is taken to be the natural logarithm of the PCE of a household. In Tables 4.3A to 4.3C of Chapter 4, the incidence of absolute poverty was seen to vary across different size classes of household land possessed. It would therefore seem logical to incorporate the size of household land possessed among the explanatory variables in the analysis. The level of poverty was also observed to vary over households of different sizes in the same Chapter (vide Tables 4.5 and 4.6). This was taken care of by using as regressors the number of adult males, the number of adult females, and the number of children[5/] in the household. These three regressors would also reflect the effect of household composition on consumption needs and on the supply of manpower for economic activities. Thus, the key cardinal explanatory variables were taken to be the natural logarithm of per capita land possessed by a

[5/] Persons who have not completed 15 years of age.

household (ln PCL)[6], the number of adult males (N_m), the number of adult females (N_f) and the number of children (N_c) in the household.

In order to capture the effects of factors such as occupation, social group and region on the PCE of a household, a series of dummy variables for each such factor was introduced as explanatory variables. It may be reiterated that no interaction terms were introduced in the model to keep the number of regressors within manageable limits. The dummy variables introduced for the different factors were defined in the following manner :

(a) Social Group

The five social groups studied in Chapters 3 and 4, namely, Scheduled Castes (SC), Scheduled Tribes (ST), 'other Hindus', 'other Muslims' and 'others' were considered for the present study. In most of the selected states, the number of sample households reporting themselves as 'other Hindus' was found to be the highest[7]. For this reason, the 'other Hindu' households were taken to constitute the reference social group for each state. Thus, the dummy variables corresponding to the remaining social groups were :

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[6] For landless households, the logarithmic transformation was made assuming that each such household possessed 0.005 acre of land.

[7] However, for the Punjab, the number of sample households was the highest for the 'others' group.

$$GP1 = \begin{cases} 1 \text{ if the household belonged to the SC,} \\ 0 \text{ otherwise;} \end{cases}$$

$$GP2 = \begin{cases} 1 \text{ if the household belonged to the ST,} \\ 0 \text{ otherwise;} \end{cases}$$

$$GP3 = \begin{cases} 1 \text{ if the household was an 'other Muslim' one,} \\ 0 \text{ otherwise;} \end{cases}$$

$$GP4 = \begin{cases} 1 \text{ if the household belonged to the 'others' group (i.e. not-ST Sikhs, Jains, Buddhists, Christians, Parsis, etc.),} \\ 0 \text{ otherwise.} \end{cases}$$

One may remember that GP1 covers only Hindu SC households. The 'other Muslims' group consisted of almost all Muslim households in the sample as the sample size for Muslim ST was only 4 [8].

(b) Household Occupation

All agricultural households other than agricultural labourers were taken to represent the reference occupation class for each state. This group consisted of 'owner cultivators', 'tenant cultivators', plantation workers, hunters, loggers, fishermen, etc. and constituted a large proportion of sample households in each state. Since the bulk of the reference class were 'owner cultivator' and 'tenant cultivator'

[8] See Table 3.6 of Chapter 3.

households, it will be referred to as the 'cultivator' class. The dummy variables corresponding to the other occupations were defined as follows[9/]:

$$OC1 = \begin{cases} 1 & \text{if the household was an agricultural labour household,} \\ 0 & \text{otherwise;} \end{cases}$$

$$OC2 = \begin{cases} 1 & \text{if the household occupation was professional, technical or related, administrative, executive, managerial, clerical or related, or the household was a non-worker or a 'non-response' one,} \\ 0 & \text{otherwise;} \end{cases}$$

$$OC3 = \begin{cases} 1 & \text{if the household occupation was sales or service,} \\ 0 & \text{otherwise;} \end{cases}$$

$$OC4 = \begin{cases} 1 & \text{if the principal occupation of the household were production or related workers, transport equipment operators or labourers,} \\ 0 & \text{otherwise.} \end{cases}$$

The dummy variable OC2 covered the residual occupational category which was formed by combining the white collar occupations constituting a small proportion of the rural population with the 'non-response' or 'non-worker' households.

[9/] See Chapter 3 for 3-digited occupation codes used to form the occupational categories.

For Rajasthan and Gujarat, the number of sample households having sales or service occupations was small. Therefore, for these two states, the 'sales or service' group was merged with the residual category. The corresponding dummy variable was :

$$OC5 = \begin{cases} 1 & \text{if the household occupation was sales, service, professional, etc.,} \\ 0 & \text{otherwise.} \end{cases}$$

(c) NSS Regions

For a state having J NSS regions, (J-1) regional dummy variables were defined. For each of the states, the reference regions and regions corresponding to the different regional dummy variables are indicated in Tables 6.3.1 to 6.3.9.

(d) Sub-rounds

As mentioned earlier, sub-round dummy variables were included as regressors in order to get better estimates of the effects of other explanatory variables. The time period from October to December, 1973 was taken to be the reference period for each state. The sub-round dummy variables were then defined as

$$SR2 = \begin{cases} 1 & \text{for households allotted for interviewing during January to March, 1974,} \\ 0 & \text{otherwise;} \end{cases}$$

$$SR3 = \begin{cases} 1 & \text{for households allotted for interviewing during April to June, 1974,} \\ 0 & \text{otherwise.} \end{cases}$$

6.4 The Stepwise Selection of Factors Determining PCE

For each of the nine selected states, the regressors were selected in several steps. The basic regression model for each state contained the key explanatory variables only, viz., ln PCL, N_m, N_f and N_c, and was written as :

$$\ln PCE_i = \alpha + \beta_1 \ln PCL_i + \beta_2 N_{mi} + \beta_3 N_{fi} + \beta_4 N_{ci} + \varepsilon_i \qquad \ldots (6.1)$$

for the ith household, i = 1, 2, ..., n, where n was the number of sample households for the state. It was assumed that $E(\varepsilon_i) = 0$, $E(\varepsilon_i^2) = \sigma^2$, $E(\varepsilon_i \varepsilon_j) = 0$, for all $i, j = 1, 2, \ldots, n$, $i \neq j$. ε_i's were also assumed to be independent of the regressors. Further, for the purpose of testing the significance of effects of regressors on ln PCE, it was assumed that $\varepsilon_i \sim N(0, \sigma^2)$, $i = 1, 2, \ldots, n$.

As the sample was self-weighting within the rural areas of each state, the regression analysis was done by the ordinary least squares (OLS) method of estimation, that is, without using the multipliers or probability weights needed for the estimation of aggregates or averages for the population. In fact, in the process of selection of regressors also, the complications of NSS sampling design were ignored, and the NSS sample of households was treated as a simple random sample selected with replacement.

Here, it may be mentioned that alternative estimates of standard errors of the regression coefficients of the final multiple linear regression models were obtained using (i) White's method (vide White (1980)) and (ii) half-sample based estimates of the regression coefficients. These standard errors are presented in Appendix C together with the standard errors obtained in the conventional manner using OLS technique, and are used to compare the significance levels of the t-values of regression coefficients estimated by the OLS method. White's estimates allow for heteroscedasticity of OLS disturbances (that is, allows for the possibility that $E(\varepsilon_i^2) \neq E(\varepsilon_j^2)$, for some $i \neq j$, $i, j = 1, 2, \ldots, n$). The half-sample based estimates go further — they can take account of complications of NSS sampling design which White's method and conventional (OLS) method ignore. For each state, the regressors were selected in the following steps :

Step 1 : In this step, the basic regression model (6.1) was estimated using OLS.

Let SSR = sum of squares due to regression,

and SSE_1 = error sum of squares.

Then, $F_1 = \frac{SSR/4}{SSE_1/(n-5)}$ indicates the goodness of fit of model (6.1). If $F_1 > F_{4,n-5}(0.05)$, then one proceeded to step 2, otherwise the analysis was abandoned for the state. The latter event, it may be mentioned, did not happen for any state.

<u>Step 2</u> : For each of the factors, namely, (a) social group, (b) household occupation, (c) NSS region, and (d) sub-round, the following model was estimated separately using OLS :

$$\ln PCE_i = \alpha + \sum_{j=1}^{M_k} \alpha_j z_{ij} + (\beta_1 + \sum_{j=1}^{M_k} \beta_{1j} z_{ij}) \ln PCL_i$$

$$+ (\beta_2 + \sum_{j=1}^{M_k} \beta_{2j} z_{ij}) N_{mi} + (\beta_3 + \sum_{j=1}^{M_k} \beta_{3j} z_{ij}) N_{fi}$$

$$+ (\beta_4 + \sum_{j=1}^{M_k} \beta_{4j} z_{ij}) N_{ci} + \varepsilon_{1i} \qquad \ldots (6.2)$$

where, for the kth factor (with $M_k + 1$ levels)

$$z_{ij} = \begin{cases} 1 & \text{if the ith household belongs to the jth class of the kth factor,} \\ 0 & \text{otherwise,} \end{cases}$$

$i = 1, 2, \ldots, n$, $j = 1, 2, \ldots, M_k$, and M_k is the number of dummy variables defined for the kth factor. Note that, for each factor, there is a reference group for which $z_{ij} = 0$ for all i. Also, $E(\varepsilon_{1i}) = 0$, $E(\varepsilon_{1i}^2) = \sigma_1^2$, $E(\varepsilon_{1i}\,\varepsilon_{1j}) = 0$, $\varepsilon_{1i} \sim N(0, \sigma_1^2)$, $i,j = 1, 2, \ldots, n$, $i \neq j$. Now let

SSE_{2k} = error sum of squares for model (6.2) for the kth factor,

and SST = total sum of squares.

The value of the adjusted coefficient of multiple determination for the model including the kth factor computed as

$$\bar{R}_k^2 = 1 - \left(\frac{n-1}{n-p_k}\right) \frac{SSE_{2k}}{SST},$$

where $(p_k - 1)$ is the number of cardinal plus dummy variables included in model (6.2) for the kth factor. The value of $\bar{R}_k^2$ was examined for each of the factors (a) to (d) listed at the beginning of Step 2 above. The set of dummy variables corresponding to the factor 1, say, which gave the highest value of $\bar{R}_k^2$ for model (6.2) was now considered for possible selection. The question was : Did the set of dummy variables so added to the basic model (6.1) contribute significantly towards explaining ln PCE? To answer this question, the following F-test was performed to test the hypothesis

$$H_{01} : \alpha_1 = \dots = \alpha_{M1} = \beta_{11} = \dots = \beta_{1M1} = \beta_{21} \dots$$
$$\dots = \beta_{2M1} = \beta_{31} = \dots = \beta_{3M1} = \beta_{41} = \dots$$
$$\dots . = \beta_{4M1} = 0$$

against the alternative that not all of $\alpha_1, \dots, \alpha_{M1}, \beta_{11}, \dots$ $\dots, \beta_{1ML}, \beta_{21}, \dots\dots, \beta_{2M1}, \beta_{31}, \dots, \beta_{3M1}, \beta_{41}, \dots, \beta_{4M1}$ are zero[10]. Note that this procedure of selecting first a factor with highest $\bar{R}_1^2$ and then testing the significance of its contribution to the regression model is practical but biased and is likely to give a significant result. Now consider

$$F_2 = \frac{(SSE_1 - SSE_{21})/5\ M1}{SSE_{21} / (n - p_1)}$$

If $F_2 > F_{5M1,(n-p_1)}(0.05)$, then hypothesis H_{01} was rejected, otherwise model (6.1) was retained as the final model.

When H_{01} was rejected, the following model, where only the intercept varies, was estimated by OLS for the lth factor:

$$\ln PCE_i = \alpha + \sum_{j=1}^{M1} \alpha_j z_{ij} + \beta_1 \ln PCL_i + \beta_2 N_{mi} + \beta_3 N_{fi} + \beta_4 N_{ci} + \varepsilon_{2i} \qquad \dots (6.3)$$

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[10] The dummy variables representing any factor were tested jointly because going by individual t-values one might select different subsets of variables for the same problem, if the reference group is changed.

where the assumptions on disturbances ε_{2i} were similar to those in case of models (6.1) and (6.2), that is, $E(\varepsilon_{2i}) = 0$, $E(\varepsilon_{2i}^2) = \sigma_2^2$, $E(\varepsilon_{2i}\,\varepsilon_{2j}) = 0$ and $\varepsilon_{2i} \sim N(0, \sigma_2^2)$, $i, j = 1, 2, \ldots, n$, $i \neq j$. Let

SSE_{31} = error sum of squares for model (6.3).

The hypothesis to be tested was :

$$H_{02} : \beta_{11} = \ldots = \beta_{1Ml} = \beta_{21} = \ldots = \beta_{2Ml}$$
$$= \beta_{31} = \ldots = \beta_{3Ml} = \beta_{41} = \ldots = \beta_{4Ml} = 0,$$

that is, the effect of key explanatory variables on ln PCE was unchanged over the classes of the lth factor. Now, let

$$F_3 = \frac{(SSE_{31} - SSE_{21})/\,4Ml}{SSE_{21}\,/\,(n - p_1)} \; .$$

If $F_3 > F_{4Ml,(n-p_1)}(0.05)$, then the hypothesis of equal slopes was rejected, and one proceeded to step 3 with model (6.2) as the basic model. If, on the other hand, $F_3 \leq F_{4Ml,(n-p_1)}(0.05)$, then the hypothesis H_{02} was accepted. For the sake of interest, one would now test

$$H_{03} : \alpha_1 = \ldots = \alpha_{Ml} = 0,$$

given that H_{02} is true, that is, intercepts were all equal assuming that the slopes were equal. Note that heterogeneity of regression equations (H_{01} rejected) and homogeneity of slopes (H_{02} accepted) together necessarily imply that differential intercepts α_j's are significantly different from zero. Therefore, this test really provided a confirmatory check. In this case if the test statistic

$$F_4 = \frac{(SSE_1 - SSE_{31})/M1}{SSE_{31}/(n - 5 - M1)}$$

was greater than $F_{M1,(n-5-M1)}(0.05)$, then model (6.3) was used as the basic model in the next step.

<u>Step 3</u> : Model (6.2) (or (6.3)) was the basic model in this step. As in step 2 above, the dummy variables corresponding to the remaining factors were added separately, considering one factor at a time, to the basic model (6.2) (or (6.3)). (Each such regression allowed for variation of slope parameters and intercepts as in model (6.2).) Each time, the regression model was estimated by OLS. Following the procedure outlined in Step 2, one of these models was selected for Step 4. This procedure was continued until either all subsets of dummy variables were included in the model or until some set of dummy variables corresponding to a factor was found to contribute non-significantly towards explaining the variation of ln PCE.

When a set of dummy variables representing a factor was included, they were included on the basis of their joint contribution. It was possible that some of the individual contributions were non-significant. Now, from the model determined in the manner outlined above, variables whose t-values were non-significant at two-sided 20 per cent level of significance were dropped. The contribution of all these dropped variables, taken together, was then tested by the F-test. If their contribution was non-significant at 5 per cent level of significance, then the regression equation was re-estimated and the process of dropping non-significant variables was continued until all explanatory variables in the model were found to be significant. In a few cases, the joint contribution of the dropped variables was found to be significant, and there the level of significance for the t-test of the individual variables was slightly raised above 20 per cent and the procedure repeated.

6.5 Results of Multiple Regression Analysis of PCE

This Section first discusses the findings based on the stepwise selection of factors determining PCE for the nine selected states. Next, it describes the effects of the key explanatory variables, viz., ln PCL, N_m, N_f and N_c on ln PCE of households in different categories in these states on the basis of the estimated final multiple linear regression models.

6.5.1 The Sequence of Selection of Factors

Table 6.2 shows the factors selected at different stages of the process of setting up the regression model along with the value of adjusted squared multiple correlation coefficient ($\bar{R}^2$). Col. (2) of this table presents, for the different states, the values of $\bar{R}^2$ for the finally estimated multiple linear regression model (6.1) containing only the key explanatory variables namely, ln PCL, N_m, N_f and N_c. The subsequent columns show the factors included in the later steps, together with the improvement in the value of $\bar{R}^2$.

In Step 1, $\bar{R}^2$ was very low for Rajasthan followed by Orissa, Maharashtra, and Uttar Pradesh. As ln PCL was the main explanatory variable in this step, such low values of $\bar{R}^2$ were obtained possibly because of the heterogeneity of land in these states. An idea of heterogeneity within a state is given by Table 6.1 (vide Col. (5) for indices of regional variation in average PCE). The figures for Rajasthan and Orissa support this explanation of low values of $\bar{R}^2$, but not those for Uttar Pradesh. However, for all four states, regional dummy variables were included in later stages of the stepwise regression. In case of the Punjab and Kerala, homogeneity across regions, as seen from the indices in col. (5) of Table 6.1, is reflected in Table 6.2 — the latter table does not show 'region' for these two states.

Table 6.2 : Values of $\bar{R}^2$ and factors included at different steps of the process of regression modelling, separately by states

State	Values of $\bar{R}^2$ and factors included*				
	Step 1**	Step 2	Step 3	Step 4	Step 5
(1)	(2)	(3)	(4)	(5)	(6)
Rajasthan	0.0462	REGION (I) 0.1372	SOCIAL GROUP (I) 0.1725	OCCUPATION (SI) 0.1991	-
Punjab	0.3011	SOCIAL GROUP (SI) 0.3214	-	-	-
Uttar Pradesh	0.1213	OCCUPATION (SI) 0.1790	REGION (SI) 0.1926	SUB-ROUND (I) 0.2057	SOCIAL GROUP (I) 0.2203
Orissa	0.0857	OCCUPATION (SI) 0.2463	REGION (SI) 0.3486	SUB-ROUND (I) 0.3820	SOCIAL GROUP (I) 0.3963
West Bengal	0.2569	OCCUPATION (SI) 0.3349	REGION (SI) 0.3732	SOCIAL GROUP (SI) 0.3981	SUB-ROUND (SI) 0.4150
Tamil Nadu	0.1928	OCCUPATION (SI) 0.2653	SUB-ROUND (SI) 0.2840	REGION (SI) 0.3008	-
Kerala	0.2134	OCCUPATION (SI) 0.3548	SOCIAL GROUP (SI) 0.3846	-	-
Gujarat	0.1948	OCCUPATION (SI) 0.3219	SOCIAL-GROUP (I) 0.3574	REGION (I) 0.3845	-
Maharashtra	0.1196	OCCUPATION (SI) 0.2113	REGION (SI) 0.2307	-	-

* Code I in parentheses against the name of the factor included in any step indicates that the dummy variables corresponding to the particular factor are included in the intercept of the regression model of the previous step; Code SI indicates that the dummy variables are included in both the slope and intercept.

** In all the cases, the regression model in Step I included the basic explanatory variables ln PCL, N_m, N_f and N_c.

Table 6.2 shows that dummy variables corresponding to all factors, namely, social group, occupational class, NSS region and sub-round were selected, either in the intercept or in the slope, as possible regressors for the states of Uttar Pradesh, Orissa and West Bengal. In these three states, intercept and slope dummy variables corresponding to occupational groups were selected at Step 2, followed by inclusion of regional intercept and slope dummy variables at the next step. At the fourth step, dummy variables corresponding to either social groups or sub-rounds were included in the regression equations for these states.

For the Punjab, it was found that only the social group to which a household belonged had any effect on household PCE. In case of Rajasthan, intercept dummy variables corresponding to NSS regions within the state appeared to have the largest significant effect on PCE compared to dummy variables corresponding to the remaining factors. For this state, occupational dummies entered the regression equation only at Step 4, with social group dummies being added at Step 3. In the remaining states of Tamil Nadu, Kerala, Gujarat and Maharashtra, both intercept and slope dummy variables corresponding to occupational classes were added to the regression equation in Step 2.

The overall view is that among household classificatory factors, household occupation was the most important

Table 6.3.1 : Regression equations for ln PCE of form (6.2) estimated for rural households in different States : NSS 28th round, October 1973 - June 1974 : Rajasthan

Household Characteristic Dummies	Intercept or Differential intercept	Coefficient or differential coefficient of main explanatory variables[a]			
		ln PCL	N_m	N_f	N_c
(1)	(2)	(3)	(4)	(5)	(6)
reference group : 'other Hindu', cultivator households in North-eastern region allotted for subround 1 (Oct. - Dec. 1973)	4.354 (103.66)	0.030** (3.27)	-	-	-0.044** (-3.97)
REG1 (Western region)	-0.129** (-2.69)	-	-	-	-
REG2 (Southern region)	-0.376** (-6.57)	-	-	-	-
REG3 (South-eastern region)	-0.191** (-3.26)	-	-	-	-
GP1 (Scheduled Caste)	-0.162** (-3.23)	-	-	-	-
GP2 (Scheduled Tribe)	-0.233** (-4.31)	-	-	-	-
OC1 (Agricultural labour)	-	-	-	-	-
OC5 (Professional, technical, etc., clerical and related, sales, service, 'non-response' or 'non-worker')	0.705** (4.83)	-	-	-0.194* (-2.40)	-0.095* (-2.21)
OC4 (Production, transport and related)	-	-	-	-	-
SR2 (January-March, 1974)	-	-	-	-	-
SR3 (April-June, 1974)	-	-	-	-	-

$\bar{R}^2$ = 0.2035, F = 15.59 , no. of sample households = 572.

[a] The entry in the row for OC5 and column for N_c - to give an example - is the coefficient of the interaction term OC5 x N_c, where OC5 is the dummy variable representing the professional, managerial, technical, clerical and related, sales or service occupation groups, non-workers and 'non response' households.

Note : ** means that the coefficient is significant at two-sided 1% level;

* means that the coefficient is significant at two-sided 5% level.

Table 6.3.2 : Regression equations for ln PCE of form (6.2) estimated for rural households in different States : NSS 28th round, October 1973-June 1974 : Punjab

Household characteristic Dummies	Intercept or differential intercept	Coefficient of main explanatory variables or interaction terms			
		ln PCL	N_m	N_f	N_c
(1)	(2)	(3)	(4)	(5)	(6)
reference group : 'other Hindu' cultivator households in Northern region interviewed during Oct.-Dec., 1973	4.719 (157.81)	0.059** (10.00)	-	-	-0.107** (-12.24)
REG1 (Southern region)	-	-	-	-	-
GP1 (Scheduled Caste)	-	-	-	-0.116** (-4.22)	-
GP4 ('other religious group')	-	-	-	-	-
OC1 (Agricultural labour)	-	-	-	-	-
OC2 (Professional, technical, etc., clerical and related, 'non-response' or 'non-worker')	-	-	-	-	-
OC3 (sales or service)	-	-	-	-	-
OC4 (Production, transport and related)	-	-	-	-	-
SR2 (Jan.-Mar., 1974)	-	-	-	-	-
SR3 (Apr.- June, 1974)	-	-	-	-	-

$\bar{R}^2$ = 0.3175, F = 103.02, no. of sample households = 659.

See Note below Table 6.3.1.

Table 6.3.3 : Regression equations for ln PCE of form (6.2) estimated for rural households in different States : NSS 28th round, October 1973 - June 1974 : Uttar Pradesh

Household Characteristic Dummies	Intercept or Differential intercept	Coefficient or differential coefficient of main explanatory variables			
		ln PCL	N_m	N_f	N_c
(1)	(2)	(3)	(4)	(5)	(6)
reference group : 'other Hindu' cultivator households in Western Region interviewed during Oct.-Dec., 1973	4.019 (143.63)	0.071** (7.29)	0.056** (4.48)	-	-0.053** (-8.15)
REG1 (Himalayan Region)	-	-	-	-0.079** (-2.96)	-
REG2 (Central Region)	-	-	-0.070** (-4.35)	-	-
REG3 (Eastern Region)	-	-	-0.054** (-2.92)	0.032 (1.89)	-
REG4 (Southern Region)	-	-	-0.049 (-1.90)	-	-
GP1 (Scheduled Caste)	-0.145** (-6.03)	-	-	-	-
GP3 ('Other Muslim')	-	-	-	-	-
GP4 ('Other religious group')	-	-	-	-	-
OC1 (Agricultural labour)	-0.103 (-1.86)	-0.048** (-3.13)	-	-	-0.032* (-2.19)
OC2 (Professional, technical, etc., clerical and related, 'non-response' or 'non-worker')	0.198 (1.86)	-0.070** (-3.06)	0.138** (2.78)	-0.121* (-2.06)	-0.084** (-3.22)
OC3 (sales or service)	0.450** (3.54)	-0.048* (-1.99)	-0.210** (-3.75)	-	-0.075** (-2.93)
OC4 (Production, transport and related)	0.288** (2.94)	-0.047* (-2.33)	-	-0.117** (-3.06)	-0.067** (-2.92)
SR2 (Jan.-Mar., 1974)	0.084** (3.62)	-	-	-	-
SR3 (Apr.-June, 1974)	0.138** (5.89)	-	-	-	-

$\bar{R}^2$ = 0.2234, F = 19.81 , *no. of sample households* = 1766.

Note : See note below Table 6.3.1.

Table 6.3.4 : Regression equations for ln PCE of form (6.2) estimated for rural households in different states : NSS 28th round, October 1973 - June 1974 : Orissa

Household Characteristic Dummies	Intercept or Differential intercept	Coefficient or differential coefficient of main explanatory variables			
		ln PCL	N_m	N_f	N_c
(1)	(2)	(3)	(4)	(5)	(6)
reference group : 'other Hindu' cultivator households in Coastal region interviewed during Oct.-Dec., 1973	3.924 (128.60)	0.054** (5.09)	-	-	-
REG1 (Southern region)	-0.227** (-3.39)	-0.050** (-2.88)	-	-	-0.071** (-3.12)
REG2 (Northern region)	-	-	-0.038 (-1.40)	-	-0.062** (-3.41)
GP1 (Scheduled Caste)	-0.132** (-2.90)	-	-	-	-
GP2 (Scheduled Tribe)	-0.157** (-3.88)	-	-	-	-
OC1 (Agricultural labour)	-	-	0.103** (3.05)	-0.101** (-2.87)	-0.085** (-4.43)
OC2 (Professional, technical, etc., clerical and related, 'non-response' or 'non-worker')	-	-0.092** (-3.33)	0.403** (5.49)	-0.414** (-5.63)	-
OC3 (sales or service)	0.597** (3.46)	-	-	-0.234 (-1.93)	-
OC4 (Production, transport and related)	0.545** (4.60)	-	-	-0.308** (-3.59)	-
SR2 (Jan.-Mar., 1974)	-	-	-	-	-
SR3 (Apr.-June, 1974)	0.192** (5.96)	-	-	-	-

$\bar{R}^2$ = 0.3983, F = 23.3, no. of sample households = 642.

Note : See note below Table 6.3.1.

Table 6.3.5 : Regression equations for ln PCE of the form (6.2) estimated for rural households in different states : NSS 28th round, October 1973 - June 1974 : West Bengal

Household Characteristic Dummies	Intercept or Differential intercept	Coefficient or differential coefficient of main explanatory variables			
		ln PCL	N_m	N_f	N_c
(1)	(2)	(3)	(4)	(5)	(6)
reference group : 'other Hindu' cultivator households in Central Plains interviewed during Oct.-Dec., 1973	4.318 (83.38)	0.190** (8.54)	0.090** (4.76)	-	-0.072** (-6.26)
REG1 (Himalayan Region)	-0.283** (-4.11)	-0.051* (-2.21)	-	-	-
REG2 (Eastern Plains)	-0.450** (-6.12)	-0.041** (-2.79)	-	0.091** (2.80)	-
REG3 (Western Plains)	-0.304** (-4.91)	-	-	0.064 (1.85)	-
GP1 (Scheduled Caste)	-0.107 (-1.59)	-	-0.110** (-3.32)	-	0.050** (2.89)
GP2 (Scheduled Tribe)	-	-0.048** (-2.71)	-0.127** (-4.14)	-	-
GP3 ('Other Muslim')	-	0.042** (3.80)	-	-	-
OC1 (Agricultural labour)	-0.234** (-3.14)	-0.092** (-3.75)	-	-	-0.039* (-2.20)
OC2 (Professional, technical, etc., clerical and related, 'non-response' or 'non-worker')	-	-0.107** (-4.29)	0.111** (2.72)	-	-0.082** (-3.11)
OC3 (sales or service)	-	-0.112** (-4.05)	0.151** (2.76)	-0.216** (-3.73)	-
OC4 (Production, transport and related)	-	-0.095** (-3.61)	-	-	-0.037 (-1.59)
SR2 (Jan.-Mar., 1974)	0.157** (2.86)	-	-	-0.081* (-2.52)	-
SR3 (Apr.-June, 1974)	-	-0.040** (-3.69)	0.028 (1.40)	-	-

$\bar{R}^2$ = 0.4216, F = 24.9, no. of sample households = 1018.

Note : See note below Table 6.3.1.

Table 6.3.6 : Regression equations for ln PCE of form (6.2) estimated for rural households in different states : NSS 28th round, October 1973 – June 1974 : <u>Tamil Nadu</u>

Household Charac-teristic Dummies	Intercept or Diffe-rential intercept	Coefficient or differential coefficient of main explanatory variables			
		ln PCL	N_m	N_f	N_c
(1)	(2)	(3)	(4)	(5)	(6)
reference group : 'other Hindu' cultivator households in the Inland region interviewed during Oct.-Dec., 1973	4.243 (111.44)	0.039** (5.31)	–	-0.102** (-4.10)	-0.066** (-4.23)
REG1 (Coastal, Northern region)	–	–	-0.062** (-3.16)	–	–
REG2 (Coastal, Southern region)	–	–	-0.110** (-4.00)	0.117** (3.79)	–
GP1 (Scheduled Caste)	–	–	–	–	–
GP3 ('Other Muslim')	–	–	–	–	–
GP4 ('Other religious group')	–	–	–	–	–
OC1 (Agricultural labour)	–	–	–	-0.142** (-5.02)	-0.034* (-1.97)
OC2 (Professional, technical, etc., clerical and related, 'non-response' or 'non-worker')	–	–	–	–	–
OC3 (sales or service)	–	-0.046* (-2.05)	–	-0.110 (-1.54)	–
OC4 (Production, transport and related)	–	-0.040** (-2.60)	–	–	-0.069* (-2.37)
SR2 (Jan.-Mar., 1974)	–	–	–	0.093** (3.37)	-0.051** (-2.66)
SR3 (Apr.-Jun., 1974)	–	–	0.110** (4.58)	–	-0.029 (-1.50)

$\bar{R}^2$ = 0.2979, F = 25.05, no. of sample households = 908.

Note : See note below Table 6.3.1.

Table 6.3.7 : Regression equations for ln PCE of form (6.2) estimated for rural households in different states : NSS 28th round, October 1973 – June 1974 : <u>Kerala</u>

Household Charac-teristic Dummies	Intercept or Diffe-rential intercept	Coefficient or differential coefficient of the main explanatory variables			
		ln PCL	N_m	N_f	N_c
(1)	(2)	(3)	(4)	(5)	(6)
reference group : 'other Hindu' cultivator households in Southern region interviewed during Oct.-Dec., 1973	4.559 (73.62)	0.122** (6.33)	–	–	-0.109** (-5.82)
REG1 (Northern region)	–	–	–	–	–
GP1 (Scheduled Caste)	–	-0.053 (-1.58)	-0.098 (-1.58)	-0.141* (-2.10)	0.059 (1.34)
GP3 ('Other Muslim')	-0.189 (-1.50)	0.059 (1.81)	–	–	0.060* (2.13)
GP4 ('Other religious group')	-0.151* (-1.97)	–	–	–	0.043 (1.55)
OC1 (Agricultural labour)	-0.286* (-2.53)	-0.077* (-2.34)	–	–	-0.073* (-2.51)
OC2 (Professional, techni-cal, etc., clerical and related, 'non-res-ponse' or 'non-worker')	0.277* (2.12)	-0.118** (-3.56)	–	–	-0.089** (-2.67)
OC3 (sales or service)	0.546** (4.02)	–	0.131* (2.37)	-0.251** (-3.75)	-0.069* (-2.04)
OC4 (Production, transport and related)	–	-0.070** (-2.91)	0.067 (1.76)	-0.304** (-5.22)	–
SR2 (Jan.-Mar., 1974)	–	–	–	–	–
SR3 (Apr.-Jun., 1974)	–	–	–	–	–

$\bar{R}^2$ = 0.3891, F = 17.9, no. of sample households = 638.

Note : See note below Table 6.3.1.

Table 6.3.8 : Regression equations for ln PCE of form (6.2) estimated for rural households in different states : NSS 28th round, October 1973 - June 1974 : Gujarat

Household Characteristic Dummies	Intercept or Differential intercept	Coefficient or differential coefficient of main explanatory variables			
		ln PCL	N_m	N_f	N_c
(1)	(2)	(3)	(4)	(5)	(6)
reference group : 'other Hindu' cultivator households in Northern Plains interviewed during Oct.-Dec., 1973	4.160 (105.40)	0.051** (4.46)	-	-	-0.066** (-7.20)
REG1 (Eastern region)	0.175** (3.39)	-	-	-	-
REG2 (Southern Plains)	0.228** (4.77)	-	-	-	-
REG3 (Dry Areas)	0.140** (2.77)	-	-	-	-
REG4 (Saurashtra)	0.097* (2.16)	-	-	-	-
GP1 (Scheduled Caste)	-	-	-	-	-
GP2 (Scheduled Tribe)	-0.276** (-5.80)	-	-	-	-
GP3 ('Other Muslim')	-	-	-	-	-
OC1 (Agricultural labour)	-	-0.032* (-2.15)	-0.078* (-2.08)	-0.085* (-2.39)	-
OC5 (Professional, technical etc., clerical and related, sales, service, 'non-response' or 'non-worker')	0.512** (5.55)	-	-	-	-0.114** (-4.26)
OC4 (Production, transport and related)	-	-0.048* (-2.26)	0.094* (2.01)	-0.160 (-1.94)	-
SR2 (Jan.-Mar., 1974)	-	-	-	-	-
SR3 (Apr.-June, 1974)	-	-	-	-	-

$\bar{R}^2$ = 0.3942, F = 23.6, no. of sample households = 522.

Note : See note below Table 6.3.1.

. Table 6.3.9 : Regression equations for ln PCE of form (6.2) estimated for rural households in different states : NSS 28th round, October 1973 - June 1974 : Maharashtra

Household Characteristic Dummies	Intercept or Differential intercept	Coefficient or differential coefficient of main explanatory variables			
		ln PCL	N_m	N_f	N_c
(1)	(2)	(3)	(4)	(5)	(6)
reference group : 'other Hindu' cultivators in Inland, Western region interviewed during Oct.-Dec., 1973	4.063 (89.79)	0.051** (4.09)	-	0.029 (1.40)	-0.052** (-4.90)
REG1 (Coastal region)	0.158* (2.07)	-	-	-0.063 (-1.42)	-
REG2 (Inland, Northern region)	-	-	-	-	-
REG3 (Inland, Central region)	-	-	-	-	-
REG4 (Inland, Eastern region)	0.087* (2.19)	0.039** (3.44)	-	-	-
REG5 (Eastern region)	0.251* (2.29)	-	-0.085 (-1.77)	-	-0.048 (-1.56)
GP1 (Scheduled Caste)	-	-	-	-	-
GP2 (Scheduled Tribe)	-	-	-	-	-
GP3 ('Other Muslim')	-	-	-	-	-
GP4 ('Other religious group')	-	-	-	-	-
OC1 (Agricultural labour)	-0.102 (-1.45)	-0.044** (-3.03)	-	-0.066 (-1.90)	-0.033* (-2.02)
OC2 (Professional, technical, etc., clerical and related, 'non-response' or 'non-worker')	0.179 (1.26)	-0.056* (-2.35)	0.137 (1.74)	-	-0.101** (-3.07)
OC3 (sales or service)	0.620** (3.89)	-	-	-0.236** (-2.61)	-
OC4 (Production, transport and related)	-	-0.048* (-2.55)	-	-	-0.052* (-2.52)
SR2 (Jan.-Mar., 1974)	-	-	-	-	-
SR3 (Apr.-June, 1974)	-	-	-	-	-

$\bar{R}^2$ = 0.2264, F = 16.08, no. of sample households = 1135.

Note : See note below Table 6.3.1.

determinant of household PCE, followed by the NSS region or social group to which the household belonged. Sub-round (that is, season) was the least important. In case of Tamil Nadu, however, dummy variables corresponding to sub-rounds were included in Step 3. For Orissa also, $\bar{R}^2$ was raised considerably by the sub-round dummies.

The findings from the final regression models for PCE, for the selected states, are now discussed.

6.5.2 <u>The Estimated Multiple Linear Regression Models</u>

The regression coefficients relating to the finally chosen regression equations for ln PCE for rural households of the nine selected states are presented in Tables 6.3.1 to 6.3.9. Each table gives the results based on the combined sample for one state. From these tables, it appears that the regression models so set up do not give satisfactory fit (as judged by $\bar{R}^2$) for the states of Rajasthan, Uttar Pradesh and Maharashtra. As noted earlier, $\bar{R}^2$ was low in Step 1 for Rajasthan, Uttar Pradesh, Orissa and Maharashtra, but for Orissa it increased appreciably with the inclusion of other factors in later steps. However, this did not happen for the other three states, possibly because such important determinants of PCE as the number of earners in a household, their levels of education and occupations, etc. were not incorporated in the analysis.

In each of Tables 6.3.1 to 6.3.9 cols. (2) to (6) of the first row give the intercept and coefficients of the main explanatory variables, namely, ln PCL, N_m, N_f and N_c, for the reference group of households of the state, specified in the first row under col. (1). In the remaining rows, these columns give the differential intercepts or coefficients of the same explanatory variables across various categories of households in the form of coefficients of appropriate dummy variables. Thus, for example, the entry in the row for OC5 and column for N_c in Table 6.3.1, which relates to Rajasthan, is the coefficient for the interaction term N_c x OC5[11/]. For each state, all regional, social group and occupational dummy variables defined for it and also the two sub-round (seasonal) dummy variables are presented. Each row covers one dummy variable for differential intercept and other dummy variables for the differential slopes or interactions. An empty cell implies that the corresponding coefficient is non-significant, at two -sided 20 per cent level. It may be mentioned that most of the coefficients presented are significant at two-sided 5 per cent or 1 per cent level.

The estimates in the first row of each table, that is, those relating to the reference group of households in a state

[11/] Here OC5 is the dummy variable taking the value 1 for the residual occupational category consisting of professional, technical or related, administrative, executive, managerial, clerical or related workers, sales, service workers, non-workers or 'non-response' households, and 0 otherwise.

will be discussed first. The choice of the reference groups was naturally somewhat arbitrary. In all the nine states, 'other Hindu' 'cultivator' households in the richest[12/] region (as judged by average nominal PCE), allotted for interview during the first sub-round, (October to December, 1973) formed the reference group.

6.5.2a Effects of Key Explanatory Variables : The Reference Group of Households

As expected, in all the nine states, average PCE rose significantly if PCL was increased, other factors remaining constant[13/]. The elasticity of PCE with respect to PCL was positive and significant, typically at 1 per cent level, in every state. This elasticity is seen to vary from 0.03 (Rajasthan) to 0.19 (West Bengal). Note that PCL refers to the land possessed per capita by a household on the date of interview. Returns from the three components of land possessed — owned land, leased in land and leased out land - differ considerably. Also, cropping pattern, productivity of land, average size of landholdings, tenancy patterns, etc. vary across states and even regions. Therefore, increasing the geometric mean of PCL means very different things for

[12/] For Gujarat, however, the poorest region was taken to be the reference region.

[13/] Note that average PCE here means the geometric mean of PCE since logarithmic transformation of PCE was taken.

different states. Such elasticities are, therefore, difficult to interpret and are not fully comparable across states. However, if one is interested in studying the effects of redistribution of land, one should examine $\frac{\partial PCE}{\partial PCL}$ for the states. This, however, has not been done.

Except for Orissa, in all other states, an additional child brought down the average household PCE. This negative correlation was generally significant at 1 per cent level.

The addition of an adult male to a household caused a significant rise in average PCE in Uttar Pradesh and West Bengal; the corresponding coefficients were non-significant in the remaining states. Only in Tamil Nadu did N_f appear to have a significant effect on PCE. Here, an increase in N_f made average PCE fall.

In Orissa, none of N_m, N_f and N_c had a significant effect on average PCE.

The next part of this Section compares the levels of average PCE[14/] across different NSS regions, social groups, occupational categories and sub-rounds.

[14/] It may be reiterated that average PCE here refers to the geometric mean of PCE. One is really comparing the geometric means of PCE across household categories. If variability of PCE is similar across groups, their geometric means would be proportional to the arithmetic means.

6.5.2b **Level of Average PCE : Variation across Household Categories**

Through the multiple linear regression model developed for a state, separate regression lines have been estimated for the different categories of households in the state. In Tables 6.3.1 to 6.3.9 it can be seen that the intercept term and coefficients of ln PCL, N_m, N_f and N_c do not vary significantly across

(1) regions in the Punjab and Kerala;

(2) social groups in Tamil Nadu and Maharashtra;

(3) occupational categories in the Punjab; and

(4) sub-rounds in Rajasthan, the Punjab, Kerala, Gujarat and Maharashtra.

Note that these conclusions can also be drawn from Table 6.2. In all other cases, one finds significant lack of homogeneity across regions, social groups and sub-rounds. As far as occupational groups are concerned, every state other than the Punjab shows significant variation in both intercept and slope parameters across the occupational groups.

It is well-known that the average level of household PCE for a given category can be compared with that for reference group households only when the slopes of ln PCL, N_m, N_f and N_c for that category are not significantly different from those of the reference group of households. Such clearly evident divergences in average levels of PCE are reflected in the differentials of the intercept term across the categories. This is the case, for example, for the social groups in rural areas of Orissa or Gujarat.

Judging by the differential intercepts in col. (2) of Tables 6.3.1 to 6.3.9, it is found that, other variables remaining constant, the average levels of PCE for the remaining three regions of Rajasthan were significantly lower than that of households in the reference region of the state[15/]. The average PCE for the Southern region was the lowest, the geometric mean of PCE for the reference region being about 1.5 times that for this region. Similarly, in Gujarat, the average level of PCE of reference group of households was significantly lower than those in the remaining four regions. The Southern Plains of the state appeared to be most prosperous — its average PCE being about 1.3 times that of the reference region. It may be mentioned that these findings agree broadly with those based on regionwise arithmetic means of PCE for these two states shown in Tables5.1 of Chapter 5.

Proceeding in the same manner, one finds that other factors remaining constant Scheduled Caste households in Rajasthan, Uttar Pradesh and Orissa had significantly lower

15/ Such comparisons based on differential intercepts are necessarily based on the assumption that all other factors including ln PCL, N_m, N_f and N_c are held fixed over the regions or social groups or occupational groups or sub-rounds (as the case may be) under consideration. In such a case, the differential intercept gives the difference between the logarithms of the geometric means of PCE for a category and the reference group.

averages of PCE compared to 'other Hindu' households in the respective states. The disparity between Scheduled Castes and 'other Hindus' is observed to be the highest for Rajasthan where the average PCE of 'other Hindus' was about 1.2 times that of Scheduled Castes. A similar pattern is observed for Scheduled Tribe households in Rajasthan, Orissa and Gujarat, where other things remaining constant, the average PCE of 'other Hindus' were 1.3, 1.2 and 1.3 times the average PCEs of Scheduled Tribes, respectively.

Comparisons of average PCE across occupation groups were not possible for any state except the Punjab, where no difference is observed. Variation in the level of PCE over sub-rounds were examined for the states of Uttar Pradesh and Orissa, for which the corresponding differential intercepts are significant, but not the differential slopes. All other factors remaining fixed, the average levels of PCE during the second and third sub-rounds were higher than that during the first sub-round in Uttar Pradesh. In Orissa, the average level of PCE in the third sub-round was significantly higher compared to that during the first sub-round.

After examining the variation in levels of average PCE across different household categories, one may now study the differential effects of ln PCL, N_m, N_f and N_c on ln PCE for different regions, social groups, occupational groups and sub-rounds.

6.5.2c Effects of ln PCL, N_m, N_f and N_c : Variation across Household Categories

From the results presented in Tables 6.3.1 through 6.3.9, one can also examine which of the differential slopes of ln PCL, N_m, N_f and N_c are statistically significant. It may also be of interest to discuss slopes of these variables for different household categories, obtained by adding up the slope for the reference groups and the differential slope of the particular group under study. However, standard errors of these sums of slope coefficients are not easy to obtain. In what follows, comments are made on some of the strikingly significant results on the differential slopes, and on some of the slopes obtained by the addition process mentioned above which are almost certainly significant.

Effect of ln PCL

The coefficient of ln PCL does not vary significantly over regions in most of the states, viz., Rajasthan, the Punjab, Uttar Pradesh, Tamil Nadu, Kerala and Gujarat. In the remaining states, however, one finds a few differentials across regions which are significant. For example, in Maharashtra the elasticity of PCE with respect to PCL was higher for the Inland - Eastern region compared to the reference region of the state. For Orissa, this elasticity for the Southern region appeared to be nearly 0.

The elasticity of PCE with respect to PCL varied significantly over social groups only in West Bengal. Kerala also shows such variation but that is not significant. For West Bengal, a 1 per cent increase in PCL caused a larger percentage rise in average PCE for 'other Muslim' households, and a smaller percentage increase for Scheduled Tribe households compared to 'other Hindu' households in the state. However, for reasons stated earlier, these elasticities are hard to interpret. It is possible that Scheduled Tribes who mostly inhabit forest or hilly areas possess inferior quality of land.

On studying the differential coefficients of ln PCL over the occupational groups in Tables 6.3.1 to 6.3.9, it is found that the elasticities of average PCE with respect to PCL for many occupational classes other than 'cultivators' is nearly 0 or closer to 0 than the elasticity for 'cultivators'. For agricultural labourers this elasticity is found to be significantly lower than that for 'cultivators' in Uttar Pradesh, West Bengal, Kerala, Gujarat and Maharashtra. In all other states, the elasticity for agricultural labourers is not significantly different from that for 'cultivators'.

The effect of PCL on PCE was subject to seasonal variation in West Bengal only. Thus, for this state, the percentage increase in average PCE due to a 1 per cent increase in PCL was significantly lower in sub-round 3 (April to June, 1974) than in sub-round 1 (October to December, 1973). This finding is understandable since in West Bengal the main crops are harvested in October to December well before April to June.

Effect of N_m

In Rajasthan, the Punjab and Maharashtra, N_m had no significant effect on PCE. Among the remaining states, while the effect of N_m on PCE was not significant for the reference group of households in Orissa, Tamil Nadu, Kerala and Gujarat, differential effects were significant in some household categories indicating that N_m might have had some effect on PCE of households in these categories. However, one cannot comment on the significance of these effects with confidence as their standard errors are unknown.

Some regional variation in the effects of N_m on PCE can be seen in Uttar Pradesh and Tamil Nadu. In Uttar Pradesh, the coefficient of N_m was close to 0 for some regions. In West Bengal, for Scheduled Castes or Scheduled Tribes, N_m probably did not influence average PCE as much as it did in the reference group. In Kerala, an increase in N_m in a Scheduled Caste household appeared to depress the average PCE of such households. But this effect does not seem to be significant. Coming now to occupational groups, it is observed that an increase in N_m in agricultural labour households in Orissa brought about a significant rise in their average PCE. The opposite effect is seen for agricultural labour households in Gujarat. In case of non-agricultural households, with the exception of 'sales or service' households in Uttar Pradesh, all the significant differential effects of N_m are found to be positive. In Tamil Nadu, an increase in N_m during sub-round 3 seemed to bring about a rise in PCE.

Effect of N_f

It is observed that there was some regional variation in the effect of N_f on PCE in the states of Uttar Pradesh, West Bengal and Tamil Nadu. For example, in the Himalayan Region of Uttar Pradesh, an increase in N_f appeared to cause a decrease in average PCE. The opposite is observed for the Eastern Plains of West Bengal. In all social groups or occupational groups or sub-rounds, where the differential coefficients of N_f are significant, N_f appeared to have a dampening effect on average household PCE. However, an exception is Tamil Nadu, where for sub-round 2, the coefficient of N_f (sum of reference group coefficient and differential) is nearly 0.

Effect of N_c

For many states, for most regions, the sum of slope of N_c for reference group and differential coefficient of N_c is negative and very likely to be significant.

In general, it is found that for most groups, an increase in N_c brought about a larger (or equal) relative decrease in average PCE compared to the reference group[16].

6.6 Concluding Remarks

The regression models developed in this Chapter describe the variation in average PCE of households across different social groups, occupational classes and NSS regions within the rural areas of each of nine states as well as the effects of PCL, N_m, N_f and N_c on average PCE of households belonging to different categories of these factors during the period from October 1973 to June 1974.

It is found that, in general, the most important factor effecting the PCE of a household was PCL, followed by its occupational category, and then its social group or the NSS region to which it belonged.

[16] For Scheduled Caste households in West Bengal, the coefficient of N_c is nearly 0. For Kerala, an increase in N_c in an 'other Muslim' household brought about a smaller relative decrease in average PCE compared to the reference group. For the same state, similar effects are observed for Scheduled Castes and 'others', but these are non-significant.

In the previous Chapters, the averages of PCE or the incidence of poverty was compared over geographical areas and different socio-economic groups, taking one or two factors at a time. These studies, therefore, show gross effects rather than the partial or net effects of different factors which are investigated in this Chapter. Thus, much of the effect of social group studied earlier was a composite of many effects including those of land and occupation. In this Chapter, an attempt was made to find net effect of a factor, eliminating effects of the remaining factors. This may not be so meaningful for many purposes. For example, for the same size of landholding and occupation, one might still have social group effects because of education, etc. However, some of the findings in the previous Chapters relating to social groups (Chapters 3 and 4) or NSS regions (Chapter 5) are clearly corroborated in this Chapter.

Thus, for some of the states, the variation of PCE across social groups, when other factors are fixed, is clearly captured in the estimated regression model for PCE. For example, in Rajasthan, Uttar Pradesh and Orissa, the Scheduled Caste households had a lower (geometric) average of PCE compared to 'other Hindu' households. Similarly, for Scheduled Tribe households in Rajasthan, Orissa and Gujarat the (geometric) average of PCE was significantly smaller compared to 'other Hindus'. These results agree with those reported in Chapter 3, where the (arithmetic) averages of PCE for Scheduled Caste and Scheduled Tribe households were below the corresponding values for 'other Hindu' households (*vide* Table 3.7 of Chapter 3). In the same manner, in Rajasthan and Gujarat, where the variation in average PCE over NSS regions was observed to be large (*vide* Table 5.1 of Chapter 5), such regional effects are captured in the PCE models set up for these states in the present Chapter, even after allowances have been made for the effects of PCL, N_m, N_f, N_c and social groups, occupational classes and sub-rounds.

As regards the effect of PCL on PCE, some general patterns are observed. For example, it is found that the elasticity of PCE with respect to PCL was usually the highest for 'cultivator' households. Some 'non-cultivator' households, on the other hand, showed small or near-zero elasticities.

In general, an increase in N_c in any household appeared to bring about a decrease in average PCE. So far as the effect of N_f is concerned, only Tamil Nadu showed a significant negative effect for the reference group. As regards other groups, the coefficients of N_f, obtained by adding the reference group coefficients to the significant differential coefficients of N_f, were in general negative or close to zero. In case of N_m, the non-zero coefficients of

N_m tended to be positive[17/]. For the reference group, the coefficient of N_m was positive and significant for two states — West Bengal and Uttar Pradesh.

In a sense, the models developed in this study are somewhat inadequate for explaining variations in PCE. Thus, $\bar{R}^2$ was as low as 0.204 for Rajasthan and the highest value, observed for West Bengal, was only 0.422. As already mentioned, this could be because such important determinants of PCE as the number of earners in a household, their individual occupations and the levels of education and age-distribution of the household members were not included in the study due to non-availability of data. It is also possible that the measure of land is insufficient. It is just area of land possessed, and nothing is known about its quality or productivity. Even considering regions within a state might not totally eliminate the effects of heterogeneity of land. Also as returns from owned land, leased in land and leased out land differ, it would have been more appropriate to take a weighted sum of areas of these three components of land possessed. Finally, part of the land possessed by a household might not be used for cultivation. A further limitation of this study is the omission of all possible interaction effects of different factors from the regression model.

17/ Exceptions are the two coastal regions of Tamil Nadu, and agricultural labourers of Gujarat, where the coefficients of N_m appeared to be negative.

Despite the limitations mentioned above, some significant factors explaining PCE of a household have been identified in this study. It is expected that poverty defined in terms of PCE should also be explained by the same factors together with other concomitants such as those mentioned above that could not be included in this analysis. In the next Chapter, an attempt is made to estimate a logit model of poverty in order to explain variations in the probability of a household being poor in terms of the factors that were found to explain variations in ln PCE in this Chapter. The results of regression analysis and logit analysis will naturally be closely related. However, the logit model allows one to find directly how a deterministic measure of poverty that is similar to the head-count ratio changes with change in the key cardinal explanatory variables.

Chapter 7

POVERTY IN RURAL INDIA - AN APPLICATION OF THE LOGIT MODEL

7.1 Introduction

In the previous Chapter, NSS 28th round (October 1973 - June 1974) disaggregated household budget data were employed to develop a multiple linear regression model separately for the rural areas of each of nine selected states in order to examine the effects of ln PCL, N_m, N_f and N_c on ln PCE of households belonging to different NSS regions, social groups and occupational classes. In this Chapter the same data are used in an attempt to discover how these key explanatory variables can explain the poverty status of such households (that is, whether a household is poor or non-poor, defined in terms of PCE) during the NSS 28th round period. Since a set of variables could be identified as possible explanatory factors of PCE (or ln PCE) in Chapter 6, poverty status, which is defined here in terms of PCE, is also sought to be explained by the same set of variables. However, since not much is known about the form of the function that relates these variables to poverty, one can think of setting up a binary response model for poverty. In this Chapter, thus, a logit model of poverty is estimated to capture the effects of various factors on the poverty status of a household *via* its PCE.

As mentioned earlier in Section 1.2.5 of Chapter 1, Bardhan (1984) performed a logit analysis of poverty to examine the phenomenon of poverty of agricultural labour households in rural West Bengal in 1977-78. He expressed the probability of an agricultural labour household being poor as a function of a large number of possible determinants of poverty. More specifically, he considered determinants such as the area cultivated by the household, the number of men in the age group 15-60 having more than primary education, the number of men in the household engaged in non-farm work, and also such regional factors as the quantity of fertilizer used per hectare under foodgrains in the district, the rate of growth of agricultural production in the district, irrigation level in the village, rainfall in the district, etc. This analysis showed that, *ceteris paribus*, the probability of an agricultural labour household falling below the poverty line seemed to be higher if it was in a district where agricultural production had grown at a faster rate. Bardhan (1986) also carried out a similar analysis for primarily cultivator households (described by NSS as 'self-employed in agricultural occupations') in West Bengal for the year 1977-78 using a somewhat different set of explanatory variables. Here also, among other things, growth in agricultural production had a significant positive effect on the probability of a household being poor. Also, the probability of a primarily cultivator household being poor was found to be significantly higher for a Scheduled Tribe household during this period in West Bengal.

A logit analysis of poverty was also carried out by Gaiha (1988) for rural India as a whole and also separately for cultivator households, casual labour households, permanent wage earning households and business and craft households in rural India. He utilized the data thrown up by the Additional Rural Income Survey conducted by the NCAER in the year 1968-69. He tried to explain the probability of a household being poor in terms of a set of technological variables, household demographic and employment variables and village specific variables. He concluded that village specific indicators of development and the new agricultural technology tended to decrease poverty, and education also appeared to lower the probability of a household being poor. It appeared that the probability of a household being poor was reduced more sharply for cultivating households than for casual labour households under the impact of the new technology.

The analysis carried out in the present Chapter, however, is somewhat different both in nature and scope, especially in regard to the set of explanatory variables tried. As in the case of the regression models for PCE reported in Chapter 6 only a few household specific explanatory variables could be considered in the present analysis. Many important determinants of PCE and, hence of poverty status of the household, such as the level of education, age and occupations of individual earners in a household, could not be incorporated in the analysis due to the non-availability of such information in the data tapes obtained from the NSS Organisation.

Briefly, the scope of the present analysis is as follows. For the rural areas of each of the nine states covered in Chapter 6, namely, Rajasthan, Punjab, Uttar Pradesh, Orissa, West Bengal, Tamil Nadu, Kerala, Gujarat and Maharashtra, logit models were estimated to quantify the effects of ln PCL[1/], N_m, N_f and N_c on the probability of individual households being poor. This was done separately for each individual state allowing for variation in the probability across households belonging to different NSS regions in the state, social groups and occupational classes by incorporating dummy variables corresponding to these categories in the logit model, in exactly the same manner as done in Chapter 6.

The plan of this Chapter is as follows : Section 7.2 describes the logit model, and the method followed for its estimation is outlined in Section 7.3. Section 7.4 compares the logit model set up for a state with the corresponding multiple linear regression model for ln PCE reported in the

[1/] As in Chapter 6, landless households were assumed to possess 0.005 acre of land.

preceding Chapter. Section 7.5 reports on the findings from the logit models of poverty estimated for the nine states. Finally, the Chapter is concluded in Section 7.6.

7.2 The Logit Model

In the present study, the information on PCE is condensed into an indicator variable y, where

$$y = \begin{cases} 1 & \text{if the household is poor,} \\ 0 & \text{otherwise .} \end{cases} \qquad \ldots (7.1)$$

Let z[2] represent the poverty line applicable to the households in a state. This means if the PCE of a household in the state is less than or equal to z, then it is called poor and if the PCE is greater than z, then it is called non-poor. Then the probability of sample household i in the state being poor is

$$\begin{aligned} p_i &= P(y_i = 1) \\ &= P(PCE_i \leq z), \text{ for } i = 1, 2, \ldots, n, \end{aligned}$$

n being the number of sample households from the state. Denoting $z^* = \ln z$, p_i is rewritten as

2/ The poverty lines for the rural areas of different states were derived from Bardhan's (1973) statewise poverty lines for 1960-61, using the Consumer Price Index Numbers for Agricultural Labourers (base : 1960-61 = 100) for the states during the NSS 28th round period. These poverty lines were used in Chapters 4 and 5 to estimate the incidence of absolute poverty in rural areas of different States.

$$p_i = P(\ln PCE_i \leq z^*)$$
$$= P(\underline{\beta}' \underline{x}_i + \varepsilon_i \leq z^*)$$
$$= P(\varepsilon_i \leq z^* - \underline{\beta}' \underline{x}_i)$$

where,

$$\ln PCE_i = \underline{\beta}' \underline{x}_i + \varepsilon_i$$

is the regression model for the state, set up in Chapter 6, which explains $\ln PCE_i$ in terms of household characteristics, x_{ij}, ε_i being the random disturbance term for the ith household, $\underline{x}_i' = (1, x_{i1}, x_{i2}, \ldots, x_{ir})$ and $\underline{\beta}' = (\beta_0, \beta_1, \ldots, \beta_r)$, $i = 1, 2, \ldots, n$.

To set up a logit model of poverty, it is assumed that the disturbance term ε_i follows a logistic distribution. It then follows that

$$p_i = P(y_i = 1) = F(z^* - \underline{\beta}' \underline{x}_i) \qquad \ldots (7.2)$$

where,

$$F(z^* - \underline{\beta}' \underline{x}_i) = \frac{\exp(z^* - \underline{\beta}' \underline{x}_i)}{1 + \exp(z^* - \underline{\beta}' \underline{x}_i)} \qquad \ldots (7.3)$$

is the standard form of the distribution function of the logistic distribution[3].

[3] If, on the other hand, ε_i is assumed to follow N(0, 1), one arrives at a probit model. The logistic distribution function and the standard normal distribution function are very close over a wide range in the centre of the distribution, but the logistic distribution has slightly thicker tails (*vide* Amemiya (1981)).

The logit model can be interpreted as a threshold model : if the PCE of a household is greater than the threshold PCE level z, then it ceases to be poor. The odds that household i is poor are given by the ratio $p_i/(1 - p_i)$. From the model (7.3), it follows that

$$\ln\left(\frac{p_i}{1 - p_i}\right) = z^* - \underline{\beta}' \underline{x}_i \qquad \dots (7.4)$$

That is, the logarithm of odds that a household is poor is a linear function of the explanatory variables.

From the model (7.3) one can study how the probability of a household being poor depends on the different independent variables. The rate of change in p_i with respect to changes in the value, x_{ij}, of the jth variable characterizing a household is given by

$$\frac{\partial p_i}{\partial x_{ij}} = -\beta_j \, p_i \, (1 - p_i), \qquad \dots (7.5)$$

$i = 1, 2, \dots, n, \quad j = 1, 2, \dots, r.$

Thus, if β_j is positive, then the probability of household i being poor decreases with increase in the value of x_{ij}. Since $p_i \, (1 - p_i)$ is maximum when $p_i = 0.5$, an independent variable will have its maximum impact on p_i when p_i is close to 0.5.

Given the logit model described above, it is possible to estimate the head-count ratio of poverty separately for different categories of households in the population. Thus, for a given state, let household i ($i = 1, 2, \ldots, n_k$, n_k being the number of sample households in category k) in some category k have N_i members, and let its probability of being poor be p_i. The expected number of poor persons belonging to such a household may be taken as $N_i p_i$. On aggregating over the households in category k, the expected number of poor persons in the sample in category k would be $\sum_{i=1}^{n_k} N_i p_i$. For the present analysis based on 28th round NSS data, the sampling design is self-weighting at state level, and therefore, unequal probability weights or multipliers are not needed for estimating population proportions or population values like arithmetic means or geometric means of PCE, PCL, etc. for the rural (or urban) areas of a state. Thus, the expected head-count ratio[4] for households in category k would be

$$p_k^* = \frac{1}{\sum_{i=1}^{n_k} N_i} \sum_{i=1}^{n_k} N_i p_i \qquad \ldots (7.6)$$

Expression (7.6) can be used to compute changes in the head-count ratio for a household category with change in

[4] By replacing p_i's by their estimates $\hat{p}_i$'s, one gets an estimate of the 'expected head-count ratio'. For the rest of the present analysis, these estimates will be referred to as the estimated head-count ratios.

values of the explanatory variables for that category. For example, for a given category one can estimate the change in the head-count ratio due to a marginal increase in per capita land possessed or due to a unit increase in the average number of children per household in that category. Appendix E shows how this can be done. However, no empirical results are presented.

7.3 Estimation of the Logit Model

In the present exercise based on disaggregated household level data, where a large number of explanatory variables are considered for each state, the method of maximum likelihood (ML) is chosen for estimating the logit model for each state[5/]. The ML method is appealing since (1) a unique likelihood function always exists for the logit model; and (2) the maximum likelihood estimator of $\underline{\beta}$ is consistent and asymptotically normal under general conditions[6/] [7/]. The latter properties are useful for testing the significance of the estimated coefficients of the independent variables.

5/ Other methods of estimation are discussed in Cox (1970), Amemiya (1981) and Pindyck and Rubinfeld (1981).

6/ See Amemiya (1981).

7/ A general proof of the consistency and asymptotic normality of ML estimators of qualitative response models is given in the appendix of Manski and McFadden (1981).

An outline of the ML method used here for the estimation of the logit model is given below :

Let $y_1, y_2, \ldots, y_n$ be n independent observations on the variable y (defined by (7.1)) for the n sample households in a state. Then, the likelihood function is given by

$$L(y_1, y_2, \ldots, y_n, \underline{\beta}) = \prod_{i=1}^{n} p_i^{y_i} (1 - p_i)^{1-y_i} \qquad \ldots (7.7)$$

where $\underline{\beta}' = (\beta_0, \beta_1, \ldots, \beta_r)$ is the vector of parameters. From equation (7.3) we get

$$L(\underline{y}, \underline{\beta}) = \prod_{i=1}^{n} \left[\frac{\exp(z^* - \underline{\beta}' \underline{x}_i)}{1 + \exp(z^* - \underline{\beta}' \underline{x}_i)} \right]^{y_i} \left[\frac{1}{1 + \exp(z^* - \underline{\beta}' \underline{x}_i)} \right]^{1-y_i}$$

$$= \prod_{i=1}^{n} \frac{\exp(z^* y_i - \underline{\beta}' \underline{x}_i \underline{y}_i)}{1 + \exp(z^* - \underline{\beta}' \underline{x}_i)} \qquad \ldots (7.8)$$

where $\underline{y}' = (y_1, y_2, \ldots, y_n)$. The log-likelihood function is

$$l(\underline{y}, \underline{\beta}) = \ln L(\underline{y}, \underline{\beta}) = \sum_{i=1}^{n} (z^* y_i - \underline{\beta}' \underline{x}_i y_i) - \sum_{i=1}^{n} \ln \left[1 + \exp(z^* - \underline{\beta}' \underline{x}_i) \right]$$

On differentiating $l(\underline{y}, \underline{\beta})$ with respect to $\underline{\beta}$, one obtains

$$S(\underline{\beta}) = \frac{\partial l(\underline{y}, \underline{\beta})}{\partial \underline{\beta}} = -\sum_{i=1}^{n} \underline{x}_i y_i$$

$$- \sum_{i=1}^{n} \frac{1}{1 + \exp(z^* - \underline{\beta}' \underline{x}_i)} \cdot \frac{\partial}{\partial \underline{\beta}} \exp(z^* - \underline{\beta}' \underline{x}_i)$$

$$= - \sum_{i=1}^{n} \underline{x}_i y_i + \sum_{i=1}^{n} \frac{\exp(z^* - \underline{\beta}' \underline{x}_i)}{1 + \exp(z^* - \underline{\beta}' \underline{x}_i)} \underline{x}_i \quad \ldots (7.9)$$

and the maximum likelihood estimator (MLE) of $\underline{\beta}$ is the solution of the non-linear normal equations

$$S(\underline{\beta}) = \underline{0} \quad \ldots (7.10)$$

In the present exercise, $G = -l(\underline{y}, \underline{\beta})$ is minimised with respect to $\underline{\beta}$ using a modified version of the Gauss-Newton algorithm for non-linear least squares (see Jennrich and Moore (1975)), to obtain the MLE of the parameters $\underline{\beta}$. The details of the estimation procedure are given in Appendix D.

Equation (7.10) can also be expressed as follows :

$$S(\underline{\beta}) = \sum_{i=1}^{n} (-y_i + p_i)\, \underline{x}_i = \underline{0} \quad \ldots (7.11)$$

(From equation (7.3), $p_i = \dfrac{\exp(z^* - \underline{\beta}' \underline{x}_i)}{1 + \exp(z^* - \underline{\beta}' \underline{x}_i)}$.)

If $\hat{p}_i$ be estimates of p_i, $i = 1, 2, \ldots, n$, corresponding to the MLE $\hat{\underline{\beta}}$ of $\underline{\beta}$, then obviously $\hat{p}_i$'s should satisfy equation (7.11), that is,

$$\sum_{i=1}^{n} (-y_i + \hat{p}_i)\, \underline{x}_i = \underline{0}.$$

Since $\underline{x}_i$ contains a constant term, that is, 1, it follows that

$$\sum_{i=1}^{n} (-y_i + \hat{p}_i) = 0,$$

that is,

$$\sum_{i=1}^{n} \hat{p}_i = \sum_{i=1}^{n} y_i \qquad \ldots (7.12)$$

= the total number of poor households in the sample.

In fact, (7.12) provides a check that the model (7.3) has been fitted correctly[8]. On dividing both sides of equation (7.12) by n, the total number of sample households in the state, it is found that,

$$\frac{1}{n}\sum_{i=1}^{n} \hat{p}_i = \frac{1}{n}\sum_{i=1}^{n} y_i$$

$\doteq$ the proportion of poor households in the state.

The MLE $\hat{\underline{\beta}}$ is, as mentioned earlier, consistent and asymptotically normal under general conditions with variance-covariance matrix equal to $-\left[E\left(\frac{\partial^2 l(\underline{y}, \underline{\beta})}{\partial \underline{\beta}\ \partial \underline{\beta}'} \right) \right]^{-1}$ [9].

8/ See Maddala (1981).

9/ See Amemiya (1981).

This asymptotic variance - covariance matrix can be written as

$$V(\hat{\underline{\beta}}) = \left[\sum_{i=1}^{n} p_i(1 - p_i) \underline{x}_i \underline{x}_i' \right]^{-1} \quad \ldots (7.13)$$

Next, to test the overall significance of the estimated equation, that is, the null hypothesis

$$H_0 : \beta_1 = \beta_2 = \ldots = \beta_r = 0$$

one employs the likelihood ratio test based on the test statistic

$$\lambda = \frac{\max_{H_0} L(\underline{y}, \underline{\beta})}{\max_{\underline{\beta}} L(\underline{y}, \underline{\beta})} = \frac{L(\underline{y}, \hat{\underline{\beta}}^o)}{L(\underline{y}, \hat{\underline{\beta}})} \quad \ldots (7.14)$$

where $\hat{\underline{\beta}}^o = (\hat{\beta}^o_o, 0, \ldots, 0)$ is the MLE of $\underline{\beta}$ under H_0. It is well-known that under H_0

$$-2 \ln \lambda = -2 (\ln L(\underline{y}, \hat{\underline{\beta}}^o) - \ln L(\underline{y}, \hat{\underline{\beta}}))$$

$$= -2(l(\underline{y}, \hat{\underline{\beta}}^o) - l(\underline{y}, \hat{\underline{\beta}}))$$

follows a χ^2 -distribution with r degrees of freedom.

The measure of goodness of fit used for the logit models estimated here is McFadden's ρ^2 (vide McFadden (1974)), which is analogous to the coefficient of multiple determination of the multiple linear regression model. It is defined as

$$\rho^2 = 1 - \frac{l(\underline{y}, \hat{\underline{\beta}})}{l(\underline{y}, \hat{\underline{\beta}}^o)} \qquad \ldots (7.15)$$

The quantity ρ^2 has the following properties :

(a) $\rho^2 \varepsilon \ [0, 1)$. The better the fit given by the model, the greater is $l(\underline{y}, \hat{\underline{\beta}})$ and the closer is ρ^2 to 1. In principle, the lower bound, 0, is attained when none of the explanatory variables used explain the poverty status of a household (that is, the fit obtained by including terms in these variables is no better than that obtained with the intercept term alone).

(b) ρ^2 stands in a one - to - one relation to the $\underset{\sim}{\chi}^2$ - statistic, $-2 \ln \lambda$, used for testing H_0. Thus,

$$-2 \rho^2 l(\underline{y}, \hat{\underline{\beta}}^o) = -2 \ln \lambda \sim \chi^2_r .$$

7.4 The Logit Model and the Multiple Linear Regression Model : A Comparison

In the multiple linear regression model for a state set up in the previous Chapter, the effect of a set of explanatory variables on ln PCE of households in the state was examined. In the logit model estimated here (using the same explanatory variables as in the preceding Chapter) essentially the same examination is done again without employing the actual values of PCE - the information on PCE is condensed into an indicator variable which takes a value 0 or 1

Table 7.1.1 : Comparative study of estimated parameters and associated t-values for regression and logit models fitted to household level PCE data : NSS 28th round, rural

State : <u>Rajasthan</u>

Independent variable	REGRESSION MODEL			LOGIT MODEL		
	coefficient	standard error	t	coefficient	asymptotic standard error	t
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intercept	4.354	0.042	103.66	5.931	0.244	24.32
ln PCL	0.030	0.009	3.27**	0.063	0.050	1.25
N_c	-0.044	0.011	- 3.97**	-0.180	0.064	-2.84**
REG1	-0.129	0.048	- 2.69**	-0.184	0.274	-0.67
REG2	-0.376	0.057	- 6.57**	-1.490	0.285	-5.23**
REG3	-0.191	0.058	- 3.26**	-0.529	0.295	-1.79+
GP1	-0.162	0.050	- 3.23**	-0.789	0.251	-3.15**
GP2	-0.233	0.054	- 4.31**	-0.670	0.281	-2.39*
OC5	0.705	0.146	4.83**	2.119	1.132	1.87+
N_f x OC5	-0.194	0.081	- 2.40*	-0.824	0.512	-1.61
N_c x OC5	-0.095	0.043	- 2.21*	-0.158	0.374	-0.42

McFadden's ρ^2 = 0.1103, $-2 \log_e \lambda$ = 73.95

Note : + denotes significance at (two-sided) 10 percent level, * at (two-sided) 5 per cent level and ** at (two-sided) 1 per cent level.

Table 7.1.2 : Comparative study of estimated parameters and associated t-values for regression and logit models fitted to household level PCE data : NSS 28th round, rural

State : <u>Punjab</u>

Independent variable	REGRESSION MODEL			LOGIT MODEL		
	coefficient	standard error	t	coefficient	asymptotic standard error	t
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intercept	4.719	0.030	157.81	7.799	0.335	23.29
ln PCL	0.059	0.006	10.00**	0.286	0.056	5.08**
N_c	-0.107	0.009	-12.24**	-0.404	0.060	-6.73**
N_f x GP1	-0.116	0.028	- 4.22**	-0.527	0.168	-3.13**

McFadden's ρ^2 = 0.1803, $-2 \log_e \lambda$ = 100.55

Note : See note below Table 7.1.1.

Table 7.1.3 : Comparative study of estimated parameters and associated t-values for regression and logit models fitted to household level PCE data : NSS 28th round, rural

State : Uttar Pradesh

Independent variable	REGRESSION MODEL coefficient	standard error	t	LOGIT MODEL coefficient	asymptotic standard error	t
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intercept	4.019	0.028	143.63	4.627	0.160	28.83
ln PCL	0.071	0.010	7.29**	0.418	0.052	8.09**
N_m	0.056	0.013	4.48**	0.244	0.070	3.48**
N_c	-0.053	0.007	- 8.15**	-0.194	0.035	-5.50**
N_f x REG1	-0.079	0.027	- 2.96**	-0.427	0.144	-2.97**
N_m x REG2	-0.070	0.016	- 4.35**	-0.311	0.089	-3.50**
N_m x REG3	-0.054	0.018	- 2.92**	-0.270	0.100	-2.70**
N_f x REG3	0.032	0.017	1.89+	0.153	0.090	1.70+
N_m x REG4	-0.049	0.026	- 1.90+	-0.387	0.163	-2.38*
GP1	-0.145	0.024	- 6.03**	-0.674	0.137	-4.92**
OC1	-0.103	0.055	- 1.86+	-0.315	0.309	-1.02
ln PCL x OC1	-0.048	0.015	- 3.13**	-0.359	0.085	-4.24**
N_c x OC1	-0.032	0.014	- 2.19*	-0.308	0.085	-3.60**
OC2	0.198	0.106	1.86+	0.551	0.700	0.79
ln PCL x OC2	-0.070	0.023	- 3.06**	-0.499	0.137	-3.64**
N_m x OC2	0.138	0.050	2.78**	0.557	0.341	1.64
N_f x OC2	-0.121	0.059	- 2.06*	-0.277	0.390	-0.71
N_c x OC2	-0.084	0.026	- 3.22**	-0.423	0.172	-2.45*
OC3	0.450	0.127	3.54**	1.378	0.845	1.63
ln PCL x OC3	-0.048	0.024	- 1.99+	-0.332	0.141	-2.35*
N_m x OC3	-0.210	0.056	- 3.75**	-0.855	0.354	- 2.41*
N_c x OC3	-0.075	0.026	- 2.93**	-0.304	0.164	-1.86+
OC4	0.288	0.098	2.94**	2.149	0.700	3.07**
ln PCL x OC4	-0.047	0.020	- 2.33*	-0.145	0.118	-1.24
N_f x OC4	-0.117	0.038	- 3.06**	-0.768	0.252	-3.04**
N_c x OC4	-0.067	0.023	- 2.92**	-0.331	0.142	-2.34*
SR2	0.084	0.023	3.62**	0.336	0.132	2.55*
SR3	0.138	0.023	5.89**	0.410	0.130	3.15**

McFadden's ρ^2 = 0.1378, $-2 \log_e \lambda$ = 335.78

Note : See note below Table 7.1.1.

Table 7.1.4 : Comparative study of estimated parameters and associated t-values for regression and logit models fitted to household level PCE data : NSS 28th round, rural

State : Orissa

Independent variable	REGRESSION MODEL coefficient	REGRESSION MODEL standard error	REGRESSION MODEL t	LOGIT MODEL coefficient	LOGIT MODEL asymptotic standard error	LOGIT MODEL t
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intercept	3.924	0.031	128.60	4.394	0.184	23.94
ln PCL	0.054	0.011	5.09**	0.253	0.073	3.48**
REG1	-0.227	0.067	- 3.39**	-0.933	0.440	-2.12*
ln PCL x REG1	-0.050	0.023	- 2.88**	-0.124	0.133	-0.93
N_c x REG1	-0.071	0.017	- 3.12**	-0.819	0.279	-2.93**
N_m x REG2	-0.038	0.027	- 1.40	-0.089	0.172	-0.52
N_c x REG2	-0.062	0.018	- 3.41**	-0.389	0.124	-3.13**
GP1	-0.132	0.046	- 2.90**	-0.175	0.305	-0.58
GP2	-0.157	0.040	- 3.88**	-0.935	0.278	-3.36**
N_m x OC1	0.103	0.034	3.05**	0.334	0.240	1.40
N_f x OC1	-0.101	0.035	- 2.87**	-0.473	0.283	-1.67+
N_c x OC1	-0.085	0.019	- 4.43**	-0.341	0.155	-2.20*
ln PCL x OC2	-0.092	0.028	- 3.33**	-0.458	0.290	-1.58
N_m x OC2	0.403	0.073	5.49**	2.596	0.824	3.15**
N_f x OC2	-0.414	0.073	- 5.63**	-2.427	0.689	-3.52**
OC3	0.597	0.173	3.46**	1.674	1.510	1.11
N_f x OC3	-0.234	0.121	- 1.93+	-0.272	1.237	-0.22
OC4	0.545	0.118	4.60**	3.037	1.051	2.89**
N_f x OC4	-0.308	0.086	- 3.59**	-1.820	0.698	-2.61**
SR3	0.192	0.032	5.96**	1.097	0.231	4.75**

McFadden's ρ^2 = 0.2798, $-2 \log_e \lambda$ = 242.06.

Note : See note below Table 7.1.1.

Table 7.1.5 : Comparative study of estimated parameters and associated t-values for regression and logit models fitted to household level PCE data : NSS 28th round, rural

State : West Bengal

Independent variable	REGRESSION MODEL coefficient	standard error	t	LOGIT MODEL coefficient	asymptotic standard error	t
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intercept	4.318	0.052	83.38	5.757	0.334	17.26
ln PCL	0.190	0.022	8.54**	0.813	0.154	5.27**
N_m	0.090	0.019	4.76**	0.386	0.123	3.14**
N_c	-0.072	0.011	-6.26**	-0.402	0.076	-5.27**
REG1	-0.283	0.069	-4.11**	-1.747	0.401	-4.36**
ln PCL x REG1	-0.051	0.023	-2.21*	-0.316	0.166	-1.91^+
REG2	-0.450	0.073	-6.12**	-1.990	0.449	-4.43**
ln PCL x REG2	-0.041	0.015	-2.79**	-0.189	0.116	-1.62
N_f x REG2	0.091	0.032	2.80**	0.269	0.200	1.35
REG3	-0.304	0.062	-4.91**	-1.359	0.386	-3.52**
N_f x REG3	0.064	0.034	1.85^+	0.399	0.212	1.88^+
GP1	-0.107	0.067	-1.59	-0.799	0.423	-1.89^+
N_m x GP1	-0.110	0.033	-3.32**	-0.524	0.240	-2.19*
N_c x GP1	0.050	0.017	2.89**	0.414	0.119	3.48**
ln PCL x GP2	-0.048	0.018	-2.71**	-0.113	0.127	-0.89
N_m x GP2	-0.127	0.031	-4.14**	-0.472	0.207	-2.28*
ln PCL x GP3	0.042	0.011	3.80**	0.319	0.106	3.01**
OC1	-0.234	0.074	-3.14**	-0.094	0.503	-0.19
ln PCL x OC1	-0.092	0.024	-3.75**	-0.205	0.174	-1.18
N_c x OC1	-0.039	0.018	-2.20*	-0.508	0.164	-3.10**
ln PCL x OC2	-0.107	0.025	-4.29**	-0.409	0.178	-2.30*
N_m x OC2	0.111	0.041	2.72**	1.024	0.463	2.21*
N_c x OC2	-0.082	0.026	-3.11**	-0.606	0.254	-2.39*
ln PCL x OC3	-0.112	0.028	-4.05**	-0.665	0.180	-3.69**
N_m x OC3	0.151	0.055	2.76**	0.492	0.370	1.33
N_f x OC3	-0.216	0.058	-3.73**	-1.256	0.442	-2.84**
ln PCL x OC4	-0.095	0.026	-3.61**	-0.367	0.171	-2.15*
N_c x OC4	-0.037	0.023	-1.59	-0.087	0.144	-0.61
SR2	0.157	0.055	2.86**	0.724	0.353	2.05*
N_f x SR2	-0.081	0.032	-2.52*	-0.446	0.199	-2.25*
ln PCL x SR3	-0.040	0.011	-3.69**	-0.134	0.090	-1.49
N_m x SR3	0.028	0.020	1.40	0.310	0.142	2.19*

McFadden's $\rho^2 = 0.3286$, $-2 \log_e \lambda = 419.52$.

Note : See note below Table 7.1.1.

Table 7.1.6 : Comparative study of estimated parameters and associated t-values for regression and logit models fitted to household level PCE data : NSS 28th round, rural

State : Tamil Nadu

Independent variable	REGRESSION MODEL			LOGIT MODEL		
	coefficient	standard error	t	coefficient	asymptotic standard error	t
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intercept	4.243	0.038	111.44	5.783	0.234	24.69
ln PCL	0.039	0.007	5.31**	0.140	0.041	3.44**
N_f	-0.102	0.025	- 4.10**	-0.534	0.138	-3.87**
N_c	-0.066	0.016	- 4.23**	-0.219	0.082	-2.65**
N_m x REG1	-0.062	0.020	- 3.16**	-0.251	0.112	-2.24*
N_m x REG2	-0.110	0.028	- 4.00**	-0.397	0.143	-2.77**
N_f x REG2	0.117	0.031	3.79**	0.351	0.167	2.10*
N_f x OC1	-0.142	0.028	- 5.02**	-0.429	0.155	-2.77**
N_c x OC1	-0.034	0.017	- 1.97+	-0.259	0.100	-2.59**
ln PCL x OC3	-0.046	0.023	- 2.05*	-0.164	0.126	-1.31
N_f x OC3	-0.110	0.071	- 1.54	-0.313	0.373	-0.84
ln PCL x OC4	-0.040	0.015	- 2.60**	-0.179	0.094	-1.89+
N_c x OC4	-0.069	0.029	- 2.37*	-0.326	0.174	-1.88+
N_f x SR2	0.093	0.028	3.37**	0.340	0.158	2.15*
N_c x SR2	-0.051	0.019	- 2.66**	-0.222	0.108	-2.05*
N_m x SR3	0.110	0.024	4.58**	0.644	0.139	4.63**
N_c x SR3	-0.029	0.019	- 1.50	-0.190	0.103	-1.85+

McFadden's ρ^2 = 0.1741, $-2 \log_e \lambda$ = 216.16.

Note : See note below Table 7.1.1.

Table 7.1.7 : Comparative study of estimated parameters and associated t-values for regression and logit models fitted to household level PCE data : NSS 28th round, rural

State : Kerala

Independent variable	REGRESSION MODEL coefficient	standard error	t	LOGIT MODEL coefficient	asymptotic standard error	t
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intercept	4.559	0.062	73.62	5.999	0.370	16.21
ln PCL	0.122	0.019	6.33**	0.229	0.110	2.08*
N_c	-0.109	0.019	-5.82**	-0.388	0.095	-4.10**
ln PCL x GP1	-0.053	0.033	-1.58	-0.213	0.192	-1.11
N_m x GP1	-0.098	0.062	-1.58	-0.035	0.364	-0.10
N_f x GP1	-0.141	0.067	-2.10*	-1.214	0.413	-2.94**
N_c x GP1	0.059	0.044	1.34	0.459	0.253	1.81+
GP3	-0.189	0.126	-1.50	-0.366	0.677	-0.54
ln PCL x GP3	0.059	0.033	1.81+	0.329	0.191	1.73+
N_c x GP3	0.060	0.028	2.13*	0.233	0.153	1.52
GP4	-0.151	0.077	-1.97+	-0.155	0.437	-0.35
N_c x GP4	0.043	0.027	1.55	0.035	0.155	0.22
OC1	-0.286	0.113	-2.53*	-0.534	0.610	-0.88
ln PCL x OC1	-0.077	0.033	-2.34*	-0.096	0.183	-0.52
N_c x OC1	-0.073	0.029	-2.51*	-0.440	0.190	-2.32*
OC2	0.277	0.131	2.12*	0.790	0.882	0.90
ln PCL x OC2	-0.118	0.033	-3.56**	-0.329	0.235	-1.40
N_c x OC2	-0.089	0.033	-2.67**	-0.242	0.231	-1.05
OC3	0.546	0.135	4.02**	1.298	0.948	1.37
N_m x OC3	0.131	0.055	2.37*	0.433	0.311	1.39
N_f x OC3	-0.251	0.067	-3.75**	-0.825	0.448	-1.84+
N_c x OC3	-0.069	0.034	-2.04*	-0.210	0.212	-0.99
ln PCL x OC4	-0.070	0.024	-2.91**	-0.089	0.121	-0.74
N_m x OC4	0.067	0.038	1.76+	0.381	0.213	1.79+
N_f x OC4	-0.204	0.040	-5.12**	-0.753	0.194	-3.89**

McFadden's $\rho^2 = 0.2205$, $-2 \log_e \lambda = 193.23$.

Note : See note below Table 7.1.1.

Table 7.1.8 : Comparative study of estimated parameters and associated t-values for regression and logit models fitted to household level PCE data : NSS 28th round, rural

State : Gujarat

Independent variable	REGRESSION MODEL			LOGIT MODEL		
	coefficient	standard error	t	coefficient	asymptotic standard error	t
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intercept	4.160	0.039	105.40	5.897	0.313	18.85
ln PCL	0.051	0.011	4.46**	0.273	0.095	2.88**
N_c	-0.066	0.009	- 7.20**	-0.299	0.073	-4.11**
REG1	0.175	0.052	3.39**	0.076	0.370	0.20
REG2	0.228	0.048	4.77**	1.236	0.402	3.08**
REG3	0.140	0.050	2.77**	1.229	0.415	2.96**
REG4	0.097	0.045	2.16*	0.350	0.347	1.01
GP2	-0.276	0.048	- 5.80**	-1.250	0.325	-3.85**
ln PCL x OC1	-0.032	0.015	- 2.15*	-0.227	0.112	-2.03*
N_m x OC1	-0.078	0.038	- 2.08*	-0.442	0.258	-1.72^{+}
N_f x OC1	-0.085	0.036	- 2.39*	-0.751	0.241	-3.11**
OC5	0.512	0.092	5.55**	2.091	1.281	1.63
N_c x OC5	-0.114	0.027	- 4.26**	-0.348	0.293	-1.19
ln PCL x OC4	-0.048	0.021	- 2.26*	-0.420	0.176	-2.39*
N_m x OC4	0.094	0.047	2.01*	0.177	0.368	0.48
N_f x OC4	-0.160	0.082	-1.94^{+}	-1.146	0.630	-1.82^{+}

McFadden's ρ^2 = 0.2670, $-2 \log_e \lambda$ = 171.76.

Note : See note below Table 7.1.1.

Table 7.1.9 : Comparative study of estimated parameters and associated t-values for regression and logit models fitted to household level PCE data : NSS 28th round, rural

State : <u>Maharashtra</u>

Independent variable	REGRESSION MODEL			LOGIT MODEL		
	coefficient	standard error	t	coefficient	asymptotic standard error	t
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intercept	4.063	0.045	89.79	4.630	0.237	19.50
ln PCL	0.051	0.012	4.09**	0.142	0.064	2.23*
N_f	0.029	0.021	1.40	0.158	0.111	1.49
N_c	-0.052	0.011	-4.90**	-0.199	0.055	-3.59**
REG1	0.158	0.077	2.07*	-0.076	0.430	-0.18
N_f x REG1	-0.063	0.045	-1.42	0.180	0.260	0.69
REG4	0.087	0.040	2.19*	0.488	0.218	2.24*
ln PCL x REG4	0.039	0.011	3.44**	0.189	0.061	3.10**
REG5	0.251	0.110	2.29*	0.996	0.662	1.50
N_m x REG5	-0.085	0.048	-1.77^{+}	-0.291	0.264	-1.10
N_c x REG5	-0.048	0.031	-1.56	-0.293	0.164	-1.78^{+}
OC1	-0.102	0.070	-1.45	0.085	0.378	0.22
ln PCL x OC1	-0.044	0.014	-3.03**	-0.124	0.073	-1.70^{+}
N_f x OC1	-0.066	0.035	-1.90^{+}	-0.322	0.190	-1.69^{+}
N_c x OC1	-0.033	0.017	-2.02*	-0.277	0.092	-3.02**
OC2	0.179	0.142	1.26	-0.643	0.757	-0.85
ln PCL x OC2	-0.056	0.024	-2.35*	-0.273	0.123	-2.21*
N_m x OC2	0.137	0.079	1.74^{+}	0.821	0.587	1.40
N_c x OC2	-0.101	0.033	-3.07**	-0.251	0.180	-1.39
OC3	0.620	0.159	3.89**	1.819	0.990	1.84^{+}
N_f x OC3	-0.236	0.090	-2.61**	-0.488	0.537	-0.91
ln PCL x OC4	-0.048	0.019	-2.55*	-0.174	0.094	-1.85^{+}
N_c x OC4	-0.052	0.021	-2.52*	-0.155	0.099	-1.57

McFadden's $\rho^2 = 0.1272$, $-2 \log_e \lambda = 197.26$

Note : See note below Table 7.1.1.

depending on whether PCE > z or ≤ z. It would, therefore, be of interest to compare the effects of the explanatory variables on ln PCE and on poverty status in the two models and also to see which model predicts ln PCE and poverty status better.

Tables 7.1.1 to 7.1.9 present the estimated coefficients[10/] of the logit model along with their asymptotic standard errors and t-values. Each table sets out the results for one state. The symbols in these tables represent the same variables as they did in Tables 6.1.1 to 6.1.9 of the previous Chapter. For the purpose of comparisons, the combined sample estimates of the corresponding multiple regression models are also presented in these tables, together with their standard errors and t-values.

In each table, the 'intercept' and the coefficients corresponding to ln PCL, N_m, N_f and N_c indicate the intercept term and the coefficients of the respective explanatory variables for the <u>reference group</u> of households in the state. As stated earlier in Chapter 6, for most of the states, 'other Hindu', 'cultivator' households in the most prosperous NSS region of the state (as judged by average PCE of the region), allotted for interview during the first sub-round (October-December, 1973 , of the 28th round) were taken to constitute

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[10/] Only combined sample estimates of the coefficients of the logit model are presented for reasons of space.

the reference group. Only for Gujarat, the poorest NSS region was taken to define the reference group. The coefficients corresponding to dummy variables such as REG1, GP2 or OC1 give the differential intercepts of the corresponding household categories. The intercept term for the category corresponding to the dummy variables GP1 (Scheduled Caste), say, can be obtained by adding the coefficient of GP1 to the intercept term for the reference group of households. The coefficient of a variable such as N_c x OC1 gives the differential slope coefficient of N_c for the household category corresponding to OC1 (agricultural labourers). The slope coefficient of N_c for this category can be obtained, as above, by adding the coefficient of N_c x OC1 to the coefficient of N_c for the reference group. However, as mentioned in Chapter 6, standard errors of such intercepts and slope coefficients are difficult to obtain.

From Tables 7.1.1 to 7.1.9, it is evident that the signs of the $\hat{\beta}$'s are often the same in the two models. At least for variables which are significant in both the models, a variable which had an increasing (decreasing) effect on the PCE of a household had a decreasing (increasing) effect on the probability of the household being poor. This is, of course, only to be expected. Next, it is observed that, in general, the estimated coefficients in the logit model have larger standard errors than the corresponding coefficients of the regression model. A plausible explanation for this seems to be that, in the case of the logit model, a large part of sample information on PCE remains unutilized because the observations on the continuous PCE-variable are transformed into a dichotomous indicator variable taking value 0 or 1.

In Bardhan (1984), the opposite pattern is observed. The standard errors of the estimated regression coefficients are generally higher than those of the estimated logit model coefficients. This is, however, contrary to expectations and requires probing. It may be mentioned that Bardhan analyzed PCE instead of ln PCE and, therefore, the heteroscedasticity of disturbances may have led to wrong estimates of standard errors. Also note that the NSS 32nd round sampling design was self-weighting at (NSS) region level rather than at state level. Therefore, Bardhan's use of ordinary least squares method to estimate the regression models might be inappropriate.

The significance levels of the estimated coefficients of the explanatory variables in the two models are now compared. Table 7.2 is a two-way frequency table of all the estimated coefficients of the regression and logit models (over all nine states) according to significance levels of their t-values. The t-ratios of all the coefficients shown in Tables 7.1.1 to 7.1.9 were considered in preparing this table.

Table 7.2 : Joint distribution of t-values for all the estimated regression and logit model coefficients for the rural areas of all the nine states : NSS 28th round

	t-ratios of regression coefficients	t-ratios of logit model coefficients							
		-ve coefficients				+ve coefficients			
		**	*	+	non-significant	non-significant	+	*	**
-ve coefficient	**	33	13	6	14	1			
	*	6	6	4	10				
	+		1	2	3				
	non-sig.			3	6	2			
+ve coefficient	non-sig.				1	2	1	1	
	+					2	4		
	*				1	6		1	
	**					10	2	7	19

Note : See note below Table 7.1.1.

The columns represent intervals of t-values (according to significance levels) of logit model coefficients while the rows represent the corresponding intervals of t-values for regression coefficients. It is found that, in general, the estimated coefficients in the logit model are less clearly significant - have higher P-values — than the corresponding estimates in the multiple linear regression model. This can be seen from the following summary table :

model	no. of t-values in Tables 7.1.1 to 7.1.9 significant at					
	lower 0.5 per cent level	lower 2.5 per cent level	lower 5 per cent level	upper 5 per cent level	upper 2.5 per cent level	upper 0.5 per cent level
regression model	67	26	6	6	8	38
logit model	39	20	15	7	9	19

This difference is obviously due to the larger standard errors of the estimated coefficients in the logit model.

The observed ln PCEs of households in a state may now he compared with the ln PCEs predicted from the regression and the logit models, (strictly, the regression implicit in the logit models) to find which model gives a better fit. The correlation coefficients between the observed ln PCE and ln PCEs predicted from the regression model and the logit model for each of the nine states are presented below in Table 7.3. The correlation coefficients in the last column of this table should also be of some interest.

Table 7.3 : Correlation coefficients between observed ln PCE and ln PCEs predicted from regression and logit models for rural areas of selected states : NSS 28th round

State	correlation coefficient between		
	observed ln PCE and predicted ln PCE		ln PCEs predicted from regression and logit models
	regression model	logit model	
(1)	(2)	(3)	(4)
Rajasthan	0.466	0.454	0.974
Punjab	0.566	0.562	0.993
Uttar Pradesh	0.485	0.472	0.973
Orissa	0.645	0.621	0.962
West Bengal	0.663	0.643	0.970
Tamil Nadu	0.557	0.549	0.985
Kerala	0.642	0.621	0.967
Gujarat	0.642	0.606	0.945
Maharashtra	0.491	0.467	0.951

Note : These correlations were computed using household level values of PCE and expected PCE, ignoring household size.

The difference observed between figures in cols. (2) and (3) of Table 7.3 was only to be expected. Thus, for each of the nine states, the correlation coefficient between the observed ln PCE and predicted ln PCE appears to be a little higher for the regression model than for the logit model. However, predicted ln PCEs from the two models agree very well; the correlation coefficients between the two appear to vary between 0.945 and 0.993.

Thus, even though much of the sample information on PCE seems to remain unutilized in the logit model, the regression implicit in it performs quite well in predicting ln PCE compared to the multiple linear regression model for ln PCE.

It would now be of interest to examine which model — the regression model or the ligit model - predicts poverty status better. For each state, the households observed to be poor (or non-poor) are re-classified as poor and non-poor on the basis of ln PCE predicted by the estimated regression and logit models. In a similar manner, households shown to be poor (or non-poor) by the estimated regression model are re-classified as poor and non-poor on the basis of ln PCE predicted by the logit model. The number of sample households classified as poor or non-poor by observed PCE and ln PCE predicted from the two models are shown for different states in Table 7.4. This table shows that :

(i) Both models predict poverty status of a household better for Orissa and West Bengal compared to the other states[11].

[11] The comparative performance of the two models for different states are, on the whole, reflected in the values of R^2 and ρ^2 for the different states.

Table 7.4 : Comparative study of classifications of rural households by poverty status based on observed PCE and PCE predicted from regression and logit models, separately by states : NSS 28th round

State	number of sample households											
	observed to be poor		observed to be non-poor		observed to be poor		observed to be non-poor		poor by the regression model		non-poor by the regression model	
	poor by the regression model	non-poor by the regression model	poor by the regression model	non-poor by the regression model	poor by the logit model	non-poor by the logit model	poor by the logit model	non-poor by the logit model	poor by the logit model	non-poor by the logit model	poor by the logit model	non-poor by the logit model
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Rajasthan	40	116	22	394	38	118	21	395	51	11	8	502
Punjab	15	84	16	544	17	82	14	546	28	3	3	625
Uttar Pradesh	398	413	176	779	458	353	216	739	562	12	112	1080
Orissa	289	95	63	195	308	76	80	178	347	5	41	249
West Bengal	612	80	138	188	609	83	137	189	721	29	25	243
Tamil Nadu	210	181	90	427	221	170	103	414	294	6	30	578
Kerala	177	106	71	284	179	104	73	282	232	16	20	370
Gujarat	78	82	33	329	91	69	35	327	102	9	24	387
Maharashtra	241	247	125	522	240	248	117	530	327	39	30	739
all states	2060	1404	734	3662	2161	1303	796	3600	2664	130	293	4773

(ii) For Orissa, the logit model performs better than the regression model in predicting the poverty status of households observed to be poor (vide cols. (2), (3), (6) and (7)), while the regression model does better in predicting the poverty status of households observed to be non-poor. However, the differences in the predictive powers of the two models is rather small.

(iii) For the more prosperous states of Rajasthan and the Punjab, neither model performs well in predicting the poverty status of households observed to be poor. The opposite is found to be true for non-poor households. Both models do very well in predicting the poverty status of non-poor households.

(iv) For the remaining states, both models perform relatively well in predicting poverty status compared to Rajasthan and the Punjab. As in the case of Orissa, for Uttar Pradesh, in particular, and also for Tamil Nadu and Gujarat, to some extent, the logit model predicts the poverty status of households observed to be poor better, while the regression model is more successful in predicting the poverty status of non-poor households. For Kerala, Maharashtra and West Bengal, the differences in prediction of poverty status by the two models are marginal.

(v) Except for Uttar Pradesh, Orissa and West Bengal, both models agree relatively well in predicting the poverty status of non-poor households.

(vi) Taking the nine states as a whole, the logit model predicts the poverty status of poor households somewhat more correctly than the regression model; the picture is reversed for non-poor households; for them, the predictions from the regression model are somewhat more successful.

7.5 Effects of Different Factors on the Probability of a Household Being Poor

In Section 6.5 of Chapter 6, the effects of ln PCL, N_m, N_f and N_c on ln PCE of households belonging to different categories were examined. In a similar manner, the effects of ln PCL, N_m, N_f and N_c on the probability of households in different NSS regions, social groups and occupational classes being poor are examined in this section on the basis of estimates presented in Tables 7.1.1 to 7.1.9. In the first step, the results for the reference group of households will be discussed for the different states. Next, the variation in the probability of a household being poor across different household categories is examined through differential intercepts and differential slope coefficients of the key explanatory variables, viz., ln PCL, N_m, N_f and N_c.

7.5.1 Effects of Key Explanatory Variables on the Probability of a Reference Group Household Being Poor

Tables 7.1.1 to 7.1.9 give estimates, $\hat{\beta}$'s, of the coefficients β in model (7.3). Here, if $\hat{\beta}_j > 0$, then as the value of the explanatory variable x_{ij} increases, the probability of the ith household being poor falls.

Judging by the results for the reference group of households in different states, one finds that except in the case of Rajasthan, an increase in PCL significantly lowered the probability of a household being poor, other factors remaining constant. Similarly, for all states other than Orissa, an increase in N_c in the reference group of households significantly increased the probability of the household falling below the poverty line. In West Bengal and Uttar Pradesh, an additional adult male in a reference group household significantly decreased the probability of the household being poor. The addition of an adult female in a reference group household significantly increased the probability of the household being poor in only one state, viz., Tamil Nadu.

7.5.2 Probability of a Household Being Poor : Variation across Household Categories

One may now examine the differential intercepts and slope coefficients presented in Tables 7.1.1 - 7.1.9 for the light they throw on effects of different groups of factors - region, occupation, social group or season (sub-round) - on the poverty status of a household. Some of the obviously significant findings are reported below.

To start with, variation in the probability of a household being poor may be examined for household categories whose differential intercepts are significant, but differential slopes are not because the interpretation of results is easy in only such situations. Thus, it appears that, other factors remaining constant, a household in the Southern region (REG2) of Rajasthan had a greater chance of being poor than one in the reference region of the state. Similarly, other things remaining constant, households in the Southern Plains (REG2) and Dry Areas (REG3) of Gujarat appeared to be less likely to be poor compared to reference region households in the same state.

In the same manner, the differentials of the intercept term show that, other factors remaining constant, the probability of a Scheduled Caste (GP1) household being poor was significantly higher than that of reference group ('other Hindu') households in Rajasthan and Uttar Pradesh. Scheduled Tribe (GP2) households, on the other hand, had a significantly greater likelihood of being poor compared to 'other Hindu' (reference group) households in Rajasthan, Orissa and Gujarat.

The variation in the probability of a household being poor could be compared across occupational groups only for the Punjab, where there was no significant variation across occupations.

Finally, other things remaining same, the probability of a household being poor was less during the third sub-round (SR3)(April-June, 1974) compared to that during the first sub-round (October-December, 1973) in the states of Uttar Pradesh and Orissa. Again, in Uttar Pradesh, the probability of a household being poor in the second sub-round (SR2) (January-March, 1974) was significantly lower than that during the first sub-round.

7.5.3 Differential Effects of ln PCL, N_m, N_f and N_c on the Probability of Households Belonging to Different Categories Being Poor

On examining the differential slope coefficients of ln PCL, one finds that the slope coefficient of ln PCL did not vary significantly over regions, social groups, occupational classes or sub-rounds in the states of Rajasthan, Punjab and Orissa. In other words, the rate of change in the probability of a household being poor in response to an increase in its PCL did not vary over regions, social groups, occupational classes, or sub-rounds in these three states. In Maharashtra, on the other hand, increasing PCL of a household in the Inland - Eastern region (REG4) depressed the probability of the household being poor by a greater amount than in the reference region (Inland - Western) of the state. In West Bengal, the decrease in this probability for an 'other Muslim' (GP3) household resulting from an increase in ln PCL was significantly greater than the corresponding decrease for an 'other Hindu' (reference group) household. In Uttar Pradesh, West Bengal, Gujarat and Maharashtra, the negative effect of ln PCL on the probability of a household being poor was significantly less pronounced for many of the other occupation groups compared to that for 'cultivator' households (reference occupation). The effect of ln PCL did not vary significantly over sub-rounds in any of the states according to the logit models.

It appears that N_m did not have any significant differential effects on the probability of a household being poor in the states of Rajasthan, the Punjab and Maharashtra. However, an increase in N_m appeared to increase this probability in both the coastal regions (REG1, REG2) of Tamil Nadu compared to the reference region (Inland) of the state. Similarly, for Uttar Pradesh, it seems that an increase in N_m in households belonging to the Central (REG2), Eastern (REG3) and Southern (REG4) regions had no depressing effect on the probability of the household being poor. For most of the states, the differential coefficients of N_m were not so clearly significant for the occupation groups. However, in a few cases where such effects were significant, an increase in N_m in non-agricultural households generally had a decreasing or no significant effect on its probability of being poor[12/]. It is observed that during the third sub-round (SR3), an increase in N_m appeared to lower the likelihood of the household being poor in Tamil Nadu. The same differential slope coefficient (i.e., the coefficient of N_m x SR3) is also observed to be positive and significant for West Bengal.

Ceteris paribus, in households belonging to the Himalayan region (REG1) of Uttar Pradesh, an increase in N_f appeared to increase the probability of the households being poor. Similarly, in Kerala, an increase in N_f in Scheduled Caste (GP1) households appeared to increase their chances of being poor. Coming now to occupational categories, it is observed that in households belonging to many occupational groups other than 'cultivators', an increase in N_f raised the probability of such households being poor compared to that of 'cultivator' households in most of the states. In sub-round 2 (SR2), an increase in N_f in a household in Tamil Nadu, appeared to produce a significantly lower increase in its probability of falling below the poverty line compared to that in the reference period (i.e., sub-round 1). During the same period, an increase in N_f in a household in West

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12/ An exception is the 'sales or service' group (OC3) of households in Uttar Pradesh.

Bengal seemed to increase the probability of the household being poor.

In Rajasthan, the Punjab and Gujarat, the rate of change in the probability of a household being poor with an increase in N_c did not vary significantly over regions, social groups, occupational classes or sub-rounds. In Orissa, an increase in N_c in households belonging to the Southern (REG1) and Northern (REG2) regions appeared to increase the likelihood of the household falling below the poverty line. Coming to social groups, in West Bengal, a rise in N_c in a Scheduled Caste (GP1) household appeared to have no significant effect on its probability of being poor which is in sharp contrast to the pattern observed for reference group households. In households belonging to occupational groups other than 'cultivators'. in West Bengal, increasing N_c caused a rise in probability of being poor, at least as fast as that for 'cultivator' households. Again, in Tamil Nadu, an additional child caused a greater increase in the probability of a household being poor during the second sub-round (SR2) compared to that during the first sub-round (reference period).

7.6 Concluding Remarks

The concluding observations made in Chapter 6 which, in a sense, represents the most comprehensive type of analysis made in this thesis, are not repeated here. In this Section, the additional points that arise on a joint consideration of Chapters 6 and 7 are briefly commented upon.

For each of the nine states studied in Chapter 6, a logit model of poverty was estimated in this Chapter to explain variation in the probability of a rural household being poor (that is, having PCE $\leq$ poverty line) in terms of the same set of variables found to explain variations in ln PCE. It may be reiterated that no fresh search was made for explanatory variables for the logit model. This logit model for a state may be viewed as an alternative way to explain variations in ln PCE without directly using the actual magnitudes of PCE. On comparing the multiple linear regression model for ln PCE and the logit model of poverty estimated for a state, it was found that the number of significant explanatory variables was lower for the logit model. However, even though the logit model did not use the full information on PCE, it compared fairly well with the multiple regression model in predicting the values of ln PCE. The logit model performs somewhat better in predicting poverty status of households observed to be poor in the states of Orissa, Uttar Pradesh, Tamil Nadu and Gujarat compared to the regression model. Neither model performs well for this purpose for the relatively prosperous states of Rajasthan and the Punjab. For a number of states, the regression models are found to predict the poverty status of households observed to be non-poor somewhat better than the logit model.

The logit models and the regression models also agree fairly well in the sense that an explanatory variable (significant in both models) which has an increasing (decreasing) effect on ln PCE of a household had a decreasing (increasing) effect on the probability of the household being poor. As in the case of the multiple regression models, in most of the states, an increase in PCL appeared to decrease the probability of a household being poor in most household categories, other factors remaining constant. Similarly, an increase in N_c in households belonging to most categories in the states (with the exception of Orissa) seemed to increase the likelihood of the households falling below the poverty line.

Appendix A

COMPARATIVE RESULTS FOR DISTRIBUTION OF LANDHOLDINGS IN NSS 26th AND 28th ROUNDS

Table A.1 : Comparative study of average size of landholding per household in NSS 26th and 28th rounds, by States

State/Union territory	no. of sample households		average land possessed/operated per household (in acres)						% difference in average landholding/hh (28th-26th)/26th x 100		
			hs 1		hs 2		combined				
	26th round	28th round	26th round	28th round	26th round	28th round	26th round	28th round	hs 1	hs 2	comb.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Andhra Pradesh	3284	1236	3.80	3.86	3.44	3.24	3.61	3.54	1.58	- 5.81	- 1.94
Assam*	1385	600	2.11	3.37	2.53	3.19	2.32	3.28	59.72	26.09	41.38
Bihar	2849	1288	2.35	2.85	2.53	2.36	2.43	2.61	21.28	- 6.72	7.41
Gujarat	1424	530	5.81	6.59	5.80	5.38	5.81	5.98	13.43	- 7.24	2.93
Haryana	952	603	5.18	6.46	4.63	5.62	4.89	6.06	24.71	21.38	23.93
Himachal Pradesh	637	394	3.86	2.69	2.88	2.51	3.43	2.60	-30.31	-12.85	-24.20
Jammu & Kashmir	1142	657	2.83	2.80	2.72	2.92	2.78	2.86	- 1.06	7.35	2.88
Karnataka	1433	621	5.80	5.13	5.31	5.51	5.54	5.32	-11.55	3.77	- 3.97
Kerala	1834	645	1.11	1.14	1.11	1.08	1.11	1.11	2.70	- 2.70	0.00
Madhya Pradesh	3124	1320	6.67	6.36	7.62	6.96	7.12	6.66	- 4.65	- 8.66	- 6.46
Maharashtra	2575	1135	6.21	5.91	6.81	6.16	6.48	6.04	- 4.83	- 9.54	- 6.79
Manipur	788	222	2.56	5.96	2.43	2.01	2.48	3.97	132.81	-17.28	60.08
Meghalaya	1133	225	2.46	2.86	2.45	4.88	2.45	3.82	16.26	99.18	55.92
Orissa	1533	671	2.88	2.60	2.27	2.68	2.54	2.64	- 9.72	18.06	3.94
Punjab	874	670	4.26	4.03	3.89	5.06	4.06	4.54	- 5.40	30.08	11.82
Rajasthan	1010	613	10.38	10.74	11.53	11.26	10.98	11.01	3.47	- 2.34	0.27
Tamil Nadu	2709	910	1.99	1.78	1.81	1.84	1.90	1.81	-10.55	1.66	- 4.74
Tripura	739	187	1.92	1.78	2.01	1.78	1.96	1.78	- 7.29	-11.44	- 9.18
Uttar Pradesh	3807	1784	2.99	2.92	2.81	2.94	2.89	2.93	- 2.34	4.63	1.38
West Bengal	2353	1030	1.89	1.78	1.93	1.68	1.91	1.73	- 5.82	-12.95	- 9.42
Delhi	107	17	3.96	0.29	2.55	1.20	3.17	0.72	-92.68	-52.94	-77.29
Goa	122	42	0.76	1.49	1.09	0.84	0.87	1.14	96.05	-22.94	31.03
Pondicherry	133	52	1.39	1.28	0.82	1.72	1.08	1.49	- 7.91	109.76	37.96
INDIA	35947	15452	3.99	3.95	3.93	3.90	3.96	3.93	- 1.00	- 0.76	- 0.76

* Mizoram was included in Assam during NSS 26th round, but was excluded from the scope of the 28th round survey.

Note : The figures for NSS 26th round were computed from the estimates presented in <u>Sarvekshana</u>, Vol. V, Nos. 3 and 4 (January - April, 1982).

Table A.2 : Cumulative percentage of households and of land operated/possessed by households in rural India by size classes of household land operated/ possessed : NSS 26th (July 1971-September 1972) and NSS 28th (October 1973-June 1974) rounds

Household landholding (in acres)	Cumulative percentage of households		Cumulative percentage of land operated/ possessed	
	26th round	28th round	26th round	28th round
(1)	(2)	(3)	(4)	(5)
landless/operating no land	27.41	4.76	0	0
0.01 - 0.49	35.45	36.13	0.47	0.65
0.50 - 0.99	42.34	41.77	1.69	1.59
1.00 - 1.24	46.65	46.71	2.81	2.91
1.25 - 2.49	60.28	59.13	9.25	8.68
2.50 - 4.99	76.72	75.83	24.16	23.24
5.00 - 7.49	85.38	85.21	37.47	37.12
7.50 - 9.99	89.66	89.11	46.77	45.38
10.00 - 12.49	92.74	93.18	55.37	56.57
12.50 - 14.99	94.38	94.20	60.99	60.05
15.00 - 19.99	96.53	96.49	70.29	69.59
20.00 - 24.99	97.76	97.91	77.17	76.16
25.00 - 29.99	98.47	98.40	82.01	80.68
30.00 - 49.99	99.59	99.53	92.50	90.79
50.00 -	100.00	100.00	100.00	100.00

Source : NSS Report No. 215 : 26th round, July 1971-September 1972, Tables on Landholdings, p. 72.

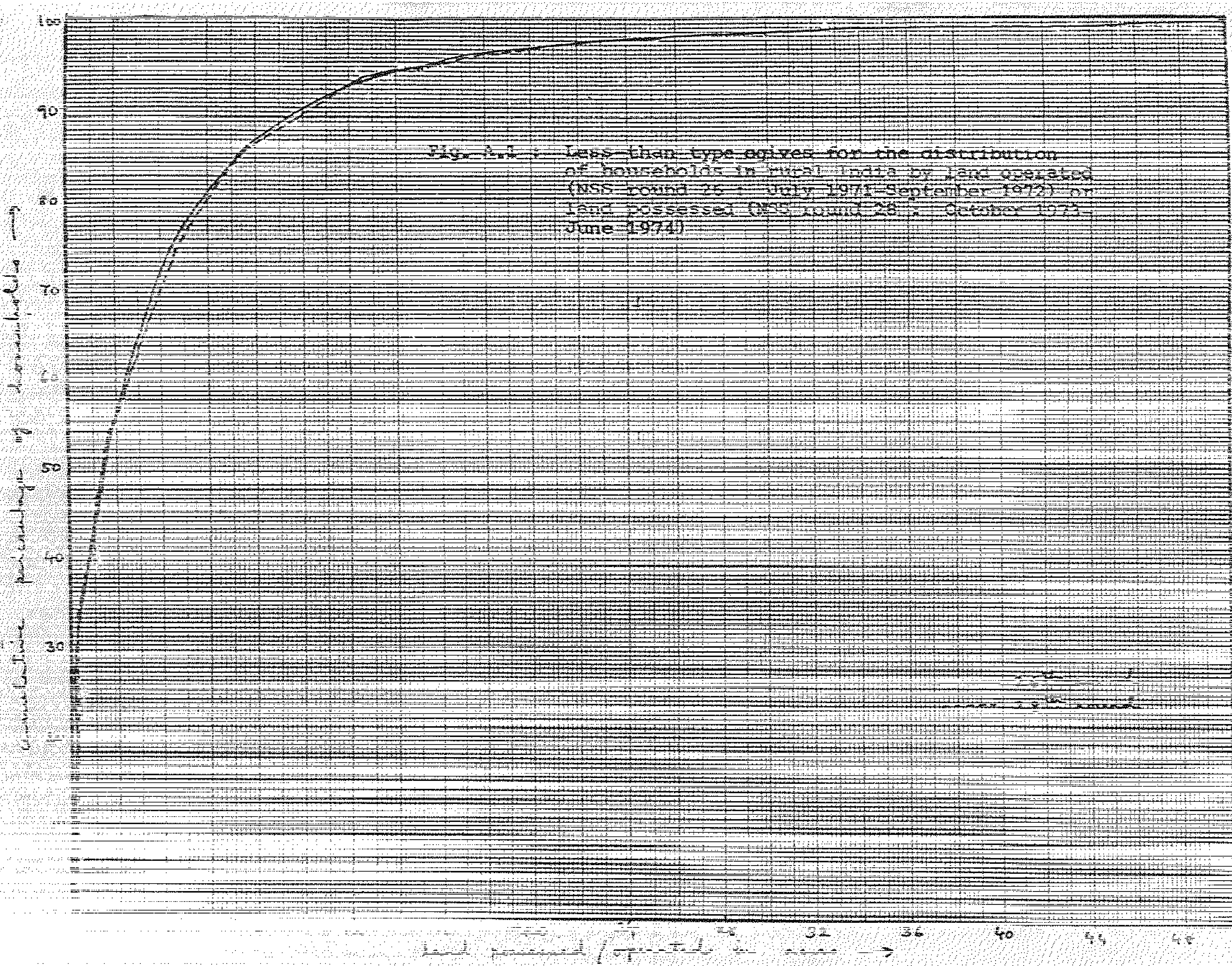

Fig. A.1 : Less-than type ogives for the distribution of households in rural India by land operated (NSS round 26 : July 1971–September 1972) or land possessed (NSS round 28 : October 1973–June 1974)

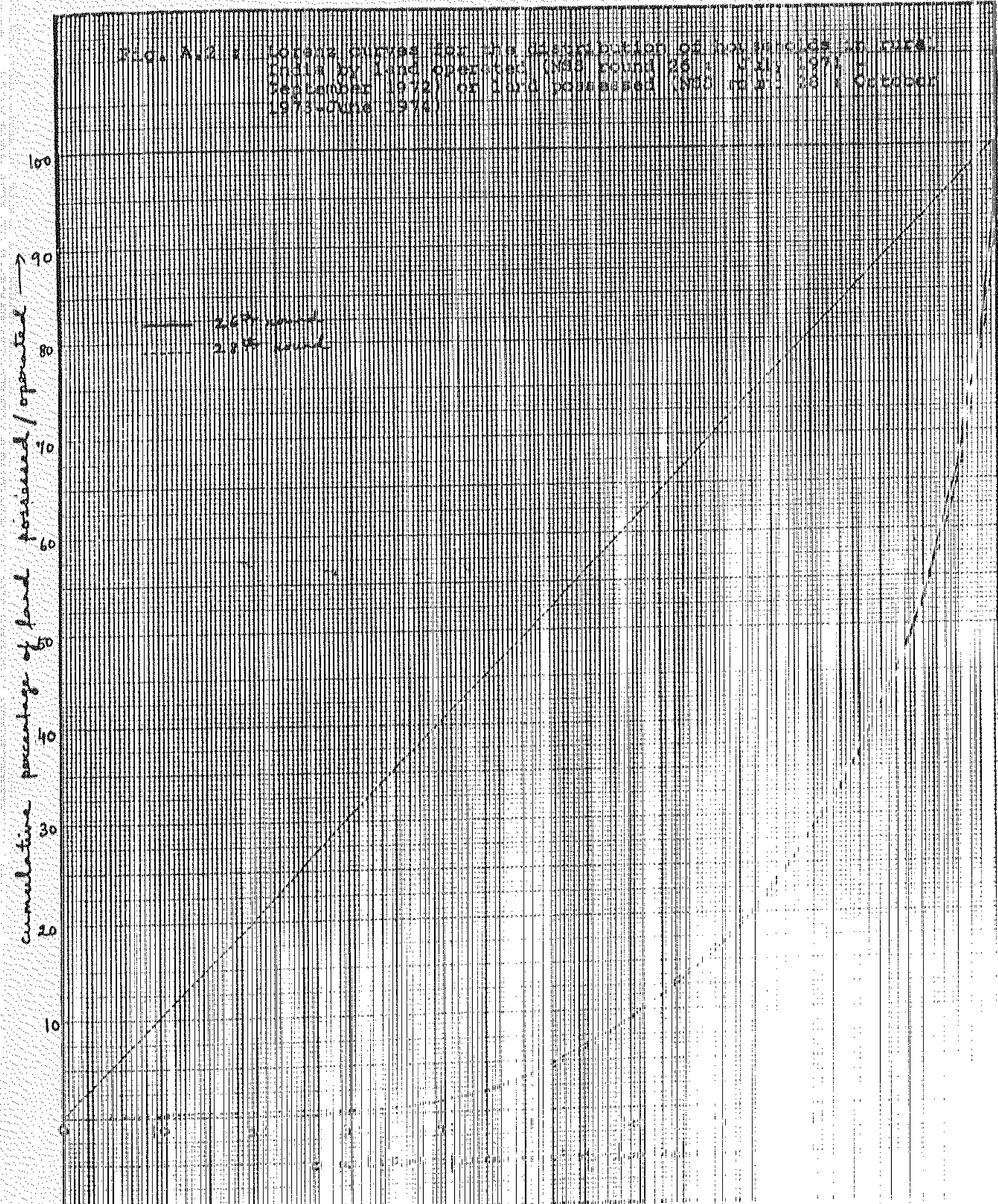

Fig. A.2 : Lorenz curves for the distribution of households in rural India by land operated (NSS Round 26 : July 1971 – September 1972) or land possessed (NSS Round 28 : October 1973–June 1974)

Appendix B

List of NSS regions with their composition : Twentyeighth Round (1973-74)

srl. no.	state	region		
		no.	description	composition (districts)
(1)	(2)	(3)	(4)	(5)
1.	Andhra Pradesh	1	Coastal	Srikakulam, Vishakapatnam, East Godavari, West Godavari, Krishna, Guntur, Ongole and Nellore.
2.		2	Inland, Northern	Adilabad, Karimnagar, Nizamabad, Medak, Warrangal, Khammam, Nalgonda, Hyderabad and Mehboobnagar.
3.		3	Inland, Southern	Kurnool, Anantapur, Cuddapah and Chittoor.
4.	Assam	1	Plains	Lakhimpur, Sibsagar, Darrang, Nowgong, Kamrup, Goalpara and Cachar.
5.		2	Hills	Mikir Hills and North Cachar Hills.
6.	Bihar	1	Southern	Santhal Parganas, Dhanbad, Hazaribagh, Palamau, Ranchi and Singhbhum.
7.		2	Northern	Purnea, Saharsa, Darbhanga, Muzaffarpur, Champaran and Saran.
8.		3	Central	Bhagalpur, Mongyr, Patna, Gaya and Shahabad.
9.	Gujarat	1	Eastern	Sabarkantha (Tehsils Khedbrahma, Vijayanagar, Bhiloda and Meghraj), Panchmahals (Tehsils Limkheda, Dohad, Jhalod and Santrampur), Vadodara (Tehsils Nasvadi, Tilkwada, Chotta-Udaipur and Jabugam), Bharuch (Tehsils Ankleshwar, Valia, Jagadia, Dadipada, Sagbara and Nandod Surat (Tehsils Vyara, Mahuva, Valod, Songadh, Mandvi, Uchhal, Nizar, Mangral, Balsana, and Bardoli), Dangs (Tehsil Dangs) and Valsad (Tehsils Dharampur, Chikhli, Bansada, Umbargaon, Valsad and Pardi).
10.		2	Plains, Northern	Sabarkantha (Tehsils Prantij, Modasa, Himatnagar, Malpur, Bayed and Idar), Mehsana (Tehsil Sidhpur, Patan, Mehasana, Kheralu, Visnagar, Vijapur, Kadi and Kalol), Ahmedabad (all Tehsils), Gandhi Nagar (all Tehsils) and Kheda (all Tehsils).
11.		3	Plains, Southern	Panchmahals (Tehsils Halol, Kalol, Godhra, Devgadhbarai, Jambughada, Shahera and Lunawada), Vadodara (Tehsils Savli, Debhoi, Sihar, Karjan, Padra, Waghodia, Vadodara and Sankheda), Bharuch (Tehsils Hanset, Vagra, Amod, Jambusar and Bharuch), Surat (Tehsils Ghorasi, Kamrej and Olpad) and Valsad (Tehsils Gandevi and Navsari).
12.		4	Dry Areas	Banaskantha (all Tehsils), Kutch (all Tehsils), Mehsana (Tehsils Chamsma, Sami and Harij), and Surendranagar (all Tehsils).
13.		5	Saurashtra	Rajkot (all Tehsils), Bhavnagar (all Tehsils), Amreli (all Tehsils) Junagadh (all Tehsils) Kamnagar (all Tehsils).
14.	Haryana	1	Eastern	Karnal, Ambala, Rohtak, Gurgaon, Kurukshetra and Sonepat.
15.		2	Western	Mohindergarh, Jind, Hissar and Bhiwani.

Appendix B (Continued)

srl. no.	state	region		
		no.	description	composition (districts)
(1)	(2)	(3)	(4)	(5)
16.	Himachal Pradesh	1	Himachal Pradesh	Chamba, Mardi, Bilaspur, Solan, Sirmur, Kinnaur, Simla, Kangra, Kulu, Lahaul and Spiti, Hamirpur and Una.
17.	Jammu and Kashmir	1	Mountainous	Jammu and Kathua.
18.		2	Outer Hills	Doda, Udhampur, Poonch and Rajouri.
19.		3	Jhelum Valley	Baramulla, Srinagar and Anantanag.
20.	Kerala	1	Northern	Cannanore, Koshikode, Mallappuram and Palghat.
21.		2	Southern	Tirchur, Ernakulam, Kottayam, Alleppy, Quilon and Trivandrum.
22.	Madhya Pradesh	1	Eastern	Surguja, Raigarh, Bilaspur, Raipur, Durg, Balaghat, Bastar and Rajnandgaon.
23.		2	Inland, Eastern	Sidhi, Rewa, Satna, Panna, Jabalpur Shahdol, Mandia and Seoni.
24.		3	Inland, Western	Dameh, Sagar, Vidisha, Sehore, Bhopal, Narsimhapur, Chhindwara, Hosangabad and Betul.
25.		4	Western	Mandsaur, Rajgarh, Shajapur, Ujjain, Ratlam, Jhabua, Dhar, Indore-Dewas, Khargone and Khandwa.
26.		5	Northern	Chhatarpur, Tikamgarh, Bhind, Datia, Gwalior, Morena, Shivpuri and Guna.
27.	Maharashtra	1	Coastal	Thana, Greater Bombay, Kalaba and Ratnagiri.
28.		2	Inland, Western	Ahmednagar, Poona, Sholapur, Satara, Sangli and Kolhapur.
29.		3	Inland, Northern	Jalgaon, Dhulia and Nasik.
30.		4	Inland, Central	Aurangabad, Bhir, Parbhani, Nanded and Osmanabad.
31.		5	Inland, Eastern	Nagpur, Wardha, Amaravati, Buldana, Akola and Yeotmal.
32.		6	Eastern	Bhandara and Chandrapur.
33.	Manipur	1	Plains	Central.
34.		2	Hills	West, North, East and South.
35.	Meghalaya	1	Meghalaya	Khasi Hills, Jaintia Hills and Garo Hills.
36.	Mysore	1	Coastal and Ghats	North Kanara and South Kanara.
37.		2	Inland, Eastern	Shimoga, Chikmagalur, Hassan and Coorg.
38.		3	Inland, Southern	Kolar, Tumkur, Bangalore, Mandya and Mysore.
39.		4	Inland, Northern	Bidar, Gulbarga, Bijapur, Belgaum, Dharwar, Raichur, Bellary and Chitaldrug.
40.	Nagaland	1	Nagaland	Kohima, Mokokchung and Tuensang.
41.	Orissa	1	Coastal	Balasore, Cuttack, Puri and Ganjam (Plains).
42.		2	Southern	Ganjam (Agency), Baudh Khandmahals, Kalahandi and Koraput.
43.		3	Northern	Mayurbhanj, Keonjhar, Sundergarh, Sambalpur, Dhenkanal and Bolangir.

Appendix B (Concluded)

srl. no.	state	region		
		no.	description	composition (districts)
(1)	(2)	(3)	(4)	(5)
44.	Punjab	1	Northern	Gurdaspur, Amritsar, Kapurthala, Jullunder, Ludhiana, Hoshiarpur, and Ropar.
45.		2	Southern	Patiala, Sangrur, Ferozepur and Bhatinda.
46.	Rajasthan	1	Western	Jhunjhuna, Sikar, Ghuru, Bikaner, Nagaur, Jodhpur, Jaisalmer, Barmer and Jalore.
47.		2	North Eastern	Ganganagar, Alwar, Bharatpur, Sawani, Madhopur, Jaipur, Tonk, Bhilwara, Ajmer and Pali.
48.		3	Southern	Banawara, Dungarpur, Udaipur and Sirohi.
49.		4	South Eastern	Jhalawar, Kotah, Bundi and Chittargarh.
50.	Tamil Nadu	1	Coastal, Northern	Madras, Chingleput, North Arcot, and South Arcot.
51.		2	Coastal, Southern	Thanjavur, Ramanathapuram, Tirunelveli and Kanyakumari.
52.		3	Inland	Salem, Dharmpuri, Tiruchirapalli, Madurai, Coimbatore and the Nilgiris.
53.	Tripura	1	Tripura	West Tripura, North Tripura and South Tripura.
54.	Uttar Pradesh	1	Himalayan	Pithorgarh, Chamoli, Uttarkashi, Dehradun, Tehri Garhwal, Garhwal, Almora and Nainital.
55.		2	Western	Saharanpur, Muzaffarnagar, Bijnor, Meerut, Moradabad, Bulandshahr, Rampur, Bareilly, Pillibhit, Shajhananpur, Budaur, Aligarh, Mathura, Etah, Farukkabad, Mainpuri, Etawah and Agra.
56.		3	Central	Kheri, Sitapur, Hardoi, Lucknow, Barabanki, Raibareilly, Unnao, Fatehpur and Kanpur.
57.		4	Eastern	Bahraich, Gonda, Basti, Gorakhpur, Deoria, Ballia, Azamgarh, Faizabad, Sultanpur, Jaunpur, Ghazipur, Varanashi, Mirzapur, Allahabad and Pratapgarh.
58.		5	Southern	Banda, Himirpur, Jalaun and Jhansi.
59.	West Bengal	1	Himalayan	Darjeeling, Jalpaiguri and Cooch Bihar.
60.		2	Eastern plains	West Dinajpur, Malda, Murshidabad, Nadia and Birbhum.
61.		3	Central plains	24-Parganas, Calcutta, Howrah, Hooghly and Burdwan.
62.		4	Western plains	Bankura, Purulia and Midnapur.
63.	Arunachal Pradesh	1	Hills	Kameng, Subansiri, Siang, Lohit and Tirap.
64.	Chandigarh	1	Chandigarh	Chandigarh.
65.	Delhi	1	Delhi	Delhi.
66.	Goa, Daman and Diu	1	Goa, Daman and Diu	Goa, Daman and Diu.
67.	Pondicherry	1	Pondicherry	Pondicherry, Karikal, Mahe and Yenam.

Appendix C

SOME EXERCISES ON THE VALIDITY OF THE T-TESTS REPORTED IN CHAPTER 6

C.1 Introduction

The t-tests and F-tests carried out in Chapter 6 in the context of the multiple linear regression model for ln PCE assumed, among other things, that the error terms (ε_i's) are spherical and that the NSS sample of households is a simple random sample selected with replacement. However, for the NSS household budget data, the assumption of spherical error terms is likely to be violated. One likely source of trouble is that the NSS design is a complicated one involving stratification, multistage selection, systematic sampling, etc. The t-test and F-tests performed might, therefore, be inappropriate and mislead in the choice of regressors. Some attempt is made in this Appendix to check the validity of these t-tests for the final regression model, using alternative estimates of standard errors of the estimated regression coefficients. Section C.2 examines the possible effects of heteroscedastic disturbances using White's method of handling heteroscedasticity; and Section C.3 employs standard errors based on half-samplewise estimates, that take into account all the complications of the NSS sampling design, to re-examine the significance of the estimated regression coefficients.

C.2 Examination of Possible Effects of Heteroscedasticity

The regression models developed in Chapter 6 are of the form

$$\ln PCE_i = \beta_0 + \sum_{j=1}^{r} x_{ij} \beta_j + \varepsilon_i \qquad \ldots (C.1)$$

where i = 1, 2, ..., n, n being the number of sample households in a state. The assumptions made about the disturbances (ε_i's) are

(i) $E(\varepsilon_i) = 0$, $i = 1, 2, \ldots, n$;

(ii) $E(\varepsilon_i x_{ij}) = 0$, ($\varepsilon_i$'s are independent of x_{ij}), $i = 1, 2, \ldots, n$, $j = 1, 2, \ldots, r$;

(iii) $E(\varepsilon_i^2) = \sigma^2$, $i = 1, 2, \ldots, n$; that is, the disturbances are homoscedastic or have equal variances; and

(iv) $E(\varepsilon_i \varepsilon_j) = 0$, $i \neq j$, $i, j = 1, 2, \ldots, n$; in other words, the disturbances are pairwise uncorrelated.

In addition, for tests of significance, ε_i's were assumed to be normally distributed.

In the multiple linear regression models developed in Chapter 6, dummy variables were employed to characterize households belonging to different categories (viz., regions, social groups, occupations). It may not be safe to assume that the disturbances for households belonging to different categories will have the same variance. Thus, the assumption of homoscedasticity is likely to be violated. As mentioned in Section 6.1, the logarithm of PCE was taken as the regressand in the hope of reducing the extent of heteroscedasticity. However, this may not completely eliminate the problem of heteroscedasticity.

Model (C.1) can be written in the form

$$\underline{y} = X\underline{\beta} + \underline{\varepsilon} \qquad \ldots \text{(C.2)}$$

where $\underline{y}' = (\ln PCE_1, \ln PCE_2, \ldots, \ln PCE_n)$,

$$X = \begin{pmatrix} 1 & x_{11} & \cdots\cdots & x_{1r} \\ 1 & x_{21} & \cdots\cdots & x_{2r} \\ \cdot & \cdot & \cdots & \cdot \\ 1 & x_{n1} & \cdots\cdots & x_{nr} \end{pmatrix}$$ is the

matrix of observations on independent variables,
$\underline{\beta}' = (\beta_0, \beta_1, \ldots, \beta_r)$, $\underline{\varepsilon}' = (\varepsilon_1, \varepsilon_2, \ldots, \varepsilon_n)$.

In the presence of heteroscedasticity, $V(\underline{\varepsilon}) = \text{diag}(\sigma_1^2, \sigma_2^2, \ldots, \sigma_n^2) = \Sigma$, say, that is, $V(\varepsilon_i) = \sigma_i^2$, $i = 1, 2, \ldots, n$, where σ_i^2 may vary with i.

On application of the Generalised Least Squares (GLS) method, the estimator of β is given by

$$\hat{\underline{\beta}} = (X'\Sigma^{-1}X)^{-1} \; X'\Sigma^{-1}\,\underline{y} \qquad \ldots \text{(C.3)}.$$

and the covariance matrix of the estimated parameters $\hat{\underline{\beta}}$ is given by

$$V(\hat{\underline{\beta}}) = (X'\Sigma^{-1}X)^{-1} \qquad \ldots (C.4).$$

In such a model, if β is estimated by OLS, then the OLS estimator

$$\underline{b} = (X'X)^{-1} X' \underline{y} \qquad \ldots (C.5)$$

is unbiased. However, $\hat{\underline{\beta}}$ given by (C.3) is the minimum variance unbiased estimator of $\underline{\beta}$ and, therefore, $\underline{b}$ is less efficient than $\hat{\underline{\beta}}$. However, since the number of sample households is fairly large for each of the states, the loss in efficiency (that is, increase in standard errors) due to use of OLS may not be serious.

The really serious implication of the presence of heteroscedasticity for the OLS estimator of $\underline{\beta}$ is that the estimated covariance matrix of the parameters

$$\widehat{V(\underline{b})} = \hat{\sigma}^2 (X'X)^{-1} \qquad \ldots (C.6.1)$$

where, $$\hat{\sigma}^2 = \frac{1}{n-r-1} \sum_{i=1}^{n} \left[\ln PCE_i - b_o - \sum_{j=1}^{r} b_j x_{ij} \right]^2 \qquad \ldots (C.6.2)$$

is an inconsistent estimator of the true covariance matrix of b. The standard errors obtained from (C.6.1)-(C.6.2) may, therefore, be seriously misleading. In some situations, this inconsistency of $\widehat{V(\underline{b})}$ may cause the t- and

F-statistics for testing hypotheses regarding regression coefficients to be unduly large or small and hence lead to a wrong selection of the set of regressors.

A useful technique for overcoming such problems caused by heteroscedastic disturbances was suggested by White (1980), who showed that if M is a diagonal matrix with the squares of the OLS residuals, e_i's on the diagonal, that is,

$$M = \text{diag}\,(e_1^2, e_2^2, \ldots, e_n^2) \qquad \ldots(C.7.1)$$

then $$\bar{V} = (X'X)^{-1} X'M X(X'X)^{-1} \qquad \ldots(C.7.2)$$

is a consistent estimator of the true covariance matrix of b. The standard errors obtained from (C.7.1)-(C.7.2) can be compared with those obtained by the OLS method, that is from (C.6.1)-(C.6.2), to check whether the regressors selected on the basis of usual t-ratios are indeed significant (at two-sided 20 per cent level) (*vide* Deaton (1980)). This was done in the present study for three states, viz., Rajasthan, Punjab and West Bengal and the results are reported below.

Tables C.1.1 to C.1.3 present the conventional (OLS-based) standard errors and t-values together with those obtained by White's method for these three states[1/]. The

[1/] The half-sample-based standard errors and t-values discussed in the next Section are also presented in these tables.

Table C.1.1 : SE's and t-values of estimated regression coefficients obtained by three different approaches : Rajasthan

Variable	Regression coefficient	standard error			t		
		OLS formula	Half-sample based	White's formula	OLS formula	Half-sample based	based on White's s.e.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	4.354	0.042	0.011	0.044	103.66	407.90	99.09
ln PCL	0.030	0.009	0.015	0.010	3.27**	2.01	2.95**
N_c	-0.044	0.011	0.008	0.010	- 3.97**	- 5.71	-4.23**
REG1	-0.129	0.048	0.039	0.047	- 2.69**	- 3.35	-2.75**
REG2	-0.376	0.057	0.072	0.054	- 6.57**	- 5.23	-6.93**
REG3	-0.191	0.058	0.034	0.057	- 3.26**	- 5.56	-3.33**
GP1	-0.162	0.050	0.020	0.045	- 3.23**	- 8.01+	-3.59**
GP2	-0.233	0.054	0.002	0.053	- 4.31**	-105.04**	-4.40**
OC5	0.705	0.146	0.197	0.188	4.83**	3.59	3.75**
N_f x OC5	-0.194	0.081	0.008	0.068	- 2.40	-23.84*	-2.87**
N_c x OC5	-0.095	0.043	0.061	0.040	- 2.21*	- 1.56	-2.37*

Note : ** means significant at two-sided 1 per cent level, * means significant at two-sided 5 per cent level and + means significant of two-sided 10 per cent level.

Table C.1.2 : SE's and t-values of estimated regression coefficients obtained by three different approaches : Punjab

Variable	Regression coefficient	standard error			t		
		OLS formula	Half-sample based	White's formula	OLS formula	Half-sample based	based on White's s.e.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	4.719	0.030	0.022	0.032	157.81	211.02	147.90
ln PCL	0.059	0.006	0.005	0.006	10.00**	11.76+	9.75**
N_c	-0.107	0.009	0.008	0.009	-12.24**	-13.45*	-12.01**
N_f x GP1	-0.116	0.028	0.015	0.021	- 4.22**	- 7.86+	- 5.65**

Note : See note below Table C.1.1.

Table C.1.3 : *SE's and t-values of estimated regression coefficients obtained by three different approaches* : West Bengal

Variable	Regression Coefficient	standard error			t		
		OLS formula	Half-sample based	White's	OLS formula	Half-sample based	based on White's s.e.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	4.318	0.052	0.026	0.051	83.38	167.94	84.74
ln PCL	0.190	0.022	0.020	0.025	8.54**	9.31+	7.60**
N_m	0.090	0.019	0.012	0.016	4.76**	7.23+	5.48**
N_c	-0.072	0.011	0.007	0.011	-6.26**	- 9.71+	-6.67**
REG1	-0.283	0.069	0.113	0.063	-4.11**	- 2.51	-4.52**
ln PCL x REG1	-0.051	0.023	0.006	0.023	-2.21*	- 7.92+	-2.23*
REG2	-0.450	0.073	0.013	0.070	-6.12**	-35.33*	-6.38**
ln PCL x REG2	-0.041	0.015	0.011	0.014	-2.79**	- 3.79	-2.89**
N_f x REG2	0.091	0.032	0.038	0.035	2.80**	2.38	2.60**
REG3	-0.304	0.062	0.034	0.067	-4.91**	- 9.02+	-4.56**
N_f x REG3	0.064	0.034	0.004	0.037	1.85+	16.23*	1.74+
GP1	-0.107	0.067	0.010	0.073	-1.59	-10.29+	-1.46
N_m x GP1	-0.110	0.033	0.013	0.036	-3.32**	- 8.36+	-3.11**
N_c x GP1	0.050	0.017	0.010	0.017	2.89**	5.18	2.99**
ln PCL x GP2	-0.048	0.018	0.019	0.015	-2.71**	- 2.50	-3.15**
N_m x GP2	-0.127	0.031	0.040	0.030	-4.14**	- 3.20	-4.28**
ln PCL x GP3	0.042	0.011	0.004	0.011	3.80**	9.42+	3.73**
OC1	-0.234	0.074	0.028	0.072	-3.14**	- 8.47+	-3.25**
ln PCL x OC1	-0.092	0.024	0.008	0.026	-3.75**	-10.87+	-3.50**
N_c x OC1	-0.039	0.018	0.007	0.017	-2.20*	- 5.23	-2.29*
ln PCL x OC2	-0.107	0.025	0.066	0.031	-4.29**	- 1.63	-3.44**
N_m x OC2	0.111	0.041	0.011	0.035	2.72**	9.74+	3.15**
N_c x OC2	-0.082	0.026	0.031	0.029	-3.11**	- 2.64	-2.86**
ln PCL x OC3	-0.112	0.028	0.079	0.039	-4.05**	- 1.41	-2.88**
N_m x OC3	0.151	0.055	0.002	0.084	2.76**	62.12*	1.81+
N_f x OC3	-0.216	0.058	0.157	0.079	-3.73**	- 1.37	-2.73**
ln PCL x OC4	-0.095	0.026	0.032	0.028	-3.61**	- 2.99	-3.38**
N_c x OC4	-0.037	0.023	0.033	0.024	-1.59	- 1.11	-1.53
SR2	0.157	0.055	0.068	0.055	2.86**	2.29	2.83**
N_f x SR2	-0.081	0.032	0.016	0.033	-2.52*	- 4.99	-2.46*
ln PCL x SR3	-0.040	0.011	0.009	0.011	-3.69**	-4.51	-3.58**
N_m x SR3	0.028	0.020	0.030	0.018	1.40	0.91	1.51

Note : See note below Table C.1.1.

Table C.2 : Joint distribution of t-values for all the estimated regression coefficients for the states of Rajasthan, Punjab and West Bengal obtained by OLS approach and by White's approach

	t (OLS approach)	t (based on White's estimate of standard error)							
		-ve coefficients				+ve coefficients			
		**	*	+	non-sig.	non-sig.	+	*	**
-ve coefficient	**	24							
	*	1	4						
	+								
	non-sig.				2				
+ve coefficient	non-sig.					1			
	+						1		
	*								
	**						1		10

Note : ** means significant at two-sided 1 per cent level
* " " " " 5 " " "
+ " " " " 10 " " "

standard errors of estimated regression coefficients estimated by the two methods appear to be fairly close. The significance levels of the t-values of coefficients obtained by the two methods are compared in Table C.2. This is a two-way table, where the columns represent intervals of t-values obtained by employing standard errors estimated by White's method, corresponding to different levels of significance, while the rows represent corresponding intervals of t-values based on the conventional OLS approach. A typical cell gives the number of regression coefficients whose t-values by the two methods fall in that cell. The statewise results for all the regressors are considered together in forming the table. The table below summarises the results further : it shows that, in general, the t-tests based on OLS standard errors agree well with those based on White's estimates of standard errors for the three states under consideration.

t-value	number of t-values significant at					
	lower 0.5% level	lower 2.5% level	lower 5% level	upper 5% level	upper 1.5% level	upper 0.5% level
1. based on OLS approach	24	5	0	1	0	11
2. based on White's method	25	4	0	2	0	10

C.2 Comparisons with Half-sample-based Standard Errors and t-values

In the analyses made in Chapter 6, the NSS sample of households was treated as a simple random sample selected with replacement for the calculation of standard errors and tests of significance. Such a treatment may be unwarranted, since the NSS design has many complications - e.g., stratification, multi-stage selection, systematic sampling, etc. Also, the data are affected by various types of non-sampling error, which may be partly random and, therefore, amenable to laws of probability. The Mahalanobis technique of inter-penetrating samples has been widely used for assessment of margin of uncertainty associated with the estimates based on such samples. In this procedure, the combined sample is divided into two (or more) independent and inter-penetrating half-samples (or sub-samples) such that each of these gives an equally valid estimate of the population characteristic. The divergence between these half-sampleswise (or sub-samplewise) estimates indicates the margin of uncertainty associated with the combined sample estimate.

In this background, standard errors based on half-samplewise estimates are examined and used to study the significance levels of the estimated regression coefficients for all the nine states. Standard errors of regression coefficients estimated from the combined sample are estimated as follows from the half-samplewise estimates of these coefficients :

$$s.e._h(\hat{\beta}_i) = \frac{\left|\hat{\beta}_{i,1} - \hat{\beta}_{i,2}\right|}{2} \qquad \text{... (C.8)}$$

where $\hat{\beta}_{i,j}$ = estimate of β_i from half-sample j, j = 1,2 ;

$\hat{\beta}_i$ = combined sample estimate of β_i,

and i = 1,2,..., r.

The corresponding t-values are then

$$t_h\,(\hat{\beta}_i) = \frac{\hat{\beta}_i}{s.e._h\,(\hat{\beta}_i)} \qquad \text{... (C.9)}$$

The statistic $t_h(\hat{\beta}_i)$ ~ Student's t with 1 d.f. under the null hypothesis H_o : $\beta_i = 0$.

As already mentioned, the half-sample based estimates of standard error and t-values of the estimated regression coefficients are shown in Tables C.1.1 to C.1.3 for the states of Rajasthan, Punjab and West Bengal. For the six remaining states, viz., Uttar Pradesh, Orissa, Tamil Nadu, Kerala, Gujarat and Maharashtra, the conventional (OLS) standard errors and t-values are presented together with half-sample based standard errors and t-values in Tables C.3.1 to C.3.6. The half-sample based standard errors of the estimated coefficients of **regressors** are observed to vary to a

Table C.3.1. : *SE's* and t-values of estimated regression coefficients obtained by two different approaches : Uttar Pradesh

Variable	Regression Coefficient	standard error		t	
		OLS formula	Half-sample based	OLS formula	Half-sample based
(1)	(2)	(3)	(4)	(5)	(6)
Intercept	4.019	0.028	0.008	143.63	534.49
ln PCL	0.071	0.010	0.017	7.29**	4.17
N_m	0.056	0.013	0.001	4.48**	67.29**
N_c	-0.053	0.007	0.005	- 8.15**	- 9.98+
N_f x REG1	-0.079	0.027	0.027	- 2.96**	- 2.89
N_m x REG2	-0.070	0.016	0.005	- 4.35**	-14.07*
N_m x REG3	-0.054	0.018	0.028	- 2.92**	- 1.95
N_f x REG3	0.032	0.017	0.001	1.89+	25.26*
N_m x REG4	-0.049	0.026	0.029	- 1.90+	- 1.67
GP1	-0.145	0.024	0.010	- 6.03**	-13.88*
OC1	-0.103	0.055	0.052	- 1.86+	- 1.97
ln PCL x OC1	-0.048	0.015	0.016	- 3.13**	- 2.97
N_c x OC1	-0.032	0.014	0.010	- 2.19*	- 3.05
OC2	0.198	0.106	0.062	1.86+	3.18
ln PCL x OC2	-0.070	0.023	0.037	- 3.06**	- 1.87
N_m x OC2	0.138	0.050	0.041	2.78**	3.35
N_f x OC2	-0.121	0.059	0.018	- 2.06*	- 6.86+
N_c x OC2	-0.084	0.026	0.002	- 3.22**	-39.47*
OC3	0.450	0.127	0.215	3.54**	2.09
ln PCL x OC3	-0.048	0.024	0.027	- 1.99*	- 1.82
N_m x OC3	-0.210	0.056	0.083	- 3.75**	- 2.53
N_c x OC3	-0.075	0.026	0.045	- 2.93**	- 1.66
OC4	0.288	0.098	0.008	2.94**	37.81*
ln PCL x OC4	-0.047	0.020	0.030	- 2.33*	- 1.56
N_f x OC4	-0.117	0.038	0.010	- 3.06**	-11.17+
N_c x OC4	-0.067	0.023	0.027	- 2.92**	- 2.53
SR2	0.084	0.023	0.004	3.62**	23.34*
SR3	0.138	0.023	0.006	5.89**	24.48*

Note : See note below Table C.1.1.

Table C.3.2 : SE's and t-values of estimated regression coefficients obtained by two different approaches : Orissa

Variable	Regression coefficient	standard error		t	
		OLS formula	Half-sample based	OLS formula	Half-sample based
(1)	(2)	(3)	(4)	(5)	(6)
Intercept	3.924	0.031	0.025	128.60	154.26
ln PCL	0.054	0.011	0.017	5.09**	3.14
REG1	-0.227	0.067	0.088	- 3.39**	- 2.58
ln PCL x REG1	-0.050	0.017	0.020	- 2.88*	- 2.44
N_c x REG1	-0.071	0.023	0.022	- 3.12**	- 3.28
N_m x REG2	-0.038	0.027	0.016	- 1.40	- 2.37
N_c x REG2	-0.062	0.018	0.030	- 3.41**	- 2.04
GP1	-0.132	0.046	0.004	- 2.90**	-30.43*
GP2	-0.157	0.040	0.023	- 3.88**	- 6.97^{+}
N_m x OC1	0.103	0.034	0.038	3.05**	2.73
N_f x OC1	-0.101	0.035	0.001	- 2.87**	-131.32**
N_c x OC1	-0.085	0.019	0.012	- 4.43**	- 7.25^{+}
ln PCL x OC2	-0.092	0.028	0.001	- 3.33**	-151.38**
N_m x OC2	0.403	0.073	0.108	5.49**	3.74
N_f x OC2	-0.414	0.073	0.041	- 5.63**	-10.10^{+}
OC3	0.597	0.173	0.251	3.46**	2.38
N_f x OC3	-0.234	0.121	0.093	- 1.93^{+}	- 2.51
OC4	0.545	0.118	0.097	4.60**	5.59
N_f x OC4	-0.308	0.086	0.081	- 3.59**	- 3.82
SR3	0.192	0.032	0.070	5.96**	2.73

Note : See note below Table C.1.1.

Table C.3.3 : SE's and t-values of estimated regression coefficients obtained by two different approaches : Tamil Nadu

Variable	Regression coefficient	standard error		t	
		OLS formula	Half-sample based	OLS formula	Half-sample based
(1)	(2)	(3)	(4)	(5)	(6)
Intercept	4.243	0.038	0.051	111.44	83.59
ln PCL	0.039	0.007	0.001	5.31**	43.36*
N_f	-0.102	0.025	0.071	- 4.10**	- 1.44
N_c	-0.066	0.016	0.036	- 4.23**	- 1.83
N_m x REG1	-0.062	0.020	0.006	- 3.16**	- 9.84$^+$
N_m x REG2	-0.110	0.028	0.074	- 4.00**	- 1.48
N_f x REG2	0.117	0.031	0.067	3.79**	1.75
N_f x OC1	-0.142	0.028	0.004	- 5.02**	-34.00*
N_c x OC1	-0.034	0.017	0.015	- 1.97*	- 2.27
ln PCLxOC3	-0.046	0.023	0.012	- 2.05*	- 3.87
N_f x OC3	-0.110	0.071	0.018	- 1.54	- 6.29
ln PCLxOC4	-0.040	0.015	0.008	- 2.60**	- 5.15
N_c x OC4	-0.069	0.029	0.001	- 2.37*	-61.76*
N_f x SR2	0.093	0.028	0.042	3.37**	2.20
N_c x SR2	-0.051	0.019	0.031	- 2.66**	- 1.64
N_m x SR3	0.110	0.024	0.073	4.58**	1.49
N_c x SR3	-0.029	0.019	0.069	- 1.50	- 0.42

Note : See note below Table C.1.1.

Table C.3.4 : SE's and t-values of estimated regression coefficients obtained by two different approaches : Kerala

Variable	Regression coefficient	standard error		t	
		OLS formula	Half-sample based	OLS formula	Half-sample based
(1)	(2)	(3)	(4)	(5)	(6)
Intercept	4.559	0.062	0.096	73.62	47.49
ln PCL	0.122	0.019	0.016	6.33**	7.47^{+}
N_c	-0.109	0.019	0.024	-5.82**	- 4.53
ln PCL x GP1	-0.053	0.033	0.064	-1.58	- 0.82
N_m x GP1	-0.098	0.062	0.032	-1.58	- 3.04
N_f x GP1	-0.141	0.067	0.080	-2.10*	- 1.76
N_c x GP1	0.059	0.044	0.038	1.34	1.56
GP3	-0.189	0.126	0.031	-1.50	- 6.05
ln PCL x GP3	0.059	0.033	0.007	1.81^{+}	8.67^{+}
N_c x GP3	0.060	0.028	0.026	2.13*	2.33
GP4	-0.151	0.077	0.028	-1.97*	- 5.31
N_c x GP4	0.043	0.027	0.004	1.55	10.10^{+}
OC1	-0.286	0.113	0.064	-2.53*	- 4.45
ln PCL x OC1	-0.077	0.033	0.008	-2.34*	-10.12^{+}
N_c x OC1	-0.073	0.029	0.044	-2.51*	- 1.64
OC2	0.277	0.131	0.002	2.12*	114.65**
ln PCL x OC2	-0.118	0.033	0.005	-3.56**	-26.09*
N_c x OC2	-0.089	0.033	0.005	-2.67**	-17.31*
OC3	0.546	0.135	0.049	4.02**	11.14^{+}
N_m x OC3	0.131	0.055	0.012	2.37*	10.64^{+}
N_f x OC3	-0.251	0.067	0.008	-3.75**	-33.26*
N_c x OC3	-0.069	0.034	0.035	-2.04*	- 1.96
ln PCL x OC4	-0.070	0.024	0.046	-2.91**	- 1.53
N_m x OC4	0.067	0.038	0.0004	-1.76^{+}	151.65**
N_f x OC4	-0.204	0.040	0.070	-5.12**	- 2.91

Note : See note below Table C.1.1.

Table C.3.5 : SE's and t-values of estimated regression coefficients obtained by two different approaches : Gujarat

Variable	Regression coefficient	standard error		t	
		OLS formula	Half-sample based	OLS formula	Half-sample based
(1)	(2)	(3)	(4)	(5)	(6)
Intercept	4.160	0.039	0.028	105.40	150.51
ln PCL	0.051	0.011	0.002	4.46**	31.43*
N_c	-0.066	0.009	0.010	- 7.20**	- 6.37$^+$
REG1	0.175	0.052	0.003	3.39**	56.12*
REG2	0.228	0.048	0.031	4.77**	7.26$^+$
REG3	0.140	0.050	0.017	2.77**	8.24$^+$
REG4	0.097	0.045	0.080	2.16*	1.22
GP2	-0.276	0.048	0.044	- 5.80**	- 6.23
ln PCL x OC1	-0.032	0.015	0.007	- 2.15*	- 4.65
N_m x OC1	-0.078	0.038	0.016	- 2.08*	- 4.79
N_f x OC1	-0.085	0.036	0.003	- 2.39*	-33.79*
OC5	0.512	0.092	0.215	5.55**	2.39
N_c x OC5	-0.114	0.027	0.045	- 4.26**	- 2.57
ln PCL x OC4	-0.048	0.021	0.005	- 2.26*	- 9.35$^+$
N_m x OC4	0.094	0.047	0.049	2.01*	1.93
N_f x OC4	-0.160	0.082	0.041	- 1.94$^+$	- 3.87

Note : See note below Table C.1.1.

Table C.3.6 : SE's and t-values of estimated regression coefficients obtained by two different approaches : Maharashtra

Variable	Regression coefficient	standard error		t	
		OLS formula	Half-sample based	OLS formula	Half-sample based
(1)	(2)	(3)	(4)	(5)	(6)
Intercept	4.063	0.045	0.019	89.79	207.94
ln PCL	0.051	0.012	0.001	4.09**	73.71**
N_f	0.029	0.021	0.009	1.40	3.23
N_c	-0.052	0.011	0.030	-4.90**	- 1.73
REG1	0.158	0.077	0.135	2.07*	1.17
N_f x REG1	-0.063	0.045	0.036	-1.42	- 1.77
REG4	0.087	0.040	0.030	2.19*	2.96
ln PCL x REG4	0.039	0.011	0.016	3.44**	2.50
REG5	0.251	0.110	0.035	2.29*	7.23+
N_m x REG5	-0.085	0.048	0.038	-1.77+	- 2.24
N_c x REG5	-0.048	0.031	0.016	-1.56	- 2.96
OC1	-0.102	0.070	0.048	-1.45	- 2.15
ln PCL x OC1	-0.044	0.014	0.015	-3.03**	- 2.93
N_f x OC1	-0.066	0.035	0.012	-1.90+	- 5.69
N_c x OC1	-0.033	0.017	0.033	-2.02*	- 1.01
OC2	0.179	0.142	0.233	1.26	0.77
ln PCL x OC2	-0.056	0.024	0.039	-2.35*	- 1.45
N_m x OC2	0.137	0.079	0.027	1.74+	5.02
N_c x OC2	-0.101	0.033	0.051	-3.07**	- 2.00
OC3	0.620	0.159	0.191	3.89**	3.24
N_f x OC3	-0.236	0.090	0.169	-2.61**	- 1.39
ln PCL x OC4	-0.048	0.019	0.004	-2.55*	-12.93*
N_c x OC4	-0.052	0.021	0.020	-2.52*	- 2.56

Note : See note below Table C.1.1.

large extent from those based on OLS method and also from those estimated by White's method. It may be recalled that the standard errors obtained by the latter two methods were found to be close, in general, in the previous Section.

As done in the previous Section, a two-way frequency table, Table C.4, is used to compare half-sample based t-values with those obtained by the OLS method. The columns of Table C.4 represent intervals of half-sample based t-values corresponding to different levels of significance, and the rows represent corresponding intervals of t-values based on the OLS approach. As in Table C.2, a typical cell of Table C.4 shows the number of estimated coefficients of regressors (taking the results for all the nine states and for all the regressors in the count) whose t-values by the conventional method and by the half-sample based method fall in that cell. It is found that, on the whole, the t-test based on half-sample estimates gives less significant conclusions about the regression coefficient both when t-values are positive and when t-values are negative. This should be clear from the summary table presented below :

t-value	number of t-values significant at					
	lower 0.5% level	lower 2.5% level	lower 5% level	upper 5% level	upper 2.5% level	upper 0.5% level
1. based on OLS approach	67	26	6	6	8	38
2. based on half-sample approach	3	14	19	13	9	4

Table C.4 : Joint distribution of t-values for all the estimated regression coefficients for all nine states obtained by OLS approach and using halfsample based SE's

	t (OLS approach)	t (half-sample based)							
		-ve coefficients				+ve coefficients			
		**	*	+	non-sig.	non-sig.	+	*	**
-ve coefficients	**	3	10	14	40				
	*		4	4	18				
	+				6				
	non-sig.			1	10				
+ve coefficients	non-sig.					4	1		
	+					2	1	2	1
	*					5	2		1
	**					20	9	7	2

Note : See note below Table C.2.

Table C.5 : Joint distribution of t-values for all the estimated regression coefficients for the states of Rajasthan, Punjab and West Bengal obtained by using half-sample based SE and by White's approach

t (half-sample based)		t (based on White's estimate of standard error)							
		-ve coefficient				+ve coefficient			
		**	*	+	non-sig.	non-sig.	+	*	**
-ve coefficients	**	1							
	*	3							
	+	7	1		1				
	non-sig.	14	3						
+ve coefficients	non-sig.				1	1			5
	+								5
	*						2		
	**								

Note : See note below Table C.2.

This difference could be expected, because half-samplewise results yield a rough standard error based on only 1 d.f. which will naturally lead to a t (on 1 d.f.) which is frequently inconclusive.

From the above discussions, one might also infer that half-sample based standard errors would give less significant results compared to White's estimates of standard errors. This is indeed so, as can be seen from Table C.5, where significance levels of t-values of estimated regression coefficients for the states of Rajasthan, Punjab and West Bengal, as obtained by the two methods, are compared.

On the other hand, conventional standard errors based on OLS method or standard errors estimated by White's procedure, in spite of being based on larger degrees of freedom, might be misleading because they completely ignore the complicated nature of the NSS sampling design and significant results from the half-sample based approach may be taken as more conclusive evidence than significant results by the two other approaches.

Appendix D

ESTIMATION OF THE LOGIT MODEL

D.1 Introduction

In Chapter 7, the logit model of poverty for a state was defined as

$$p_i = P(y_i = 1) = \frac{\exp\ (z^* - \underline{\beta}' \underline{x}_i)}{1 + \exp\ (z^* - \underline{\beta}' \underline{x}_i)} \qquad \ldots (D.1)$$

where y_i is an indicator variable defined as

$$y_i = \begin{cases} 1 & \text{if PCE of household } i \leq z, \text{ i.e., if household } i \text{ is poor,} \\ 0 & \text{otherwise;} \end{cases}$$

z is the poverty line for the state; $z^* = \ln z$;
$\underline{\beta}' = (\beta_0, \beta_1, \ldots, \beta_r)$ is a vector of parameters and
$\underline{x}_i' = (1, x_{i1}, x_{i2}, \ldots, x_{ir})$ is the vector of observations on explanatory variables of PCE or poverty, $i = 1, 2, \ldots, n$; n is the number of sample households in the state.

As mentioned in Section 7.3, this model was estimated by the method of maximum likelihood, employing the BMDP-79 (vide Dixon and Brown (eds.)(1979)) P3R program for non-linear regression. This program is based on the Gauss-Newton algorithm for non-linear regression modified to get maximum likelihood estimates of the parameters (vide Jennrich and Moore (1975)). The present appendix seeks to give a description of this method. Section D.2 gives a brief outline of the

Gauss-Newton algorithm, while the modifications incorporated to get maximum likelihood estimates of parameters are described in Section D.3.

D.2 The Gauss-Newton Algorithm for Non-Linear Regression

As in the linear regression model, one can write

$$y_i = E(y_i) + \varepsilon_i \qquad \ldots \text{(D.2)}$$

where $E(\varepsilon_i) = 0$, $i = 1, 2, \ldots, n$. Since $E(y_i)$ is a non-linear function of the parameters $\beta_0, \beta_1, \ldots, \beta_r$, one can write

$$E(y_i) = f(\underline{x}_i, \underline{\beta}) \qquad \ldots \text{(D.3)}$$

Thus, model (D.2) can be expressed as

$$y_i = f(\underline{x}_i, \underline{\beta}) + \varepsilon_i \qquad \ldots \text{(D.4)}$$

The least squares criterion can then be written as :

$$Z = \sum_{i=1}^{n} (y_i - f(\underline{x}_i, \underline{\beta}))^2 \qquad \ldots \text{(D.5)}$$

The partial derivative of Z with respect to β_j is then

$$\frac{\partial Z}{\partial \beta_j} = 2 \sum_{i=1}^{n} (y_i - f(\underline{x}_i, \underline{\beta})) \left[- \frac{\partial f(\underline{x}_i, \underline{\beta})}{\partial \beta_j} \right], \qquad \ldots \text{(D.6)}$$

$j = 0, 1, 2, \ldots, r$. When the $(r + 1)$ partial derivatives are set equal to zero and the parameters β_j are replaced by the least squares estimate b_j, the normal equations obtained are

$$\sum_{i=1}^{n} y_i \left[\frac{\partial f(\underline{x}_i, \underline{\beta})}{\partial \beta_j} \right]_{\underline{\beta}=\underline{b}} - \sum_{i=1}^{n} f(\underline{x}_i, \underline{b}) \left[\frac{\partial f(\underline{x}_i, \underline{\beta})}{\partial \beta_j} \right]_{\underline{\beta}=\underline{b}} = 0 \qquad \ldots (D.7)$$

$j = 0, 1, 2, \ldots, r.$

The Gauss-Newton method applies a Taylor series expansion to approximate the non-linear regression model with linear terms, and then employs ordinary least squares (OLS) method to estimate the parameters. This is an iterative process which generally leads to a solution of the non-linear regression problem.

One begins with initial or starting values for the regression parameters $\beta_0, \beta_1, \ldots, \beta_r$, denoted $g_0^{(o)}, g_1^{(o)}, \ldots, g_r^{(o)}$, where the superscript in parentheses indicates the iteration number. The starting values may be obtained from previous or related studies, theoretical expectations, or a preliminary search for parameter values that leads to a comparatively high starting value of Z.

One writes

$$f(\underline{x}_i, \underline{\beta}) \simeq f(\underline{x}_i, \underline{g}^{(o)}) + \sum_{j=0}^{r} \left[\frac{\partial f(\underline{x}_i, \underline{\beta})}{\partial \beta_j} \right]_{\underline{\beta}=\underline{g}^{(o)}} (\beta_j - g_j^{(o)})$$

where $\underline{g}^{(o)'} = (g_0^{(o)}, g_1^{(o)}, \ldots, g_r^{(o)})$. Then equation (D.4) is approximated by

$$y_i \simeq f_i^{(o)} + \sum_{j=0}^{r} D_{ij}^{(o)} \beta_j^{(o)} + \varepsilon_i \qquad \ldots \text{(D.8)}$$

where $i = 1, 2, \ldots, n$, $f_i^{(o)} = f(\underline{x}_i, \underline{g}^{(o)})$, $D_{ij}^{(o)} = \left[\frac{\partial f(\underline{x}_i, \underline{\beta})}{\partial \beta_j} \right]_{\underline{\beta}=\underline{g}^{(o)}}$, $\beta_j^{(o)} = \beta_j - g_j^{(o)}$. Now, by shifting $f_i^{(o)}$ to the left hand side of equation (D.8) and denoting $y_i - f_i^{(o)}$ by $y_i^{(o)}$, a linear regression model approximation is obtained :

$$y_i^{(o)} \simeq \sum_{j=0}^{r} D_{ij}^{(o)} \beta_j^{(o)} + \varepsilon_i \qquad \ldots \text{(D.9)}$$

$i = 1, 2, \ldots, n$. The approximation model can be written as :

$$\underline{y}^{(o)} \simeq D^{(o)} \underline{\beta}^{(o)} + \underline{\varepsilon} \qquad \ldots \text{(D.10)}$$

where $\underline{y}^{(o)} = \begin{pmatrix} y_1 - f_1^{(o)} \\ y_2 - f_2^{(o)} \\ \vdots \\ y_n - f_n^{(o)} \end{pmatrix}$

$$D^{(o)}_{n \times (r+1)} = \begin{pmatrix} D^{(o)}_{10} & D^{(o)}_{11} & \cdots & D^{(o)}_{1r} \\ D^{(o)}_{20} & D^{(o)}_{21} & \cdots & D^{(o)}_{2r} \\ \cdot & \cdot & \cdots & \cdot \\ D^{(o)}_{n0} & D^{(o)}_{n1} & \cdots & D^{(o)}_{nr} \end{pmatrix},$$

and $$\underline{\beta}^{(o)}_{(r+1) \times 1} = \begin{bmatrix} \beta^{(o)}_0 \\ \beta^{(o)}_1 \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ \beta^{(o)}_r \end{bmatrix}$$

The parameters $\beta^{(o)}$ can therefore be estimated by OLS to get the estimates

$$\underline{b}^{(o)} = [D^{(o)'} D^{(o)}]^{-1} D^{(o)'} \underline{y}^{(o)} \qquad \ldots \text{(D.11)}$$

Using these least squares estimates, the starting values are revised to get

$$g_j^{(1)} = g_j^{(0)} + b_j^{(0)},$$

and the process is repeated.

The initial value of the least squares criterion measure Z, denoted by $SSE^{(o)}$, is

$$SSE^{(o)} = \sum_{i=1}^{n} \left[y_i - f(\underline{x}_i, \underline{g}^{(o)}) \right]^2$$

$$= \sum_{i=1}^{n} (y_i - f_i^{(o)})^2$$

At the end of the first iteration, the estimated regression coefficients are $g^{(1)}$ and the value of Z is

$$SSE^{(1)} = \sum_{i=1}^{n} \left[y_i - f(\underline{x}_i, \underline{g}^{(1)}) \right]^2$$

$$= \sum_{i=1}^{n} (y_i - f_i^{(1)})^2$$

If the Gauss-Newton method is working effectively in the first iteration, $SSE^{(1)}$ should be smaller than $SSE^{(o)}$, since $\underline{g}^{(1)}$ should be better estimates of $\underline{\beta}$ then $\underline{g}^{(o)}$. The process of iteration is repeated until $\left| \frac{SSE^{(s+1)} - SSE^{(s)}}{SSE^{(s+1)}} \right| < h$, for some h, sufficiently small. Unless otherwise stated, the value of h is taken by the P3R program to be 0.00001.

D. 3 Maximum Likelihood Estimation by the Gauss-Newton Method

Jennrich and Moore (1975) suggested modifications such that the common Gauss-Newton algorithm for non-linear least squares becomes equivalent to the Fisher scoring algorithm for maximum likelihood estimation. The standard errors produced are information-based standard errors and this means that much of the auxiliary output produced by a least squares analysis is directly applicable to a maximum likelihood analysis. In addition, if the model is a linear exponential one, that is, if its likelihood function can be written in the form :

$$L\,(\underline{y},\ \underline{\beta}) = \exp\,(\,\nu\,(\underline{\beta}) + \underline{\eta}'(\underline{\beta})\ \underline{y}),$$

where $\nu\,(\underline{\beta})$ and $\underline{\eta}'\,(\underline{\beta}) = (\eta_1(\underline{\beta}),\ \eta_2(\underline{\beta}),\ \ldots,\ \eta_n(\underline{\beta}))$ are functions of $\underline{\beta}$, and $\underline{y}' = (y_1,\ y_2,\ \ldots,\ y_n)$, then the Newton-Raphson algorithm is also identical to the Fisher scoring algorithm. The binomial model is a linear exponential model, hence this method can be employed to find the MLE of parameters of the logit model.

For estimating the parameters of the model (D.1) by the maximum likelihood method, the log-likelihood function, ln L, is maximised (or - ln L is minimised) with respect to β. The log-likelihood function is given by

$$l(\underline{y},\ \underline{\beta}) = \ln L\,(\underline{y},\ \underline{\beta}) = \sum_{i=1}^{n} \left[\, y_i \ln p_i + (1 - y_i) \ln (1 - p_i) \,\right] \qquad \ldots (D.12)$$

On differentiating $l(\underline{y},\ \underline{\beta})$ with respect to β_j, $j = 0, 1, 2, \ldots, r$, one obtains

$$\frac{\partial l\ (\underline{y},\ \underline{\beta})}{\partial\ \beta_j} = \sum_{i=1}^{n} x_{ij}\ (y_i - p_i).$$

where x_{ij} is the coefficient of β_j in equation (D.1). The solutions of

$$\frac{\partial l\ (\underline{y},\ \underline{\beta})}{\partial\ \beta_j} = 0 \qquad \ldots\ (D.13)$$

for j = 0, 1, 2, ..., r, yield the maximum likelihood estimates (MLE) of β.

$$\text{Let } S(\underline{\beta}) = \begin{bmatrix} \dfrac{\partial l\ (\underline{y},\ \underline{\beta})}{\partial\ \beta_0} \\ \dfrac{\partial l\ (\underline{y},\ \underline{\beta})}{\partial\ \beta_1} \\ \vdots \\ \dfrac{\partial l\ (\underline{y},\ \underline{\beta})}{\partial\ \beta_r} \end{bmatrix}_{(r+1)\ \times\ 1}$$

For the Fisher scoring algorithm, the estimated variance-covariance matrix of MLE of parameters, $(\hat{\underline{\beta}})$ is

$$\hat{V}\ (\hat{\underline{\beta}}) = \left[\ \hat{V}\ (S\ (\hat{\underline{\beta}}))\ \right]^{-1} \qquad \ldots\ (D.14)$$

For the Gauss-Newton algorithm one has :

$$\hat{V}\ (\hat{\underline{\beta}}) = \hat{\sigma}^2 \left[\ \hat{V}\ (S(\hat{\underline{\beta}}))\ \right]^{-1} \qquad \ldots\ (D.15)$$

where $\hat{\sigma}^2$ is the residual mean square error.

Thus, if in the P3R program $\hat{\sigma}^2$ is set equal to 1, then the covariance matrices estimated as (D.14) and (D.15) are identical. Now, let

$$f(\underline{x}_i, \underline{\beta}) = y_i \ln p_i + (1 - y_i) \ln (1 - p_i).$$

Then equation (D.12) can be rewritten as

$$l(\underline{y}, \underline{\beta}) = \sum_{i=1}^{n} f(\underline{x}_i, \underline{\beta}),$$

and, therefore,

$$\frac{\partial l(\underline{y}, \underline{\beta})}{\partial \beta_j} = \sum_{i=1}^{n} \frac{\partial f(\underline{x}_i, \underline{\beta})}{\partial \beta_j} \qquad \ldots \text{(D.16)}$$

$j = 0, 1, 2, \ldots, r$. Then equation (D.13) is

$$\sum_{i=1}^{n} \frac{\partial f(\underline{x}_i, \underline{\beta})}{\partial \beta_j} = 0 \qquad \ldots \text{(D.17)}$$

$j = 0, 1, 2, \ldots, r$.

The Gauss-Newton algorithm solves the normal equations (E.6) given by

$$\sum_{i=1}^{n} \left[y_i - f(\underline{x}_i, \underline{\beta}) \right] \frac{\partial f(\underline{x}_i, \underline{\beta})}{\partial \beta_j} = 0,$$

$j = 0, 1, 2, \ldots, r$. If the expression $(y_i - f(\underline{x}_i, \underline{\beta}))$ is set equal to 1 for all $i = 1, 2, \ldots, n$, then equations (D.6) reduce to the maximum likelihood equations (D.17).

Thus, in the BMDP-79 P3R program, the dependent variable was taken to be $y_i^* = f(\underline{x}_i, \underline{\beta}) + 1$ for ML estimation. The functions F_i (i.e., $f(\underline{x}_i, \underline{\beta})$), the derivatives DF_i (J) (i.e., $\frac{\partial f(\underline{x}_i, \underline{\beta})}{\partial \beta_j}$), $i = 1, 2, \ldots, n$, and $j = 0, 1, 2, \ldots, r$, are defined in FORTRAN statements in the FUNCTION subroutine of the P3R program. If further, a LOSS function, denoted by $XLOSS_i$ is defined in the same sub-routine, then $\sum_{i=1}^{n} XLOSS_i$ is minimised. Hence, the loss function was defined as $- F_i$, so that $- \ln L(\underline{y}, \underline{\beta})$ or $-l\ (\underline{y}, \underline{\beta})$ was minimised, and was used as the basis of the criterion for convergence. For this purpose, a corresponding statement 'LOSS' had to be added to the 'REGRESS' paragraph of the program.

Appendix E

MEASURING EFFECT OF LAND POSSESSED AND NUMBER OF CHILDREN ON POVERTY STATUS OF A HOUSEHOLD

E.1 Introduction

The logit model, as mentioned earlier in Chapter 7, allows one to directly compute how the head-count ratio of absolute poverty changes with change in the value of an explanatory variable. This, however, cannot be done using the regression model. The present Appendix derives expressions which show how (i) changes in total land possessed by a household category (that is, social group or occupational class or NSS region) affect the head-count ratio, other things remaining constant, and (ii) a unit increase in the average number of children per household in the category affect the head-count ratio, other factors remaining constant.

E.2 Effect of Land Possessed by a Household on its Poverty Status

The head-count ratio for households of a given category k, say, estimated from the logit model is given by[1]

$$p_k^* = \frac{1}{\sum_{i=1}^{n_k} N_i} \sum_{i=1}^{n_k} N_i \hat{p}_i \qquad \ldots (E.1)$$

[1] Since the sampling design is self-weighting at state-level, therefore, unweighted sample proportions are estimates of corresponding population proportions.

where N_i is the number of members in household i, n_k, the number of sample households in category k and p_i the probability of household i being poor, $i = 1, 2, \ldots, n_k$; p_i is given by the expression

$$p_i = \frac{\exp(z^* - \underline{\beta}' \underline{x}_i)}{1 + \exp(z^* - \underline{\beta}' \underline{x}_i)} \qquad \ldots (E.2)$$

where $\underline{\beta}' = (\beta_0, \beta_1, \ldots, \beta_r)$, $\underline{x}_i' = (1, x_{i1}, x_{i2}, \ldots, x_{ir})$ and $z^* = \ln z$, z being the poverty line for the state under consideration.

The change in p_k^* with increase in total land possessed by households in category k can be examined in two ways :

(i) The increase in total land possessed by households in category k is assumed to be shared equally by all the individuals in the category, and then the change in p_k^* in response to a unit increase in the arithmetic mean ($PCLM_k$) of PCL (per capita land possessed) is computed.

(ii) The increase in total land possessed by households in category k is assumed to be distributed in proportion to the original values of PCL, and the change in p_k^* corresponding to a unit increase in the geometric mean ($PCLG_k$) of PCL is computed.

As poor households tend to have lower PCL, the distribution of additional land by equal absolute amounts should be, a priori, more beneficial to the poor households than a distribution in proportion to existing PCL values, since in the former case, there is a greater absolute as well as relative increase in PCL for the poorer households than in the latter case. Thus, the percentage decrease in the estimated head-count ratio of poverty due to a unit increase in $PCLM_k$ in the first case is expected to be larger than that due to a corresponding increase in $PCLG_k$ in the second.

Ceteris paribus, the marginal change in p_k^* with respect to an increase in $PCLM_k$ is computed in the following manner :

Let PCL_i = PCL of household i in category k, i = 1, 2, ..., n_k ;

$$\text{and } PCLM_k = \frac{1}{\sum_{i=1}^{n_k} N_i} \sum_{i=1}^{n_k} N_i \; PCL_i \qquad \ldots \text{(E.3)}$$

be the arithmetic mean of PCL for category k. Then,

$$\eta_{Mk} = \frac{\partial p_k^*}{\partial PCLM_k} = \frac{\partial}{\partial PCLM_k} \left[\frac{1}{\sum_{i=1}^{n_k} N_i} \sum_{i=1}^{n_k} N_i \, p_i \right]$$

from equation (E.1)

$$= \frac{1}{\sum_{i=1}^{n_k} N_i} \left[\sum_{i=1}^{n_k} N_i \frac{\partial p_i}{\partial \ln PCL_i} \cdot \frac{\partial \ln PCL_i}{\partial PCL_i} \cdot \frac{\partial PCL_i}{\partial PCLM_k} \right]$$

From equation (7.5) of Chapter 7,

$$\frac{\partial p_i}{\partial \ln PCL_i} = - \beta_{Lk} \, p_i \, (1 - p_i) \qquad \ldots (E.4)$$

Where β_{Lk} is the coefficient of ln PCL in equation (E.2) of households of category k.

$$\therefore \quad \eta_{Mk} = \frac{1}{\sum_{i=1}^{n_k} N_i} \sum_{i=1}^{n_k} (-\beta_{Lk}) \, p_i \, (1 - p_i) \frac{1}{PCL_i} \cdot N_i,$$

from equation (E.4) and by the assumption that, other things remaining the same, the PCL of all households in category k increase by the <u>same amount</u>, that is, $\frac{\partial PCL_i}{\partial PCLM_k} = 1.$

Thus,

$$\eta_{Mk} = \frac{\partial p_k^*}{\partial PCLM_k} = \frac{-\beta_{Lk}}{\sum_{i=1}^{n_k} N_i} \sum_{i=1}^{n_k} p_i(1 - p_i) N_i / PCL_i \quad \ldots \text{(E.5)}$$

The expression for the marginal change in p_k^* with respect to an increase in the geometric mean, $PCLG_k$, of PCL of households in category k, is obtained as follows[2/]:

Let

$$PCLG_k = \left(\prod_{i=1}^{n_k} PCL_i^{N_i} \right)^{\frac{1}{\sum_{i=1}^{n_k} N_i}} \quad \ldots \text{(E.6)}$$

be the geometric mean of PCL of households (really, persons) in household category k. Then,

$$\eta_{Gk} = \frac{\partial p_k^*}{\partial PCLG_k} = \frac{\partial}{\partial PCLG_k} \left[\frac{1}{\sum_{i=1}^{n_k} N_i} \sum_{i=1}^{n_k} N_i \, p_i \right]$$

(from equation (E.1))

$$= \frac{1}{\sum_{i=1}^{n_k} N_i} \sum_{i=1}^{n_k} N_i \cdot \frac{\partial p_i}{\partial PCLG_k}$$

$$= \frac{1}{\sum_{i=1}^{n_k} N_i} \sum_{i=1}^{n_k} N_i \cdot \frac{\partial p_i}{\partial \ln PCL_i} \cdot \frac{\partial \ln PCL_i}{\partial \ln PCLG_k} \cdot \frac{\partial \ln PCLG_k}{\partial PCLG_k}$$

$$= \frac{1}{\sum_{i=1}^{n_k} N_i} \sum_{i=1}^{n_k} (-\beta_{Lk}) \, p_i \, (1 - p_i) \frac{N_i}{PCLG_k}$$

2/ As noted earlier in Chapters 6 and 7, landless households were assumed to possess 0.005 acre of land and, therefore, $PCL_i \neq 0$ for any $i = 1, 2, \ldots, n_k$.

by equation (E.4) and the assumption that, other things remaining constant, the PCL of all households in category k increase in the same proportion, that is, $\frac{\partial \ln PCL_i}{\partial \ln PCLG_k} = 1.$

Thus,

$$\eta_{Gk} = \frac{\partial p_k^*}{\partial \cdot PCLG_k} = \frac{-\beta_{Lk}}{PCLG_k \sum_{i=1}^{n_k} N_i} \sum_{i=1}^{n_k} N_i p_i (1 - p_i) \quad \ldots (E.7)$$

E.3 Effect of the Number of Children in a Household on its Poverty Status

Now, the change in p_k^* with respect to a unit increase in the average number of children ($\bar{N}_{ck}$) per household of category k can be obtained in the manner shown below :

Let N_{ci} = the number of children in the ith household of the kth category, so that

$$\bar{N}_{ck} = \frac{1}{n_k} \sum_{i=1}^{n_k} N_{ci} \quad \ldots (E.8)$$

is the average number of children per household in category k. Then,

$$\frac{\partial p_k^*}{\partial \bar{N}_{ck}} = \frac{\partial}{\partial \bar{N}_{ck}} \left[\frac{1}{\sum_{i=1}^{n_k} N_i} \sum_{i=1}^{n_k} N_i \, p_i \right]$$

from equation (E.1).

$$= \frac{\sum_{i=1}^{n_k} N_i \frac{\partial}{\partial \bar{N}_{ck}} \left(\sum_{i=1}^{n_k} N_i p_i \right) - \sum_{i=1}^{n_k} N_i p_i \frac{\partial}{\partial \bar{N}_{ck}} \left(\sum_{i=1}^{n_k} N_i \right)}{\left(\sum_{i=1}^{n_k} N_i \right)^2}$$

$$= \frac{1}{\sum_{i=1}^{n_k} N_i} \left[\sum_{i=1}^{n_k} N_i \cdot \frac{\partial p_i}{\partial \bar{N}_{ck}} + \sum_{i=1}^{n_k} p_i \frac{\partial N_i}{\partial \bar{N}_{ck}} - \frac{\sum_{i=1}^{n_k} N_i \, p_i \sum_{i=1}^{n_k} \frac{\partial N_i}{\partial \bar{N}_{ck}}}{\sum_{i=1}^{n_k} N_i} \right]$$

$$= \frac{1}{\sum_{i=1}^{n_k} N_i} \left[\sum_{i=1}^{n_k} N_i \frac{\partial p_i}{\partial N_{ci}} \cdot \frac{\partial N_{ci}}{\partial \bar{N}_{ck}} + \sum_{i=1}^{n_k} p_i \frac{\partial N_i}{\partial N_{ci}} \cdot \frac{\partial N_{ci}}{\partial \bar{N}_{ck}} - p_k^* \sum_{i=1}^{n_k} \frac{\partial N_i}{\partial N_{ci}} \cdot \frac{\partial N_{ci}}{\partial \bar{N}_{ck}} \right]$$

from equation (E.1).

Now from equation (7.5) of Chapter 7,

$$\frac{\partial p_i}{\partial N_{ci}} = -\beta_{ck}\, p_i\,(1 - p_i) \qquad \text{... (E.9)}$$

where β_{ck} is the coefficient of N_{ci} in equation (E.2) for households of category k.

$$\therefore \quad \frac{\partial p_k^*}{\partial \bar{N}_{ck}} = \frac{1}{\sum_{i=1}^{n_k} N_i} \left[\sum_{i=1}^{n_k} (-\beta_{ck})\, p_i\,(1 - p_i)\, N_i + \sum_{i=1}^{n_k} p_i - p_k^* \sum_{i=1}^{n_k} 1 \right]$$

by equations (E.9) and (E.1) and the assumption that, other things remaining constant, the number of children increases by one unit in each household in category k, that is,

$$\frac{\partial N_{ci}}{\partial \bar{N}_{ck}} = 1, \text{ and } \frac{\partial N_i}{\partial N_{ci}} = 1.$$

Thus,

$$\frac{\partial p_k^*}{\partial \bar{N}_{ck}} = \frac{-\beta_{ck}}{\sum_{i=1}^{n_k} N_i} \sum_{i=1}^{n_k} N_i p_i (1 - p_i) + \frac{n_k}{\sum_{i=1}^{n_k} N_i} \left(\frac{1}{n_k} \sum_{i=1}^{n_k} p_i - p_k^* \right)$$

$$\text{... (E.10)}$$

It may be noted that the second term on the right hand side of equation (E.10) vanishes when the proportion of poor households in category k is equal to the proportion of poor persons in the same category.

E. 4 Effects on Head-Count Ratio at the State Level

So far the effect of changes in land possessed or number of children on the head-count ratio for households of a particular category have been examined. One now considers the same effects on the head-count ratio for the State as a whole.

The estimated head-count ratio (p*) for the rural areas of any state as a whole can be expressed in terms of the estimated head-count ratios of different categories of households in that state, classified by a given factor, in the following manner :

$$p^* = \frac{1}{\sum_k N^k} \sum_k N^k p_k^* \qquad \ldots \text{(E.11)}$$

where $N^k = \sum_{i=1}^{n_k} N_i$ is the sample population in households of category k of a given factor (that is, NSS region or social group or occupational class).

Thus, the marginal change in p* with respect to a unit increase in the overall arithmetic mean (PCLM) of PCL for rural areas of the state is :

$$\frac{\partial p^*}{\partial PCLM} = \frac{1}{\sum_k N^k} \sum_k N^k \frac{\partial p_k^*}{\partial PCLM}$$

$$= \frac{1}{\sum_k N^k} \sum_k N^k \frac{\partial p_k^*}{\partial PCLM_k} \cdot \frac{\partial PCLM_k}{\partial PCLM}$$

$$= \frac{1}{\sum_k N^k} \sum_k N^k \frac{\partial p_k^*}{\partial PCLM_k} \qquad \ldots (E.12)$$

from equation (E.11) and by the assumption that, other things remaining constant, the increase in total land possessed is shared equally among all persons in the rural areas of the state, that is, all PCLs increase by the same amount, so that $\frac{\partial PCLM_k}{\partial PCLM} = 1$.

The marginal change in p* with respect to a unit increase in the overall geometric mean (PCLG) of PCL for rural areas of the state as a whole is computed as :

$$\frac{\partial p^*}{\partial PCLG} = \frac{1}{\sum_k N^k} \sum_k N^k \frac{\partial p_k^*}{\partial PCLG} \quad \text{(from equation (E.11))}$$

$$= \frac{1}{\sum_k N^k} \sum_k N^k \frac{\partial p_k^*}{\partial PCLG_k} \cdot \frac{\partial \ln PCLG_k}{\partial \ln PCLG} \cdot \frac{PCLG_k}{PCLG}$$

As before, it is assumed that any increment in total land possessed by households in rural areas of the state, other factors remaining constant, is distributed among all persons in proportion to the existing values of their PCL. This implies that $\frac{\partial \ln PCLG_k}{\partial \ln PCLG} = 1$. Then,

$$\frac{\partial p^*}{\partial PCLG} = \frac{1}{\sum_k N^k} \sum_k N^k \frac{PCLG_k}{PCLG} \cdot \frac{\partial p_k^*}{\partial PCLG_k} \qquad \ldots (E.13)$$

Finally, the marginal change in p* with respect to a unit increase in $\bar{N}_c$, the average number of children per household in rural areas of the state, can be obtained as follows :

$$\frac{\partial p^*}{\partial \bar{N}_c} = \frac{1}{\partial \bar{N}_c} \left[\frac{1}{\sum_k N^k} \sum_k N^k p_k^* \right]$$

(from equation (E.11))

$$= \frac{1}{\sum_k N^k} \sum_k N^k \frac{\partial p_k^*}{\partial \bar{N}_{ck}} \cdot \frac{\partial \bar{N}_{ck}}{\partial \bar{N}_c}$$

$$+ \frac{1}{\sum_k N^k} \sum_k p_k^* \frac{\partial N^k}{\partial \bar{N}_{ck}} \cdot \frac{\partial \bar{N}_{ck}}{\partial \bar{N}_c}$$

$$- p^* \frac{1}{\sum_k N^k} \sum_k n_k$$

It is assumed that, other factors remaining the same, the number of children in each household increases by the same number, that is, $\frac{\partial \bar{N}_{ck}}{\partial \bar{N}_c} = 1$, and $\frac{\partial N^k}{\partial \bar{N}_{ck}} = n_k$, the number of sample households in category k. It follows that

$$\frac{\partial p^*}{\partial \bar{N}_c} = \frac{1}{\sum_k N^k} \sum_k N^k \frac{\partial p_k^*}{\partial \bar{N}_{ck}} + \frac{1}{\sum_k N^k} \sum_k n_k (p_k^* - p^*) \quad \ldots (E.14)$$

The marginal changes in 'estimated head-count ratio' with respect to increase in the arithmetic and geometric means of PCL and in the average number of children per household in a category can be computed from the sample data for the different states using estimated $\hat{p}_i$'s, sample sizes, sample populations and sample estimates of p_k^*, p^*, $PCLM_k$, $PCLG_k$, PCLM, PCLG, $\bar{N}_{ck}$ and $\bar{N}_c$. Such empirical results are, however, not presented here.

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