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Estimating Consumption Deprivation in India using Survey Data: A State-Level Rural-Urban Analysis before and during Reform Period

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Abstract

This paper assesses deprivation in India employing a measure proposed by Sitaramam and using consumption data at the household level. As cereals constitute a staple food and form a major portion of expenditure on food, the deprivation measure considered here is deprivation in cereal consumption. The total expenditure at which the Engel curve for cereals turns from concave to convex is taken as the cut-off to determine the deprived households. It is shown that cereal deprivation at the all-India level exhibits a declining trend over the period 1987-88 and 1999-2000, in the rural sector, while there is little change in the urban sector. Further, this decline in cereal deprivation seems to have been slowing down during the reform period. The estimates of deprivation are poorly correlated with the HCI and PGI at state level, both in rural and urban sectors. They, however, have better temporal correlations with those poverty measures. We offer some explanation for these observed differences in alternate deprivation indices. The trends in cereal deprivation are accompanied in some cases by a decline, in real terms, in maximum cereal consumption of each group of consumers. Whether this is an improvement or otherwise of the living standards of the poor, must await further analysis of per capita food consumption in general, with an analysis of prices and quantities of various food items. It is hoped that this kind of study on deprivation of essential commodities may increase our understanding of poverty, and even suggest direct intervention strategies.

Keywords: household consumption, Engel curve, India, cereal deprivation

JEL Classification: D12, H24

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Estimating Consumption Deprivation in India using Survey Data: A State-Level Rural-Urban Analysis before and during Reform Period

T. Krishna Kumar, Sushanta Mallick, and Jayarama Holla [#]

1. Introduction

Poverty studies in recent years moved away from measurement of poverty with defined poverty line to measuring it with respondent-defined poverty line on the one hand, and to understanding poverty through an examination of the living standards of the poor, on the other. It is our aim to present a new measure of deprivation with respect to cereals, an essential commodity, apply it to examine the cereal consumption deprivation in India before and during economic reforms.

Cereals constitute a staple food in all parts of India, rice in some parts of the country and wheat in others[1]. Cereal expenditure forms a significant share of the food budget and forms on an average more than one-third of the total budget. The Engel curve for cereals saturates first among all those commodities that have concave Engel curves[2]. We therefore chose cereal as the essential commodity. We define a measure of deprivation of cereal without any subjective notion of a researcher-determined or subject-determined norm or deprivation point (poverty line). We determine the deprivation point objectively as that value of total expenditure at which the Engel curve for cereal stops being concave and starts to become

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[1] It is true that there are some states where the consumption pattern is somewhat different from those of others, such as Kerala with significant consumption of fish, tapioca (cassava), and cocoanut; Punjab with significant consumption of milk and milk products; Orissa and Assam with significant consumption of rice and fish. This may be kept in mind while interpreting our results.

[2] Sitaramam et al. (1996) observed this result for a slightly different specification and for earlier rounds of NSS data. The authors thank B.P. Vani for checking this out to be true with the Engel curve specification used in this paper and with the NSS data for the 55th Round used in this study.

convex. This deprivation point is determined from the revealed behavior by the entire group of consumers to which the household belongs, the deprived as well as the non-deprived.

We use the deprivation measure suggested by Sitaramam (see Kumar *et al.* (1996), and Sitaramam *et al.* (1996)). We use household survey data at unit level made available by the National Sample Survey Organization (NSSO). We examine the extent of cereal consumption deprivation in India before and during economic reforms, for all of India and 15 major Indian states, and both for the urban and the rural sectors. Although the economic reforms in India started in July 1991, with a significant devaluation of the Indian rupee and the dependence on IMF credit for getting out of the balance of payment crisis, it is only two years later that its effect is felt. Hence 1993-94 is taken as a benchmark for the pre-reform and post-reform performance. That also happens to be the year in which the important periodic large sample survey was conducted.

The plan of the paper is as follows. We review briefly some of the studies in section 2 to set the stage for our present investigation. Section 3 deals with the conceptual basis of the approach we use in this paper. In section 4 we describe in detail the data we use and present the analysis plan. In section 5 we present the estimates of cereal consumption deprivation. In this section we also present an analysis of cereal consumption deprivation and poverty between states and over time. Finally, in section 6 we offer some concluding remarks.

2. Poverty, Deprivation, and Consumption of an Essential Commodity

Poverty studies over the period of nearly three decades, spanning the period 1960-1987, concentrated on (i) defining who the poor are through a poverty line, (ii) defining poverty as the state of economic conditions of those persons whose income is less than the poverty line, and (iii) measuring poverty by indices such as percentage of people below the poverty line, and poverty gap index. As income of the poor is difficult to measure and as it fluctuates erratically from time to time, income is often replaced by total expenditure that is also considered as a proxy for the permanent income. The poverty line was initially characterized in India as that level of total expenditure that could afford a person to have two square meals a day. Different people may interpret this concept differently thereby making it quite arbitrary and subjective. Dandekar and Rath (1971) brought objectivity into the Indian economics literature on poverty by defining clearly what could be meant by having two

square meals a day. They defined it through a nutritional norm of calories needed to perform basic functions. If this norm were to be used directly then the measure of deprivation would become only a measure of under-nutrition. As poverty is defined in terms of not having the means to acquire basic needs, and food being only one of the basic necessities, this calorie norm was transformed into total expenditure that could afford this basic need. Thus emerged the notion that poverty line is the amount of total expenditure which is sufficient to purchase a basket of food items that would ensure, on an average, the minimum calories required[3].

This poverty line has been the subject of controversy. The calories required could vary from individual to individual for any given community with age, sex, occupation, and activity distribution. Some suggested using the mean of the minimum calories required, while others recommended much lower levels based on the assumption that the body metabolism has adjustment mechanism to adjust for short run shortfalls from the mean. The transition from the minimum calorie requirement to the total expenditure is not one-to-one.

Despite the claim by its proponents that it is not a measure of under nutrition but poverty one must note that calories-based definition of poverty line is based on nutrition dimension of poverty. The calorie norm also depends on the length of time over which it is set (as the body metabolism adjusts for any short run shortfall and excess of calorie intake versus the calorie requirement)[4].

One normally chooses a fixed norm such as a dollar a day, 2100 kilocalories (Calories), etc for poverty comparisons over space and time. The norm, whether it is objectively determined by a researcher or a community of researchers, or subjectively determined by the respondent of a survey, has to have variation depending on the conditions applicable to the subject. Hence there is bound to be a dilemma - that for comparison purposes one must have some standardized norm, but in reality one cannot impose the same norm for all[5]. It has been observed that the poverty lines based on calorie norms fixed at all India level in 1973-74 at

[3] There is an implicit assumption that the other basic needs are also met at this total expenditure. It is also possible, this being an average condition that some persons below this poverty line may consume more calories than the specified norm and those above the poverty line may consume less.

[4] There is a comprehensive coverage of this aspect in Dasgupta (1993, pp. 443-461). Srinivasan (1992) presents an excellent treatment of this dynamic adjustment mechanism of energy balance, originally proposed by Sukhatme. Bhargava (1992) provides an empirical counterpart to such a dynamic model.

[5] This dilemma explains the differences between the recommendation made by the Planning Commission's Expert Group on Poverty (1993) and its critique by Rath (1996). The resolution of this dilemma is not simple. It requires issues such as interpersonal comparison of utilities and making choices between alternate institutional resource allocation mechanisms.

2400 Calories for rural and 2100 Calories for urban do not guarantee the consumption of the minimum calories even as an average at the state level and over time (Rath (2003)). There is also some evidence that there has been a change in the consumption pattern over time as revealed by the preferences of people at all income ranges. This has led to the impression that the nutrition base of the poverty line is losing its significance, and that there is a need to examine consumption deprivation of essential commodities (Sen (2005)). Under these circumstances it is desirable to examine the observed revealed preferences and the associated relation between expenditures on various essential commodities and total expenditure needed to meet quantities of those essential commodities. Engel curves for essential commodities provide the needed information.

Economists, and not the poor, decided in the past on what constitutes their basic necessities in defining the poverty line. It is this realization that prompted researchers in recent years to use the perceived poverty threshold using a question in household surveys called the "Minimum Income Question" which asked the respondents of the household surveys what they consider to be the minimum income required to meet both ends (Pradhan and Ravallion(2000)).[6] Atkinson (1987) treated the poverty line as belonging to a fuzzy domain. Kumar *et al.* (1996) took a different position and proposed a new way of measuring poverty as commodity-specific deprivation with respect to an essential commodity. Their procedure did not require a poverty line. Their approach was based on the Engel law of microeconomic theory of consumer behavior. The concept of poverty can be handled at three levels of abstraction. First, it can be regarded very broadly as deprivation, a condition where the poor do not have the means to acquire the basic necessities of life. Second, it can be handled more precisely by defining a particular norm for determining what is meant by deprivation, and what is meant by not having the means. Third, the focus may be shifted from defining the extremely poor by some criterion and one can then view poverty as the deprivation experienced by them. Banerjee and Duflo (2007) examine poverty in this sense. What we do in this paper is to take a course that embraces all these three levels of analysis.

[6] Pradhan and Ravallion (2000) consider a regression relation between the perceived poverty line by the individuals and their total expenditures, (controlling for some other variables) and use the point where the regression line meets the 45^0 line as the collective subjective poverty line. The chosen poverty line thus depends on the researcher's specification of the regression relation and how good the regression fit is. Hence it is not as objective as it appears to be.

3. Cereal Consumption Deprivation as a Measure of Poverty

There are several approaches to measure poverty. We described the calorie-based method in the previous section. For a good discussion of alternative measures one may see Eastwood and Lipton (2000). Deprivation can be defined and measured as consumption deprivation of an essential commodity. The idea of using deprivation as a measure of poverty goes back at least to Rao (1981), if not earlier. We present next the basic structure of the approach in Kumar *et.al.* (1996) as that approach is used here. Rao argued that for the extremely poor persons the proportion spent on food increases, and that the point where it stops increasing and begins to decrease might be taken as a deprivation point to define acute poverty.[7]

We focus on an essential commodity for measuring deprivation and rely on the Engel law. We postulate that the Engel curve for an essential commodity is convex at very low levels of total expenditure, then concave up to a point, and then becomes convex again[8]. The concave portion of the Engel curve would then have a maximum value of consumption. Hence the difference between this maximum consumption expenditure on an essential commodity and the actual consumption expenditure on that commodity by a person may be taken as the consumption deprivation of that person with respect to the consumption pattern of the community to which she belongs. One may normalize this by the maximum consumption. Hence the consumption deprivation of a person lies between 0 and 1 (see Figures 1a and 1b).

Since the Engel curve is concave, the deprivation function is convex. Taking this deprivation function as –p(Y,Z) of the general class of poverty measures given in Atkinson (1987) the consumption deprivation measure can be treated as a poverty index without any poverty line. We specify the saturating Engel curve by the equation[9]:

[7] He also suggested using 1.5 times this level as a poverty line.

[8] There is a view that the expenditure elasticity of rice is negative and that it has become an inferior good in Asia (see Ito *et. al.* (1989)). This view can possibly be refuted by saying that what is observed is not a movement along the Engel curve but a shift in the Engel curve due to substitution. To address this issue one therefore has to examine the entire consumer demand system. In this paper, we consider the cereal sub-group, which includes all cereal items including rice.

[9] Sitaramam, one of the authors of Kumar et al. (1996) paper, is a biochemist and a nutrition scientist. He was working at the National Institute of Nutrition, Hyderabad, India in the early Eighties when, based on extensive statistical analysis of NSS data and NNMB (National Nutrition Monitoring Bureau) data, he conceived the basic idea of that paper of defining poverty without a poverty line and using the saturating level of cereal consumption. Biochemists use a specific functional form for saturation curves, and the following specification is similar to that used by the biochemists.

$$C(y) = \frac{Vy}{(K + y)} \quad \text{.....3.1}$$

Here C(y) is the expenditure on cereals given the total expenditure y.

The parameters V and K of this specification have an economic interpretation. V is interpreted as the maximum consumption expenditure on cereals in the community to which the individual belongs, and K is the total expenditure required to spend $\frac{V}{2}$ on cereals. V, the maximum the community spends on cereals, pulls up the individual's expenditure on cereals (the effect of community interaction), and K pulls it down. K is influenced by the price of cereals and other goods and services. Sitaramam *et. al.* (1996) found that this functional form fits the cereal consumption expenditure, treated as a function of total expenditure, very well for various rounds of NSS data. In subsequent explorations on Engel curves with NSS data the first author observed that the residuals did not have a mean zero, necessitating the addition of an intercept term. Similarly the scatter diagrams between cereal expenditures and total expenditure show a very blurred pattern for the Engel curve, which became smoother when one controlled for the household size. Hence the functional form of Engel curve chosen in this paper is:

$$C(y) = A + Bh + \frac{Vy}{(K + y)} \quad \text{.....3.2}$$

.

Where h is the household size.

The limit of C(y) as $y \rightarrow \infty$ is A+Bh+V

K can be interpreted as that level of total expenditure at which the cereal consumption expenditure of a household with household size h equals A+Bh+V/2

We define the consumption deprivation index as the mean percentage shortfall in consumption from the saturating level A+Bh+V. We call it Sitaramam Index, or SI for short. It is given by the following equation:

$$SI = \frac{100}{n} \sum_{i=1}^{n} \frac{\{(A + Bh_i + V) - A - Bh_i - \frac{Vy_i}{(K + y_i)}\}}{A + Bh_i + V} \quad \text{.....3.3}$$

This can be rewritten as:

$$SI = \frac{100}{n}\sum_{i=1}^{n}\frac{VK}{(K+y_i)(A+Bh_i+V)} \quad \text{.....3.4}$$

As the above index is based on the maximum cereal consumption of a given data set and its Engel curve, we may call it a relative consumption deprivation index. The indices so estimated for different data sets are not comparable over space and time. In order to make such comparisons we construct a slightly modified version of the above index by replacing the maximum consumption of the given data set by the maximum cereal consumption over all the data sets:

$$SI^{*} = \frac{100}{n}\sum_{i=1}^{n}\frac{VK}{(K+y_i)(A+Bh_i+V)}\left[\frac{(A+Bh_i+V)}{(A^{*}+B^{*}h_i+V^{*})}\right]\} \quad \text{.....3.5}$$

Where the parameters with asterisk refer to the parameters of the data set that gives maximum cereal consumption over all the data sets, while the parameters without asterisk refer to the data set for which the SI* is being calculated. It may be noticed that for the data set with maximum cereal consumption SI* equals SI.

4. Cereal Consumption Deprivation in India: A Detailed Description of Our Approach

We use the National Sample Survey Organization (NSSO) data on consumer expenditures for the 43rd Round (1987-1988), 50th Round (1993-1994), and 55th Round (1999-2000) to estimate the cereal consumption deprivation. There are certain features of NSSO survey that one needs to note as they have implications on the interpretation of the results. It was noted that "affluent households" consume a larger variety of consumer items and hence the variance of the survey estimates of consumer expenditure is larger for such households. In order to reduce the variance of the mean expenditure, NSSO over-sampled the affluent households. While such over-sampling might very well reduce the variance of the estimates they also have the effect of biasing upwards the estimates of consumer expenditure, unless they are suitably adjusted.

The consumer expenditure includes expenditure incurred by the households for guests and on festivals and religious functions. It also includes expenditure on food cooked for servants or employees. Using the NSS data for the 38th Round (1983), Minhas (1993) observed that a

household at the poverty line is neither a net giver nor a net taker of food from others. In fact he went to the extent of suggesting that the point of food consumption where such correction factor is zero may be taken as the poverty line. In contrast Subramaniam and Deaton (1996) used the NSS data of the same 38th Round for rural Maharashtra collected by the state, called the state sample, and observed that a correction was needed.[10] We made no correction for it in using these estimates, as the consumption pattern could have changed considerably since 1983, and we did not have detailed information on the meals served for guests and employees for the survey periods we used. These features have the effect of biasing upwards the per capita consumption expenditure. The sample frame used to sample the second level units, households, is based on house lists. Hence NSSO excludes the homeless, and the estimates of poverty and deprivation based on NSSO data are therefore underestimates of actual deprivation[11].

Apart from these features of sample surveys there are some other aspects of the Indian agricultural scene that may be kept in mind while interpreting food consumption deprivation or poverty. Over the past three and half decades there has been a change in the cropping patterns as a result of the green revolution, price support schemes and other subsidies, and market forces. The areas that were used for cultivation of coarse grains, that constitute the staple food for the poor, are gradually being shifted to cultivating rice, wheat, and oil seeds. The rate of growth of agricultural production declined and the growth of population far exceeded the growth of cereal production, thereby reducing the per capita availability of cereal. As a result over the years poor are consuming, in real terms, less of cereals as they buy finer grain cereals at higher prices. If the poverty line is determined for a reference year of the past and the poverty lines for the subsequent years are determined only through price adjustments for subsequent years, this aspect of cereal consumption deprivation and the associated calorie deficiencies will not be captured by the traditional measures of poverty[12]. It is these issues that necessitate an examination of cereal deprivation as distinct from head count index of poverty. As considerable emphasis is laid on traditional poverty measures to design and evaluate poverty alleviation programmes, it is also desirable to examine the

[10] In calorie terms they estimate that a meal taken at home normally would have 727 calories, while a meal served to a guest at a ceremony would have 1550 calories, the meal served to a guest at other occasions would have 1379, and the meal served to an employee would have 608.

[11] It is necessary for this reason to have special surveys of the poor including the homeless such as that of Banerjee and Duflo (2007).

[12] Sharadini Rath (2003) brought out this point quite emphatically. However, even in her study what is brought out is the contribution of state-to-state variations in poverty levels attributable to differing calorie intakes in the reference year only.

degree of correlation between cereal consumption deprivation and the traditional poverty measures.

There is a debate on poverty estimates in India in recent years. This debate is in the papers by Rath (1996), Rath (2003), Sundaram and Tendulkar (2003), Deaton and Kozel (2005), and Kulshrestha and Kar (2005). We briefly cover some of this debate as it relates to our own work on estimating cereal consumption deprivation. There are basically four issues in this debate.

First, whether to use an all-India reference poverty line based on calorie requirement and derive the state poverty lines or to use state-specific poverty lines based on calorie requirements and choose the all-India poverty line consistent with the state lines is crucial, so that the state poverty estimates aggregate to all-India poverty estimates. Rath (1996) and Rath (2003) are critical of using an all India level of poverty and adjusting it by price indices to arrive at the state level poverty indices. They recommend instead using the same calorie norm for all states and determine for a base year state-specific poverty lines and adjust them for the other years using price indices. To the extent possible, Rath (2003) used the prices from the NSSO survey data. One may however question the use of the same calorie norm for all states irrespective of the age-sex and occupation profiles of their populations, and climate and terrain they confront. Although we are not using a calorie-based poverty line we also derive state-specific Engel curves separately for rural and urban sectors, and use the cereal prices from NSSO survey data to convert all figures to 1993-1994 all India rural prices. But we do need a uniform norm for comparison over time and space and use the maximum real cereal consumption over all the states and the sectors over the period of investigation.

The second issue of the debate is the discrepancy in per capita total expenditure estimates obtained by the NSSO and by the National Accounts Division of the Central Statistical Organization, and the need to make an upward adjustment of the NSSO estimates. According to Kulshrestha and Kar (2005) this discrepancy is negligible with respect to food items, and in particular with respect to expenditure on cereals. As we are estimating the Engel curve for cereals we use the same source, NSSO, both for the cereal expenditure and the total expenditure.

Third issue in the debate is a change in the reference period used in different rounds, the effect of that on the estimates, and comparability of the estimates between the rounds (Deaton

and Dreze (2002), and Deaton and Kozel (2005). As per the report of NSSO's Expert Group on Non-Sampling Errors (2003), as far as the cereals are concerned, the estimates based on 30-day recall period are more accurate than the estimates based on the 7-day recall period. We used only the 30-day recall period estimates for all the three Rounds in our study.

The fourth issue in the debate is the price deflators used in converting the total expenditures and the poverty lines. Deaton and Tarozzi (2000), Deaton and Dreze (2002), and Deaton (2003) were not the first ones to use better prices from NSS source in computing the poverty lines for India. Chatterjee and Bhattacharya (1974) used NSS data on quantities and values to compute spatial variation in prices and used them to construct state-wise poverty estimates from All India index. Minhas *et. al.* (1987) made an excellent attempt to compute the prices at the minimum calorie norm point using detailed consumption patterns observed for different states, instead of using a general price index determined from external sources, such as the consumer price index of agricultural labour (CPIAL) as a price index for rural areas, and consumer price index of industrial workers (CPIIW), as the index for urban areas.

Rath (1996) and Rath (2003) highlight the differences in the poverty line estimates one gets by sticking to the calorie norm and calculating the poverty estimates separately for each state in a given reference year, compared to using an all India rural reference year poverty line and adjusting it for price differentials between states. Rath (2003) recommends using to the extent possible the spatial and temporal prices from NSSO data itself. We employ the price indices derived from NSSO data given by Deaton (2003) to deflate the estimates of cereal consumption for comparison purposes between years, between states, and between rural and urban sectors[13].

Data do not come the way the theory conceptualizes it. While we expected cereals to be an essential commodity that would saturate at a finite level of total expenditure, it is not confirmed by the data. Monthly per capita cereal expenditure (mpccereal) plotted against monthly per capita total expenditure (mpce) shows that at higher levels of total expenditure the proportion spent on cereals increases. This is because the cereal expenditure includes cereal products purchased, and the rich do spend a lot on purchased food preparations in

[13] It may be noted that the price indices constructed by Deaton were based on limited price data on 173 items available from NSSO survey data, while the price indices constructed by S. Rath were based not only on the limited NSS data, but also on additional data from other sources for a wider range of commodities.

restaurants, Kellog's cereal etc. In addition, this could be due to such affluent households spending more on cereals for guests and for family and religious festivals.

In order to take care of this situation one must determine a cut-off point in "mpce" where the Engel curve would turn from concave to convex. Using the notion that any curve can be approximated by a polynomial of sufficient degree and that a cubic allows for the curve to be both concave and convex in different segments, we estimated a third degree polynomial between "mpcceral" and "mpce". We then determined a cut-off point such that below that cut-off point the cubic fit would be concave with an asymptote[14]. Subsequently we used households whose monthly per capita total expenditure is less than the cut-off in further analysis[15].

From the scatter diagram of the truncated sample we observed that the relation between monthly per capita cereal expenditure and monthly per capita total expenditure is such that this relationship is nonlinear, concave in most part, and had a non-zero intercept. We also observed that the scatter diagrams between per capita cereal expenditure and monthly per capita total expenditure for the Engel curves were erratic with a lot of unexplained variation between households. A part of this variation was due to variation in household size[16]. Even when we added it as an additional explanatory variable there was still a lot of unexplained variation when we use unit level data. For obtaining a smoother Engel curve we considered group means of these variables for different total expenditure classes. We, however, used a much finer group of expenditure class intervals than what NSSO used. We started with 30 equally spaced class intervals, and merged the cells whenever the cell frequencies were less than 5. We ended up with much larger number of class intervals than 12 class intervals used by NSSO. We use the specification given in equation 3.2 of the previous section. We used the three specifications to choose from, semi-log, double-log and equation 3.2.

[14] When we first determined a cut-off point like this, the censored sample also had a cubic Engel curve with a convex portion. So we iterated this process until we got a censored sample that had a concave Engel curve. As the data sets differ we could not use the same numerical tolerance limit for determining the closeness of the second derivative to zero. In 15 out of 96 cases either the truncated sample became too small or the cut-off point was too large. In these exceptional cases we modified the tolerance limit and had separate calculations.

[15] As pointed out by the referee this procedure is equivalent to our treating this cut-off point as a poverty line. This is analogous to, but different from the suggestion of Rao (1981). Kumar et al. (1996) dispense with the focus axiom and the poverty line under the assumption that the Engel curve for cereals saturates.

[16] There is an extensive literature on the need to include this variable in the Engel curve, and on the expected sign of its coefficient based on the notions of economies of scale and scope within a household. One may see Deaton and Paxton (1998) and Perali (2001).

We used the maximum likelihood method of estimation and wrote a GAUSS program for estimation. We used the option of obtaining bootstrap estimates of standard-errors as the asymptotic standard errors are inaapropriate to use with grouped data with sample size equal to 30 or less. All the three estimated functions are shown alongside the actual plot of cereal expenditure versus total expenditure in Figure 2.

We estimated a total of 288 Engel curves, three for each data set, and we have 96 data sets. There are 32 data sets for each of the three years (NSS Rounds), of which 16 are for rural and 16 for urban[17]. The sixteen cases refer to one all-India and 15 major states for which we have data for all the rounds. As the dependent variables are not the same in all the three specifications of the Engel curve, and as one of the specifications (equation 3.2) is non-linear in parameters, we calculated a goodness of fit measure that is the square of the correlation between the predicted values and the actual values of "pccereal", and we called it R^2. Among these 96 sets of Engel curves estimated we find that in 89 cases the specification given by equation 3.2 has the highest R^2. In three of the other seven cases that specification misses the first position only at the fourth decimal point. Even in the other four cases the specification 3.2 has the second highest R^2, not much smaller in magnitude than the competing case. Further the estimated errors of specification 3.2 are checked for their Normality and found to be Normal. In view of this we accepted the specification 3.2 for all cases as it gave rise to errors that are distributed as a Normal with least variance. The estimated Engel curve parameters are presented in Tables A1.1-1.3 of Appendix. The actual and predicted values for a typical data set are plotted in Figure 3.

While making comparisons between estimates of different rounds we must note two aspects. First expenditures depend on price level and hence deflation is needed. Second, the structure of Engel curve could differ over time and space. Hence the deprivation measures SI of equation 3.3 at different points in time and space refer to different maximum cereal consumption expenditures. To make them comparable one must use SI* given by equation 3.5. The total expenditure cut-off point and the maximum cereal consumption per capita were deflated using the ideal price deflators given by Deaton (2003). The cereal consumption deprivation index given by equation 3.5 is a dimensionless number and hence needs no deflation.

[17] As the computation involved a large number of regression runs using repetitive procedures we had written a GAUSS program to carry out all the calculations.

5. An Analysis of Cereal Consumption Deprivation in India before and during Economic Reforms

The deflated values (with 1993-1994 all India rural prices as the base) of maximum per capita total expenditure cut-off (deprivation point) and maximum per capita cereal consumption expenditure are presented in Tables 1 and 2. Although the cut-offs are increasing over time in nominal terms, they remain more or less stable in real terms. Using the saturation estimates we derive the Sitaramam Index (SI*) of deprivation based on equation 3.5. All the SI* estimates are presented in Tables 3. Only in five cases the deprivation point we obtained was lower than the poverty line. These are for the states of UP rural in 1993-1994, states of Bihar, Kerala and West Bengal for urban 1993-1994, and Kerala for urban 1999-2000.

At all-India level the estimates of rural cereal consumption deprivation are higher than the urban deprivation. Figure 4 shows the trends at All India level for the cereal consumption deprivation in rural and urban sectors. While the cereal consumption deprivation had declined significantly during the economic reforms in the rural sector, there has been little improvement in the urban sector during the reforms.

Table 4 summarizes the pattern regarding the rural and urban gaps in cereal consumption deprivation and the overall trends in SI* over the pre-reform and post-reform periods at the all India level and among the 15 major Indian states. The deprivation rates estimated from the three different surveys suggest that the rate of rural deprivation at all India level declined by as much as 27.76 % between 1987-88 and 1993-1994 (before economic reforms), while it declined by only 23.14% between 1993-1994 and 1999-2000 during economic reforms. The estimates for the urban sector at all India level show that the decline in cereal consumption deprivation was 8.11% before economic reforms, while there was no change in the cereal deprivation index during economic reforms. In other words, improvement in cereal consumption deprivation seems to have slowed down during the reforms, both in rural and urban sectors.

The pattern of changes among the states is not as clear-cut as at all India level. Table 4 shows clearly the different patterns among different states. Figure A2.1 presents graphs showing the rural and urban trends in SI* for all the 15 major states. In some states the cereal consumption deprivation has actually increased during economic reforms suggesting that reforms could

have worsened the consumption of cereals in some states. This could be due to the benefits of such reforms not going to those states, while the availability of cereals could also have in fact decreased, and prices of cereals increased, due to interregional transfers of food grains to reform-friendly states from other states. This pattern of differences in deprivation among states and among the rural and urban areas seem to suggest some possible hypotheses on underlying forces for migration, rural to urban and inter-state (see Palmer-Jones and Sen (2003, 2006)).

Till recently, the available estimates of poverty did not offer a definitive answer on how living standards of the poor have been changing in the post-reform period. Our estimates provide some information on this aspect. It is not appropriate to compare our SI* estimates of deprivation with the traditional poverty estimates, as deprivation is defined differently in these cases. While the traditional poverty indices depend on the distribution of total expenditure, the cereal consumption deprivation used here depends on the distribution of cereal consumption expenditure. These two distributions are however related statistically through the Engel law. It therefore makes sense to see how these two measures move relative to each other. We provide correlations between our measure of deprivation and the poverty estimates of Deaton and Dreze (2002), and Rath (2003). These are provided in Tables 6 and 7 for rural and urban sectors respectively. The correlations demonstrate quite tellingly that there is little spatial correlation between the traditional measure of poverty and cereal consumption deprivation index at state level. It is worth noting that this correlation is rather poor for the urban sector, both temporally and spatially.

One might argue that SI* is based on a deprivation point much above the poverty line and hence these trends are not comparable. To answer this question we estimated SI* separately for persons with total expenditure less than poverty line (SI*-PL). We note that SI* and SI*-PL are strongly correlated and differ in levels but maintain similar trends for most states. One conclusion we draw from this is that trends across space and time in the traditional poverty indices do not reflect the trends in cereal consumption deprivation. Hence if commodity specific deprivation, and its alleviation, with respect to essential commodities is the focus of state policy then the traditional measures of poverty are of little help. The results seem to suggest that further investigations are needed on commodity-specific deprivation to understand the problem of deprivation or poverty.

The temporal trends at all India level in our measure of deprivation SI*, SI* at the poverty line and below (SI*-PL), and those of Deaton and Dreze, DD-HCI and DD-PGI, are presented in Figures 5 and 6. The magnitude of SI*-PL is uniformly above that of SI*, as the deprivation cut-off point is above the poverty line of Rs.205.8 per capita per month (for all India rural 1993-94, derived from the nominal poverty line using Deaton's price deflator). While the trends in rural deprivation are similar with respect to all the four measures, it is clear that there is a marked difference in these trends in the urban sector. These trends are over a long period of five years. While the head count index seems to indicate that there is a decline in the deprivation during economic reforms in the urban sector our index shows no such decline. The temporal trends between these indices of deprivation among the states (as given in Table 3) do not show any particular pattern. Figure A3.1 and A3.2 of Appendix present graphs of the trends between the four deprivation indices for 15 major states of India for rural and urban separately.

We examined analytically the variations in SI* estimates we obtained by formulating a Probit model with the limited dependent variable SI*, which lies between 0 and 100:

$$\frac{SI^*}{100} = \Phi(Z = X\beta) \quad where\ \Phi\ is\ the\ cumulative\ distribution\ \ function\ of\ \ a\ Normal\ Distribution$$

$$X\beta = \beta_0 + \beta_1 Urb + \beta_2' State\ Dummies + \beta_3' Year\ Dummies + u \quad \text{.....5.1}$$

Where the parameter β_2 is a vector of 15 coefficients associated with the 15 state dummy variables (All-India Rural mean is the reference point); the parameter β_3 is a vector of two coefficients associated with the year dummy variables (year 1987-88 is taken as reference year). It may be mentioned that this is just a rudimentary model meant to understand the variation in the deprivation index between states, between rural and urban areas and between years. Under the assumption that this specification is correct one may interpret the statistical significance of the estimated coefficients.

As $\Phi(X)$ is a monotonic increasing function of X the sign of the coefficients signify the direction of influence of the explanatory variable on the level of SI*. The results of the regression are presented in Table 5. The urban dummy is negative and significant, implying that at the all India level urban deprivation is less than rural deprivation for 1987-1988, as is demonstrated in Figure 4. We also observe that the decline between 1987-1988 and 1993-1994 is statistically significant only at 10% level, while that over a longer period, from 1987-1988 to 1999-2000, it is highly significant. The low level of significance between 1987-1988

and 1993-94 period is partly due to poverty rising in many states in the immediate aftermath of the early nineties economic restructuring. The early 1990s post-crisis experience with regard to increase in poverty is analysed by Datt and Ravallion (1997), who found that only about a tenth of the measured increase in poverty could be attributed to factors that could be readily linked to the macro crisis and the subsequent stabilisation programme. Positive (negative) signs for the state dummies show that the corresponding cereal consumption deprivation is more (less) than the all India level for the rural sector for the year 1987-1988. Some state dummies are significant, implying that those states have rural SI* significantly larger or smaller than all India rural level.

6. Concluding Remarks

The estimates presented in this paper using NSS consumption expenditure data from the three quinquennial rounds of 1987-1988, 1993-1994 and 1999-2000 indicate that there has been a decline in rural deprivation between 1987-88 and 1999-2000 at the all India level. Even here the rate of decline was more before economic reforms than during the reforms. At the state level our estimates show that for some states there has been deterioration in the deprivation levels during the economic reform period. This is perhaps due to economic reforms having differential impacts on different states.

There is an opinion that with economic development and growth, particularly after introduction of economic reforms, people at all levels of income have more incomes and are consuming less of rice, and thus rice is an inferior good (Ito *et al*. (1989). One may argue that the estimated negative income elasticity of rice in Asian countries could be due to a misspecification, or that the observed negative elasticity is not due to a movement along the Engel curve but due to a shift in the Engel curve. As suggested by Ingco (1991) there is a need to undertake a detailed analysis of interrelated demand functions to answer the question if rice is an inferior good. In particular one must examine both the effects of changes in income and price on rice consumption of persons in different total expenditure classes using quantile regressions, and see if negative expenditure elasticity holds in the lowest quartile.

In our own study also we observe that the level of maximum cereal consumption had declined over time in some states and at all India level. This indicates either that (i) the per capita availability of cereals had declined, other things remaining the same, or (ii) the cereal

prices have increased, other things remaining the same, or (iii) that the people were substituting non-cereal and non-food items for cereals, either due to increase in cereal prices or due to a change in preferences or, (iv) any combination of these.

As the SI* index is poorly correlated with the traditional HCR poverty index we recommend a shift from poverty index to cereal deprivation index, or in general to commodity-specific deprivation indices, if it is reduction of such commodity deprivation of essential commodities that is our policy objective. There could be a substitution of milk and milk products for cereals in some states (as in Punjab and Haryana). As the cereal composition in the consumption baskets has undergone significant change over the years, with pulses, particularly gram, playing an important complementary or substitution role to that of cereals in consumption in many states, it may be useful to combine pulses with cereals in constructing an alternative measure of commodity-specific deprivation index for India. We made no effort to relate or correlate the cereal consumption deprivation with other dimensions of living standards or other components of human development index such as infant mortality rate, life expectancy at birth, morbidity rate etc. We may however point out that a distinction be made between measures of deprivation based on stock variables such as health and flow variables such as cereal consumption. Flow variables may be poorly correlated with stock variables.

References:

Atkinson, A.B. (1987), 'On the measurement of poverty', *Econometrica*, 55: 749–764.

Banerjee, Abhijit, and Esther Duflo (2007), "The Economic Lives of the Poor", *The Journal of Economic Perspectives*, 21 (1): 141-167.

Bhargava, A. (1992), "Malnutrition and the Role of Individual Variation with Evidence from India and the Philippines", *Journal of the Royal Statistical Society*, Series A, 155 (2): 221-231.

Chatterjee, G.C. and N. Bhattacharya (1974), "Between State Variation in Consumer Prices and Per Capita Household Consumption in Rural India", in *Poverty and Income Distribution in India*, Statistical Publishing Society, Kolkota

Dandekar, V.M. and N. Rath (1971): *Poverty in India,* Indian School of Political Economy, Pune.

Dasgupta, P. (1993), *An Inquiry Into Well-Being and Destitution*, Clarendon Press, Oxford.

Datt, G. and M. Ravallion (1997), 'Macroeconomic Crises and Poverty Monitoring: A Case Study for India', *Review of Development Economics*, 1:135-52.

Deaton, A. (2003), "Prices and Poverty in India: 1987-2000", *Economic and Political Weekly*, 38 (4): 362-368.

Deaton, A., and Jean Dreze (2002), "Poverty and Inequality in India: *Economic and Political Weekly*, 37 (36): 3729-3748.

Deaton, A., Kozel, V. (2005), 'Data and dogma: The great Indian poverty debate', *World Bank Research Observer*, 20 (2): 177-199.

Deaton, A. and C. Paxon (1998), "Economies of Scale, Household Size, and the Demand for Food", *Journal of Political Economy*, 106 (5): 897-930.

Deaton, A. and A. Tarozzi (2000), "Prices and Poverty in India", Princeton Research Program in Development Studies, Available from http:www.wws.princeton.edu/~rpds.

Eastwood, Robert and Michael Lipton (2000), "Pro-poor Growth and Pro-Growth Poverty Reduction: Meaning, Evidence, and Policy Implications", *Asian Development Review*, 18 (2): 22-58.

Ito, S., E. Peterson, and W. Grant (1989), "Rice in Asia: Is it Becoming an Inferior Good", *American Journal of Agricultural Economics*, 71: 32-42.

Ingco, M.D. (1991), "Is Rice Becoming an Inferior Good? Food Demand in Philippines", World Bank Policy Research Working Paper Series WPS 722, The World Bank.

Kulshrestha, A.C. and Aloke Kar (2005), " Consumer Expenditure from National Accounts and National Sample Survey", in Deaton, A. and Valerie Kozel (Eds), *The Great Indian Poverty Debate*, New Delhi, Macmillan

Kumar, T.K., A.P. Gore and V. Sitaramam (1996), 'Some conceptual and statistical issues on measurement of poverty', *Journal of Statistical Planning and Inference*, 49 (1): 53-71.

Minhas, B.S., Jain, L.R., Kansal, S.M., and Saluja, M.R. (1987), "On the Choice of Appropriate Consumer Price Indices and Data Sets for Estimating the Incidence of Poverty in India", *Indian Economic Review*, 22 (1): 19-50.

Minhas, B.S. (1993), "On Estimating the Inadequacy of Energy Intakes: Revealed Food Consumption Behaviour versus Nutrition Norms (Nutritional Status of Indian People in 1983), *Journal of Development Studies*, 28 (1): 1-38.

National Sample Survey Organization Expert Group on Non-Sampling Errors (2003), " Stability of Different Reference Periods for Measuring Household Consumption: Results of a Pilot Study", NSSO: New Delhi.

Palmer-Jones, R., and K. Sen (2006), 'It is where you are that matters: the spatial determinants of rural poverty in India', *Agricultural Economics*, 34 (3): 229-242.

Palmer-Jones, R., Sen, K. (2003), 'What has luck got to do with it? A regional analysis of poverty and agricultural growth in rural India', *Journal of Development Studies*, 40 (1): 1-31.

Perali, F. (2001), "The Second Engel Law and Economies of Scale: An Empirical Puzzle to be Resolved", Department of Economics, University of Verona, Italy. http://www.child-centre.it/papers/child28_2001.pdf

Perspective Planning Division, Government of India, (1993), *Report of the Expert Group on Estimating Proportion and the Number of Poor*, Planning Commission: New Delhi

Pradhan, M. and M. Ravallion (2000), 'Measuring Poverty Using Qualitative Perceptions of Consumption Adequacy', *The Review of Economics and Statistics*, 82 (3): 462-471.

Rao, Bhanoji, V.V. (1981), "Measurement of Deprivation and Poverty Based on the Proportion Spent on Food: An Exploratory Exercise", *World Development*, 9 (4): 337-353.

Rath, Nilkanth. (1996), "Poverty in India Revisited", *Indian Journal of Agricultural Economics*, Vol. 51(1&2), Jan-June, pp. 76–108.

Rath, Sharadini. (2003), "Poverty by Price Indices", *Economic and Political Weekly*, 38 (40): 4260-4268.

Sen, Pronab (2005), "Of Calories and Things: Reflections on Nutritional Norms, Poverty Lines and Consumption Behaviour in India", *Economic and Political Weekly*, 40 (43): 4611-4618.

Sitaramam, V., S.A. Paranjpe, T.K. Kumar, A.P. Gore and J.G. Sastry (1996), 'Minimum Needs of Poor and Priorities Attached to them', *Economic and Political Weekly*, Special Number, 31 (35-37): 2499-2505.

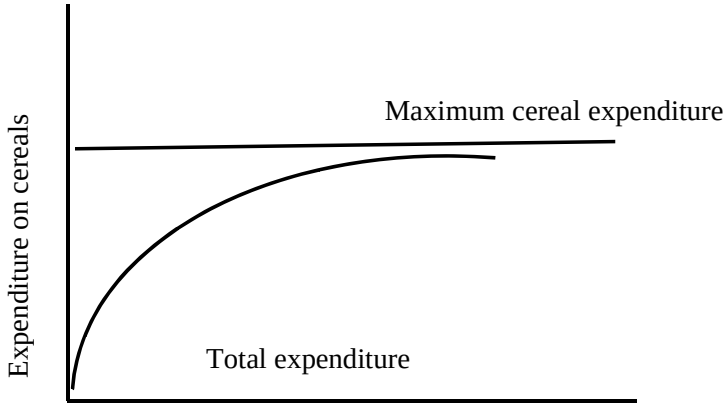
Srinivasan, T.N. (1992), "Undernutrition: Concepts, Measurement, and Policy Implications", in S.R. Osmani (Editor), *Nutrition and Poverty*, Clarendon Press, Oxford.

Subrananiam S. and A.S. Deaton (1996), "Demand for Food and Calories", *The Journal of Political Economy*, 104 (1): 133-162.

Sundaram and Tendulkar (2003), "Poverty Has Declined in 1990s: A Resolution of Comparability Problem in NSS Consumer Expenditure Data", *Economic and Political Weekly*, 38 (4): 327-337.

Figures and Tables

Figure 1a



Engel Curve for Cereals

Figure 1b

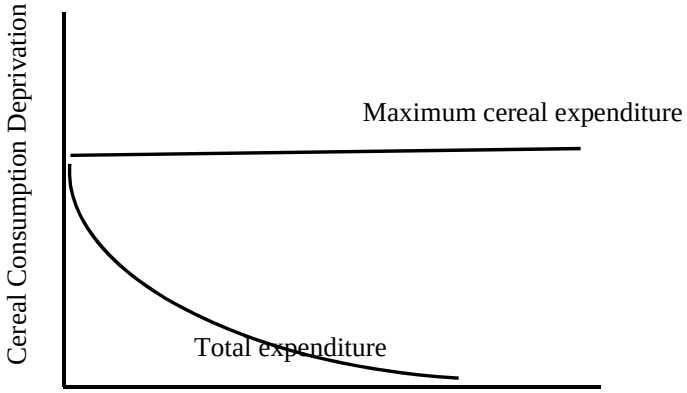


Figure 2

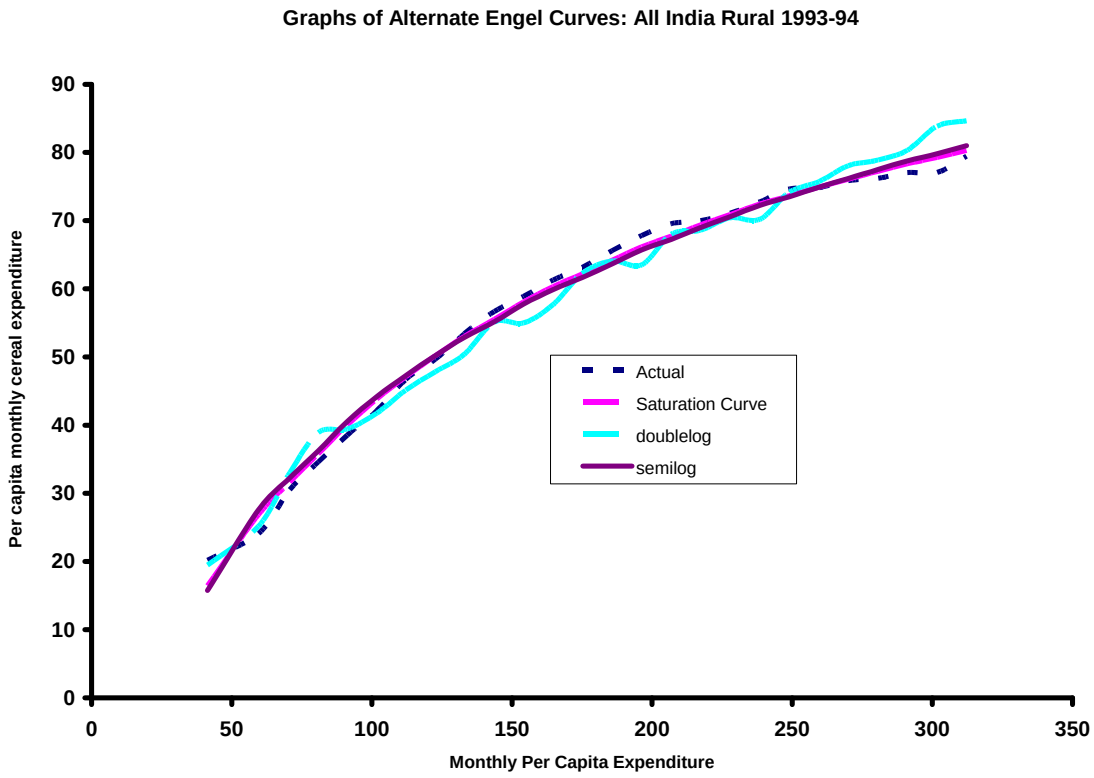


Figure 3

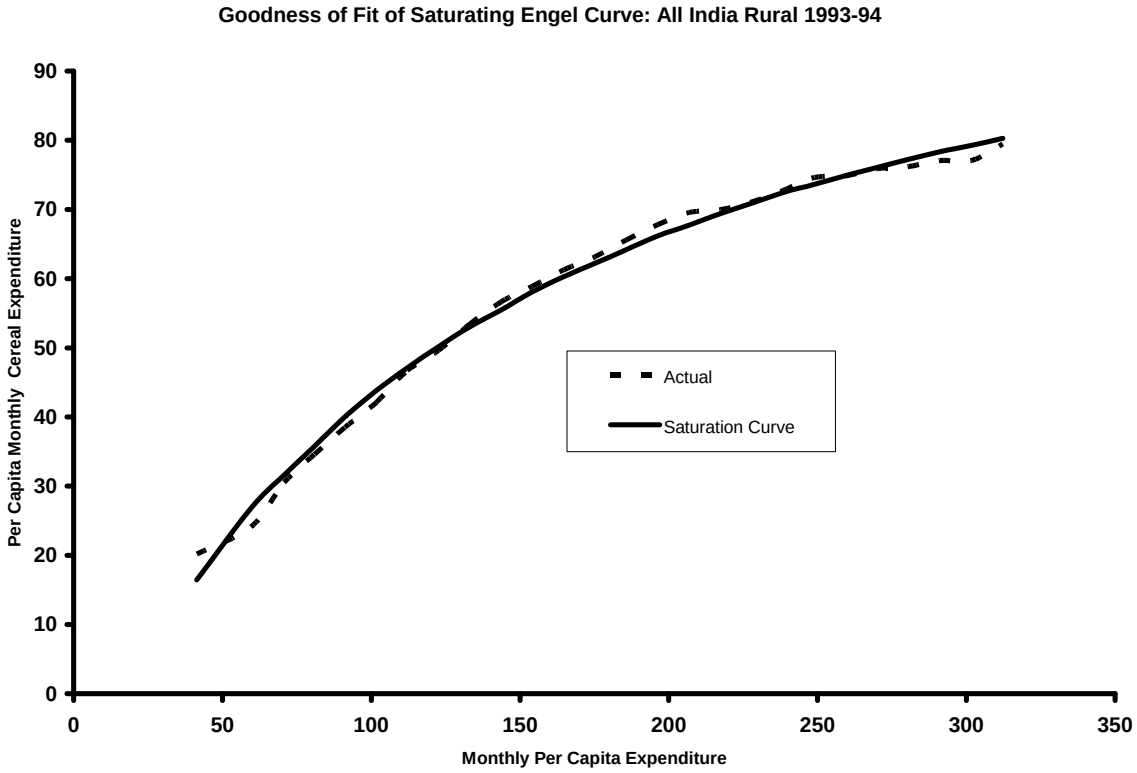


Figure 4

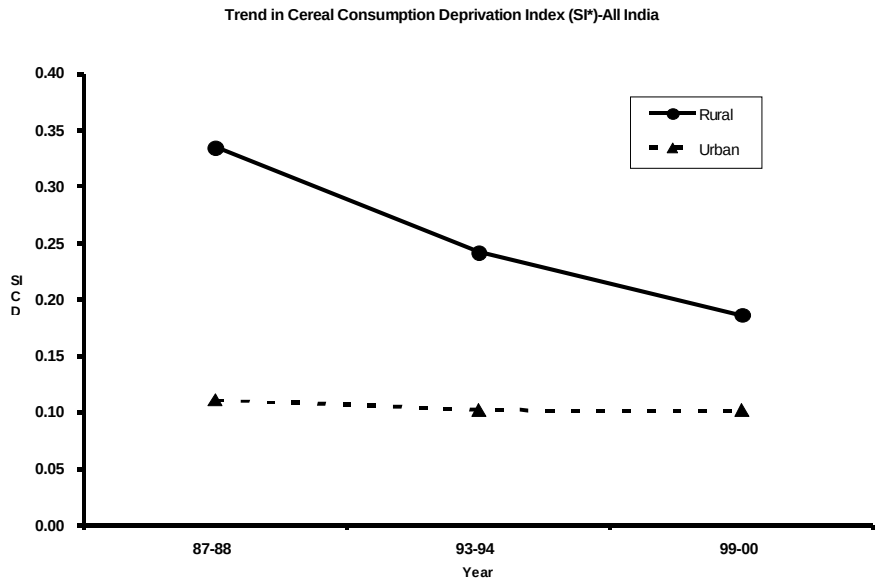


Figure 5

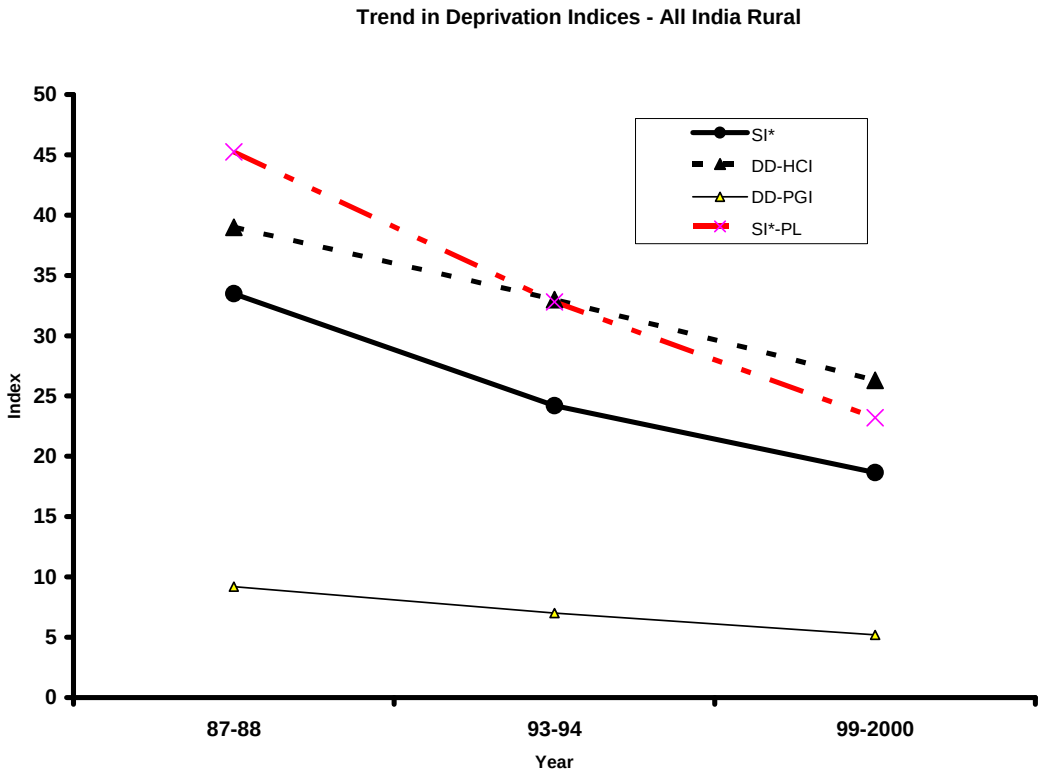


Figure 6

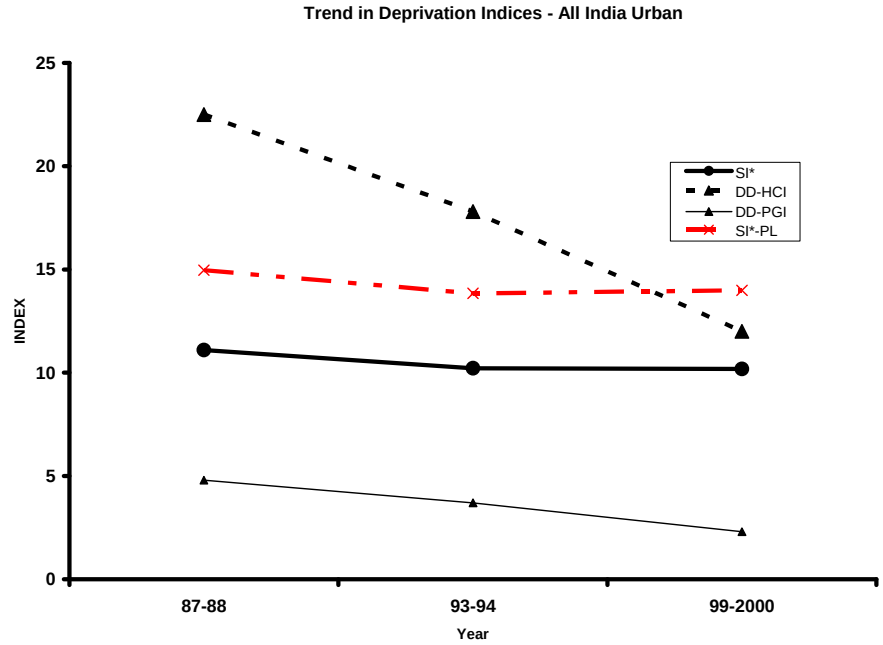


Table 1: Upper Limit to Total Expenditure and Saturation Levels of Cereal Consumption in Rural India

State	1987-88		1993-94		1999-2000	
	Upper Limit Total Exp	Maximum Consumption	Upper Limit Total Exp	Maximum Consumption	Upper Limit Total Exp	Maximum Consumption
All-India	265.2	133.8	317.6	116.1	318.7	104.6
Andhra Pradesh	393.2	139.0	585.8	171.8	487.7	142.4
Assam	278.4	147.8	395.8	126.6	464.2	141.8
Bihar	322.7	175.2	305.8	130.9	284.8	131.2
Gujarat	407.4	187.2	446.5	88.9	650.5	89.1
Haryana	436.0	81.3	234.2	65.0	496.9	62.8
Karnataka	471.3	174.4	442.4	206.5	766.9	155.3
Kerala	302.1	93.8	236.3	83.0	712.7	84.2
Maharashtra	392.8	84.4	689.0	114.3	660.1	117.8
Madhya Pradesh	368.6	120.4	314.5	116.8	242.1	108.4
Orissa	358.0	144.3	374.5	139.0	294.8	141.2
Punjab	299.2	54.0	553.6	71.4	775.1	68.3
Rajasthan	364.8	97.8	356.7	85.2	530.5	91.9
Tamil Nadu	526.1	159.2	628.3	134.8	515.2	127.1
Uttar Pradesh	283.8	95.6	191.9	75.5	288.3	77.1
West Bengal	316.3	159.5	364.8	134.3	448.2	146.7

Notes:
The nominal values are deflated using the price deflators used by Deaton (2003)
The upper limit to total expenditure is the minimum of total expenditure at which the Engel curve is concave.
It may be noted that the poverty line for the base period 1993-94 and All India Rural was 205.8

Table 2: Upper Limit to Total Expenditure and Saturation Levels of Cereal Consumption in Urban India

State	1987-88		1993-94		1999-2000	
	Upper Limit Total Exp	Maximum Consumption	Upper Limit Total Exp	Maximum Consumption	Upper Limit Total Exp	Maximum Consumption
All-India	227.9	65.6	266.6	66.9	247.9	63.7
Andhra	225.7	66.7	631.8	85.3	616.8	108.8
Assam	238.9	100.6	530.1	105.3	482.2	105.1
Bihar	213.1	112.2	182.4	92.5	283.5	125.7
Gujarat	293.8	58.3	332.8	61.9	389.1	48.5
Haryana	269.7	77.6	665.2	120.2	425.5	41.3
Karnataka	467.7	77.6	262.5	140.8	427.6	117.0
Kerala	289.7	47.4	185.2	45.8	154.1	55.9
Maharashtra	268.4	52.3	296.4	59.3	281.4	69.0
Madhya Pradesh	333.7	42.5	302.3	55.5	373.6	55.9
Orissa	311.1	117.3	325.2	88.4	432.0	106.7
Punjab	634.4	112.2	390.5	39.0	397.3	34.0
Rajasthan	421.3	57.7	279.9	43.6	313.0	43.6
Tamil Nadu	275.5	101.5	393.5	105.9	660.8	148.8
Uttar Pradesh	243.3	59.4	288.6	57.5	351.9	58.9
West Bengal	416.0	90.0	188.1	103.3	487.8	104.8

Notes: All figures are in constant rupees per month per person with 1993-94 All-India rural prices as the base. The nominal values are deflated using the price deflators used by Deaton (2003).
The upper limit to total expenditure is the minimum of total expenditure at which the Engel curve is concave. It may be noted that the poverty line for the base period 1993-94 and All India Rural was 205.8

Table 3: Trends in Cereal Consumption Deprivation Index at the National Level and 15 Major States: India

	SI*-Rural			SI*-Urban		
Area	*1987-1988* [a]	*1993-1994* [b]	*1999-2000* [c]	*1987-1988* [a]	*1993-1994* [b]	*1999-2000* [c]
All India	33.5	24.2	18.6	11.1	10.2	10.2
Andhra Pradesh	28.3	38.1	32.2	11.1	15.7	24.8
Assam	32.2	22.8	33.0	12.1	10.4	11.0
Bihar	42.6	25.8	27.1	23.4	14.9	28.9
Gujarat	63.6	18.4	18.6	11.8	12.3	8.2
Haryana	14.6	12.9	10.0	17.6	42.2	3.3
Karnataka	48.4	67.6	40.9	10.1	43.3	28.0
Kerala	20.8	17.3	13.6	9.2	8.4	15.4
Maharashtra	16.7	30.1	27.3	8.9	11.0	15.7
Madhya Pradesh	23.7	25.6	22.8	3.5	8.5	7.5
Orissa	28.2	27.1	28.8	17.5	8.9	10.7
Punjab	7.7	17.8	13.0	41.3	4.9	2.2
Rajasthan	14.8	14.4	16.3	9.7	4.7	5.5
Tamil Nadu	39.9	27.4	34.6	20.9	21.9	42.8
Uttar Pradesh	15.8	11.1	10.2	8.1	5.9	6.3
West Bengal	35.7	22.1	30.9	13.3	20.7	12.5

Note: a, b and c correspond to the 43rd, 50th and 55th survey rounds respectively. The pre-reform period refers to 1987-88 and 1993-94 surveys; the post-reform Period covers the period between 1993-94 and 1999-2000.

Table 4: Qualitative Trends in Cereal Consumption Deprivation Index (SI*): All India and 15 Major States

	Before Reforms: Between1987-88 and 1993-1994 [a]			*After Reforms: Between 1993-94 and - 1999-2000* [b]			*Entire Period: Between 1987-1988 and 1999-2000* [c]		
Area	Changes in SI*-Rural	Change in SI*-Urban	Change in Rural-Urban Gap in SI*	Change in SI* Rural	Change in SI* Urban	Change in Rural-Urban Gap in SI*	Change in SI*- Rural	Change in SI*- Urban	Change in Rural-Urban Gap in SI*
All India	Decreasing	Decreasing	Decreasing	Decreasing	No change	Decreasing	Decreasing	Decreasing	Decreasing
Andhra Pradesh	Increasing	Increasing	Increasing	Decreasing	Increasing	Decreasing	Increasing	Increasing	Decreasing
Assam	Decreasing	Decreasing	Decreasing	Increasing	Increasing	Increasing	Increasing	Decreasing	Increasing
Bihar	Decreasing	Decreasing	Decreasing	Increasing	Increasing	Decreasing	Decreasing	Increasing	Decreasing
Gujarat	Decreasing	Increasing	Decreasing	Increasing	Decreasing	Increasing	Decreasing	Decreasing	Decreasing
Haryana	Decreasing	Increasing	Decreasing	Decreasing	Decreasing	Increasing	Decreasing	Decreasing	Increasing
Karnataka	Increasing	Increasing	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing	Increasing	Decreasing
Kerala	Decreasing	Decreasing	Decreasing	Decreasing	Increasing	Decreasing	Decreasing	Increasing	Decreasing
Maharashtra	Increasing	Increasing	Increasing	Decreasing	Decreasing	Decreasing	Increasing	Increasing	Increasing
Madhya Pradesh	Increasing	Increasing	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing	Increasing	Decreasing
Orissa	Decreasing	Decreasing	Increasing	Increasing	Increasing	Decreasing	Increasing	Decreasing	Increasing
Punjab	Increasing	Decreasing	Increasing	Decreasing	Decreasing	Decreasing	Increasing	Decreasing	Increasing
Rajasthan	Decreasing	Decreasing	Increasing	Increasing	Increasing	Increasing	Increasing	Decreasing	Increasing
Tamil Nadu	Decreasing	Increasing	Decreasing	Increasing	Increasing	Decreasing	Decreasing	Increasing	Decreasing
Uttar Pradesh	Decreasing	Decreasing	Decreasing	Decreasing	Increasing	Decreasing	Decreasing	Decreasing	Decreasing
West Bengal	Decreasing	Increasing	Decreasing	Increasing	Decreasing	Increasing	Decreasing	Decreasing	Decreasing

Note: a, b and c correspond to the 43rd, 50th and 55th survey rounds respectively. The pre-reform period refers to 1987-88 and 1993-94 surveys; the post-reform period covers the period between 1993-94 and 1999-2000.

Table 5: Parameter Estimates of a Probit Model for Analysis of Variation Between SI* estimates

	Parameter	Estimate	Std. Error	Z	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
PROBIT (a)	Urban Dummy	***-0.42******	0.03	-13.85	0.00	-0.48	-0.36
	Year 99-2000	***-0.10******	0.04	-2.83	0.00	-0.17	-0.03
	Year 93-94	***-0.06****	0.04	-1.65	0.10	-0.13	0.01
	WB	***0.17****	0.08	2.03	0.04	0.01	0.33
	UP	***-0.39******	0.09	-4.19	0.00	-0.58	-0.21
	TN	***0.45******	0.08	5.51	0.00	0.29	0.61
	Rajasthan	***-0.32******	0.09	-3.48	0.00	-0.50	-0.14
	Punjab	-0.13	0.09	-1.49	0.14	-0.30	0.04
	Orissa	0.08	0.08	1.00	0.32	-0.08	0.25
	MP	-0.11	0.09	-1.31	0.19	-0.29	0.06
	Maharashtra	0.02	0.09	0.19	0.85	-0.15	0.18
	Kerala	***-0.15****	0.09	-1.74	0.08	-0.33	0.02
	Karnataka	***0.67******	0.08	8.41	0.00	0.52	0.83
	Haryana	-0.03	0.09	-0.31	0.76	-0.19	0.14
	Gujarat	***0.15****	0.08	1.76	0.08	-0.02	0.31
	Bihar	***0.32******	0.08	3.91	0.00	0.16	0.48
	Assam	0.09	0.08	1.01	0.31	-0.08	0.25
	AP	***0.25******	0.08	3.05	0.00	0.09	0.41
	Intercept	***-0.68******	0.07	-10.41	0.00	-0.74	-0.61

Notes: (a) PROBIT model: PROBIT(p) = Intercept + BX
***, **, * indicate significance at 1%, 5%, and 10% level respectively; R^2 =Square of Correlation between actual and predicted values=0.56.

Table 6: Correlations Between SI* and Poverty Indices – All India and 15 Major States-Rural

	1987-88				1993-94				1999-2000		
	DD-HCI	**DD-PGI**	**SR-HCI**	**SI*-PL**	**DD-HCI**	**DD-PGI**	**SR-HCI**	**SI*-PL**	**DD-HCI**	**DD-PGI**	**SI*-PL**
All-India	39	9.2	-	45.2	33	7	-	32.8	26.3	5.2	23.2
AP	35	8	44.2	38.4	29.2	5.8	37.2	51.9	26.2	4.8	45.5
Assam	36.1	6.5	48.5	43.6	35.4	5.7	42.9	31.1	35.5	6.1	44.6
Bihar	54.6	13.2	47.4	57.5	48.6	10.7	44.5	34.9	41.1	8.5	36.6
Gujarat	39.4	8.4	58.3	86.0	32.5	6.8	43.5	24.9	20	3.8	24.7
Haryana	13.6	2.8	26.9	19.7	17	3	22	17.4	5.7	0.7	16.2
Karnataka	40.8	10.5	36.7	65.4	37.9	8.6	27.8	91.6	30.7	6.1	55.5
Kerala	23.8	4.8	51.9	28.1	19.5	3.9	42.6	23.3	10	1.7	18.4
Maharashtra	44.3	11.2	57.2	22.6	42.9	8.2	53.8	40.9	31.3	6.6	36.8
MP	43.7	10.8	41.9	32.0	36.6	11.2	38.8	34.6	31.9	7.6	30.3
Orissa	50.4	13	53.9	38.1	43.5	9.7	43.9	36.7	43	10.5	39.2
Punjab	6.6	1	21.7	10.4	6.2	1	16.8	24.1	2.4	0.3	17.6
Rajasthan	35.3	9.2	23.1	19.9	23	4.4	13.4	19.4	17.3	3	23.5
TN	49	13.7	64.2	54.2	38.5	9.1	55.7	37.3	24.3	4.6	47.1
UP	34.9	7.5	33.1	21.3	28.6	5.8	28.3	15.0	21.5	3.9	13.7
WB	36.3	7.7	43	48.4	25.1	4.2	33	30.1	21.9	3.5	42.0
R^2											
With SI*	0.304	0.221	0.320		0.185	0.186	0.024		0.452	0.346	
With SI*-PL	0.304	0.221	0.322		0.185	0.186	0.025		0.418	0.315	

Notes: DD-HCI: Head Count Index of Deaton and Dreze (2002); DD-PGI: Poverty Gap Index of Deaton and Dreze (2002); SR-HCI: Head Count Index of Sharadini Rath (2003); SI*-PL: SI* at the poverty line 205.8

Table 7: Correlations Between SI* and Poverty Indices – All India and 15 Major States- Urban

	1987-88				1993-94				1999-2000		
	DD-HCI	**DD-PGI**	**SR-HCI**	**SI*-PL**	**DD-HCI**	**DD-PGI**	**SR-HCI**	**SI*-PL**	**DD- HCI**	**DD-PGI**	**SI*-PL**
All-India	22.5	4.8	-	15.0	17.8	3.7	-	13.8	12.0	2.3	14.0
AP	23.4	4.9	29.6	15.1	17.8	3.4	25.5	21.3	10.8	1.9	33.7
Assam	13.6	2.0	16.8	16.5	13.0	2.0	17.2	14.2	11.8	1.9	18.0
Bihar	38.1	8.2	28.5	31.4	26.7	5.6	27.4	20.0	24.7	5.0	32.7
Gujarat	16.4	2.8	40.5	16.0	14.7	2.6	31.7	16.8	6.4	1.0	11.1
Haryana	11.8	2.3	35.6	23.8	10.5	1.9	25.4	57.6	4.6	0.7	4.6
Karnataka	26.0	5.7	32.3	13.6	21.4	4.5	30.5	58.6	10.8	2.1	35.3
Kerala	21.0	4.5	28.3	12.4	13.9	2.7	16.2	11.5	9.6	1.7	20.4
Maharashtra	20.7	4.1	51.1	12.1	18.5	3.5	51.9	15.0	13.9	2.6	21.2
MP	21.2	5.3	27.0	4.7	18.2	4.6	27.8	11.5	12.0	2.8	9.6
Orissa	20.8	4.2	25.7	23.6	15.2	3.0	14.7	12.1	15.6	3.0	14.7
Punjab	6.6	1.0	28.4	56.0	7.8	1.1	22.1	6.7	3.4	0.4	2.9
Rajasthan	19.8	4.0	29.1	13.1	18.3	3.2	24.0	6.4	10.8	1.7	8.0
TN	26.2	6.2	41.1	28.4	20.8	4.5	38.6	29.8	11.3	2.0	58.5
UP	29.3	6.3	33.4	10.8	21.7	4.6	28.1	7.9	17.3	3.3	8.4
WB	22.3	4.2	23.7	18.0	15.5	2.9	16.3	28.0	11.3	1.9	16.8
R^2											
With SI*	0.088	0.087	0.005		0.002	0.005	0.018		0.142	0.132	
With SI*-PL	0.091	0.091	0.005		0.002	0.004	0.018		0.101	0.088	

Notes: DD-HCI: Head Count Index of Deaton and Dreze (2002); DD-PGI: Poverty Gap Index of Deaton and Dreze (2002); SR-HCI: Head Count Index of Sharadini Rath (2003); SI*-PL: SI* at the poverty line 205.8

APPENDIX

Table A1.1: Results of estimation of equation 3.2 for 43rd Round-1987-88

	Cut-off	A	SE(A)	B	B(SE)	C	C(SE)	D	D(SE)
43-r-allindia	148.39	0.90	0.00	-1.34	0.00	83.35	0.00	89.10	0.00
43-r-andhra pradesh	175.66	-18.08	0.00	-0.24	0.00	81.88	0.00	50.65	0.00
43-r-assam	172.31	-141.26	0.00	2.09	0.00	218.08	0.00	27.99	0.00
43-r-bihar	188.73	-20.89	0.00	0.44	0.00	120.29	0.00	83.28	0.00
43-r-gujarat	227.71	6.88	0.00	0.20	0.00	96.37	0.00	445.55	0.00
43-r-haryana	260.39	9.39	0.00	-0.48	0.00	42.56	0.00	118.53	0.00
43-r-karnataka	239.21	-23.21	0.00	2.01	0.00	97.62	0.00	133.53	0.00
43-r-kerala	191.76	-11.89	0.00	-0.05	0.00	71.77	0.00	78.88	0.00
43-r-maharashtra	220.65	-2.57	0.00	-1.11	0.00	57.76	0.00	60.47	0.00
43-r-madhya pradesh	191.57	-13.64	0.00	-1.15	0.00	84.24	0.00	45.59	0.00
43-r-orissa	211.28	-63.67	0.00	-1.38	0.00	158.48	0.00	29.23	0.00
43-r-punjab	178.69	-373.97	0.46	-0.26	0.00	408.09	0.45	3.13	0.00
43-r-rajasthan	208.30	-32.55	0.00	0.99	0.00	81.42	0.00	32.30	0.00
43-r-tamil nadu	302.30	-4.69	0.00	0.00	0.00	96.20	0.00	125.46	0.00
43-r-uttar pradesh	158.00	-46.52	0.00	1.29	0.00	90.67	0.00	25.81	0.00
43-r-west bengal	198.50	-36.36	0.00	0.14	0.00	135.52	0.00	62.53	0.00
43-u-allindia	179.58	-10.44	0.00	-0.89	0.00	68.38	0.00	44.86	0.00
43-u-andhra pradesh	166.54	-39.97	0.00	-0.08	0.00	89.76	0.00	26.66	0.00
43-u-assam	146.80	-620.92	2.22	-0.20	0.00	684.16	2.22	2.81	0.01
43-u-bihar	155.63	-27.84	0.00	-0.17	0.00	110.94	0.00	52.31	0.00
43-u-gujarat	247.33	-7.34	0.00	0.14	0.00	55.41	0.00	97.37	0.00
43-u-haryana	187.75	-21.31	0.00	2.12	0.00	60.50	0.00	101.94	0.00
43-u-karnataka	275.98	-6.03	0.00	-2.19	0.00	67.15	0.00	33.28	0.00
43-u-kerala	328.12	-3.83	0.00	-0.61	0.00	61.80	0.00	86.34	0.00
43-u-maharashtra	224.95	-20.15	0.00	0.00	0.00	63.98	0.00	44.45	0.00
43-u-madhya pradesh	296.64	-435.72	2.57	-1.87	0.00	486.64	2.57	1.93	0.01
43-u-orissa	176.56	-47.74	0.01	-0.52	0.00	117.96	0.01	25.65	0.00
43-u-punjab	536.08	34.82	0.00	-2.39	0.00	76.76	0.01	4093.05	0.62
43-u-rajasthan	392.75	1.17	0.00	1.38	0.00	43.01	0.00	142.10	0.00
43-u-tamil nadu	178.55	-17.90	0.00	0.19	0.00	82.35	0.00	62.72	0.00
43-u-uttar pradesh	168.25	-11.61	0.00	-0.90	0.00	59.02	0.00	27.52	0.00
43-u-west bengal	302.79	-4.59	0.00	0.43	0.00	67.10	0.00	71.04	0.00

Table A1.2: Results of estimation of equation 3.2 for the 50th Round –1993-94

	Cut-off	A	SE(A)	B	SE(B)	C	SE(C)	D	SE(D)
50-r-allindia	317.60	-13.33	0.00	-0.96	0.00	136.14	0.00	119.11	0.00
50-r-andhra pradesh	463.95	-27.76	0.00	1.40	0.00	154.06	0.00	161.45	0.00
50-r-assam	446.03	-423.57	0.00	-0.40	0.00	569.01	0.00	24.78	0.00
50-r-bihar	315.31	-69.42	0.00	0.41	0.00	201.52	0.00	69.94	0.00
50-r-gujarat	438.50	-14.99	0.00	-0.44	0.00	105.42	0.00	142.54	0.00
50-r-haryana	266.03	2.59	0.00	1.23	0.00	62.67	0.00	188.20	0.01
50-r-karnataka	401.30	-0.86	0.00	-0.19	0.00	189.52	0.00	467.47	0.00
50-r-kerala	279.98	-72.43	0.00	0.25	0.00	168.97	0.00	68.89	0.00
50-r-maharashtra	652.53	-4.86	0.00	-0.72	0.00	118.14	0.00	244.46	0.00
50-r-madhya pradesh	295.00	-19.08	0.00	-2.07	0.00	143.15	0.00	97.77	0.00
50-r-orissa	353.13	-41.00	0.00	-3.42	0.00	196.06	0.00	68.88	0.00
50-r-punjab	1793.33	61.59	0.00	-4.59	0.00	51.68	0.00	1866.35	0.02
50-r-rajasthan	374.20	-50.55	0.00	1.26	0.00	131.10	0.00	74.91	0.00
50-r-tamil nadu	600.07	-29.08	0.00	-0.54	0.00	161.55	0.00	124.93	0.00
50-r-uttar pradesh	198.64	-215.56	0.08	2.36	0.00	277.17	0.07	14.03	0.00
50-r-west bengal	391.02	-110.33	0.00	1.80	0.00	241.78	0.00	57.77	0.00
50-u-allindia	364.50	-50.99	0.00	0.25	0.00	140.70	0.00	63.18	0.00
50-u-andhra pradesh	853.66	3.12	0.00	-1.33	0.00	121.35	0.00	186.02	0.00
50-u-assam	546.68	-1609.55	0.00	-2.56	0.00	1736.05	0.00	4.00	0.00
50-u-bihar	211.40	-2309.39	0.00	-1.23	0.00	2425.18	0.00	2.42	0.00
50-u-gujarat	480.69	-19.16	0.00	1.98	0.00	94.76	0.00	196.86	0.00
50-u-haryana	835.00	59.23	0.00	-3.66	0.00	117.32	0.05	5816.75	3.03
50-u-karnataka	274.04	16.25	0.00	-2.61	0.00	149.02	0.00	344.50	0.01
50-u-kerala	360.26	-42.94	0.00	-0.03	0.00	132.22	0.00	86.68	0.00
50-u-maharashtra	431.40	-37.97	0.00	0.59	0.00	120.09	0.00	101.41	0.00
50-u-madhya pradesh	477.78	-40.26	0.00	0.63	0.00	123.55	0.00	79.17	0.00
50-u-orissa	332.70	-1287.47	4.65	-3.07	0.00	1399.35	4.65	3.02	0.01
50-u-punjab	577.20	2.40	0.00	-0.94	0.00	61.89	0.00	115.96	0.01
50-u-rajasthan	443.13	-288.09	1.75	0.62	0.00	352.78	1.74	12.57	0.07
50-u-tamil nadu	456.25	-21.43	0.00	0.93	0.00	137.72	0.00	169.35	0.00
50-u-uttar pradesh	334.88	-419.07	4.86	0.75	0.00	480.52	4.86	6.62	0.07
50-u-west bengal	226.00	-204.99	0.01	-0.41	0.00	331.93	0.01	32.48	0.00

Table A1.3: Results of Estimation of Equation 3.2 for the 55th Round-1999-2000

	Cut-off	A	SE(A)	B	SE(B)	C	SE(C)	D	SE(D)
55-r-allindia	507.00	-72.01	0.00	0.70	0.00	233.56	0.00	122.69	0.00
55-r-andhra pradesh	623.00	-14.53	0.00	-5.03	0.00	231.71	0.00	220.77	0.00
55-r-assam	824.00	18.85	0.00	-6.53	0.00	278.64	0.00	313.23	0.00
55-r-bihar	461.00	-132.96	0.00	2.71	0.00	326.45	0.00	121.03	0.00
55-r-gujarat	1008.00	31.34	0.00	-3.12	0.00	128.68	0.00	442.23	0.01
55-r-haryana	876.00	-37.92	0.00	-0.38	0.00	151.34	0.00	173.41	0.01
55-r-karnataka	1154.00	-39.67	0.00	0.15	0.00	272.29	0.00	418.87	0.00
55-r-kerala	1298.00	-66.02	0.00	-3.74	0.00	245.51	0.00	161.09	0.00
55-r-maharashtra	1022.00	-22.22	0.00	2.56	0.00	186.72	0.00	395.25	0.00
55-r-madhya pradesh	366.00	-75.54	0.00	1.35	0.00	229.98	0.00	120.57	0.00
55-r-orissa	464.00	-185.73	0.00	-0.06	0.00	408.43	0.00	87.49	0.00
55-r-punjab	1784.00	40.11	0.00	-1.74	0.00	92.48	0.00	752.44	0.01
55-r-rajasthan	887.00	-12.69	0.00	0.58	0.00	162.32	0.00	265.49	0.00
55-r-tamil nadu	770.00	-10.81	0.00	-3.00	0.00	221.79	0.00	400.54	0.00
55-r-uttar pradesh	472.00	-1801.46	0.73	2.07	0.00	1913.23	0.73	5.99	0.00
55-r-west bengal	762.00	-60.12	0.00	-0.19	0.00	310.88	0.00	222.11	0.00
55-u-allindia	547.00	-77.21	0.00	-0.09	0.00	218.45	0.00	107.09	0.00
55-u-andhra pradesh	1370.00	-9.33	0.00	3.63	0.00	225.72	0.00	638.44	0.00
55-u-assam	805.00	-61.93	0.07	-3.37	0.00	260.93	0.07	86.42	0.04
55-u-bihar	523.00	-58.88	0.00	4.16	0.00	261.60	0.00	262.22	0.00
55-u-gujarat	897.00	38.97	0.00	-3.24	0.00	95.58	0.00	402.27	0.00
55-u-haryana	869.00	-658.07	4.80	-0.03	0.00	742.65	4.80	10.83	0.07
55-u-karnataka	754.00	-29.24	0.00	0.74	0.00	230.26	0.00	398.35	0.00
55-u-kerala	510.00	-59.36	0.00	-0.89	0.00	250.56	0.00	287.47	0.00
55-u-maharashtra	673.00	-17.25	0.00	0.54	0.00	178.36	0.00	356.40	0.00
55-u-madhya pradesh	897.00	-100.49	0.01	0.57	0.00	230.64	0.01	92.97	0.01
55-u-orissa	701.00	-2890.95	0.00	0.96	0.00	3057.43	0.00	4.86	0.00
55-u-punjab	899.00	-580.35	5.65	-3.07	0.00	678.73	5.65	9.00	0.08
55-u-rajasthan	822.00	-18.53	0.01	-1.26	0.00	141.77	0.01	143.28	0.02
55-u-tamil nadu	1228.00	-19.01	0.00	4.90	0.00	261.16	0.00	1105.64	0.01
55-u-uttar pradesh	657.00	-955.74	1.53	-0.98	0.00	1072.55	1.53	9.38	0.01
55-u-west bengal	969.00	-1986.73	0.00	11.50	0.00	2114.52	0.00	13.45	0.00

Figure A2.1: Rural-urban variations in SI* for all India and 15 major states

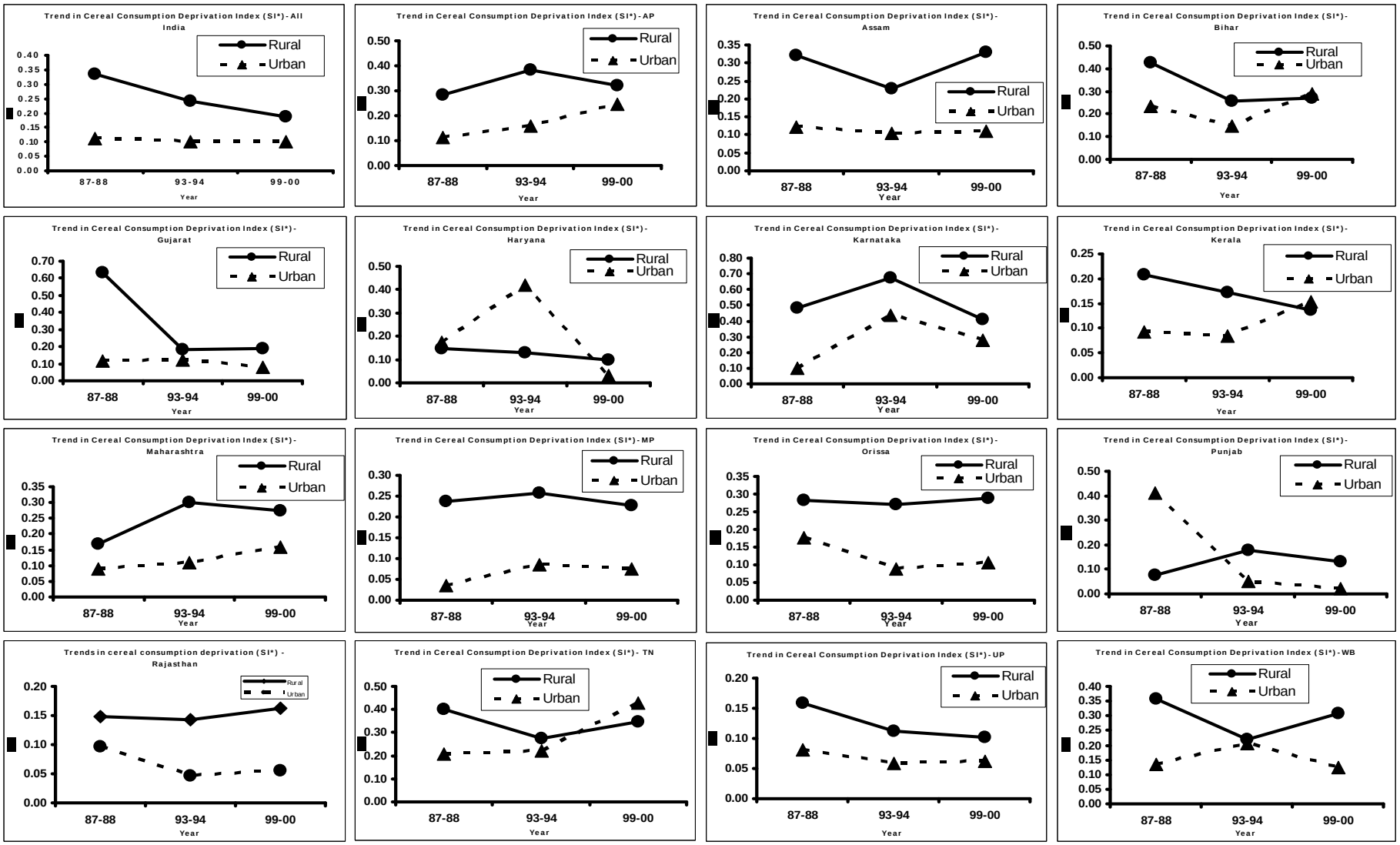


Figure A3.1: Trends in Cereal Consumption Deprivation Index and Poverty Indices at the National Level and 15 Major States of India: Rural

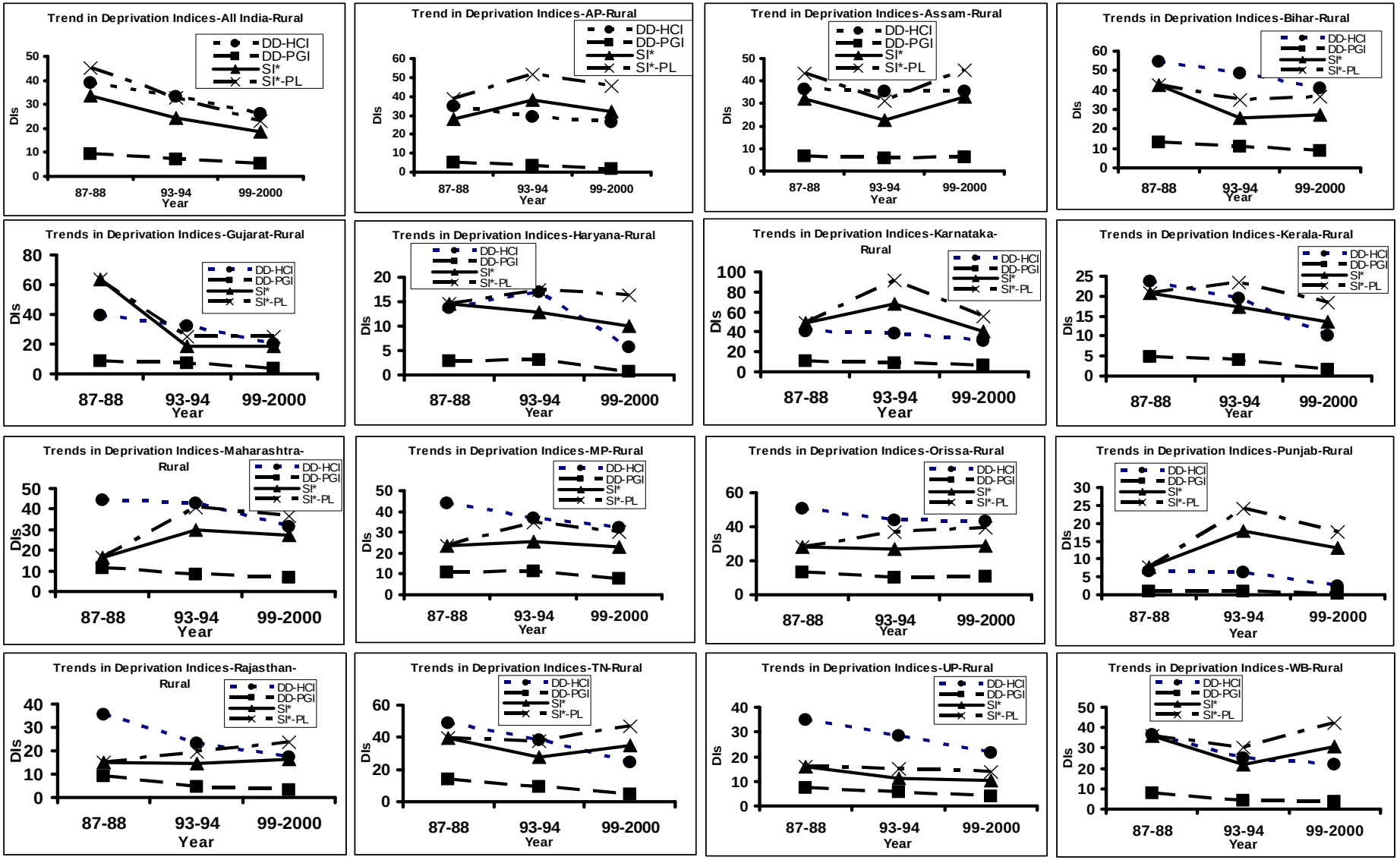


Figure A3.2: Trends in Cereal Consumption Deprivation Index and Poverty Indices at the National Level and 15 Major States of India: Urban