Derivation of Nutrient Prices from Household level Food Expenditure Data: Methodology and Applications*

by

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Abstract

In multilateral consumer price level comparisons, mismatch of the list of items consumed in individual countries poses a major problem. For example, comparison of the level of prices of food items in two countries becomes difficult, if the sets of food items consumed in the two countries are very different. In such a situation, however, if one had the data on average level of intake of major nutrients and some measure of the *corresponding nutrient prices*, a comparison of the level of nutrient prices might be done conveniently. At the level of a household, given the prices of food items paid and the corresponding quantities of intake of different nutrients (from the consumption of various food items, all put together), it is possible, in principle, to work out a set of shadow prices of individual nutrients. These shadow prices of nutrients, being based on households' actual consumption information, would be influenced by the prices of food items consumed, nominal income, household attributes and other factors characterizing the preferences of individual households. Given such sets of household level nutrient prices and corresponding nutrient intakes, a set of multilateral nutrient price index numbers may be worked out to compare nutrient price levels across population groups. Needless to mention, such a comparison would facilitate the task of comparison of the overall consumer price levels across countries/regions.

In this paper a regression analysis-based procedure has been proposed for estimation of household-level unit values of major nutrients ,namely, carbohydrate, protein and fat, using a cross-sectional household level data set on food expenditure, total consumer expenditure, quantities of nutrients consumed and related variables. The proposed procedure has been applied to the Indian household level data for the year 1999-2000 thrown up by the 55th round Consumer Expenditure Survey of the National Sample Survey Organisation, Govt. of India. Using the household level nutrient prices thus estimated and the corresponding data on quantity consumed of nutrients, multilateral price and quantity index numbers for nutrients reflecting inter-State variation in the level of nutrient prices and nutrient intake have been constructed and examined separately for the rural and the urban sector of some selected major Indian States. In another application, the estimated nutrient prices have been used to define poverty line in terms of the value of consumer expenditure that covers the cost of prescribed nutritional norm expressed as a vector of minimum required quantities of major nutrients. Using this and other alternative poverty lines, the incidence of poverty corresponding to alternative poverty lines have been compared separately for the rural and urban sector of the major Indian States.

Key Words: Nutrient Prices, Multilateral Price Comparisons, Poverty Line

JEL Classification Codes: O12, I12, C31.

1. Introduction

A basic problem of cross-sectional comparison of consumer price levels relates to the heterogeneity of the baskets of consumed goods across population groups (countries or regions or communities within a country) involved in the comparison. Because of differences in culture, institutions, tastes and preferences etc., the baskets of *representative* goods for individual population groups are often quite different and non-comparable. As is well known, when the proportion of goods *unique to the population groups* in the union set of *goods consumed by all population groups* together is large, the basis for price level comparison becomes weak because of the possibility that the extent of *homogeneity error* in the computed price index numbers may be quite large. This problem is obviously less severe if the population groups involved in the price level comparison are fairly similar or homogeneous.

The problem of heterogeneity and non-comparability of the baskets of representative goods mentioned above shows up for every individual sub-group of consumer expenditure like food, clothing, housing, communication, recreation etc. Given the fact that food commands a large share of the average consumer's budget in the developing countries, when population groups of such countries are involved in consumer price level comparison (be it an international comparison across all countries of the world or a comparison across countries within the developing world like say, the south Asia region), it is the difference in the levels of prices of food items across population groups that is likely to dominate and determine the pattern of overall price level differential. Essentially for this reason, a cross-sectional comparison of the levels of food prices alone is so immensely important. For example, comparison of the purchasing power of the poor in different countries of the world is now a declared program of the International Comparison Program (ICP), World Bank. Given the fact that a poor, no matter in which part of the world he or she resides, spends mostly on food, the computed country-specific purchasing power parities will be determined mainly by the differential in the food price levels faced by the poor in different countries. Needless to mention, non-comparability of the representative food baskets across countries may pose a major challenge to such a price level comparison exercise.

In case of comparison of food prices, however, the *homogeneity problem* mentioned above may be overcome or bypassed, if the space of comparison is changed from one of prices of food items to that of the corresponding nutrient prices. To elaborate, given the information on the composition of nutrient content (like carbohydrate, protein, fat etc.) of each food item and the quantity of each food item consumed by a household, the total quantity of each nutrient consumed by a household can be estimated. Further, the total value of all nutrients consumed should be equal to the total food expenditure of the household. That means, corresponding to the nutrient quantities, there exists a set of implicit nutrient prices for the household such that the food expenditure and the total value of all nutrients are equal. This implies, given the (average) food expenditure and the corresponding (average) intake of various nutrients of individual population groups, if it is possible to estimate the corresponding sets of (average) nutrient prices for individual population groups, price levels of nutrients can be compared across population groups bypassing the problem of homogeneity error altogether.

As regards the estimation of a set of *implicit* nutrient prices from a given set of prices of food items, there is a literature discussing the technique of estimation of nutrient prices by regressing a set of food item prices on the nutrient contents of corresponding unit food quantities (St-Pierre and Glamocic, 2000). Nutrient prices estimated by this approach, however, will be the same for all households facing a given set of prices of food items because the procedure does not use any household specific information. This is somewhat unrealistic, because even when a group of households faces the same set of food prices, the implicit nutrient prices are likely to vary from household to household. This is because given tastes and preferences and the budget constraint, individual households may purchase different bundles of food items and thus end up with different sets of nutrient quantities even if they face the same set of prices. Since comparison of consumer price levels is thought to have a welfare underpinning, one should preferably use household-specific implicit nutrient prices for comparing nutrient price levels across population groups. In this context, it may be mentioned that since *a priori* the set of implicit nutrient prices for a household is tied to the household's *optimal* food budget allocation, these are functions of the household's preference pattern, income position and the set of prices faced. Needless to mention, any change in the set of prices (prices of food items, in particular) would lead to a corresponding change in the set of implicit nutrient prices.

Conceptually, it is possible to work out a set of household level implicit nutrient prices, given the prices of food items and the quantities of different nutrients obtained from all food items consumed by a household. This is done by solving the following linear programming problem: $\underset{q}{Minimize}\ p'q$ subject to $Aq \geq \eta, q \geq 0$, where *p* and *q* denote the vectors of given prices of food items and the corresponding quantities to be found out, respectively, A' denotes the matrix of nutrient composition of food items and η denotes the vector of (given) amounts of nutrients obtained from consumption of all food items. The dual solution of this problem will give the set of shadow prices of the nutrients (see McFarlane and Tiffin, 2003).

However, although such household-specific estimates of shadow prices of nutrients may be valuable and useful on their own, the fact that some of these may be zero makes them inappropriate for use in price index number compilation. As an alternative, we have proposed here a regression analysis-based procedure for estimation of household-specific prices/unit values of major nutrients like carbohydrate, protein and fat, using a cross-sectional household level data set on food expenditure, total consumer expenditure, quantities of nutrients consumed and related variables. The proposed procedure has been applied to the Indian household level data for the year 1999-2000 thrown up by the 55th round Consumer Expenditure Survey of the National Sample Survey Organisation, Govt. of India.

Let us briefly enumerate the features of the proposed procedure. First of all, this procedure is perhaps the first of its kind as there is no reference in the existing literature to any attempt to estimate household-specific implicit nutrient prices from the available household level data on food expenditure. The procedure, being based on single-equation regression technique, is simple and straightforward. More importantly, unlike the nutritionists' approach mentioned earlier, this procedure does not require information on the prices of food items and rely on the behavioural and nutritional information that is easily available in a set of household level consumption data. Finally, one can use any positive functional form for the nutrient-specific quality equation.

Two applications of the estimated household-specific nutrient prices have been made in this paper. The first relates to an inter-state comparison of the levels of nutritional prices and nutritional intake. Using the estimated household level nutrient prices together with the corresponding data on the quantity of nutrients consumed, sets of multilateral price and quantity index numbers measuring inter-State variation in the level of nutrient prices and nutrient intake, respectively, have been compiled and examined separately for the rural and the urban sector for some selected major Indian States. In the other application, the estimated nutrient prices have been used to define poverty line in terms of the value of consumer expenditure that covers the cost of prescribed nutritional norm in terms of a vector of minimum required quantities of major nutrients. Using this and other alternative poverty lines, the incidence of poverty corresponding to alternative poverty lines have been compared separately for the rural and urban sector of the major Indian States.

The methodology on the calculation of nutrient prices from unit records of household expenditure data, that is proposed here, and its empirical applications have wider interest than the immediate context of India on whose data set the present study was conducted. The public importance of this topic in the economics literature largely stems from the central role that nutrient consumption plays in productivity, as postulated in the theory of efficiency wages.[1] Much of this theory has concentrated on the consumption of nutrients rather than on the nutrient prices implied by the household expenditure pattern of food. Yet, from a policy viewpoint, an analysis of both, namely, nutrient consumption and nutrient prices is important, especially if the authorities wish to ensure that the household has sufficient resources to consume a “balanced diet” on its way to ensuring that it consumes the minimum calorie requirement. The idea of household specific poverty lines that take into account the age and gender specific calorie requirements, recognizing the realities of existing expenditure pattern, household size and composition and regional price[2] and taste differences is, as far as we are aware, relatively new. Its incorporation in the calculation of poverty rates and their comparison with those based on conventional measures, that we do in this paper, is therefore of significant policy interest. With the increasing availability of high quality household expenditure data sets, in unit record form and containing disaggregated information on food consumption and its nutrient contents, the proposed methodology is potentially useful in future applications.

The paper is organised as follows: Section 2 explains the proposed procedure of estimation of household-specific nutrient prices. The nature of data used and the basic results are described in Section 3. In Section 4, the results of application of the estimated nutrient prices (and the corresponding quantity data) to inter-state comparison of the levels of these variables based on a set of multilateral price and quantity index numbers are discussed. The application to delineation of poverty line is also discussed here. Finally, the paper is concluded in Section 5.

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[1] Following Leibenstein (1957), Mirlees (1975) and Stiglitz (1976), the theory of efficiency wages predicts a non linear functional dependence of productivity on nutrient intake – see Strauss and Thomas (1998) for a review of empirical evidence on this dependence. Conspicuous, by its absence, is the lack of similar evidence on the impact of nutrient prices on health and productivity.

[2] Coondoo, Majumder and Ray (2004) have recently proposed a regression based methodology that measures regional price differences, from unit records of household surveys, in the context of large Federal countries such as India. The present study extends that methodology to the calculation of nutrient prices and examining their regional differences in the context of such countries.

2. The Proposed Procedure

Suppose we have a set of household level data on total food expenditure (y_h^f), total quantity of each of K *major* nutrients (η_{ih}, $i = 1,2,...,K$), per capita income/total consumer expenditure or PCE (y_h) and an array of household attributes like household size, age-sex composition etc. (z_h) for $h = 1,2,...,H$ sample households. The food expenditure-nutrient relationship relating total food expenditure to total quantities of various nutrients is

$$y_h^f = \sum_{i=1}^{K} v_{ih}\eta_{ih} + \varepsilon_h,\ h = 1,2,...,H \qquad (1)$$

where v_{ih} denotes the implicit price/unit value of the *i-th* nutrient for the *h-th* household to be estimated and ε_h is the error term. Since we have considered only three major nutrients in our exercise (viz., carbohydrate, protein and fat) and ignored all other nutrients (like vitamins, minerals etc.), ε_h measures the aggregate value of all left out nutrients[3]. In this context, it may be mentioned that when nutrient specific data on nutrient quantities are available for individual food items (i.e., η_{ijh}: quantity of the ith nutrient obtained from the consumption of the jth food item by the hth sample household), one may consider estimation of food-item specific nutrient prices. In that case, for each food item, the item expenditure-nutrient relationship will be

$$y_{jh}^f = \sum_{i=1}^{K} v_{ijh}\eta_{ijh} + \varepsilon_{jh}, j = 1,2,...,n_f, h = 1,2,...,H, \qquad (1')$$

n_f being the number of food items for which data on nutrient quantities are available. This notion of food item-specific sets of nutrient prices may be justified on the ground that one unit of protein from the consumption of rice may be treated to be different from the same obtained from fish, say, as the concerned food items may have cultural and other dimensions that may make them different even though they may possess very similar nutritive values.

Next, let us specify the nutrient price function for each major nutrient to be of the following form:

$$v_{ih} = f_i(y_h, z_h, u_{ih}), i = 1,2,...,K \qquad (2)$$

[3] It may be noted that this error specification of the food expenditure-nutrient relationship (1) gives it a *stochastic frontier* appearance as $\varepsilon_h \geq 0$.

where $f_i(.)$ is a positive valued function and u_{ih} is a random disturbance term. It may be noted that (2) is a generalized form of Prais and Houthakker's (1955) quality equation that asserts that the price/unit value paid for a commodity is a function of a consumer's real income level. It may be mentioned here that whether $f_i(.)$'s will be increasing or decreasing functions of real income is essentially an empirical issue. There are two different phenomena that may give rise to the quality equation. The first one is a consumer's quality sensitivity - i.e., if several qualities of the same commodity are available and the price increases with the quality, a consumer will shift from lower quality to higher quality when her real income rises. The other phenomenon relates to price concession in bulk purchase - e.g., even when only one quality of a commodity is available, a richer consumer buying a larger quantity may get some price concession and hence pay a lower price. Thus, the nature of the slope of the quality equation with respect to real income will be determined by the relative strength of the two kinds of phenomena mentioned above.

In order to ensure that the estimated nutrient prices are positive, we specify (2) to be of the following specific algebraic form with an additive random disturbance term:

$$v_{ih} = exp(\beta_i \ln y_h + \gamma_i' z_h + \delta_i' z_h^*) + u_{ih},\ i = 1,2,...,K \tag{3}$$

where z_h is the household composition vector[4] (consisting of number of adult males, adult females, male children and female children in the household *h*) and z_h^* is the vector of interaction terms $z_h \ln y_h$[5]. Substituting (3) in (1), we get the following estimating equation:

$$\begin{aligned} y_h^f = \exp(\beta_1 \ln y_h + \gamma_1' z_h + \delta_1' z_h^*)\eta_{1h} + ... + \exp(\beta_K \ln y_h + \gamma_K' z_h + \delta_h' z_h^*)\eta_{Kh} \\ + \varepsilon_h^*, \quad h = 1, 2, .., H \end{aligned} \tag{4}$$

where $\varepsilon_h^* = \varepsilon_h + \sum_{i=1}^{K} \eta_{ih} u_{ih}$ is the composite equation random disturbance. Note that since u_{ih}'s are unrestricted in sign, so is ε_h^*[6]. Equation (4), which is a nonlinear regression equation, can be

[4] In the empirical exercise, we have taken $z_h' = (ln(1+n_h^{am}), ln(1+n_h^{af}), ln(1+n_h^{cm}), ln(1+n_h^{cf}))$, where $n_h^{am}, n_h^{af}, n_h^{cm}, n_h^{cf}$ denote the number of adult males, adult females, male children and female children in the household *h*, respectively.

[5] It may be noted that one may choose any flexible positive functional form for the fixed effect part on the r. h. s. of (3).

[6] Note that the disturbance term of equation (4), being a linear function of the household-specific nutrient quantity vector, is heteroscedastic. Note also that in view of $E(\varepsilon_h^*) \neq 0$, equation (4) is to be estimated with an intercept . term.

estimated using any standard nonlinear estimation technique. Once this equation has been estimated, the household-specific nutrient prices can be estimated as

$$\hat{v}_{ih} = exp(\hat{\beta}_i \ln y_h + \hat{\gamma}_i' z_h + \hat{\delta}_i' z_h^*), i = 1,2,...,K; h = 1,2,....,H \, , \qquad (5)$$

where ^ denotes estimated value.

3. Data and Results

As already mentioned, the proposed procedure has been applied on the Indian household level data thrown up by the 55th round Consumer Expenditure Survey of the National Sample Survey Organisation, Government of India, covering the survey period July 1999-June 2000. Using the procedure, household-specific estimates of prices of carbohydrate, protein and fat have been obtained for every rural and urban sample household of 16 major Indian States, viz., Andhra Pradesh (AP), Assam (AS), Bihar (BH), Gujarat (GU), Haryana (HA), Himachal Pradesh (HI), Karnataka (KR), Kerala (KE), Madhya Pradesh (MP), Maharashtra (MH), Orissa (OR), Punjab (PU), Rajasthan (RJ), Tamil Nadu (TN), Uttar Pradesh (UP) and West Bengal (WB).

Let us first summarise the results of estimation of the food expenditure equation (4). This equation involves a total number of 12 explanatory variables, viz., the three nutrient quantities, logarithm of PCE, four household composition variables (i.e., number of adult males, adult females, male children, female children) and four PCE-household composition interactions and there are 27 parameters in it. Tables 1 and 2 present the state-specific number of sample households and the squared correlation coefficient value (R^2) between observed and estimated household level food expenditure obtained by fitting the food expenditure equation (4) for the rural and the urban sector, respectively[7]. These Tables also give the state-specific arithmetic mean and standard deviation of the estimated household level price of each of the three nutrients for the rural and the urban sector, respectively. For the rural sector, the R^2 value ranges from 0.746 (UP) to 0.935 (PU) and for the urban sector the corresponding range is from 0.713 (RJ) to 0.996 (WB). Considering the fact that the estimation has been done on household level data, the R^2 values would suggest that the fit has been satisfactory in most of the cases.

The state-specific mean of the three nutrient prices for the rural and urban sector have also been presented as charts in Figures 1 – 3 for carbohydrate, protein and fat, respectively, to elicit the extent of inter-state variation in these numbers. The extent of variation is indeed quite

[7] For consideration of space, the detailed regression results are not presented here. These will be supplied on request to interester readers.

large for all the three nutrients. The coefficient of variation of the state-specific mean carbohydrate, protein and fat price worked out to be 53%, 14% and 93% for the rural sector and 67%, 87%, and 96% for the urban sector. Interestingly, these are found to be much larger than the coefficient of variation of the state-specific mean quantity of carbohydrate, protein and fat, which worked out to be 15%, 26% and 40% for the rural sector and 13%, 16% and 25% for the urban sector. The state-specific mean and standard deviation of household level quantity of carbohydrate, protein and fat for the rural and urban sectors calculated from the given data set are reported in Tables 3 and 4.

4. Two Applications of Estimated Nutrient Prices

We have made two applications of the estimated household level nutrient prices. The first one is a multilateral comparison of the nutrient price levels across states separately for the rural and the urban sector based on the state-specific mean nutrient prices and the corresponding mean nutrient quantity data set. The other application relates to the estimation of state-specific incidence of poverty for the rural and the urban sectors. To be specific, for a state and sector we have considered the official poverty line fixed by the Planning Commission, Government of India, along with three other poverty lines. One of these is defined in terms of the minimum calorie norm implicit in the official poverty line. The third poverty line is defined in terms of food expenditure required to meet the minimum nutritional norm based on the computed nutrient prices. Finally, a fourth poverty line is obtained by adding an allowance for nonfood expenditure to the poverty line based on food expenditure. Using each of these, first we have estimated the incidence of poverty for the state and sector concerned. Then for every pair of poverty lines, we have cross-classified the sample households in to poor and non-poor categories to examine the extent to which the classifications based on the two poverty lines agree.

4.1 Inter-State Comparison of Price and Quantity Levels of Nutrients

Let us consider the multilateral price index number application first. The method that has been used is as follows: Let $(p^i, q^i, i = 1,2,...,S)$ denote the vectors of the mean nutrient prices and quantities for the states and let P_{ij}^F denote the Fisher binary price index number for state j

with state i as base[8]. The corresponding EKS (see Elteto and Koves, 1964 and Szulc, 1995) multilateral price index number for state j with state i as base is $P_{ij}^{EKS} = (\prod_{l=1}^{S} \sqrt{P_{il}^F . P_{lj}^F}\ )^{\frac{1}{S}}$. It may be mentioned that the EKS index is circularity-consistent - i.e., the resulting index numbers guarantee transitivity of price level comparison, by construction.

Using the state-specific estimates of mean nutrient prices and the corresponding data on mean nutrient quantities, we have computed the set of EKS price and quantity index numbers for the rural and urban sector. The estimated index numbers are presented in Tables 5 - 8. A careful examination of these Tables reveals a number of interesting observations about the ordering of states in respect of the level of nutrient prices and nutrient quantities. Let us consider first the ordering in respect of nutrient price level. For the rural sector, the ordering (where state 1 $\succ$ state 2 means that state 1 has a higher price level than state 2) appears to be as follows:

KE $\succ$ GU~PU $\succ$ HA $\succ$ WB $\succ$ OR $\succ$ AP $\succ$ TN $\succ$ MH $\succ$ BH $\succ$ KR $\succ$ RJ $\succ$ HI $\succ$ MP $\succ$ AS $\succ$ UP. For the urban sector, the corresponding ordering is

KE $\succ$ AS $\succ$ KR $\succ$ GU~WB $\succ$ HI $\succ$ OR $\succ$ BH $\succ$ AP $\succ$ MH $\succ$ PU~TN $\succ$ HA $\succ$ UP $\succ$ RJ $\succ$ MP.

As regards the level of nutrient consumption in the rural sector, the index numbers suggest the following ordering of states (where state 1 $\succ$ state 2 means that state 1 has a higher consumption level than state 2):

HA $\succ$ RJ $\succ$ UP $\succ$ PU $\succ$ BH~MP $\succ$ HI $\succ$ AS $\succ$ GU~KR $\succ$ WB $\succ$ MH $\succ$ OR $\succ$ KE $\succ$ AP $\succ$ TN.

The corresponding ordering of states for the urban sector is

RJ $\succ$ UP $\succ$ BH $\succ$ HA $\succ$ PU $\succ$ MP $\succ$ MH $\succ$ GU $\succ$ HI $\succ$ KR $\succ$ KE $\succ$ AS~AP $\succ$ WB $\succ$ OR $\succ$ TN.

As the above orderings may suggest, in case of nutrient price level, the states tend to fall broadly in three groups, viz., KE, GU, PU and WB are the high price states, OR, AP, TN, MH and BH are the moderate price states and UP, MP and RJ are the low price states for rural and urban sectors alike. The position of AS, HI, HA and KR vary widely in the rural and urban ordering. From the ordering in respect of the level of nutrient consumption it appears that RJ, HA, UP, PU, BH and MP are the high consumption states, KR, HI and GU are the moderate consumption

[8] The formula for this index number is as follows: $P_{ij}^F = \{ \frac{\sum_k p_{kj} q_{ki}}{\sum_k p_{ki} q_{ki}} \frac{\sum_k p_{kj} q_{kj}}{\sum_k p_{ki} q_{kj}} \}^{1/2}$, where p_{kj} is the mean price of the k th nutrient in the j th state and q_{kj} is the corresponding mean quantity.

states and WB, KE, AP and TN are the low consumption states for rural and urban sectors alike. Positions of the remaining states in rural and urban orderings, however, do not match.

4.2 Alternative Poverty Lines and Comparison of Incidence of Poverty

A conceptual approach to delineation of poverty line for a given population group is to evaluate the cost of procuring a basket of goods and services that will fulfill the (minimum) *basic needs* of life of an average person of the group. Typically, a basic need menu involves a nutritional norm in terms of calorie to be obtained from food consumption and an allowance for meeting non-food basic needs. In India, the official poverty lines for the rural and the urban population are based on such nutritional norms in terms of calorie intake[9].

The technique used by the Planning Commission, Government of India, for delineating the state-specific rural and urban poverty lines is as explained below (see, Government of India, 1979, 1993 for details). For a given base year, the engel curve for calorie intake (i.e., per capita calorie intake expressed as a function of PCE) is estimated separately for the all-India rural and urban population using the consumer expenditure data thrown up by the NSSO. Given the calorie norm, the PCE required to meet this norm is then worked out from the estimated engel curve for calorie by *inverse interpolation*. The interpolated PCE value is taken as a measure of the all-India poverty line for the base year. Once this all-India poverty line is obtained, the corresponding state-specific poverty lines are calibrated by adjusting the all-India poverty line for inter-state price differentials. The poverty lines for other years are calculated by indexation of the base year poverty line.

As is well known, the quality of estimated incidence of poverty for a given population crucially rests, among other things, on the appropriateness of the poverty line used. It may be mentioned that there has been considerable debate on the issue[10] as to whether the poverty lines at current prices obtained by indexation of the corresponding base year poverty line, based upon which the official poverty estimates are made in India, are realistic, particularly from the point of view of fulfillment of the nutritional norm. In fact, there is a view that the Indian official poverty

[9] To be specific, these nutritional norms have been taken to be 2400 and 2100 kcal per capita per day for the official all-India rural and urban poverty lines, respectively.

[10] The debate involves four issues, viz., whether (1) NSS consumption data underestimate the growth of mean per capita consumption, (2) the price deflators used by the Planning Commission for indexation of poverty lines over-state the actual rate of inflation, (3) the use of 30 day recall period by the NSSO until recently underestimate household expenditure and (4) official poverty lines no longer correspond to the nutritional norms originally associated with them. For a summary discussion on these, see Palmer-Jones and Sen (2004).

estimates are underestimates of the true incidence of poverty for various reasons[11]. In this context, an important question is whether the official poverty lines are such that a *non-poor* household is necessarily *non-poor* in terms of its nutritional intake.

In the present application, we have examined how the incidence of poverty in rural and urban areas of the major Indian States may vary if alternative definitions of the poverty line, some of which give a *direct* stress on the non-fulfillment of basic nutritional requirements, are used. For this purpose, we have used three alternative definitions of the poverty line other than the official poverty line. The estimated State and sector level mean nutrient prices presented in Tables 1 and 2 have been used to measure two of these three poverty lines. These alternative poverty line definitions are given below.

Poverty line based on Calorie norm: As already mentioned, the Indian official poverty lines for rural and urban population are based on calorie norms of 2400 and 2100 kcal per capita per day for rural and urban India, respectively. As per expert opinion, the age-sex specific daily

[11] The first three issues mentioned in the previous footnote relate to this. See, e.g., Deaton and Tarozzi (1999), Visaria (2000) and Sen (1996).

normative calorie requirements corresponding to the overall calorie norm of per capita 2400 kcal /day for the average rural Indian are as follows[12,13]. The corresponding figures for the Indian urban population can be obtained by scaling down these numbers by a factor 0.875 (being the ratio of 2100 and 2400).

gender	Per capita Calorie requirement per day (kcal) for the age group (in years)							
	< 3	3 - 6	6 - 9	9 - 12	12 - 15	15 - 18	18 - 60	>60
male	1200	1500	1800	2100	2500	3000	2800	1950
female	1200	1500	1800	2100	2200	2200	2200	1800

Given the above, the aggregate calorie requirement of a sample household can be calculated using available information on individual sample households' age-sex composition together with the norms given above. A household is then classified as (calorie) poor (non-poor), if its observed calorie intake turns out to be less (more) than the required amount.

Poverty line based on Food expenditure norm: As per the recommendation of the Indian Council for Medical Research (ICMR), a balanced diet of 2738.60 kcal energy should comprise 467.53 gms of carbohydrate, 66.6 gms of protein and 66.9 gms of fat (Gopalan *et. al.*, 1999). Given this *balanced diet* nutrient composition and the above-mentioned age-sex specific calorie requirement norms, the corresponding age-sex specific requirements of the three nutrients, viz., carbohydrate, protein and fat, can be calculated. Using these age-sex specific requirements, the aggregate requirement of each nutrient for a sample household can be worked out. Based on these, a household-specific *food* poverty line may be set as the total value of aggregate requirements of each of the three nutrients, using the estimated average nutrient prices for the state and sector to which the household belongs. Given the poverty line thus obtained, a household is classified as (food) poor (non-poor), if the observed food expenditure is found to be less (more) than the corresponding food poverty line.

Poverty line based on Total expenditure norm: This poverty line is obtained by adding an allowance for non-food expenditure to the *poverty line based on food expenditure* defined above.

[12] These have been obtained from the website www.MedIndia.net. It may be mentioned that these estimates are close to, though not exactly same as, the energy allowances recommended by an Expert Group of the Indian Council of Medical Research (see ICMR, 2002).

[13] Whether these stipulated calorie norms are relevant in present days has been an issue of debate. It is argued by some that with the improvement in transportation facility, spread of mechanization of agriculture and other technologies etc., the daily energy requirement of an average Indian is likely to be less today than what it used to be thirty years back. See Mehta and Venkatraman (2000).

Here we have assumed that the *engel ratio for food* for a poor household to be 0.8, so that if f_h is the food poverty line for the *h*th sample household, the corresponding non-food expenditure allowance is $0.25 f_h$ and hence the poverty line in terms of total consumer expenditure is $t_h = 1.25 f_h$. A household is thus classified as poor (non poor), if the observed household total consumer expenditure is less (more) than t_h.

It may be noted that unlike the official poverty lines, the poverty lines defined above are household-specific. In what follows, we shall refer to the official poverty line as POV1 and the household specific poverty lines based on calorie, food expenditure and total expenditure norm as POV2, POV3 and POV4, respectively.

Estimates of incidence of poverty for the rural and urban sector of the individual States based on the four alternative poverty lines mentioned above are presented in Table 9. Based on the results of this Table, following observations may be made.

First of all, it should be mentioned that the estimated incidence of poverty based on the official poverty lines (POV1) are systematically lower than the corresponding official estimates released by the Planning Commission, Government of India. However, for both the sectors the ordering of the States in terms of poverty incidence that we have obtained are same as those based on the official estimates[14].

Next, a noticeable result in this Table is the huge discrepancy between the estimates based on POV2 and those based on other definitions of poverty line. A recent study by Meenakshi and Vishwanathan (2003) on NSS data has also drawn attention to the sharp divergence between the income and calorie based poverty rates, and to the "need for fresh debate on the determination both of the calorie norm and the poverty line" (p. 369). This paper quotes FAO recommended "minimum calorie" figures that suggest that the corresponding figures recommended by the Indian Planning Commission and used here may be high and "incorporating a margin of safety". The Meenakshi and Vishwanathan (2003) study presents evidence which shows that the calorie based poverty rates drop sharply if we lower the subsistence calorie figures from those recommended by the Planning Commission. Poverty incidences based on POV1, POV3 and POV4 are by and large much closer to each other and

[14] This may be due to the fact that our estimates are based on household level data whereas the Planning Commission combine the information on the distribution of per capita expenditure obtained from the NSS data, the National Accounts estimate of aggregate consumer expenditure and the poverty line to estimate the poverty incidence. See Deaton (2001).

lower than those based on POV2, which is defined in terms of calorie norm[15,16]. These results may suggest that a large portion of households in both rural and urban India, though non-poor according to the official definition, consume less calorie than what the poverty line expenditure level is supposed to make available to them.

In order to look deeper into the effect of varying the poverty line definition on the estimate of incidence of poverty, we have next examined the cross-classification of the sample households in terms of their observed poverty status according to alternative poverty lines and counted the percentage of matched and mismatched cases, taking different pairs of poverty lines in turn. Needless to mention, such cross-classification exercise, which has not so far been done, is essential for examining the extent of mismatch of classification of households into poor and non-poor categories by alternative poverty lines.

Tables 10 and 11 present the State-specific results of such cross-classification for the rural and the urban sector, respectively. As the estimated incidences of poverty based on POV1 and POV2 are widely different in almost all cases, it is to be expected that the mismatch of classification will be greater in the case of comparison of POV1 and POV2, which indeed is the case. For this pair of poverty lines the percentage of mismatched households for the rural sector (i.e., total of columns (3) and (4) of Table 10) is highest for Tamil Nadu (58.9) and lowest for Uttar Pradesh (28.3). The corresponding figures for the urban sector are 39.8 (Assam) and 15.8 (Himachal Pradesh). More importantly, as the entries in column (3) of Tables 10 and 11 show the percentage of households, which are non-poor in terms of the official poverty line POV1, but poor in terms of the calorie norm based poverty line POV2, the discrepancy is quite large in many cases.

Classifications involving POV1 and other two poverty lines show much closer agreements. Thus, in the case of POV1 and POV3 comparison, the highest percentage of mismatch are 31.9 (Assam) for the rural sector and 29.8 (Madhya Pradesh) for the urban sector. However, these are the aberrant cases. The percentages in other cases are much smaller. The corresponding lowest percentage of mismatch are 5.0 (Himachal Pradesh) and 3.2 (Punjab) for the rural and the urban sector, respectively. Finally, the results of comparison based on POV1

[15] In some cases the discrepancy between the estimated incidence based on POV3 and/or POV4 and that based on POV1 is quite large, though not as large as that between the estimates based on POV1 And POV2.

[16] Results showing similar discrepancy between poverty incidence based on official poverty lines and those based on poverty lines defined in terms of corresponding calorie norms have been obtained in other studies as well. See, e.g., Dubey and Gangopadhyay (1998). However, they have not used age-sex specific calorie norms.

and POV4 are very similar to those based on POV1 and POV3. This is only to be expected because of the close correspondence between POV3 and POV4, the latter being a fixed multiple of the former in all the cases.

There can be two alternative explanations of the observed mismatch of poor- non-poor classification of households based on POV1 and POV2, viz., (1) the poverty line PCE at current prices may be grossly inadequate for buying the amount of food items that can give a household the stipulated calorie level and (2) the poverty line PCE level is adequate for procuring food required to meet the calorie norm, but many *non-poor* households choose to consume food bundles that provide less calorie than what is supposed to be the minimum required level, so that these households may be non-poor in terms of their PCE and food expenditure, but poor in terms of calorie intake.

As we have already noted, many non-poor households (viz., those having PCE greater than POV1) turn out to be poor in terms of the calorie norm. It is possible that these households spend more than POV3 per capita on food, consume food items/ varieties that do not conform to the balanced diet nutritional norms and thus end up with a total calorie intake lower than the stipulated calorie norm. In other words, given the nutrient prices, a household may choose a bundle of food items that could cost more than the corresponding POV3 and yet end up with a total calorie intake that falls short of POV2 per capita.

Such a behavioural pattern is not unexpected, because a household’s food consumption pattern is likely to be conditioned in large measure by physical requirements, socio-religious customs, local availability etc., among other things, so that even when the money required to meet a balanced diet is available, the actual food intake pattern may result in a calorie intake below the stipulated nutritional norm. The appropriateness of the stipulated 2400 (2100) kcal per capita nutritional norm for rural (urban) Indian population has also been an issue of debate in recent period and whether the poverty line should be anchored to a calorie norm is being questioned (see Mehta and Venkatraman (2000), Osmani (1991)).

5. Conclusions

This is basically a paper with some methodological content. Here we have proposed a methodology for estimating household-specific nutrient prices from household level data on consumer expenditure, nutrient intake and household attributes. The proposed methodology is new although there are evidences that nutritionists have used similar type of technique to estimate nutrient prices. The estimated nutrient prices have been put to use in two different applications, both of which are of contemporary interest. The first application is in the construction of multilateral spatial price index numbers and the second application is in the measurement of incidence of poverty.

So far as the index number construction application is concerned, the novelty of the approach lies in the fact that the price index numbers, being based on nutrient prices and quantities, overcome to a great extent the homogeneity error problem due to non-comparability of the sets of items consumed encountered in multilateral comparison of food price levels of countries/population groups having widely different consumption patterns and habits. The empirical application made here to measure the inter-State differentials in nutrient price levels faced by rural and urban consumers in India seems to have given quite sensible results.

The second application to the delineation of alternative poverty lines and comparison of estimated incidences of poverty based on these alternative poverty lines is also of contemporary interest. This is so because the observed time path of Indian official poverty estimates in recent years has given rise to a lively debate. Briefly, whereas the decades of seventies and eighties witnessed a declining trend of poverty in India, since 1991 the time path of poverty incidence ceased to show any clear trend pattern. Alternative explanations are being put forward of the observed stagnation in incidence of poverty in the post-nineties period and quite naturally the official methodology of measurement of poverty incidence as followed by the Planning Commission, Government of India, has been put to question by many. In this context, an issue has come up regarding the relevance of the official poverty lines and in particular of the nutritional norms attached to these poverty lines. Our results clearly show that there is a sizeable percentage of households in India in rural and urban areas of individual States that are non-poor (having PCE above the official poverty line) and yet these households are calorie-poor as their calorie intake level falls short of the calorie norm associated with the poverty lines originally. These households, however, are not necessarily spending less on food than required to meet the stipulated calorie norm. Given their tastes and preferences as conditioned by their socio-religious customs, physico-psychological requirements etc. and the relative prices of food items, they are choosing food bundles that do not conform to the nutritional norms thus yielding less calorie than what otherwise might have been obtained.

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Table 1: Summary Statistics for different Nutrients by State: NSS 55th Round, Rural

State	Sample Size	R^2 for the fitted food equation (3)	Carbohydrate		Protein		Fat	
			Estimated Mean Price (Rs./gm.)	Estimated Standard Deviation of Price	Estimated Mean Price (Rs./gm.)	Estimated Standard Deviation of Price	Estimated Mean Price (Rs./gm.)	Estimated Standard Deviation of Price
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Andhra Pradesh	5181	0.8272	0.011625	0.002800	0.011075	0.009368	0.031372	0.015094
Assam	3462	0.7649	0.010033	0.003674	0.008177	0.013481	0.002556	0.012184
Bihar	7311	0.8753	0.011726	0.003210	0.009973	0.005631	0.018125	0.015774
Gujarat	2479	0.8938	0.009777	0.003445	0.053470	0.022352	0.027965	0.015122
Haryana	1132	0.8761	0.008202	0.002749	0.000100	0.002595	0.104525	0.024257
Himachal Pradesh	1634	0.7539	0.013159	0.004069	0.005087	0.008235	0.006725	0.012106
Karnataka	2763	0.8253	0.012545	0.003074	0.000259	0.007951	0.023619	0.019132
Kerala	2604	0.8943	0.000095	0.003306	0.121235	0.030788	0.065814	0.030487
Madhya Pradesh	5144	0.8137	0.006851	0.002566	0.029366	0.013851	0.017221	0.014846
Maharashtra	4121	0.7951	0.012950	0.003971	0.007018	0.008746	0.015990	0.013184
Orissa	3477	0.9316	0.012850	0.002567	0.008800	0.007415	0.032052	0.019475
Punjab	2152	0.9547	0.018339	0.005790	0.002555	0.112443	0.025701	0.017375
Rajasthan	3229	0.8735	0.001690	0.001241	0.063912	0.019475	0.025019	0.014827
Tamil Nadu	4173	0.9349	0.005700	0.002526	0.003843	0.232706	0.097365	0.036415
Uttar Pradesh	9432	0.7460	0.009254	0.002081	0.002350	0.005769	0.015318	0.015107
West Bengal	4550	0.8865	0.002277	0.001024	0.105475	0.034153	0.012520	0.011850

Table 2: Summary Statistics for different Nutrients by State: NSS 55th Round, Urban

State	Sample Size	R^2 for the fitted food equation (3)	Carbohydrate		Protein		Fat	
			Estimated Mean Price (Rs./gm.)	Estimated Standard Deviation of Price	Estimated Mean Price (Rs./gm.)	Estimated Standard Deviation of Price	Estimated Mean Price (Rs./gm.)	Estimated Standard Deviation of Price
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Andhra Pradesh	3806	0.7891	0.017013	0.006263	0.022372	0.015468	0.0002938	0.009246
Assam	852	0.8574	0.024629	0.008058	0.002844	0.006315	0.010928	0.026724
Bihar	2279	0.8710	0.015255	0.004338	0.003519	0.010847	0.046879	0.027872
Gujarat	2764	0.8284	0.011427	0.005821	0.055994	0.027605	0.035127	0.020595
Haryana	758	0.7852	0.007980	0.005926	0.042821	0.041334	0.034362	0.025354
Himachal Pradesh	947	0.7410	0.016673	0.007643	0.028944	0.019748	0.017489	0.019889
Karnataka	2470	0.8405	0.009429	0.004353	0.046599	0.017193	0.072417	0.026206
Kerala	2015	0.8377	0.017691	0.004870	0.036894	0.016480	0.078372	0.029108
Madhya Pradesh	3145	0.7439	0.003076	0.003305	0.037384	0.026802	0.031528	0.020386
Maharashtra	5234	0.7269	0.001876	0.001891	0.102269	0.045445	0.018129	0.016006
Orissa	1050	0.8655	0.001321	0.001564	0.049666	0.029105	0.122204	0.046411
Punjab	1883	0.7555	0.017295	0.007556	0.008621	0.014328	0.016926	0.021468
Rajasthan	1985	0.7130	0.006114	0.005266	0.048898	0.027285	0.006955	0.011603
Tamil Nadu	4212	0.9708	0.013987	0.007108	0.011065	0.623094	0.031330	0.031442
Uttar Pradesh	4638	0.7628	0.007444	0.003359	0.046256	0.028997	0.006106	0.009729
West Bengal	3432	0.9959	0.000269	0.002538	0.149236	0.053212	0.010378	0.018752

Table 3: Summary Statistics of Nutrient Intake by State: NSS 55th Round, Rural

State	Sample Size	Carbohydrate		Protein		Fat	
		Mean Intake (Grams)	Standard Deviation	Mean Intake (Grams)	Standard Deviation	Mean Intake (Grams)	Standard Deviation
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Andhra Pradesh	5181	51768	27395	6618	4842	4116	3988
Assam	3462	64801	41424	8177	6408	3939	9293
Bihar	7311	68747	44473	9841	7401	4621	8059
Gujarat	2479	50560	25633	8622	4646	8820	7723
Haryana	1132	70801	43587	13594	11387	10727	8499
Himachal Pradesh	1634	59462	32084	10481	9208	7818	9811
Karnataka	2763	58710	38577	8647	6698	5980	6034
Kerala	2604	50672	24726	7544	3691	5723	3607
Madhya Pradesh	5144	66211	48012	10018	7244	5632	8203
Maharashtra	4121	53903	29670	8525	5499	6177	7142
Orissa	3477	66196	37327	7595	4871	2691	3052
Punjab	2152	67355	38285	12574	8072	10612	9562
Rajasthan	3229	72563	38849	13694	7551	9787	7307
Tamil Nadu	4173	44707	29599	5879	3509	4022	3251
Uttar Pradesh	9432	79320	60971	12994	14263	7287	11815
West Bengal	4550	65900	38175	8283	4772	4219	10384

Table 4: Summary Statistics of Nutrient Intake by State: NSS 55th Round, Urban

State	Sample Size	Carbohydrate		Protein		Fat	
		Mean Intake (Grams)	Standard Deviation	Mean Intake (Grams)	Standard Deviation	Mean Intake (Grams)	Standard Deviation
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Andhra Pradesh	3806	47403	23192	6676	4058	5455	7603
Assam	852	47477	28693	6799	6051	4597	8333
Bihar	2279	63160	36943	9625	6013	5622	4972
Gujarat	2764	42515	22828	7512	3941	8992	7267
Haryana	758	50608	34820	9174	5859	8831	13722
Himachal Pradesh	947	44046	26123	7956	5409	7770	7895
Karnataka	2470	48390	28608	7288	4521	6173	4201
Kerala	2015	46974	22575	7549	4246	5906	3653
Madhya Pradesh	3145	56654	51488	9263	6326	6882	6450
Maharashtra	5234	46322	30826	7824	4918	7381	9002
Orissa	1050	59553	51275	7762	5858	4049	3126
Punjab	1883	46865	26549	8728	6057	8068	8707
Rajasthan	1985	54986	33791	10238	6707	9552	16956
Tamil Nadu	4212	42168	35987	6071	4262	5350	13365
Uttar Pradesh	4638	60328	36738	10242	6649	7523	13746
West Bengal	3432	48739	62486	6959	4991	5083	9538

Table 5: Nutrient Price Index Numbers based on the EKS formula: NSS 55th Round, Rural[17]

State	AP	AS	BH	GU	HA	HI	KR	KE	MP	MH	OR	PU	RJ	TN	UP	WB
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
AP	1	0.85	0.96	1.11	1.09	0.92	0.95	1.23	0.89	0.96	1.04	1.11	0.94	0.98	0.82	1.07
AS	1.17	1	1.13	1.31	1.28	1.08	1.11	1.44	1.04	1.13	1.22	1.3	1.1	1.14	0.96	1.25
BH	1.04	0.89	1	1.16	1.13	0.96	0.99	1.28	0.92	1.01	1.08	1.16	0.98	1.02	0.85	1.11
GU	0.9	0.77	0.86	1	0.98	0.83	0.85	1.1	0.8	0.87	0.93	1	0.84	0.88	0.73	0.96
HA	0.92	0.78	0.88	1.02	1	0.85	0.87	1.13	0.82	0.89	0.95	1.02	0.86	0.9	0.75	0.98
HI	1.09	0.92	1.04	1.21	1.18	1	1.03	1.33	0.96	1.05	1.13	1.21	1.02	1.06	0.89	1.16
KR	1.05	0.9	1.01	1.17	1.15	0.97	1	1.29	0.93	1.02	1.09	1.17	0.99	1.03	0.86	1.12
KE	0.82	0.7	0.78	0.91	0.89	0.75	0.77	1	0.72	0.79	0.85	0.91	0.76	0.8	0.67	0.87
MP	1.13	0.96	1.08	1.25	1.23	1.04	1.07	1.38	1	1.09	1.17	1.25	1.05	1.1	0.92	1.2
MH	1.04	0.88	0.99	1.15	1.13	0.96	0.98	1.27	0.92	1	1.07	1.15	0.97	1.01	0.85	1.11
OR	0.96	0.82	0.93	1.07	1.05	0.89	0.92	1.18	0.86	0.93	1	1.07	0.9	0.94	0.79	1.03
PU	0.9	0.77	0.86	1	0.98	0.83	0.85	1.1	0.8	0.87	0.93	1	0.84	0.88	0.73	0.96
RJ	1.07	0.91	1.03	1.19	1.16	0.98	1.02	1.31	0.95	1.03	1.11	1.19	1	1.04	0.87	1.14
TN	1.02	0.87	0.98	1.14	1.12	0.94	0.97	1.26	0.91	0.99	1.06	1.14	0.96	1	0.84	1.09
UP	1.22	1.04	1.18	1.36	1.33	1.13	1.16	1.5	1.09	1.18	1.27	1.36	1.15	1.2	1	1.31
WB	0.94	0.8	0.9	1.04	1.02	0.86	0.89	1.15	0.83	0.9	0.97	1.04	0.88	0.92	0.77	1

Table 6: Nutrient Price Index Numbers based on the EKS formula:NSS 55th Round, Urban

State	AP	AS	BH	GU	HA	HI	KR	KE	MP	MH	OR	PU	RJ	TN	UP	WB
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
AP	1	1.13	1.01	1.08	0.95	1.04	1.11	1.26	0.78	0.98	1.01	0.97	0.83	0.97	0.86	1.08
AS	0.88	1	0.89	0.95	0.84	0.92	0.98	1.11	0.69	0.87	0.89	0.86	0.73	0.86	0.76	0.95
BH	0.99	1.12	1	1.07	0.95	1.03	1.1	1.24	0.78	0.97	1	0.96	0.82	0.96	0.85	1.07
GU	0.92	1.05	0.93	1	0.88	0.96	1.03	1.16	0.73	0.91	0.94	0.9	0.77	0.9	0.79	1
HA	1.05	1.19	1.06	1.13	1	1.09	1.16	1.32	0.82	1.03	1.06	1.02	0.87	1.02	0.9	1.13
HI	0.96	1.09	0.97	1.04	0.92	1	1.07	1.21	0.76	0.95	0.98	0.94	0.8	0.93	0.83	1.04
KR	0.9	1.02	0.91	0.97	0.86	0.94	1	1.13	0.71	0.89	0.91	0.88	0.75	0.87	0.77	0.97
KE	0.8	0.9	0.8	0.86	0.76	0.83	0.88	1	0.62	0.78	0.81	0.77	0.66	0.77	0.68	0.86
MP	1.28	1.45	1.29	1.38	1.22	1.32	1.42	1.6	1	1.25	1.29	1.24	1.06	1.24	1.09	1.38
MH	1.02	1.15	1.03	1.1	0.97	1.06	1.13	1.28	0.8	1	1.03	0.99	0.85	0.99	0.87	1.1
OR	0.99	1.12	1	1.07	0.94	1.03	1.1	1.24	0.77	0.97	1	0.96	0.82	0.96	0.85	1.07
PU	1.03	1.17	1.04	1.11	0.98	1.07	1.14	1.29	0.81	1.01	1.04	1	0.85	1	0.88	1.11
RJ	1.2	1.36	1.22	1.3	1.15	1.25	1.34	1.51	0.94	1.18	1.22	1.17	1	1.17	1.03	1.3
TN	1.03	1.17	1.04	1.12	0.98	1.07	1.14	1.3	0.81	1.01	1.04	1	0.86	1	0.89	1.11
UP	1.17	1.32	1.18	1.26	1.11	1.21	1.29	1.46	0.91	1.15	1.18	1.13	0.97	1.13	1	1.26
WB	0.93	1.05	0.94	1	0.88	0.96	1.03	1.16	0.73	0.91	0.94	0.9	0.77	0.9	0.79	1

[17] In Tables 5 – 8, the state in the row is the base state and the state in the column is the state compared.

Table 7: Nutrient Quantity Index Numbers based on the EKS formula:NSS 55th Round, Rural

State	AP	AS	BH	GU	HA	HI	KR	KE	MP	MH	OR	PU	RJ	TN	UP	WB
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
AP	1	1.12	1.16	1.1	1.34	1.14	1.1	1.04	1.16	1.07	1.08	1.25	1.33	0.93	1.28	1.09
AS	0.9	1	1.04	0.99	1.2	1.02	0.99	0.93	1.04	0.96	0.97	1.12	1.19	0.84	1.15	0.97
BH	0.87	0.97	1	0.95	1.16	0.99	0.95	0.9	1	0.93	0.93	1.08	1.15	0.81	1.11	0.94
GU	0.91	1.01	1.05	1	1.22	1.04	1	0.94	1.05	0.97	0.98	1.13	1.21	0.85	1.16	0.99
HA	0.75	0.83	0.86	0.82	1	0.85	0.82	0.77	0.86	0.8	0.81	0.93	0.99	0.7	0.96	0.81
HI	0.88	0.98	1.01	0.96	1.17	1	0.97	0.91	1.01	0.94	0.94	1.09	1.16	0.82	1.12	0.95
KR	0.91	1.01	1.05	1	1.21	1.04	1	0.94	1.05	0.97	0.98	1.13	1.21	0.85	1.16	0.99
KE	0.97	1.08	1.12	1.06	1.29	1.1	1.06	1	1.12	1.03	1.04	1.2	1.28	0.9	1.23	1.05
MP	0.87	0.97	1	0.95	1.16	0.99	0.95	0.9	1	0.93	0.93	1.08	1.15	0.81	1.11	0.94
MH	0.93	1.04	1.08	1.03	1.25	1.07	1.03	0.97	1.08	1	1.01	1.16	1.24	0.87	1.19	1.01
OR	0.93	1.04	1.07	1.02	1.24	1.06	1.02	0.96	1.07	0.99	1	1.16	1.23	0.87	1.19	1.01
PU	0.8	0.9	0.93	0.88	1.07	0.92	0.88	0.83	0.93	0.86	0.87	1	1.07	0.75	1.03	0.87
RJ	0.75	0.84	0.87	0.83	1.01	0.86	0.83	0.78	0.87	0.81	0.81	0.94	1	0.7	0.96	0.82
TN	1.07	1.19	1.24	1.18	1.43	1.22	1.18	1.11	1.24	1.14	1.15	1.33	1.42	1	1.37	1.16
UP	0.78	0.87	0.9	0.86	1.05	0.89	0.86	0.81	0.9	0.84	0.84	0.97	1.04	0.73	1	0.85
WB	0.92	1.03	1.06	1.01	1.23	1.05	1.01	0.95	1.06	0.99	0.99	1.15	1.22	0.86	1.18	1

Table 8: Nutrient Quantity Index Numbers based on the EKS formula:NSS 55th Round, Urban

State	AP	AS	BH	GU	HA	HI	KR	KE	MP	MH	OR	PU	RJ	TN	UP	WB
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
AP	1	1	1.13	1.04	1.11	1.02	1.02	1.01	1.11	1.04	0.98	1.05	1.16	0.95	1.16	0.99
AS	1	1	1.13	1.04	1.12	1.03	1.02	1.02	1.12	1.05	0.98	1.06	1.16	0.95	1.17	0.99
BH	0.89	0.88	1	0.92	0.99	0.91	0.9	0.9	0.99	0.92	0.87	0.94	1.03	0.84	1.03	0.88
GU	0.96	0.96	1.09	1	1.07	0.99	0.98	0.98	1.07	1	0.95	1.02	1.12	0.92	1.12	0.95
HA	0.9	0.89	1.01	0.93	1	0.92	0.91	0.91	1	0.94	0.88	0.95	1.04	0.85	1.04	0.89
HI	0.98	0.97	1.1	1.01	1.09	1	0.99	0.99	1.08	1.02	0.96	1.03	1.13	0.93	1.14	0.96
KR	0.98	0.98	1.11	1.02	1.09	1.01	1	0.99	1.09	1.02	0.96	1.04	1.14	0.93	1.14	0.97
KE	0.99	0.98	1.11	1.02	1.1	1.01	1.01	1	1.1	1.03	0.97	1.04	1.15	0.94	1.15	0.98
MP	0.9	0.9	1.01	0.93	1	0.92	0.92	0.91	1	0.94	0.88	0.95	1.04	0.85	1.05	0.89
MH	0.96	0.96	1.08	1	1.07	0.98	0.98	0.97	1.07	1	0.94	1.01	1.11	0.91	1.12	0.95
OR	1.02	1.02	1.15	1.06	1.14	1.04	1.04	1.03	1.13	1.06	1	1.08	1.18	0.97	1.19	1.01
PU	0.95	0.94	1.07	0.98	1.06	0.97	0.97	0.96	1.05	0.99	0.93	1	1.1	0.9	1.1	0.94
RJ	0.86	0.86	0.97	0.89	0.96	0.88	0.88	0.87	0.96	0.9	0.85	0.91	1	0.82	1	0.85
TN	1.05	1.05	1.19	1.09	1.17	1.08	1.07	1.07	1.17	1.1	1.03	1.11	1.22	1	1.22	1.04
UP	0.86	0.86	0.97	0.89	0.96	0.88	0.88	0.87	0.96	0.9	0.84	0.91	1	0.82	1	0.85
WB	1.01	1.01	1.14	1.05	1.13	1.04	1.03	1.03	1.13	1.06	0.99	1.07	1.18	0.96	1.18	1

Table 9: Incidence of Poverty measured in percentage based on Alternative Poverty Lines: NSS 55th Round

State	Rural				Urban			
	Official 1999-2000 Poverty Line	Poverty line based on			Official 1999-2000 Poverty Line	Poverty line based on		
		Calorie Norm (POV2)	Food Expenditure Norm (POV3)	Total Expenditure Norm (POV4)		Calorie Norm (POV2)	Food Expenditure Norm (POV3)	Total Expenditure Norm (POV4)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Andhra Pradesh	8.0	62.3	17.6	11.8	21.8	44.4	6.2	2.2
Assam	33.1	74.3	1.1	0.7	4.1	43.0	10.7	6.6
Bihar	36.4	54.1	11.5	9.0	23.3	31.6	13.9	10.5
Gujarat	9.0	62.8	17.7	12.1	12.2	45.7	5.4	1.8
Haryana	6.3	38.3	16.3	6.7	6.1	39.3	2.8	1.1
Himachal Pradesh	5.6	35.7	0.6	0.3	1.9	16.1	1.0	0.0
Karnataka	11.8	63.4	9.6	4.2	20.7	45.6	15.4	7.3
Kerala	7.2	64.9	25.6	13.4	13.2	44.4	25.8	14.1
Madhya Pradesh	30.2	59.4	11.5	5.8	30.8	40.6	1.1	0.4
Maharashtra	18.4	64.1	14.8	7.2	21.0	44.6	4.0	1.4
Orissa	39.5	56.3	37.2	33.3	31.6	27.2	23.0	16.2
Punjab	4.6	40.7	13.3	3.8	2.9	36.1	2.9	0.5
Rajasthan	10.1	34.0	2.8	0.9	15.1	31.2	0.2	0.0
Tamil Nadu	14.1	72.4	26.4	17.9	19.1	50.5	6.7	2.5
Uttar Pradesh	24.6	40.7	2.5	0.6	23.8	35.7	2.2	0.7
West Bengal	24.4	57.8	15.3	13.5	10.6	43.9	6.7	3.9

Table 10: Cross-classification of Incidence of Poverty (in percentage) based on alternative Poverty Lines: NSS 55th Round, Rural

State	POV1 x POV2				POV1 x POV3				POV1 x POV4			
	0,0*	0,1*	1,0*	1,1*	0,0	0,1	1,0	1,1	0,0	0,1	1,0	1,1
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Andhra Pradesh	37.3	54.6	0.3	7.7	81.3	10.7	1.1	6.9	87.4	4.5	0.8	7.2
Assam	23.7	43.2	1.9	31.1	66.9	0.0	31.9	1.1	66.9	0.0	32.4	0.7
Bihar	39.9	23.6	6.0	30.5	62.7	0.8	25.8	10.7	63.6	0.0	27.5	9.0
Gujarat	37.0	54.0	0.2	8.8	81.2	9.8	1.1	7.8	87.3	3.8	0.6	8.3
Haryana	61.2	32.5	0.4	5.8	83.0	10.7	0.6	5.7	92.0	1.8	1.3	4.9
Himachal Pradesh	63.5	31.0	0.9	4.7	94.4	0.0	5.0	0.6	94.4	0.0	5.3	0.3
Karnataka	36.1	52.1	0.5	11.3	85.5	2.7	5.0	6.9	88.2	0.0	7.6	4.2
Kerala	35.1	57.7	0.0	7.1	74.3	18.5	0.1	7.1	86.5	6.3	0.2	7.0
Madhya Pradesh	37.3	32.5	3.3	27.0	68.9	0.9	19.6	10.7	69.8	0.0	24.4	5.8
Maharashtra	34.5	47.1	1.4	17.0	78.2	3.4	7.0	11.3	81.6	0.0	11.2	7.2
Orissa	37.2	23.3	6.5	32.9	54.0	6.6	8.8	30.6	58.5	2.0	8.2	31.3
Punjab	58.8	36.6	0.5	4.1	86.2	9.2	0.5	4.1	94.5	0.9	1.7	2.9
Rajasthan	63.9	26.0	2.1	8.0	89.7	0.2	7.6	2.5	89.9	0.0	9.2	0.9
Tamil Nadu	27.3	58.6	0.3	13.8	72.5	13.3	1.0	13.1	80.8	5.0	1.3	12.8
Uttar Pradesh	53.2	22.2	6.1	18.5	75.2	0.2	22.3	2.4	75.4	0.0	24.0	0.6
West Bengal	39.3	36.2	2.9	21.6	73.7	1.8	10.9	13.5	75.4	0.2	11.1	13.4

* 0,0 Neither measure considers these families poor
0,1 The first measure considers these families non-poor and the second measure does not
1, 0 The first measure considers these families poor and the second measure does not
1,1 Both measures consider the family poor

Table 11: Cross-classification of Incidence of Poverty Based on Alternative Poverty Lines: NSS 55th Round, Urban

State	POV1 x POV2				POV1 x POV3				POV1 x POV4			
	0,0	0,1	1,0	1,1	0,0	0,1	1,0	1,1	0,0	0,1	1,0	1,1
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Andhra Pradesh	50.7	27.5	4.9	16.9	77.2	1.0	16.6	5.2	78.2	0.0	19.6	2.2
Assam	56.6	39.3	0.5	3.6	89.0	6.9	0.4	3.8	93.3	2.6	0.1	4.0
Bihar	61.1	15.6	7.3	16.0	74.7	2.0	11.5	11.8	76.6	0.1	12.9	10.4
Gujarat	52.6	35.3	1.8	10.4	86.6	1.3	8.1	4.1	87.8	0.0	10.3	1.8
Haryana	60.2	33.8	0.5	5.5	93.5	0.4	3.7	2.4	93.9	0.0	5.0	1.1
Himachal Pradesh	83.1	15.0	0.8	1.1	97.8	0.3	1.3	0.6	98.1	0.0	1.9	0.0
Karnataka	50.0	29.3	4.3	16.4	76.8	2.5	7.8	12.9	79.3	0.0	13.4	7.3
Kerala	54.7	32.1	0.9	12.3	73.6	13.2	0.6	12.6	84.6	2.2	1.3	11.9
Madhya Pradesh	49.7	19.6	9.7	21.0	69.2	0.1	29.7	1.1	69.2	0.0	30.4	0.4
Maharashtra	50.7	28.3	4.7	16.3	78.7	0.3	17.3	3.7	79.0	0.0	19.6	1.4
Orissa	55.7	12.7	17.0	14.6	65.8	2.6	11.2	20.4	68.4	0.0	15.4	16.2
Punjab	63.6	33.5	0.3	2.6	95.5	1.6	1.6	1.3	97.1	0.0	2.4	0.5
Rajasthan	64.1	20.8	4.7	10.4	84.9	0.1	14.9	0.2	84.9	0.0	15.1	0.0
Tamil Nadu	47.3	33.5	2.1	17.0	80.1	0.8	13.2	5.9	80.9	0.0	16.6	2.5
Uttar Pradesh	56.5	19.7	7.8	16.0	76.1	0.1	21.7	2.1	76.2	0.0	23.1	0.7
West Bengal	54.1	35.3	2.0	8.6	87.7	1.7	5.6	5.0	89.4	0.0	6.7	3.9

Figure 1: Estimated mean price of Carbohydrate: NSS 55th round

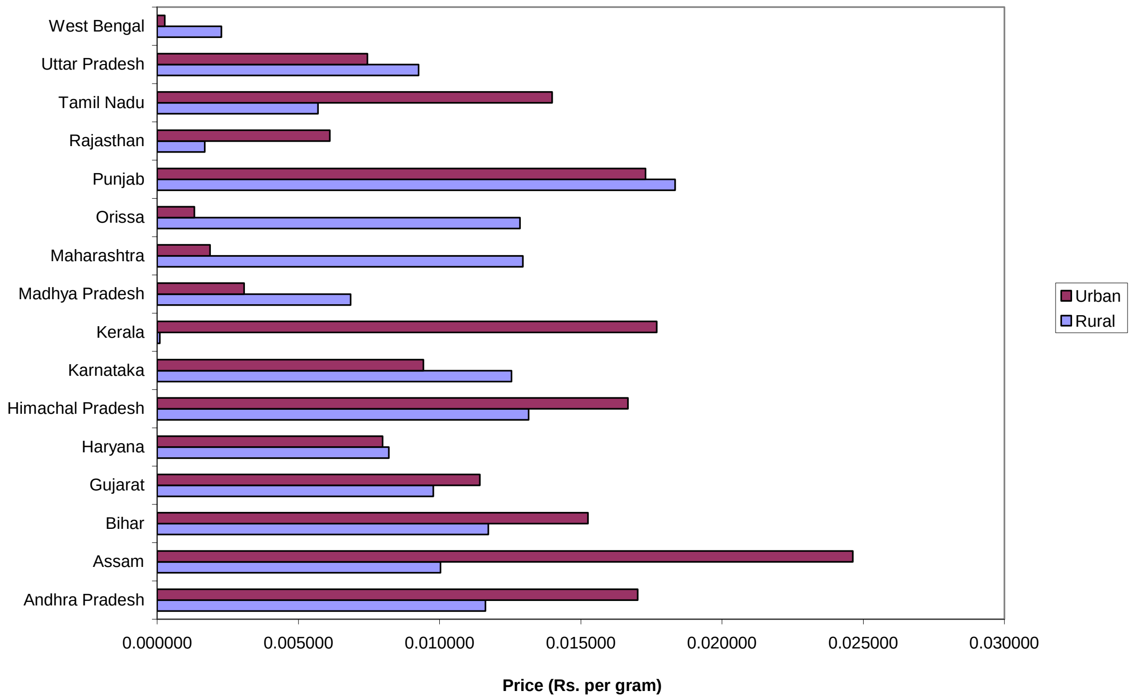

Figure 2: Estimated mean price of Protein: NSS 55th Round

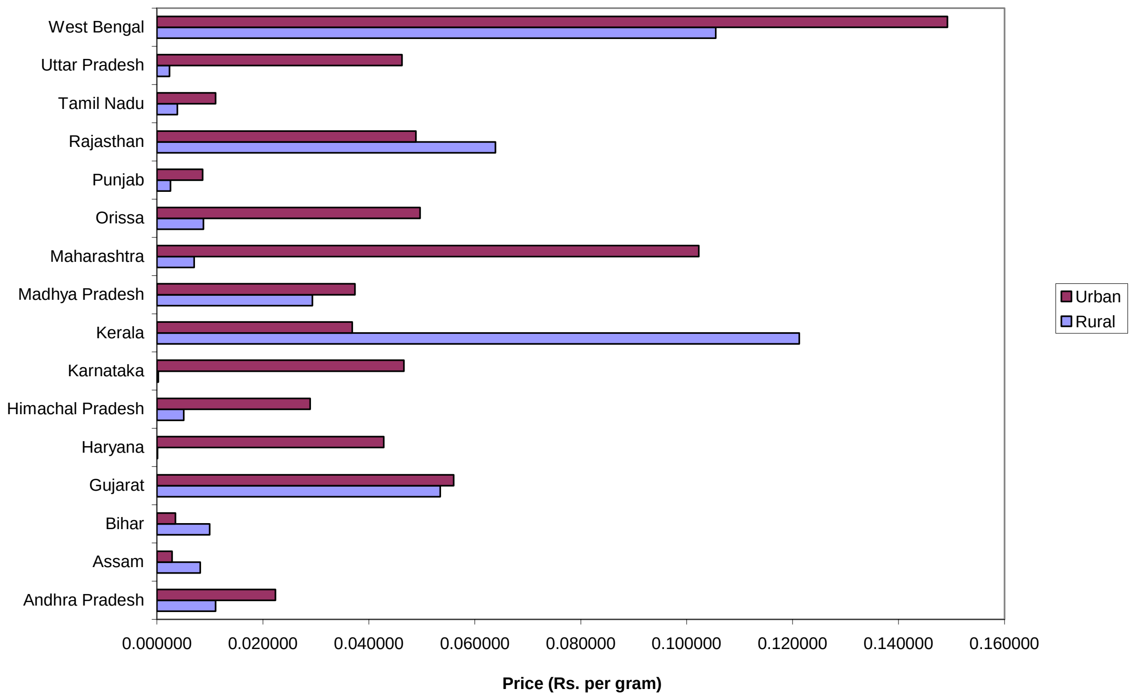

Figure 3: Estimated mean price of Fat: NSS 55th Round