Paper 4. Can we set Poverty Lines using Calorie Norms in India or Bangladesh?[1]

Abstract

It has been common to anchor poverty lines in nutritional requirements, generally calorie norms. There are many ways in which these calculations are conducted, but broadly people in households are designated as poor if they are estimated not to command sufficient calories in their diet to meet their computed requirements. Various calorie based methods of computing poverty lines or poverty are calculated for India and Bangladesh for recent years, including Food Energy Intake and Cost of Basic Needs methods. These two methods are shown to be essentially similar once constraints are introduced on the cost per calorie of the FEI method. However, poverty aggregates based on these calorie anchored poverty lines do not show the same spatial or temporal patterns of ill-being as other indicators which are plausibly related closely with poverty. This paper argues that anchoring PLs in calories is not a reliable way to compute comparable poverty lines for different domains of social groups, geographical spaces, or time periods; that is they do not produce poverty lines which represent the same standard of living in these different domains, and consequently poverty comparisons based on these lines may be comparing not differences in poverty but differences in the standards by which poverty is assessed.

Introduction

> "The food component of the poverty line is almost universally anchored to nutritional requirements for good health. " (Ravallion, 1998:15)
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> "One solution [to deriving a single measure of welfare] might be to take some standard or reference bundle of commodities (say a subsistence bundle determined by nutritional requirements) and measure welfare as a scalar multiple of this. This might work in a very poor society of consumers with very similar tastes, but if the composition of actually chosen bundle varies strongly with income or tastes, the standard is not a very relevant one. Nevertheless, some such methodology is frequently relevant in measuring welfare for individuals close to poverty." Deaton, 1980:2)
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> "In poor countries such as India, where food makes up a large share of the budget, and where the concern with poverty is closely associated with concerns about undernutrition, it makes more sense to use food and nutritional requirements to derive poverty liens than it does in the United States. … something closer to the minimum adequate diet for the country and type of occupation, and because food is closer to three-quarters that a third of the budget, the "multiplier" needed to allow for

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> non-food consumption is smaller, less important, and so inherently less controversial," (Deaton, 1997:143).

The most usual basis for establishing "absolute" poverty lines since at least the time of Rowntree in York at the end of the 19th century has been to base them on the idea of an insufficiency of means to achieve biological efficiency. The long standing poverty lines used in the USA are putatively based in a the cost of a "low cost food plan" multiplied by the reciprocal of the average share of food expenditure in average household budgets from a survey of household food consumption (Orshansky, 1965[2]). This is the approach taken in contributions to this journal by Ravallion and Sen, 1996, and by Tarp; Simler; Matusse; Heltberg, and Dava, 2002, as well as by the World Bank's Sourcebook for Poverty Reduction (World Bank, 2002b) and other authoritative sources (Lanjouw, 1999).

It would be very useful if poverty lines could be anchored in some such measure; we could then use this to establish poverty lines for different domains – countries, sectors (urban and rural), social groups, geographical regions, and over time. This is indeed what is done when nutritional poverty is computed as the number of people in households whose consumption of food items provide insufficient calories to meet the normative needs of the household, whether using the Direct Calorie Intake (DCI) or Food Energy Intake (FEI) methods; these are methods commonly used by national statistical agencies in developing countries (BBS, 2004). It is also used in most implementations of the Cost of Basic Needs (CBN) method which was put forward as a way of avoiding some of the problems patently associated with the FEI and DCI methods[3] by (in addition to those mentioned above) Ravallion and Bidani, 1994, for Indonesia, Ravallion and Sen 1996, for Bangladesh, and (although not called a CBN method) by the Indian Planning Commission (GOI (Government of India), 1993).

This paper argues that the CBN method cannot establish comparable poverty lines – that is poverty lines that reflect the same standard of living, or level of welfare - for different domains, and so cannot be used for poverty counts that aim to compare poverty in different sectors or different social groups or countries at a given time, or over time. That is if the purpose of measuring poverty is to understand the causes or poverty and to assess interventions for their effectiveness in reducing poverty. If the purpose of poverty assessment is to raise awareness about its extent, then it may well be that all that is required are poverty lines that command common agreement is that there can be no debate but that there is a lot (or not a lot) of poverty. For this purpose any figure that commands broad assent will do (Deaton, 1997), especially if it can be defended or policed in such a way as challenges either do not exist or can be marginalized. Calorie based poverty lines can, it seems, be so defended both in the sense that the logic laid out in support of them commands common assent and the numbers that result command wide – adequate - assent. However, to claim that CBN or other poverty lines based in calorie norms can serve more than this purpose, in particular to advance the understanding of the determinants of ill-being, this is to perform a confidence trick, and in the long run, their use in the conscious-raising and patch defending arena will become dysfunctional.

[2] But, according to Fisher, 1992, this was acceptable because it was close to another figure already in informal use.

[3] Table 1 sets out a schematic view of the different methods of computing poverty lines discussed here.

The paper is laid out as follows. First the FEI and DCI methods are described and the common criticism of them is supported; as an aside I comment on the continuing attraction of FEI and DCI methods and find some interesting parallels with the literature on nutrition and poverty. Next the CBN method(s) is described in more detail focusing in particular on the case of Bangladesh which has been prominent in the advocacy of the CBM method both to establish base or anchor poverty lines and to update them over time (see Ravallion and Sen, 1996, Ravallion, 1992b, Wodon, 1997), although in its most recent poverty assessment the World Bank has only used CBN to base a set of regional poverty lines which are updated over time using Consumer Price Indexes. In India a version of the CBN method was used, before it was so named, to establish a base or anchor poverty line to which Consumer Price Indexes were applied to produce State level poverty lines for the base year; these state PLs have been updated over time using CPIs, but the calorie norms have been used as yardsticks to compare and criticize these CPI PLs (Patnaik. U., 2004 ;Rath, 2003, Meenakshi and Ray, 2002). Little is said here about the CPIs that have been used in these cases, but critical discussion can be found in Palmer-Jones and Dubey, 2005b (see also Deaton, 2003). I then argue that essentially the DCI, FEI and CBN methods are very similar in that they are all based on calorie norms and behavioural allowances for non-food components of consumption; the difference lies simply in the way the latter constrains the costs of the food component to not be affected by an income effect. Once a similar constraint is applied in the FEI method it gives very similar poverty lines. Next we discuss whether it is possible to compute a non-food component of expenditure that can be added to the food component derived from calorie norms so that this non-food component corresponds to the same level of welfare in different cases. Following this I report the rejection of the CBN method for updating PLs in Bangladesh in the latest World Bank poverty assessment (World Bank, 2002a[4]), a rejection that is not given any justification, and the growing divergence between CPI based PLs and calorie norm based PLs in India including CBN PLs which are calculated for the first time for India. In India OPLs have been contested by Deaton on the grounds that they are based on out of date Laspeyres CPIs, and because to some the levels of poverty that are computed from them are implausibly low, and that calorie based poverty counts which are higher are more plausible. The former criticism is discussed elsewhere (Palmer-Jones and Dubey, 2005), but the latter falls under our discussion of the possibility of establishing calorie norms for poverty assessment. Clearly there is some confusion both in the practice of assessing poverty in Bangladesh by authors associated with the World Bank, and in poverty assessment in India. A number of possible explanations of a growing gap between “real” poverty lines and calorie consumption at these constant real expenditure levels are discussed, including declining requirements due to changing demographic and occupational structures, and declining capture of food expenditures relative to other expenditures in household expenditure surveys. These are unlikely to account for the trends observed; more consistent with the economists view of consumer choice is the possibility that the circumstances of households has overtime lead them to choose to consume less food at constant real expenditure, because of changing “tastes” and prices. Changing “tastes” may be induced by changing structure of consumption of non-market goods which together with other trends has resulted in lower consumption of food and calories at constant real expenditure.

[4] The new method is repeated in its poverty assessment for the MDG task (World Bank, 2005).

To provide some justification for these views I develop a model of the relationship between calories and well-being that is contingent on other goods and services, building in particular on the work of Peter Svedberg, 2001, which is relevant to people at low standards of living, and incorporates both choice between calories and other commodities and the idea that food consumption is productive in the sense of enabling greater income. The translation of calories into well-being is made contingent on a number of "environmental" factors which vary between domains; hence the relevant calorie norms would differ between these domains and cannot readily be computed. This is in fact a similar criticism to that which is leveled at the use of Consumer Price Indexes to compute spatial and inter-temporal poverty lines (Palmer-Jones and Dubey, 2005a). Although I am not greatly concerned here with concepts or definitions of poverty I should emphasize at this point that I am concerned with material rather than subjective deprivations to avoid the criticism that I am straying from a useful understanding of poverty as absolute material deprivation. To establish a prima facie case I assert the following as I hope uncontestable; lack of food (through lack of purchase of it) leads to lack of a minimum socially defined level of well-being, but exactly how much food is required depends on health in particular; health may be conditioned on factors other than expenditure by the individual or their household – particularly by the health environment, and publicly supplied goods and services such as clean water and health services. I elaborate these ideas further below.

Nutrition, Calories and Poverty Lines

The calorie basis of poverty lines is operationalised through nutritional norms for calories, such as those recommended in the FAO/WHO/UNU publication of 1985 (and its predecessors) (WHO/FAO/UNU, 1985). For example, Ravallion, 1998, and Lanjouw 1999, explicitly refer to calorie norms to anchor poverty lines. However, there are many problems with such practises; there is controversy over minimum needs (see Osmani, 1991); the use of behavioural demand functions for food or calories sits uneasily with the concept of subsistence "requirements"; and it may be unhelpful to use only part of consumption (food/calories) to assess welfare which requires other commodities in situations where relative prices may differ or change leading to changed consumption pattern (Deaton 1997).

The first point is illustrated by the use of two poverty lines based on different food or calorie requirements; in the case of Bangladesh calorie consumption of 2122 kcal per capita per day is used for poverty and 1850 kcal pc pd for extreme poverty. The second and third points are illustrated by the CBN method discussed below; following Ravallion, 1994b, prominent implementations of this method use a single normative calorie requirement but compute two non-food shares using a food Engel curve to estimate this proportion[5].

Anchoring poverty lines in calorie norms derives both from the observed high proportion of expenditure that the poor in developing countries allocate to food, most of which consists of low quality calories, and the biological understanding that food is an important prerequisite for survival and activity. Being well-nourished is a key

[5] Somewhat contradictorily, Ravallion and Bidani 1994, comment that the different positions of the food Engel curves in rural and urban sectors in Indonesia may be due to the prevalence of sedentary occupations but nevertheless use the same normative calorie levels for both sectors. Ravallion and Bidani 1994, Wodon, 1997, Sen and Mujeree, 2002, and World Bank 2002a do the same for Bangladesh.

capability, in itself and from its instrumental value in enabling other valued capabilities through for example employment and labour productivity. Since the 1960s, the crucial characteristic of food for the poor has been its calorie content because it was generally argued that given availability of sufficient calories to the household, other nutrients would also be available in most diets. More recently it has been argued that this is too crude a view and micro-nutrients may well be limiting the achievement of valued capabilities.

We have shown that the drift of calorie consumption at the poverty line below the norm on which it was originally based also affects the D&T and our CPI based poverty lines. However, in the process we show that comparison of calories across rounds has many problems, and cannot be made without some arbitrary assumptions, in particular, calculation of calorie availability to the household from NSS expenditure data requires adjustments for the proportion of food consumed according to the expenditure data that is actually fed to people who are outside the household, and for food that is consumed by people in the household that is not included in the expenditure aggregate. We show that the likely calorie content of meals varies not only with its source (meals at ceremonies, to guests and employees having higher calorie content than the average meal consumed at home), but also with the expenditure group of the household. Hence, adjustments to calories should take account of the wealth of the household providing the meals, so that for example meals received as guests or employees of the wealthy will have higher calorie values than those of the poor. However, such adjustments cannot be made for want of data on the wealth of the source of the meals consumed outside the home.

Hence claims that the drift of calorie consumption below the norms does not provide robust evidence in itself of declining well-being, especially when direct nutritional assessment(see above) indicates no such decline (this is the infant mortality and child and female anthropometric status evidence). Further evidence is the change in the quality of food expenditure, which indicates a progressive increase in consumption of higher calorie cost foods, even among the poor. Such an improvement in the quality of diets would seem not to be consistent with declining well-being.

A further problem is the possibility that food is increasingly under-recorded (Palmer-Jones, 2001). This could come about because of changes in the nature of food purchases towards more and more frequent small purchases that are hard to recall, and or increasing respondent fatigue leading to greater under-reporting of “non-registered” items of expenditure – of which food is typical – compared to “registered” items which are less likely to suffer memory lapse[6]. If this were the case then more food should have been recorded in more recent expenditure surveys, giving a higher food share in budgets and more calories at constant real expenditure. I do not address this issue further here.

DCI and FEI Poverty Lines

Much poverty analysis has been undertaken on the basis of poverty identified by what are called calorie requirements. Once calorie requirements have been specified the cost of meeting those requirements becomes the basis for poverty assessments. There are two methods of assessing poverty once the calorie requirement has been set – a

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[6] Gibson, 2002, has argued that food expenditures may be under-reported in households of larger size for somewhat similar reasons.

direct method which assesses as poor those households who do nor actually consume (or purchase) food items which provide the necessary quantity of calories; the second estimates a relation between calorie consumption and household expenditure, estimates the average expenditure level required to consume the minimum calorie requirement, and identifies as poor those households with lower expenditure or value of consumption, whether or not they actually consume less than the normative calorie requirement. Since the average consumption which provides consumption of required calories always includes many non-food items, this method automatically allows both for the behavioural characteristics of households in relation to food preferences, and also for other non-food items can be considered necessary to consume. As discussed further below, this indirect method is quite similar conceptually to the alternative CBN method.

Calorie requirements are specified for an average household using norms developed by the mandated International organizations – the FAO and the WHO. The recommendations of these organisations have varied over time, but have been broadly based on two components. The first is the energy required to maintain body weight (and growth of children, and foetal growth and lactation in reproducing women. The second is energy for necessary activity. As noted I the section where we discuss under nutrition, it turns out than none of this is particularly simple or even uncontroversial. Nevertheless, in practice widely used figures are for calorie requirements are around 2100 and 2400 calories per capita per day. Some approaches have set different normative calorie requirements for different groups of the population according to anthropometric, demographic and employment characteristics of the sub-group. Where the direct method of poverty identification is to be used (which also allows for assessing the intensity of poverty and inequality among the poor), individual household level calorie requirements may be set, leading to household level poverty lines. In this case households are poor if the do not consume the estimated required calories (regardless of what their total expenditure or consumption is); a group poverty line can be estimated using the average of the poverty lines of the households in the group. Where the indirect method is used (estimating an expenditure level for a group) poverty line is specified as an expenditure level in the usual way, except that it varies from group to group; households are poor if their expenditure falls below the relevant group poverty line, again regardless of whether the actually consume the specified calories.

Food Energy Intake Poverty Lines

The common way of setting absolute PLs has been to estimate the expenditure at which households can be expected to have available their normative calories; regressing monthly per capita expenditure on household calorie availability and predicting the expenditure at the normative calorie value is the usual method. This is the Food Energy Intake (FEI) method.

Those who are uncomfortable with the fall in India in calorie availability at the Official (and D&T type) Poverty Lines put forward some version of the FEI method. One version of this method (the Direct Calorie Intake method) computes the normative calorie requirements of each household, based on its age, sex and occupational characteristics, and calorie availability for each household using tables of food nutrient contents and food quantities consumed by the household and counts as poor all households (and members of households who have fewer calories available than they require[7]. But more usually a regression procedure such as that described above is used.

The FEI method directly and the DCI method indirectly have built into them both choice of cost per calorie and of non-food shares behavioural elements, as well as assumptions about the normative calorie requirements. All expenditures are conditional on availability of items that are important to welfare but are not included in the expenditure survey (and or are not paid for) but differ between geographical units and over time. Housing and have already been mentioned; access to clean drinking water and sanitation , such public goods are other examples that can have a profound effect on the translation of commodities into well-being, that are discussed further below. All of these variables may change over time and differ between geographical or sector units.

Further, higher real incomes or expenditures are associated with choices of "better quality" foods which have higher implicit per calorie prices, as well as of having a lower proportion of expenditure on foods, and a higher proportion on non-foods[8]. When estimated for different geographical regions the cost per calorie and the share of food expenditure differ and can lead to different empirical food and calorie Engel curves. Two major factors may be important; firstly, the calorie norm used to represent the poverty line may differ between the units being compared. Secondly, socially influenced consumption patterns which affect tastes (choices) may lead to different choices between calories and other characteristics of commodities, and hence lead to a different relationship between real well-being and calorie consumption. If for example urban populations generally use fewer calories for activities than rural – less energy intensive occupations and or less energetic discretional (leisure) activities - so that typical urban lifestyles require fewer calories, then a lower calorie norm would be appropriate. As noted above, Ravallion and Bidani 1994 and Ravallion, 1994a, and other authors associated with the World Bank working on poverty in Bangladesh, use the same calorie norms in the rural – urban comparisons that they claim undermine the FEI method, while the Indian Planning Commission used a lower calorie norm for urban than rural areas (GOI (Government of India) 1993).

We show below that the contrast between the FEI and CBN methods is in overdrawn, and a slight modification to the FEI method makes them effectively equivalent.

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[7] A variant of this method counts as poor all households which have available fewer than the average normative calorie requirement per capita – i.e. misses out the household specific normative calorie calculation.

[8] Another factor sometimes suggested as affecting the food and calorie Engel curves is the ability of better off households to buy in greater bulk and hence at lower unit prices. Another factor might be that as people become better off time becomes more scarce and they choose to shop in higher quality (or more accessible and higher cost) environments (besides choosing higher quality foods). Using servants to purchase foods could also result in higher unit value purchases.

Cost of Basic Needs Poverty Lines

The Cost of Basic Needs (CBN) methods have been promoted by Ravallion and co-workers[9][10]; it a method of computing poverty lines that respects local (behavioural) consumption patterns and prices (unit values) while retaining the normative calorie anchor. On the grounds of specificity (using locally relevant consumption patterns) and consistency (of treating people with the same standard of living in the same way) the CBN method is put forward as preferable to the widely used Food Energy Intake approach (FEI) which in some applications and contexts gives counter-intuitive poverty counts. For example, in both Indonesia and Bangladesh Ravallion and co-workers found that in some years urban poverty was higher than rural poverty, which they found counter-intuitive. They considered their CBN calculations more in line with their intuitions. The CBN method has been applied officially in Bangladesh[11], if somewhat reluctantly (BBS, 2005, for example does not use the CBN method). We have computed CBN PLs as an experiment for India (Table 3.2).

The CBN method can provide an anchor for a set of poverty lines constructed from these CBN base PLs by applying CPIs, as in the most recent World Bank poverty assessment for Bangladesh. Or this method can be used for each time/space location to compute PLs without using CPIs[12].

In practice the CBN method is made up of two components; the first is a calorie norm based bundle of food items giving a "food poverty line" (zfood), and the other a non-food components (znfood). Adding these together gives the poverty line. Because there may be some question as to how basic the non-food component is Ravallion and those who have followed him have computed two non-food components giving an upper and a lower poverty line (zu and zl).

The food poverty line in the CBN method is essentially a Laspeyres consumer price index using a specified bundle of food items that is common to all households to be

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[9] Ravallion, 1992a, Ravallion and Bidani 1994, Ravallion 1994b, Ravallion and Sen 1996, Ravallion 1998, and other authors associated with the World Bank such as Ravallion; Datt, and Chaudhuri, 1993, and Lanjouw and Lanjouw, 1997; see also Lanjouw 1999. One variant of this method is applied in Bangladesh by Ravallion and Sen 1996, and a version nearer to that described in Ravallion's other work was applied by Wodon, 1997

[10] Ravallion, 1998, rationalises the CBN method with reference to the capabilities model of A.K. Sen, suggesting that normative calories entail achieving a basic valued capability. We argue later that there are not normative calorie requirements that can be a base for poverty line calculations, and using this method gives inconsistent PLs.

[11] In their comparisons Ravallion and co used the same calorie norms in both urban and rural areas. This is surprising, but since it is used in both FEI and CBN calculations it does not biases the comparison against the FEI method.

[12] This is the method used by Wodon, 1997, and World Bank, 1998, for each of 14 areas in Bangladesh. It is also one of the methods used by Tarp et al., 2003; their method follows the proposals of Ravallion, 1992, and 1998, more closely. They differ from Wodon in using a behavioural food basket while Wodon and the other authors of Bangladesh PLs mentioned here use a normative food bundle. Ravallion and Sen, 1996, and Sen and Mujeree, 2003, use a variant of this method for Bangladesh; their method uses the CBN approach to calculate a food poverty line at every round and a CPI method to update an arbitrary non-food contribution to the 1983/4 PL to subsequent PLs. World Bank, 2002, uses the Wodon CBN method for its 1991/2 base year PLs for 14 areas within Bangladesh, and updates these using a composite CPI computed from UVs and Average Budget Shares (AVBS) computed from the HIES combined with official CPIs for non-food items. These calculations are discussed further below.

compared[13], valued at prices that differ spatially or change over time, and the other part is a non-food component that can either be costed directly using specified items and prices, or, more usually, indirectly from the behavioural relationship between total expenditure and non-food expenditure (the inverse Engel curve approach). The two components are termed the food poverty line (zfood) and the non-food component (znfood); together these sum to the poverty line (zCBN)[14].

It has been usual to compute the non-food component using the same behavioural relationship between expenditure on food and non-foods as used in the FEI method although the RHS is in expenditure terms rather than calories. Thus, Ravallion 1994b, suggests using the criterion of "being willing to forego food consumption" to purchase non-food items as a way of obtaining a behavioural estimate of non-food basic needs. The upper poverty line (znfu) is estimated from a food share Engel curve regression, as the non-food expenditure of households whose food expenditure is equivalent to the food poverty line. The lower poverty line uses the same regression but estimates the non-food expenditure of households whose total expenditure is equal to the food poverty line (giving zCBNu and zCBNl). These Engel curve regressions can be estimated using either parametric or non-parametric methods.

Using this method we have computed CBN poverty lines which indeed show much higher poverty lines and more poverty over time than either the Official poverty lines or those computed by the Deaton and Tarrozi method (and by us), and also more poverty than the OPLs (also because OPLs show falling calorie consumption over NSS Rounds). As noted above there are several ways in which CBN PLs can be computed; the basic method is to use an all India sectoral food bundle to compute zfood, and then to estimate the non-food components using the Engle curve regression. One can use the same food bundle for each round, or to compute a new food bundle for each round, using unit values for each state (or NSSR) to produce a state zfood. The non-food regression can be computed for the whole population, or for the group of households whose expenditure is close to the computed poverty line. This may need some iteration since the initial guess of the poverty line to compute the non-food component may not be within the specified range[15]. A second method is to use a state specific (or NSSR specific) food bundle, and a third way is to follow Tarp et al. and compute the food bundle of households whose calorie consumption is around the normative level or for all households whose calorie consumption is below the normative level. Indeed, combining the different methods of computing food bundles with different methods of estimating non-food components one can come up

[13] This ensures, according to these authors, "consistency"; e.g. that the level of welfare of the poverty line is the same in all units to be compared. Using local prices and behavioural non-food components is supposed to give rise to "specificity"; i.e. that the expenditure pattern of households at the CBN PL reflects local consumption patterns.

[14] As noted elsewhere the Ravallion and Sen/Sen and Mujeree implementation uses an assumed non-food share in the base year updated by official non-food CPIs.

[15] Several alternatives have been suggested or suggest themselves for this range. Ravallion, 1998, refers to a non-parametric method that involves a weighted average of household food-shares with the weights declining over the range +/1 10%of the estimated poverty lines. We report our implementation using a non-parametric (lowess) method to estimate the food share for zu and zl. Different methods of estimating the food Engel curve give different results.

with many methods of computing CBN PLs. We report here only basic results here but details of other methods and results can be obtained from the author[16].

Table 3.2 reports the basic CBN poverty lines using an all India food bundle, and Graph 3.1 compares all India CBN PLs with OPLs. Although the all India CBN PL is close to the OPL38r there is an increasing divergence as the CBN PLs rise significantly faster than the OPLs over rounds especially in the rural sector; in the urban sector the divergence is significant only in the 55th Round. Any method of computing Poverty Lines that is based on a behavioural link with an unchanging calorie norm would produce higher poverty lines and higher poverty in the later rounds given the general downward shift in calorie consumption at equivalent real expenditures over time. FEI poverty lines and FEI and DCI poverty (Table 3.3) both show similar patterns although the FEI PLs are even higher in later rounds than the CBN PLs and the poverty counts similarly higher (not given, but available from the author).

The State CBN PLs do not correlate well with OPLs (Graph 3.2); this is also not unexpected as even though the base OPLs for 1973/4 may have been based on normative calorie levels at the all India level, the CPIs that have been used to compute State OPLs and adjust them over time since 1973/4 are unlikely to reproduce the CBN calculations.

Similarity of CBN and FEI methods of computing Poverty Lines

The question is whether these higher CBN poverty levels are plausible? We have already discussed why a constant calorie norm is likely to be unrealistic. Ravallion and co. assert the theoretical superiority of CBN PLs on the ground that FEI PLs are contaminated by the food quality problem, but they maintain the theoretical authority of the link with calorie requirements[17].

On the surface it would appear that in many ways the indirect FEI and the CBN methods are very similar; both are based on the same normative calorie requirements and a behavioural non-food component. This is illustrated in the Figure 3.1. This figure has four quandrants. The NE quadrant shows the relationship between

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[16] For example, the food bundle can be calculated for each area, sector or group; it can be based on households around (variously defined, or below (again variously defined) the poverty lines that are computed. Iteration (if the initial guess of the poverty line with which to choose households whose food bundle is to be used is not close to the poverty line that is calculated using their food bundle the calculation is repeated and hopefully converges) may or may not be used and the criteria for terminating the iteration may vary. The normative calories that the chosen bundle has to provide may vary between regions etc., according to demographics and occupation. The criteria for including items in the food bundle may also vary – some implementations exclude items which provide a small average share of the calories (because there may not be unit values for these low importance items for some for the groups to be compared. area And so on.

[17] Although Ravallion, 1998, notes that PLs could be updated using CPIs this is argued on the basis of data availability rather than the theoretical problems of the calorie link. The World Bank, 2002, in its latest poverty assessment for Bangladesh uses the CPI method applied to a set of base poverty lines computed by the CBN method even though the data are available for repeating the CBN method. It is asserted that the CPI method is better without justification, and the relevant technical appendix shows the CBN calculations which confirm our finding that the CBN PLs inflate much faster than the CPI PLs. Informal gossip suggests that the CPI method was chosen because it showed expected patterns of poverty – decline over time and lower poverty in urban areas –rather than for theoretical reasons and the absence of any theoretical justification does not contradict this view.

expenditure pre capita (vertical axis) and the household per capita calorie consumption; the NW quadrant shows the food Engel curve. These two relationships show the calculation of the CBN poverty line from the normative calorie requirement on the horizontal NE quadrant axis to zfood and to the CBN poverty line on the horizontal axis of the NW quadrant. The SE quadrant transfers the calories per capita on to the lower vertical axis and the SW quadrant shows the FEI relationship between calories consumer per capita and monthly per capita expenditure giving the FEI poverty line[18].

Yet the FEI and CBN methods undoubtedly give very different poverty lines (Ravallion and Bidani, 1994, for Indonesia; Ravallion and Sen, 1996, and Wodon, 1997, for Bangladesh; Tharp et al., 2003, for Mozambique). This arises because of the way in which the food expenditure to meet calorie requirements is computed. In the CBN method the prices are fixed while in the FEI method the implicit prices chosen by households are used. Better off households buy better quality foods of the same type and pay higher prices (have higher unit values). We show that when the FEI method is altered to match the CBN food poverty line method (i.e. using unit values that do not rise as the quantity of calories per capita rises), very similar poverty lines arise. The underlying difference lies in the translation of calories into expenditure which includes other values besides nutrition. Thus e(mpce | calspcpd) is different to e(mpce | food expenditure | cals pcpd), because food demand expresses demand for other nutrients, demographic and occupational differences, and tastes. Nevertheless the restricted FEI and CBN methods give remarkably similar poverty lines.

As implemented by Ravallion and others, the difference between the CBN and FEI methods is that while the FEI method uses all households to estimate the relationship between calories and expenditure, their CBN method of determining the food bundle, the cost of which is the food poverty line, restricts the households to those around a probable poverty line. Ravallion and Bidani select a household “deemed to be typical of the poor ... that household … [has] the mean values of all relevant variables for the poorest 15 percent of the Indonesian population when ranked according to expenditure per person’ (86). .. The food bundle is then the food consumption of this reference household scaled to give the normative calorie requirements. This single food bundle is used for all poverty comparisons including urban-rural comparisons. Ravallion and Sen, and Wodon set food poverty lines for Bangladesh use a normative bundle of food items originally specified by Alamgir, 1974. As discussed elsewhere this food bundle is of much higher quality that that chosen by households around the poverty line. Tarp; Simmler; Mautusse; Heltberg, and Dava, 2002 use “those households whose calorie consumption was below the recommended minimum requirement of 2150 kilocalories per person”. They reject the more usual method of using “the consumption pattern of those households whose total consumption in nominal terms is below a certain level, which serves as a “first guess” of the poverty line, and then to iterate” (86-7), because “the range of resulting poverty lines appeared impossibly large” and “the consumption bundles .. in southern Mozambique commanded a higher standard of living that the poverty lines in northern Mozambique”(108, n37).

[18] The way this figure is drawn the outcomes are the same; in reality the FEI poverty line will be higher than the CBN PL because, as explained below, the FEI estimation contains a positive association between the quantity of calories and the unit value of calories.

Following this argument, Tarp and others 2002, criticize the CBN method of computing food poverty lines in a situation where food consumption patterns differ. In the original method a national food bundle is used and costed using prices for different regions. When regional food patterns differ the national bundle may not represent the food consumption in a particular (or indeed any) region; if the regional food prices differ greatly the computed food poverty line may be different to that at which using the regional consumption pattern households consume the normative calories. Instead, Tarp et al. suggest using the regional food bundle of households whose consume the normative calories and costing this at the regional prices. Thus there are two broad variants of the CBN method, both based in normative calorie requirements, one using a common food bundle that provides the required calories costed at local "prices" (unit values), the other using a local food bundle providing the required calories also costed at local "prices".

All these procedures have the effect of restricting the cost of calories in the resulting food bundles because they restrict the households for which unit values ("prices) of the food bundle items are calculated to those in the lower ranges of the expenditure distribution (i.e. poorer households)[19]. These households consume foods which provide cheaper calories, and are generally deemed of lower quality[20]. Deaton, 1988suggests quality regressions of the following form:

$$\ln v = a + b_1 \ln(x) + b_2 \ln(n) + \sum_i b_3^i \frac{n_i}{n} + g.Z + u$$

where v is – (total food expenditure) / (total calories consumed), x is total household expenditure, ni are the numbers of persons of age/sex category I, and Z is a vector of other household characteristics such as household type (labourer, cultivator, non-farm, etc.), household group (scheduled caste, tribe and other castes), religion, household head's education, and so on). Table 3.4 reports the coefficients of this quality equation for all major states of India in the 38th Round. We find "quality" elasticities of calories some 5 times higher than for unit values; for example, the "calorie quality" regression for calories for the national sample of the NSS 38th Round for the state of Maharashtra gives a coefficient on (log of) household expenditure of 0.25 where we get an elasticity of UV for rice (and a coefficient on the log of household size of -0.31), as compared to coefficients of the log of expenditure for the unit value regression of rice or other staples of 0.04 – 0.06[21].

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[19] R&S, 1996, S&M, 2002, and seemingly, World Bank, 2002, for Bangladesh use median unit values for the whole population of each area; Wodon, 1997, and World Bank, 1998, use a regression procedure which purports to estimate the unit values typical of poor households. In an appendix I show that the unit values estimated by the regression procedure and the median unit values are rather similar, but different from (greater than) the median values calculated for the lowest quartile of the expenditure distribution. They are also significantly larger, for many commodities, than the lowest mode of unit values – as shown above when discussing unit value calculations.

[20] Elsewhere we suggest that quality of items may be more of a problem in computing UVs than Deaton and Tarrozi, 1999, suggest. Deaton, 1997, suggests that the quality elasticity of UVs are "modest"; however, even though apparent quality elasticity are "modest" the calorie "quality" elasticity is higher because it is affected by shifts from low cost per calorie items such as staples to high cost per calorie items such as animal products. .

[21] our results are slightly different to those reported in Deaton, 1997:291 because we use the national not the state sample.

Once the FEI method is restricted to households whose around the poverty line, or by restricting the estimation of the total expenditure – calorie consumption regression to households whose cost of calories is typical of the lower quartile of the expenditure per capita distribution the FEI and CBN methods give the same poverty lines. Graphs 3.5a-c demonstrate the apparent equivalence of the CBN and FEI methods. Graph 3.5a shows estimates of the non-parametric estimates of the relevant relationships for the state of Andhra Pradesh in India, in the 38h Round and shows the problem that without restriction on the unit costs of the food bundle the poverty lines while very close are too high to be plausible. Graph 3.5b shows how restricting the food bundle gives poverty lines that are more plausible (but still different to the Official Poverty line and that estimated using conventional consumer price indexes). The third repeats graph 3.5.b but by eliminating the gaps between the four individual graphics more closely approximates the idealized figure drawn above.

By Calories (alone)?

We have argued that calorie based poverty lines diverge from real expenditure poverty lines over time; we have also suggested that spatial poverty lines computed by these two methods also differ. Although most implementations of calorie based PLs use some variant of the FEI or DCI methods the CBN method of computing PLs also produces similar results. In essence these methods are the same once the confounding of cost per calorie with per capita calorie intake is controlled. In what follows we argue that other explanations of the divergences of calorie and real expenditure based PLs is unlikely to be explained by other factors such as declining calorie needs due to changing demographic composition of households or reduced requirements for energy for work due to changing mix of work patterns. These divergences might be due to declining data capture (as argued for increasing household size by Gibson, 2002), but this is not established empirically. A further possible explanation is that the improved health of the population results in greater utilisation of dietary calorie availability. This is an example of a more general issue, namely that welfare depends on more than private consumption alone; rather the translation of consumption in to well-being depends also on “environmental” factors including the environment as usually construed, public goods, and culture.

The use of a calorie norm to anchor poverty lines for different domains so that poverty can be compared between these domains is not justifiable either on theoretical or empirical grounds; moreover, even if a nutritional intake norm could be established it is increasingly clear that it should not be based on calories alone. Especially perhaps at low levels of calorie intake micro-nutrients are important in determining nutritional status and health (reference required ….); it is possible that households are substituting better quality foods for calorie intensive foods in ways that improves their nutrition even though calorie intakes are lower. There is some evidence for Bangladesh that the quality of diet has improved especially in the second half of the 1990s (World Bank 2002a).

Declining calorie requirements?

One question in the face of the apparent fall in calorie availability over time is whether some deflation of the calorie norm used by the Planning Commission or others can be justified in terms of the way these norms were originally calculated. Thus the average dependency ratio of households has fallen, and since dependents (children and the old) have lower calorie requirements than adults the average household calorie requirement may have fallen. Also, work may have become less intensive due to shifting occupational patterns. The PC divided occupations in the rural sector into three grades of calorie intensity – heavy, medium and light. The PC used the operation codes in the Employment and Unemployment Survey that was carried out simultaneously and on the same sample as the CES survey in the thick rounds (up to the 55th Round); these operation codes are for agricultural tasks and do not exist for the urban sample. However, this approach can be readily modified and adapted to the urban sector by using the Occupation Codes (NCO) that are recorded for each worker in the EUS, and for the household head in the CES. The NCO codes can be divided into heavy, medium and light occupations, and the normative calorie requirements used by the PC applied. Up to the 50th Round we can use the individual NCO codes with common consumer adjustments to the calorie norms for adult males for non-workers, to compute household calorie requirements. For the 55th Round the NCO code of the household head must be used.[22]

Even after adjusting for both changing demographic composition (dependency ratios) and changing occupational structures the calorie norms calculated by these procedures are significantly greater than the average calorie availability at the OPL poverty lines (and our and D&T's PLs). These results are not reported here but may be obtained from the author; however, the NCO codes and actual household demographics are used in our implementation of the CBN method to compute poverty lines, and these are shown in Table 3.2 to have risen in relation to the Official Poverty Lines. Hence a problem remains as to how to rationalise these divergences.

Of course substitution can take place between goods as relative prices and tastes change, and, if it is the case the price of calorie providing goods has risen relative to other goods and calorie providing goods were normal goods, one might expect substitution away from calories in consumption, as suggested by Subramaniam, 2005. But the basis of the use of a calorie norm for computing poverty lines is that calories are not like other goods in that they are necessary, and they are not only desirable but essential. Thus according to this view the utility curves for calories are likely to show very limited substitutability so that changes in relative prices may not bring about much substitution.

Another factor that has been mentioned has been that the decline in common pool resources has necessitated a substitution of expenditure on these goods, which were previously collected free except for the time and energy required to gather them, for other goods such as food (Subramaniam 2005); this would require increased expenditure on these no longer free items, but might also affect the energy intensity of livelihoods. For example, if kerosene is used instead of free firewood that used to be collected from commons, less human energy is required to attain the same level of welfare. This might also explain the fall in calorie availability at constant real expenditure; however, as several changes are involved it might be difficult to determine the expenditure level with the same level of well-being. This is part of the problem identified above that the translation of consumption into well-being is

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[22] One feature of changes in recent decades that may have reduced calorie requirements in addition to occupational shifts has been: spread of mechanised transport, the adoption of mechanised grain milling, modern fuels, and of piped water. Some of these in particular have reduced the energy expenditure of women. Also confinement of women to homes (a sign of increased status) On the other hand decline in common pool resources for fuel, grazing, water collection, etc. may have entailed more physical labour.

contingent on "environmental" variables not accounted for in the poverty measurement frameworks used.

Declining data capture?

On the other hand, people may be better off because of higher but unrecorded expenditures. This possibility was raised by Palmer-Jones 2001. The intuition here was that food purchases and consumption patterns have become more difficult to record over time perhaps because more food is purchased in smaller quantities in markets and shops, and by more members of the household so that the respondent to the expenditure survey – usually the "household head" – may have more individual expenditures to record, more of which he – as it is generally a male – may have little knowledge of. Another factor may have been changes in the pattern of meals provided to guests and consumed by members of the household outside the home. Gibson, 2002, has argued that under-reporting of expenditure in larger households could account for the implausibly large economies of scale for larger households could be explained by higher under-reporting, and provided evidence from surveys that used different recall periods in support of this. The same underlying phenomenon – increasing lack of knowledge and memory lapse concerning expenditures as consumption patterns change – could underlie both excessive household economies of scale and falling expenditure reporting. The reason why this might apply more to food (and other frequently purchased items) than to infrequently purchased items such as the non-Block 5 commodities, is that the former are small and frequent and consequently not "registered" (to use the terminology of Lipton and Moore, 1972), while the non-block 5 items are infrequently purchased, individually more expensive, and hence more likely to be "registered" (and so remembered and reported).

There is some evidence to support this idea in (a) the higher expenditure reported on food when 7 day recall was used in preference to the usual 30 day recall, and (b) in the experimental surveys conducted by NSS in 2000 which compared different recall periods with day based and weighing methods (NSSO, 2003)[23].

Nevertheless, as argued below, there are other considerations that may be of more significance than either declining calorie requirements or declining data capture in explaining the phenomenon observed.

Improved Health

There may be another factor contributing to declining calorie requirements, namely improved well-being. On the one hand better health can lead to reduced calorie requirements as a higher proportion of calories is used for body maintenance, growth and activity, which was previously inefficiently used due to ill health. There may also have been reductions in the infectivity of the environment due to greater supply of public water supply and sanitation, and availability of curative health services. Improved knowledge of health and sanitation practices through increased literacy and education may have contributed. Of course other components of the normative calorie

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[23] This paper also draws attention to the increasing difficulties NSS enumerators were having in persuading respondents to spend sufficient time answering the questions in the CES.

requirements calculation may have been mis-estimated do that the real fall in normative calorie requirements has been underestimated[24].

Equivalence Scales and Economies of Scale

Most work on poverty in India is based on per capita expenditure; as is well known this is inappropriate because different members of households have different needs, particularly the old and children, and because there may be economies of scale in consumption. The problem that dependents have different needs to adults (and females from males) is generally addressed thorough the use of equivalence scales, and the NSS uses such a scale in some circumstances. The household economies of scale can be addressed through the use of a scale parameter. The issues should be addressed together since scale is confounded with household composition; for example, larger households tend to have m ore dependents, especially children.

Poverty counts based on adult equivalent expenditure, and taking account of economies of scale, produce different results, and generally less poverty, than per capita based poverty counts. However, data problems may exaggerate household scale economies (Gibson, 2002); Gibson shows how, and produces evidence from surveys using different methods, that food expenditure may be more under-recorded in larger households than in small. He also argues that the scale economies computed (for example by Lanjouw and Ravallion, 1995) are simply implausible given the absence of any plausible explanation for such economies in households most of whose expenditure is on private (food) goods.

Household Scale Economies and Household Public Goods

Most calculations of poverty are based on per capita expenditures – total reported household expenditure us divided by the number of members of the household regardless of their age or sex. Since, as we have already seen people of different age and sex are thought to have different nutritional requirements it seems unlikely that this is a reasonable method. Household composition – the proportions of members of different categories of age and sex - and total household size are likely to be important determinants of the level of expenditure required to achieve a given level of welfare. Equivalently, the poverty line for households of different size and composition should differ, and indeed taking these variables into account makes a difference to poverty counts. Dreze and Srinivasan, 1996, show that whether female headed households are on average poorer than male headed households depends on how household economies of scale are accounted for.

As several authors have pointed out, if the share of expenditure on food is a measure of welfare – by Engel's law - then empirical evidence of household economies of scale are readily available from regressions of food shares on per capita expenditures and household size (number of members).

$$w_f = a + b_1 \ln\left(\frac{x}{n}\right) + b_2 \ln(n) + \sum b_3^i \frac{n_i}{n} + g.Z + u$$

[24] Offsetting this could be a gradual rise in calorie requirements and the physical size of the population increases, increasing both calorie requirements for Basal Metabolic Rate (BMR), and Physical Activity Levels (PAL). But this increase takes generations.

where w_f is food share, x is per capita expenditure, n is number of persons in the household, n_i is the number of persons of age/sex category i, and Z is a vector of household characteristics (education etc.); a, b_1, b_2, b_3 and g are parameters. A negative coefficient for b_2 indicates that food shares are lower in households with greater numbers

The idea is that at the same per capita expenditure a larger household will be better off and therefore have a lower food share per capita (Lanjouw and Ravallion 1995). However, this implies lower absolute expenditure per capita on food in larger households at the same per capita total expenditure (Deaton and Paxson, 1998). According to this view larger households should be able to spend less per capita on goods with public characteristics and therefore spend relatively more on food, certainly at lower standards of living (as when they are poor). However the data do not support this view (as noted above). This discrepancy is sometimes known as the Deaton-Paxson puzzle).

This issue has been the subject of considerable controversy, and is compounded by problems of determining appropriate equivalence scales since these scales affect the effective size of households. Some recent authors claim that it not in fact an empirical problem since more precise tests of the (Barten[25]) model do not show inconsistence (see for example, Gan and Vernon, 2003)

Gibson (Gibson 2002) suggests that the puzzle may be resolved if data errors are correlated with households size, because perhaps the single respondent may be less able to recall or even be aware of all expenditures of household members especially on small everyday items like food, so that a lower proportion of total food expenditure is reported in larger households. There should be or a lesser effect of size on reporting of non-food expenditures. Given that the NSS has become increasingly concerned about response problems – ergo its experimentation with abridged survey schedules and with 7 day recall for frequent (mainly food items) – it is plausible that there are such problems in the Indian data and that they have increased over time. Thus, declining data capture may apply not only to households of different size, but also between sectors, and over time, accounting in part for the decline in calorie availabilities at constant real expenditures.

In the Indian context, little work has been done on household scale and equivalence ratio issues, and what has been done indicates that taking account of these phenomena does not affect the ranking of states in terms of poverty (Meenakshi and Ray 2002). In this paper household economies of scale and equivalence scales are estimated simultaneously, and a parameter derived to adjust state poverty lines taking account of the state average household composition. Besides many issues one can take with this paper, it neglects the data problem discussed by Gibson, and does not make estimates at NSSR level, which we argue is crucial. We do not make use of such adjustments on computing poverty lines.

From our point of view, the interesting point is that the theory that there are household economies of scale based on household public goods which should raise the share in larger households of expenditure on food (and per capita calorie availability) at constant real per capita expenditures is notably contradicted by the evidence (see our calorie Engel curve estimations where the sign of the log of household size is

[25] Barten, 1964.

negative, sizable and statistically significant. There are relatively few items and low expenditure shares among the poor on items that are candidates for being public in household consumption – e.g. on cooking utensils, cooking stoves, refrigerators, television sets, and so on (and we doubt that the cooking element of food preparation plays any such role (Gan and Vernon 2003)[26]). Furthermore, food shares and per capita calorie availability decline over time for all the expenditure based poverty lines that we have calculated. Also, the spatial distribution of poverty appears inconsistent with this model. This is clearly an area where more, more disaggregated work is warranted.

Calories and Poverty Lines

As noted above it is often the practice to anchor poverty lines in calorie norms and either normative of behavioural food consumption. Some PLs are updated by recalculating these calorie norm based PLs as in the India State base PLs used by the Planning Commission, and by Wodon for Bangladesh; others use CPIs to update them spatially[27], and over time. Others have compared updated poverty calculations with food and calorie consumption patterns in an attempt to verify or controvert the poverty calculations (Mehta and Venkatraman, 2000; Patnaik. U. 2004; Radhakrishna; Hanumantha Rao; K.; Ravi, and Reddy, 2004).

We argue that there is no stable relationship between calories and welfare even at low standards of living, and that any comparisons of poverty based on normative calories are likely to produce spurious results. Consequently we can infer nothing from changes or differences in calorie consumption about welfare or poverty, and we should not judge poverty calculations by their relationship to calorie availabilities. This is because the transformation of calorie availability into well-being – or a standard of living – is dependent on many variables, and is consequently context dependent. The following is a brief exposition of such a model.

Suppose, as an important example, well-being is dependent on "effective calories' which are derived from measured calorie availability by a function that depends upon the health of the person (or of member of the family)[28]. Such an argument is put forward by Sen for the capabilities approach to poverty. Health may depend on access to clean water, or to health services, or the quality of those health services[29]. These are not measured (adequately) in household expenditure surveys nor are they captured in

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[26] Although, interestingly from our point of view, these authors resolve the second prediction of the Barten model (that the elasticity of food expenditure share with respect to household size should be larger for poorer households) by restricting the geographical space of comparisons:

> "The inconsistency concerning the second prediction of the Barten model is resolved in separate regressions for households from different income groups within the same country. Comparisons among different countries are not appropriate, we argue, because the utility functions are not the same across countries with very different socioeconomic statuses and living arrangements." (op cit. 1375)

[27] Group specific CPIs could be used to calculate PLs for different groups,

[28] Using the FAO/WHO model we can view effective calories as calories available for activity above Basal Metabolic Rate. Frequent illnesses means that higher proportions of calories are used for body maintenance and fighting disease than for activity, say through days of inactivity due to illness.

[29] "….hunger and undernutrition are related both to food intake and to the ability to make nutritive use of that intake. The latter is deeply affected by health conditions (for example, the presence of parasitic diseases), and that in turn depends on communal health care and public health provisions " (Sen, 1999:314)

Consumer Price Indexes. Hence, improvement in or better access to health care or clean drinking water etc. means that more effective calories are obtained per available calorie, and so an equivalent level of welfare may be obtained with fewer calories. Figure 3.2 demonstrates this model.

In the upper panel north east quadrant available (measured) calories are transformed into effective calories, which in turn intersect the poverty line budget constraint at the utility level which the poverty line is supposed to reflect. In the lower panel the available-effective calorie transformation shifts so that more effective calories are produced by nominal calories. This makes effective calories cheaper shifting the budget constraint to p_0p_1' which of course enables a higher level of utility to be achieved. p_1p_1 is the new budget constraint supporting the original poverty line utility level, and would result in calorie availability of C_1 rather than C_0, showing that fewer calories are required to attain the original poverty line level of well–being.

We can come to a similar conclusion using the model of nutrition-productivity of Peter Svedberg (Svedberg 2001). This is illustrated in Figures 3.3 & 3.4.

The first diagram illustrates the original model; a short run calorie expenditure function (SCE(W_0,A,Z)) traces the relationship between calories consumed and work done at body weight W_0, for habitual activity A, and personal characteristics Z. There are multiple equilibria for given body weight traced by a given SCE curve, but imbalance of energy expenditure and intake leads to change in body weight and hence shifting to another SCE. The envelope of these SCE traces the long run energy expenditure curve LCE. The lower panel in Figure 3.3 shows the energy productivity or revenue curve REV(A, K, P) for given activities A, equipment and facilities K, and prices P.

Figure 3.4 shows how choice between activity and leisure leads to a choice of body weight and activity level that is less than that which gives maximum net calories. In the lower panel net calories (the difference between LCE and REV) can be substituted for non-calorie consumption with utility increasing in both. Optimal body weight etc. is determined by the tangency of the lower net calorie curve and the calorie-non-calorie utility isoquant. Svedberg uses this construction to show the effects of changing prices on choice of body weight and work effort. We can use is to demonstrate the effect of improved translation of calories consumed into effective calories. The upper panel shows what happens if the LCE shifts because more effective calories can be obtained from the same available calories (i.e. reducing the calories required for given work effort, thereby shifting the LCE curve down). This raises the net calorie production curve in the lower panel, which may result in lower or higher equilibrium body weights and, or calories consumed.

Besides clean water, improved sanitation, or other characteristics affecting environmental health, better health practices (cleanliness, immunisation) and improved quality of health goods (health care and commodities such as anti-biotics) could shift the available-effective calorie function in the way modelled. Of course deterioration in the health environment and health goods and services would have the opposite effect, but whatever their limitations, the rise in public (and NGO) spending and activities in these areas may have had a net beneficial effect. This may explain why despite falling calorie availability there appears to have been no aggregate fall in nutritional or health status.

This type of model could also explain the spatial divergence of calorie availability and nutritional (and health status) in India. It is a robust finding in recent NSS rounds that calorie availability per person is lower in "southern" India compared to "northern", but indicators of female and child nutritional statuses such as those calculated from the 1998-9 NFHS2, tend to be better in the former. Other factors which affect calories required are of course demographic and anthropometric compositions of the population and activity levels, which we have already argued are not sufficient to explain the decline in calorie availability at the poverty lines we have computed. Map 1 demonstrates this. To produce this set of maps the standard FAO/WHU/UNU method of calculating calorie requirements is implemented to take account of household composition, occupational patterns and body sizes of different segments of the population using data on heights and weights from the National Family Health Survey of 1998-9[30]. Expenditure poverty (rural HCR in 55th Round of NSS) shown in the map in central row is spatially quite differently distributed to and energy expenditure poverty (lower right map).

What remains to be explained is the gap between these two distributions, but it is not implausible that differences in the quality of diet, health environment, public goods especially for health and nutrition) and culture more generally play a significant role in these differences.

Conclusions

This paper set out to explore whether poverty lines that reflect the same standard of living can be anchored in calculations based on normative calorie requirements. Such methods are common whether operationalised through the Food Energy Intake or Direct Calorie Intake methods popular with national statistical agencies or the Cost of basic Needs methods espoused especially by authors associated with the World Bank. This question is raised in particular by apparent divergence in both India and Bangladesh, for example, between trends in poverty when calculated from poverty lines that purport to reflect constant real expenditure, such as those that are adjusted over time or space by Consumer Price Indexes, and poverty calculated directly from calorie norms. This is also manifest in the declining calorie consumption at these constant real expenditure poverty lines. We discuss various possible explanations for these divergences including data problems, and changing nutritional requirements based in changing demographics and occupational patterns. Elementary economic theories can account for changing calorie demand if relative prices change or if goods that were previously free to gather must now be purchased leading to substitution away from expenditure on staple foods. However, a further possibility is that the conversion of food into well-being has improved over time because of changes (or spatial differences) in the "environment", particularly the health of the population of its determinants. In these circumstances it is likely that a given real level of well-being is attained at lower calorie intake. Thus there are a plethora of potential explanations for a variable relationship between calorie norms and well-being.

The policy relevant question is then not whether or how to base poverty calculations in nutritional norms, but why the practice continues to command such widespread usage? We have shown that our criticisms are not limited to the FEI and DCI methods but also apply to the CBN methods put forward on the basis that they are

[30] Further details of theses calculations are available from the author.

improvements. The main difference between these different methods is the way in which improved quality of diet is allowed to affect (or not) the determination of the expenditure required to attain a given level of nutritional welfare. Otherwise the same nutritional norms and the same, or a least very similar, methods of allowing for non-food requirements are used (essentially an inverse Engel curve method). Thus the CBN methods no more result in poverty lines which reflect constant real standards of living and, along with the FEI and DCI methods should be discarded from the poverty assessment toolbox. What to put in their stead is rather more difficult to determine; we have indicated several possible lines of advance including improving the methods of data production in household economic surveys and broadening their scope to include anthropometric indicators. This would help triangulate poverty assessment methods as suggested in recent literature on poverty assessment in developed countries (Bradshaw and Finch, 2002; Iceland, 2004). Further exploration of these issues would extend and already over-long paper

Figures

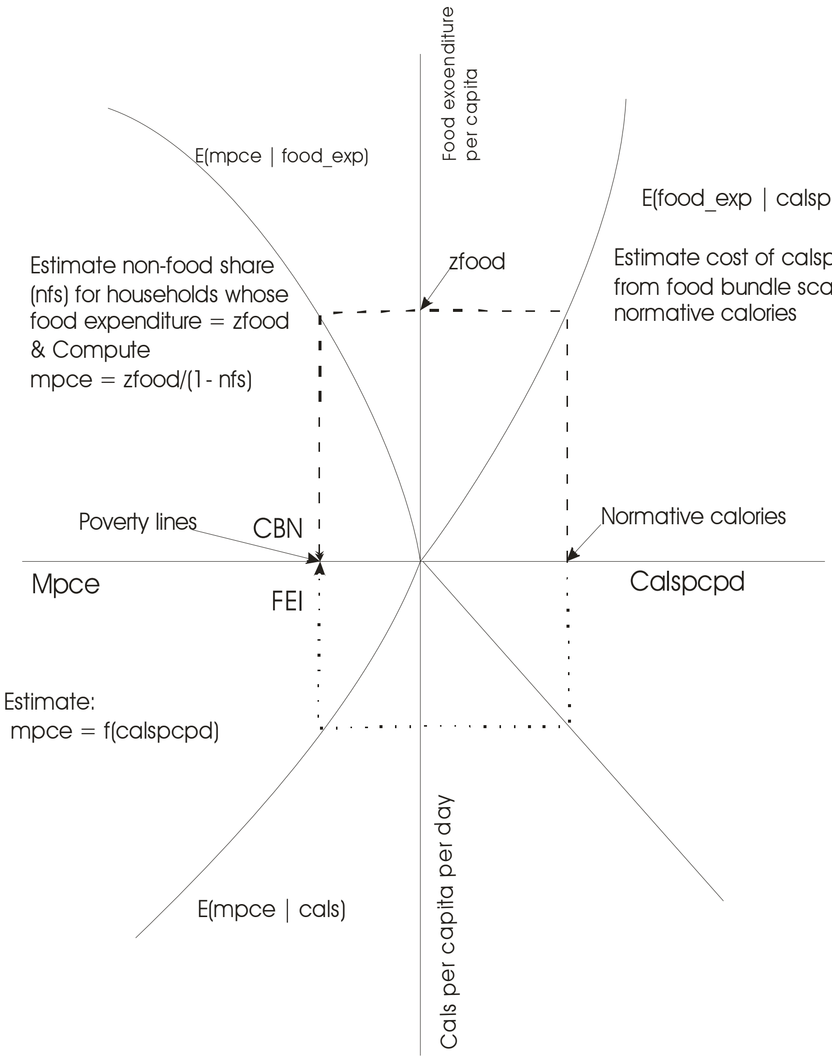


Figure 1: Demonstrates the equivalence of CBN and FEI Methods

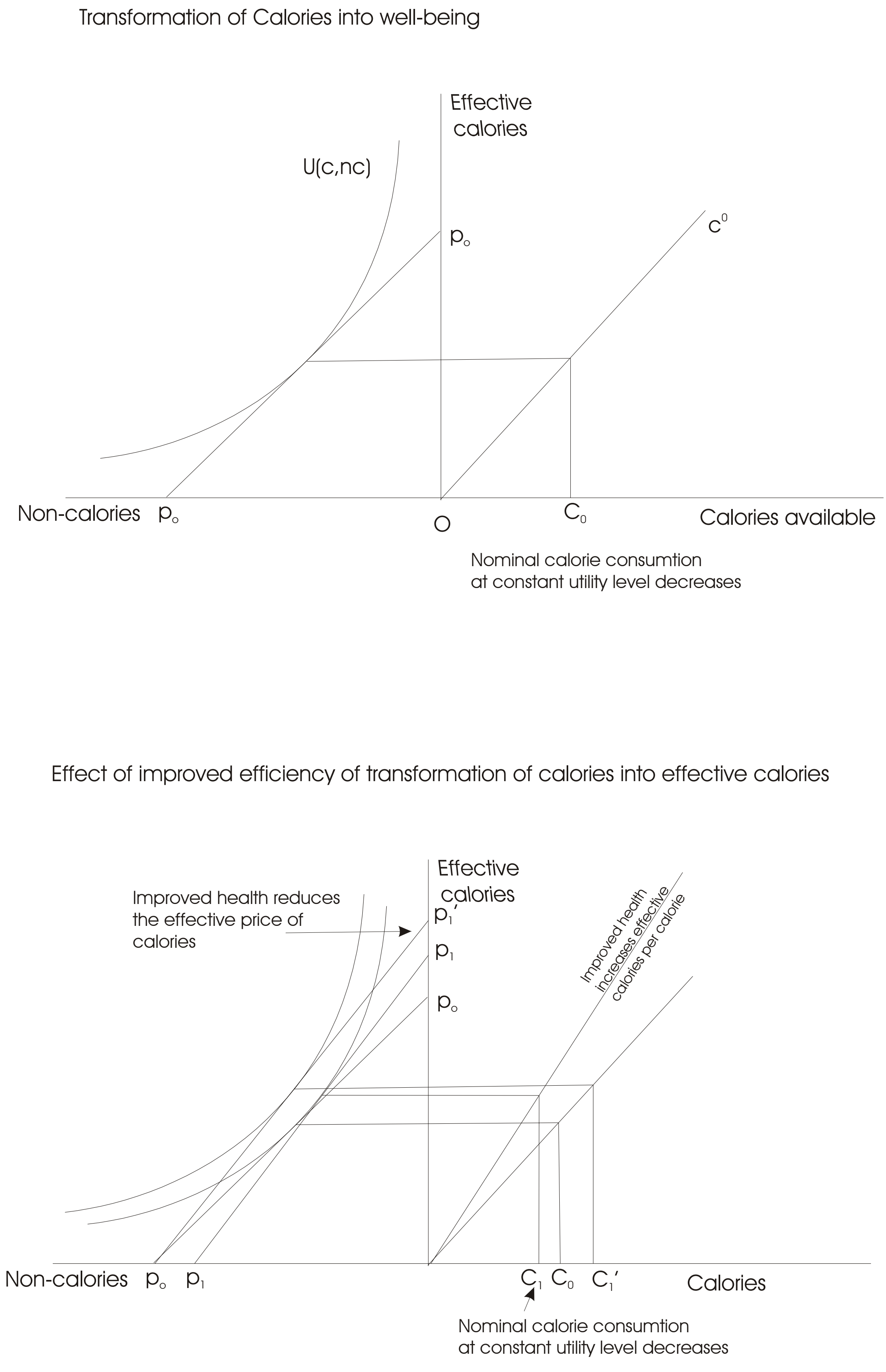
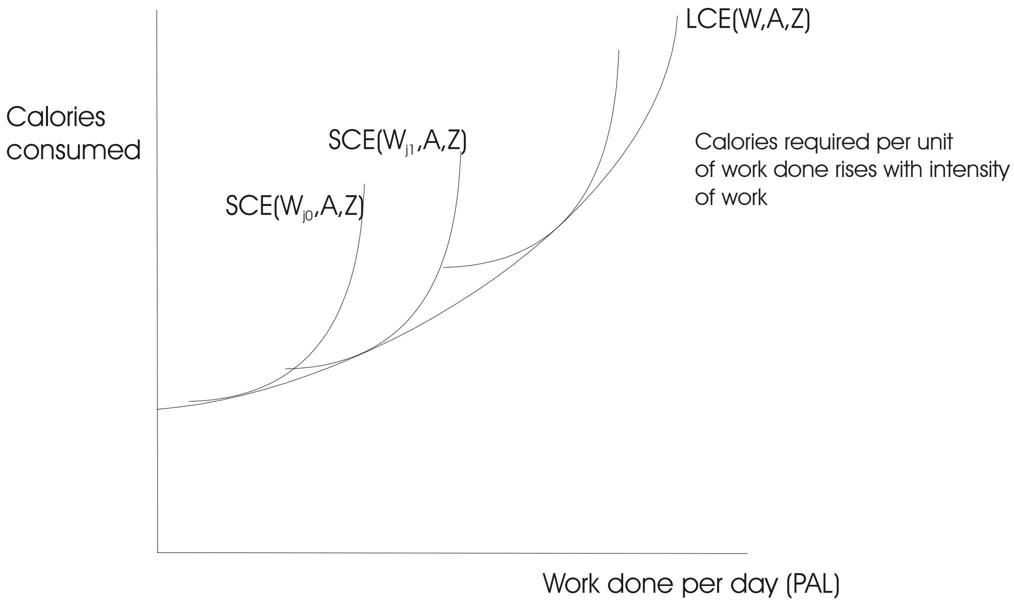


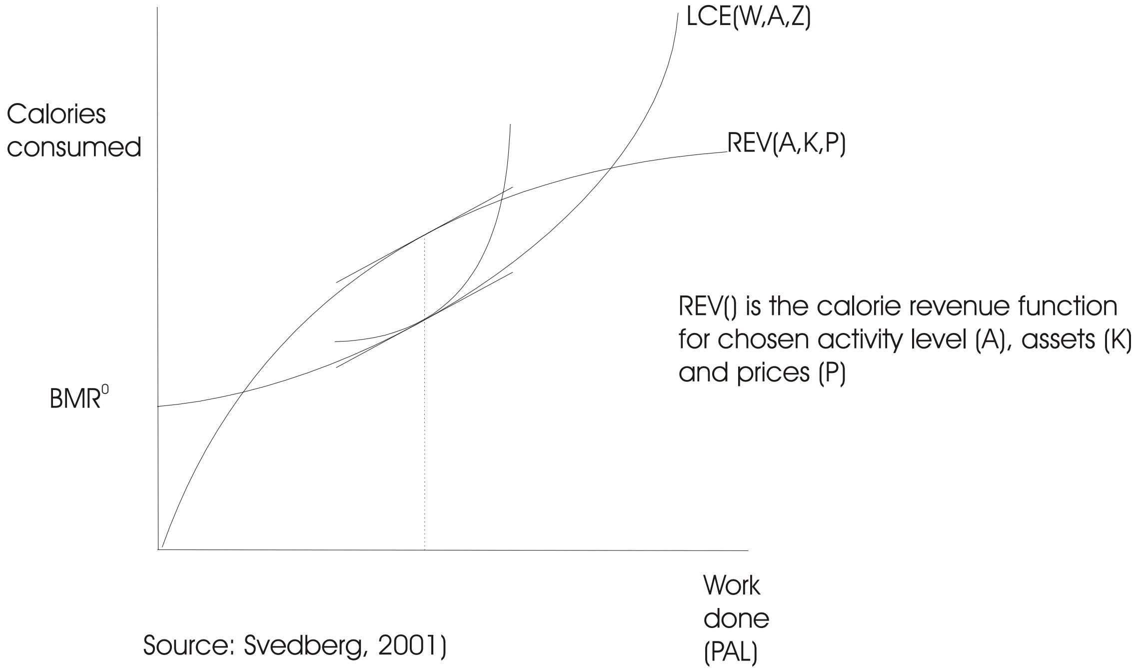
Figure 2 Transformation of Calories into Effective Calories

Short and Long Term Calorie Expenditure Functions:
Body Weight, Activity Level and Personal Characteristics



SCE() is the short run Calorie Energy expenditure function, relating external activity to calories consumed for a given body weight (W, activity level (A) and personal characteristics (Z)
LCE() is the long run curve traced by the envelope of SCE curves/

Maximum net revenue for work done



Source: Svedberg, 2001)

Figure 3 Transformations between Work and Calories

Optimum effort when health improves.

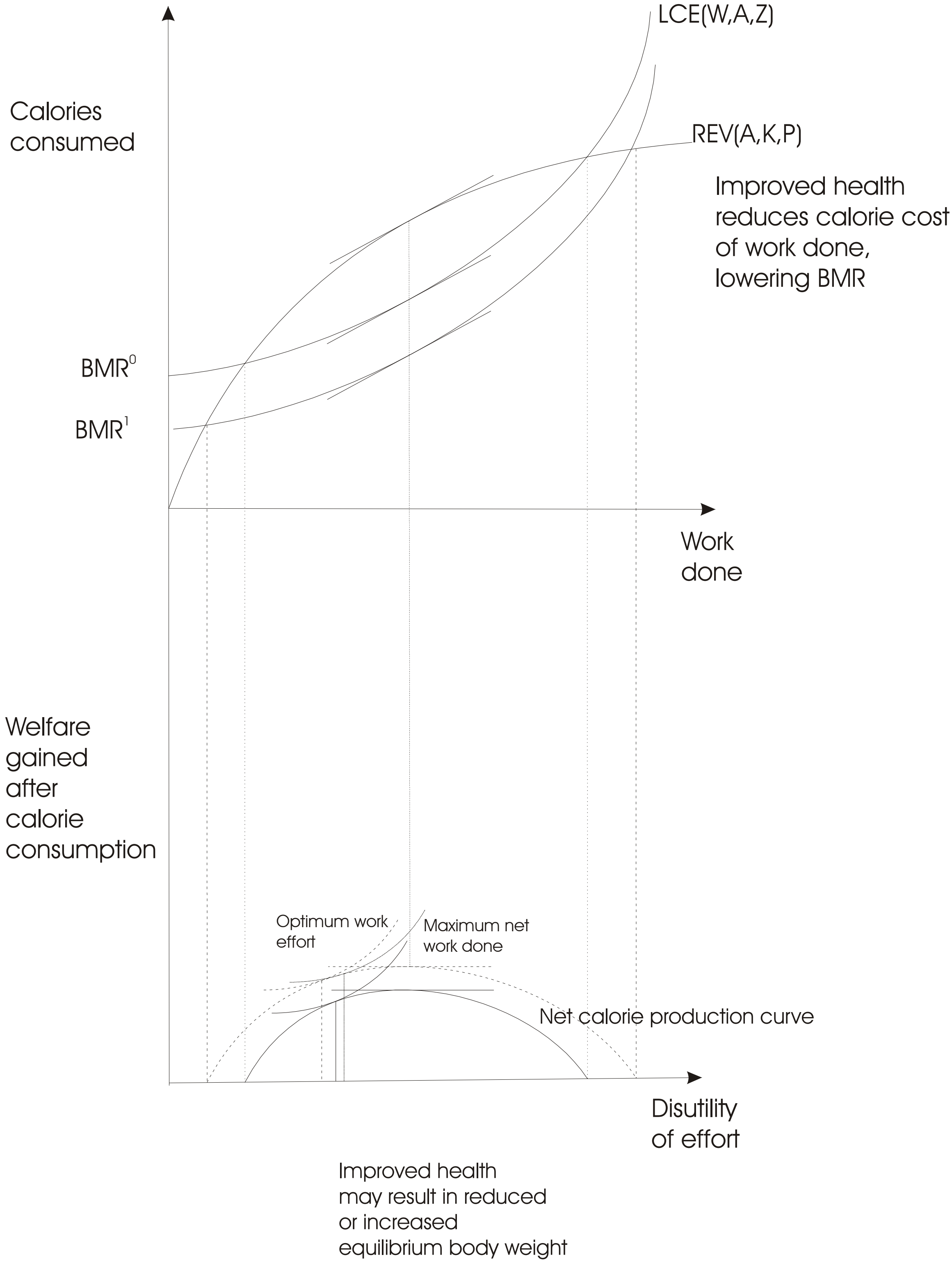


Figure 4 Optimum Work Effort

Table 1: Alternative Methods for Computing Poverty Lines

Method	Variant	Anchor	Method	Spatial PLs	Updating PLs	Comments
DCI[31]	Direct	Normative calories	Households which consume less than normative calories	Same or different normative calories for different spaces	Recalculate at each round	Can use population average of household specific normative calorie calculations Used by BBS
FEI	Indirect	Normative calories	Households whose expenditure is less that that at which households are expected to consume normative calories based on regression of calorie consumption on mpce	"	Recalculate at each round	Bidani & Ravallion criticise Indonesian poverty calculations because (a) urban poverty higher than rural, and (b) no rank correlation of regional FEI poverty with CBN poverty
CBN	Single food basket	Normative calories	Estimate zfood from single food (normative or behavioural) basket and regional/group prices	Same calorie norms for different areas, sectors and periods	Recalculate at each round Or Use unit values from survey Or use consumer food price index	Uses a limited set of food items in the normative food bundle in order to ensure prices of most items exist in all regions/groups. This bundle may not in fact be consumed by anyone. The food bundle may be drawn from consumer surveys or specified normatively. Where food bundles differ – e.g. between rural and urban sector, consistency is established informally. Ravallion and Sen use a normative food bundle that is inappropriate to poverty line consumers – too much non-rice foods whose price inflates faster than rice in 1980s Wodon uses same inappropriate food bundle.
			Then estimate non-food share	Same or different non-food share used for different spaces/times	Recalculate at each round or use official consumer non-food price index	Ravallion and Sen use a Non-food CPI in Laspeyres and inflates faster than non-food shares at food poverty lines giving sharply rising non-food share at poverty line Wodon estimates upper and lower behavioural non-food share for 14 geographical units
Modified CBN	Multiple food baskets	Normative calories	Estimate zfood based on regional/group specific food bundle of poor, and regional/group prices or unit values	Different UV prices used for different areas/sectors	Recalculate Or Use UV or official CPIs	Tarp
				Estimate regional/group non-food		

[31] The DCI method enumerates as poor households whose calorie consumption is less than the(ir) normative calorie requirement; the FEI method denominates as poor households whose monthly per capita expenditure (MPCE) falls below the expected expenditure at which normative calories will be consumed (usually estimated by a regression of expenditure on calories. The CBN method scales a normative or computed food bundle to the normative calorie level, computes the expected cost of this bundle, and adds a non-food component that is calculated generally (but not always) by the inverse Engel curve method

Table 1 (Continued)

Method	Variant	Anchor	Method	Spatial PLs	Updating PLs	Comments
India	OPL	Normative Calories from 2400/2100	All India poverty lines taken from Task Force; State Poverty lines computed from All India PLs using State/sector CPIs	Based on inverse Engel curve method	CPIAL & CPIIW (note that the Lakdawala Committee recommended that the urban deflator be the average of the CPIIW & CPIUNME, but the PC simplified this to CPIIW	All India PL "consumption expenditure with which households, on an average, consumed food which met the calorie norms together with such non-food items as they chose." State PLs: same calorie requirements in each state (age/sex/occupation composition the same); same all India food Basket, with State prices. However. Actual State PLs worked using CPIs for state vs. all India in 1960-1 and CPIs to update from 19601 – 1973-4.
	CBN		Normative calories and non-food shares to base All India sector poverty lines, with state expenditure group and region CPIs update	Use regional normative calories and unit values	Official price data using poverty line weights	
Deaton	Poverty line	Initial poverty line = 43rd Round AllIndia Rural Official Poverty Line	Estimate CPIs using survey UVs and average budget shares		Round to Round All India Rural CPI	Underestimates urban/rural PL differences because neglects higher share of non-UV items. Does not include differential CPIs for non-UV items.
			Non-food items assumed to inflate at same rate as food items			UV CPIs sensitive to items included

Table 3.2: Rural and Urban CBN Poverty Lines (India)

state50	zfood	upl	lpl	zfood	upl	lpl	zfood	upl	lpl	zfood	upl	lpl
Rural	38			43			50			55		
AllIndia	65.69	89.93	87.22	86.69	121.71	118.48	158.5	224.75	218.19	256.32	415.74	401.32
Andhra Pradesh	62.55	88.76	84.53	80.22	115.96	112.35	170.01	244.9	235.96	278.54	465.11	450.83
Assam	76.71	101.08	98.67	89.84	121.33	117.95	197.44	261.04	255.94	327.42	497.19	483.52
Bihar	73.35	94.62	92.34	89.07	116.98	114.73	152.8	204.64	199.52	253.39	373.91	361.63
Gujarat	72.09	100.27	97.27	87.44	122.89	121.05	191.07	275.51	272.71	290.87	481.83	466.47
Haryana	61.4	87.54	85.67	78.71	117.35	116.56	158.96	236.28	235.32	232.89	396.95	409.36
Himachal Pradesh	61.01	84.07	83.65	81.95	118.05	117.6	180.06	261.88	256.89	283.96	488.47	463.16
J&K	64.69	87.77	85.84	76.69	106.29	104.45	165.96	238.62	228.86	291.26	475.17	447.32
Karnataka	72.45	105.77	103.05	79.92	116.88	115.29	160.26	239.95	234	266.5	461.88	457.63
Kerala	65.96	95.82	92.64	84.25	125.15	121.46	196.57	290.43	281.19	332.37	666.24	718.21
Madhya Pradesh	62.38	83.49	80.58	81.54	113.33	110.55	153.25	220.95	214.07	247.21	417.54	395.74
Maharashtra	68.37	104.04	98.79	89.59	133.41	128.06	175.06	270.72	260.31	250.76	443.4	418.22
Orissa	72.17	91.54	90.06	84.53	115.37	110.73	152.58	206.51	199.65	269.98	428.35	404.85
Punjab	64.77	95.7	92.58	83.31	123.28	122.48	157.52	236.29	231.88	268.17	480.06	454.75
Rajasthan	70.7	101.24	96.19	100.7	144.29	142.3	174.43	257.05	257.1	281.67	472.77	469.74
Tamil Nadu	67.18	93.08	91.14	83.53	115.93	113.01	172.68	240.36	232.65	306.33	528.08	518.48
Uttar Pradesh	61.26	85.65	82.7	78.85	113.8	109.54	145.05	210.22	203.42	234.17	390.37	376.09
West Bengal	68.25	86.4	85.18	83.55	108.76	107.04	170.94	231.98	224.31	262.21	386.76	373.59
Delhi	55.2	.	75.32	75.52	.	.	202.18	.	.	303.36	.	.
Urban												
AllIndia	77.71	114.54	108.99	107.05	161.86	151.74	186.77	285.21	269.44	408.4	768.71	701.41
Andhra Pradesh	68.02	99.05	94	101.45	156	145.57	187.47	292.95	273.14	451.64	947.2	796.77
Assam	77.73	103.09	101.84	104.71	140.9	137.6	199.71	284.86	272.17	474.22	791.86	742.33
Bihar	81.69	109.59	104.85	108	148.36	140.84	184.17	254.58	245.41	406.84	682.49	627.2
Gujarat	84.07	122.92	118.08	116.68	173.33	167.14	201.79	301.75	287.19	422.04	784.46	704.86
Haryana	72.27	109	103.95	96.34	147.23	142.54	180.99	285.17	280.09	391.08	781.85	727.33
Himachal Pradesh	76.95	114.64	110.75	101.91	152.16	147.91	181.92	258.41	243.8	424.42	782.24	737.93
J&K	64.16	89.49	89.83	95.94	132.28	128.81	187.79	272.41	272.6	452.73	848.56	772.04
Karnataka	79.33	119.37	114.19	106.68	167.71	156.59	195.53	310.86	287.94	426.11	847.91	767.88
Kerala	76.12	112.53	110.1	100.28	152.62	147.31	203.95	313.18	298.81	478.63	991.37	968.77
Madhya Pradesh	74.52	110.92	104.36	107.78	163.96	152.87	181.93	284.08	267.56	374.09	734.34	659.21
Maharashtra	86.25	132.37	126.21	116.28	179.96	172.02	206.45	329.43	311.5	422.08	812.71	744.96
Orissa	78.08	109.7	104.52	104.15	149.37	141.2	172.99	258.18	240.34	397.87	685.73	634.17
Punjab	76.28	114.87	111.93	100.26	155.05	147.61	188.56	296.31	288.05	380.08	743.45	669.52
Rajasthan	78.79	118.77	111.93	113.36	173.02	163.11	196.17	298.06	285.02	395.05	736.53	675.66
Tamil Nadu	78.01	114.12	108.1	101.46	152.68	142.41	184.68	283.85	263.55	467.28	918.43	845.32
Uttar Pradesh	72.75	109.63	102.63	103.48	159.17	149.17	172.62	268.09	250.62	374.61	686.81	631.97
West Bengal	78.48	111.48	107.73	106.99	155.28	147.51	190.18	274.95	262.1	414.79	712.54	649.82
Delhi	68.65	105.87	101.42	97.38	148.44	143.27	202.15	309.02	291.29	422.9	816.04	730.96

Note: All India food bundle computed for each round

Table 3: FEI State Poverty Lines & FEI & DCI Poverty

state50	rural	urban	rural poor	urban	rural	urban
38th	FEI poverty lines		%		dci poor	
AllIndia	104.19	153.48	57.97	61.92	67.08	70.40
Andhra Pradesh	100.45	144.55	54.32	61.13	70.29	80.37
Assam	119.87	165.10	69.85	68.94	79.42	81.19
Bihar	89.59	138.93	57.30	64.49	67.13	63.84
Gujarat	100.45	144.55	46.01	54.50	68.85	65.54
Haryana	125.24	175.65	52.79	62.17	52.05	53.91
Himachal Pradesh	130.34	241.68	49.93	67.58	45.20	40.52
J&K	113.85	151.02	53.08	65.77	45.16	66.62
Karnataka	108.18	155.04	57.38	61.21	66.81	67.58
Kerala	148.75	160.05	69.83	63.07	87.35	83.88
Madhya Pradesh	90.06	138.97	55.51	64.67	63.29	63.34
Maharashtra	105.78	172.11	61.02	60.43	74.27	72.42
Orissa	100.45	144.55	64.37	64.24	71.91	73.67
Punjab	140.23	174.93	47.14	61.93	46.89	60.45
Rajasthan	98.47	150.41	47.02	60.97	49.98	50.41
Tamil Nadu	100.45	144.55	55.80	60.90	82.40	85.92
Uttar Pradesh	100.45	144.55	62.19	69.39	58.28	66.19
West Bengal	102.57	164.51	61.92	64.92	76.56	75.42
Delhi	100.45	144.55	8.76	39.69	61.38	60.03
43rd						
AllIndia	150.73	236.78	61.45	63.86	65.05	64.27
Andhra Pradesh	143.84	221.15	59.04	66.97	66.48	67.93
Assam	166.96	265.86	68.72	69.45	75.73	74.83
Bihar	133.62	192.14	63.73	70.39	67.87	67.10
Gujarat	143.84	221.15	51.08	60.73	69.85	67.01
Haryana	188.63	244.54	49.36	60.67	44.70	54.77
Himachal Pradesh	188.81	349.04	56.78	70.65	42.48	29.96
J&K	172.06	254.66	56.98	62.49	49.96	49.10
Karnataka	136.32	215.18	59.52	64.02	67.80	63.18
Kerala	208.36	252.94	70.42	65.98	80.17	72.32
Madhya Pradesh	132.31	224.51	61.43	63.41	63.85	59.25
Maharashtra	153.05	279.25	66.35	65.24	73.46	62.29
Orissa	143.84	221.15	71.53	65.76	68.45	62.36
Punjab	203.70	271.20	50.62	62.35	45.94	54.93
Rajasthan	148.59	240.23	51.66	68.52	48.51	51.60
Tamil Nadu	143.84	221.15	60.93	60.90	77.14	76.42
Uttar Pradesh	143.84	221.15	62.22	66.78	58.28	60.63
West Bengal	151.17	251.86	63.86	67.23	68.21	72.57
Delhi	143.84	221.15	6.13	28.83	52.32	49.81

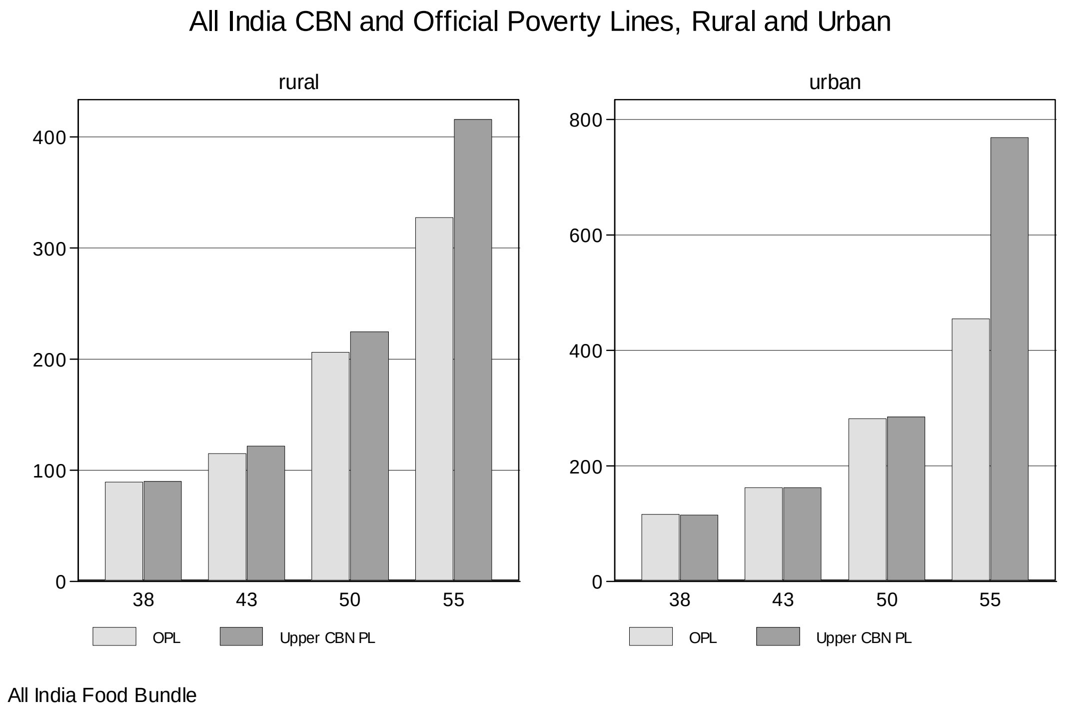
state50	rural	urban	rural poor	urban	rural	urban
50th	FEI poverty lines		%		dci poor	
AllIndia	285.88	431.42	65.90	62.36	71.96	61.69
Andhra Pradesh	280.85	413.43	64.13	65.82	81.51	66.34
Assam	301.30	438.06	76.06	61.48	90.12	62.98
Bihar	229.87	319.69	65.61	59.74	72.65	49.70
Gujarat	280.85	413.43	53.18	56.14	80.46	60.75
Haryana	332.97	440.15	54.80	56.53	57.97	56.34
Himachal Pradesh	335.21	545.99	62.29	59.33	65.12	37.43
J&K	330.40	444.55	52.23	51.77	46.68	38.82
Karnataka	292.02	428.73	70.18	63.63	75.63	64.00
Kerala	441.68	497.40	74.93	69.29	83.56	73.82
Madhya Pradesh	250.69	388.12	64.30	64.48	70.89	59.61
Maharashtra	293.99	522.37	70.90	63.79	83.91	68.05
Orissa	280.85	413.43	81.34	64.69	68.29	44.55
Punjab	402.27	510.33	60.16	60.93	58.73	60.21
Rajasthan	289.82	399.88	53.59	59.29	48.67	50.35
Tamil Nadu	280.85	413.43	64.31	64.27	85.71	73.04
Uttar Pradesh	280.85	413.43	65.96	68.98	64.17	57.55
West Bengal	285.68	438.76	68.30	61.15	71.13	58.67
Delhi	280.85	413.43	11.70	32.30	59.02	56.75
55th						
AllIndia	498.84	796.63	64.98	61.78	74.85	59.96
Andhra Pradesh	479.80	765.77	69.26	64.33	83.25	63.41
Assam	456.71	817.13	66.49	63.69	89.29	58.08
Bihar	400.51	611.29	65.49	67.22	75.24	51.55
Gujarat	479.80	765.77	46.02	52.94	77.74	61.11
Haryana	670.89	900.29	55.19	60.48	56.86	57.58
Himachal Pradesh	678.90	1189.31	62.86	61.47	60.85	29.15
J&K	684.41	888.03	58.72	55.03	43.17	34.75
Karnataka	532.34	836.91	68.89	58.81	80.56	62.72
Kerala	796.48	913.09	68.48	62.97	86.43	69.89
Madhya Pradesh	416.72	670.04	66.09	63.20	78.61	59.80
Maharashtra	501.85	908.04	64.40	61.79	83.22	64.46
Orissa	479.80	765.77	81.13	77.87	77.30	45.03
Punjab	733.83	887.61	61.05	64.81	63.78	53.08
Rajasthan	551.30	774.53	61.63	61.72	54.38	45.89
Tamil Nadu	479.80	765.77	59.07	55.48	88.86	69.44
Uttar Pradesh	479.80	765.77	66.08	72.23	65.02	57.78
West Bengal	484.94	798.56	68.30	62.53	76.30	59.51
Delhi	479.80	765.77	4.38	27.88	87.29	58.25

Table 4 Calories Quality Elasticity, 38th Round

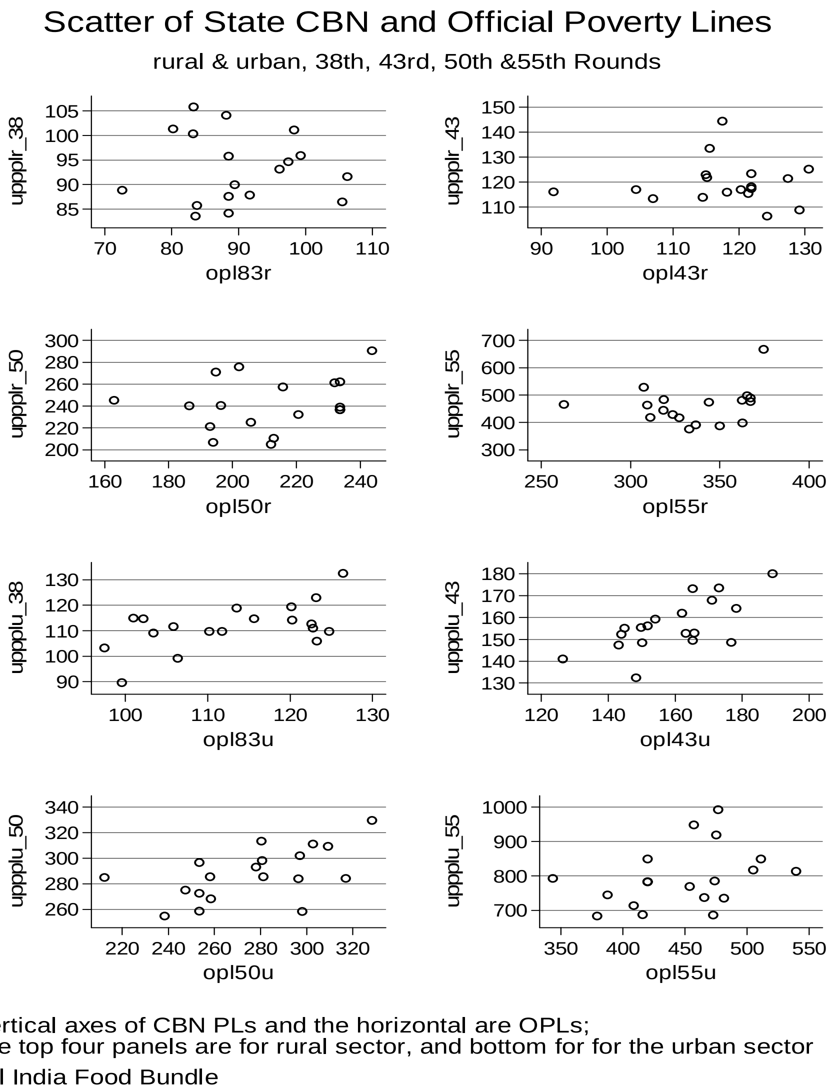
Calorie Unit Value Regression Coefficients, 38th Round.

State	sector	b1	se	b2	se
			rural		
Andhra Pradesh	2	0.135	0.008	-0.193	0.018
Assam	4	0.076	0.011	-0.169	0.015
Bihar	5	0.223	0.005	-0.235	0.008
Gujarat	7	0.164	0.011	-0.192	0.018
Haryana	8	0.269	0.017	-0.196	0.037
Himachal Pradesh	9	0.224	0.014	-0.233	0.022
J&K	10	0.158	0.018	-0.221	0.025
Karnataka	11	0.182	0.009	-0.298	0.017
Kerala	12	0.220	0.009	-0.275	0.019
Madhya Pradesh	13	0.240	0.007	-0.252	0.012
Maharashtra	14	0.267	0.007	-0.295	0.013
Orissa	19	0.152	0.008	-0.233	0.014
Punjab	20	0.044	0.022	-0.148	0.042
Rajasthan	21	0.260	0.010	-0.299	0.020
Tamil Nadu	23	0.151	0.010	-0.154	0.023
Uttar Pradesh	25	0.260	0.005	-0.275	0.009
West Bengal	26	0.165	0.007	-0.200	0.014
Delhi	31	0.090	0.147	-0.157	0.829
			urban		
Andhra Pradesh	2	0.168	0.013	-0.292	0.032
Assam	4	0.244	0.016	-0.304	0.023
Bihar	5	0.268	0.010	-0.351	0.015
Gujarat	7	0.114	0.021	-0.219	0.038
Haryana	8	0.278	0.021	-0.231	0.043
Himachal Pradesh	9	0.035	0.062	-0.140	0.116
J&K	10	0.263	0.016	-0.339	0.023
Karnataka	11	0.236	0.017	-0.487	0.032
Kerala	12	0.145	0.021	-0.302	0.044
Madhya Pradesh	13	0.286	0.009	-0.290	0.015
Maharashtra	14	0.264	0.009	-0.417	0.017
Orissa	19	0.237	0.016	-0.399	0.028
Punjab	20	-0.127	0.036	-0.080	0.079
Rajasthan	21	0.148	0.018	-0.256	0.037
Tamil Nadu	23	0.157	0.011	-0.211	0.025
Uttar Pradesh	25	0.305	0.009	-0.355	0.016
West Bengal	26	0.275	0.010	-0.367	0.019
Delhi	31	0.116	0.036	-0.183	0.070

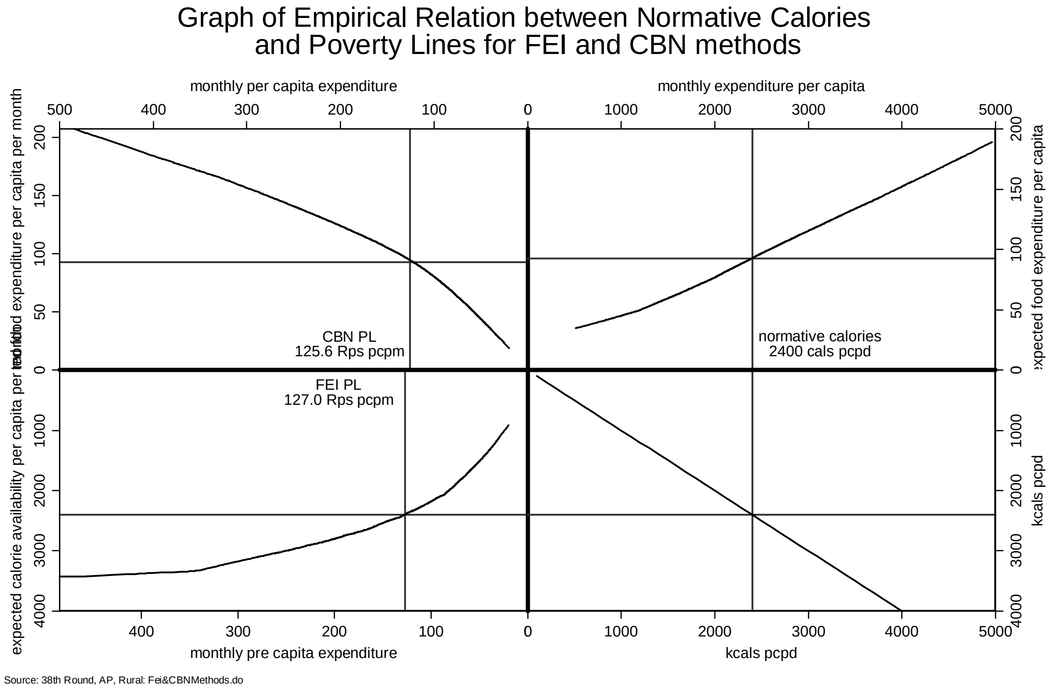
B1 is the coefficient on lnurp, and b2 if the coefficient on lnhhsize; other variables included in the regression were: household demographic composition, household type, household social group, religion, education of household head ….



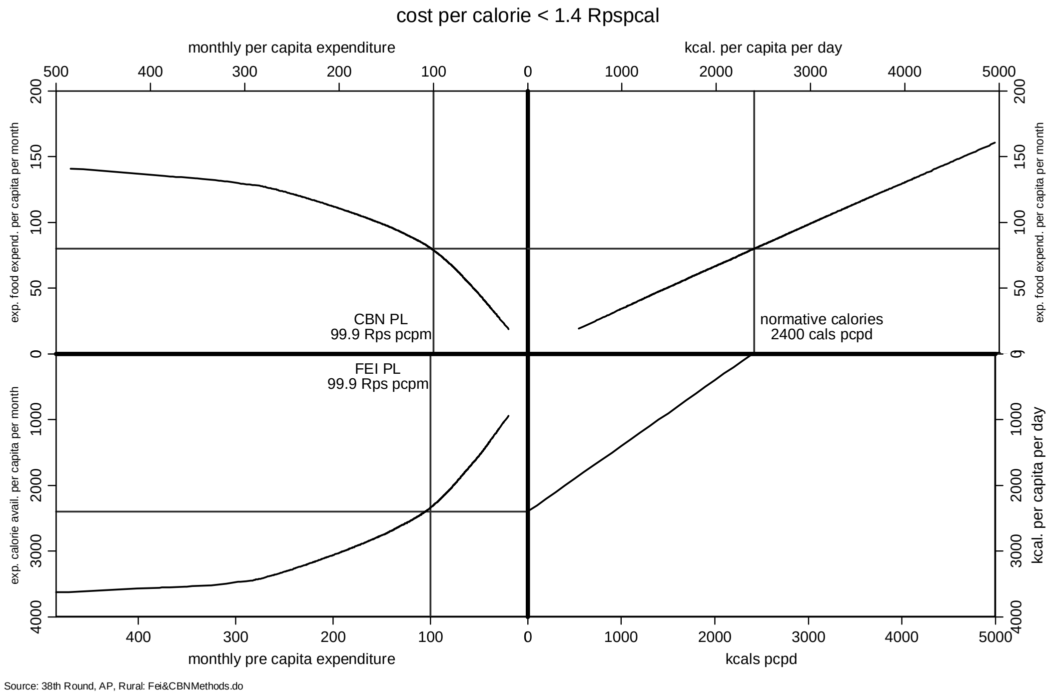
Graph 1: Inflation of Rural and Urban CBN and Official Poverty Lines over 38th – 55th Rounds



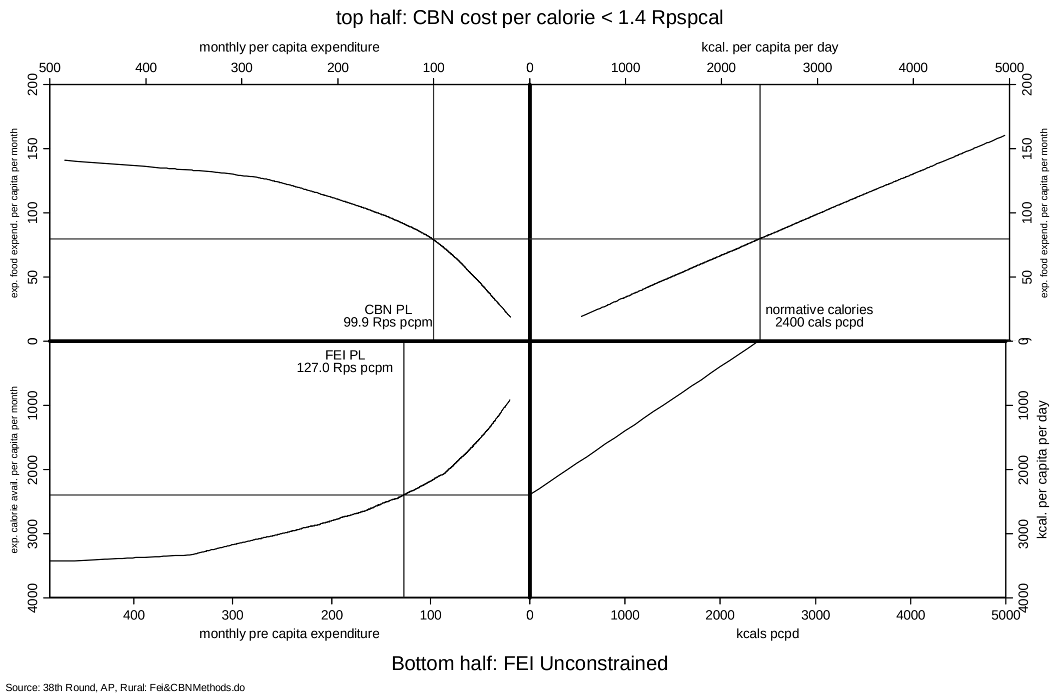
Graph 2: CBN and Official Poverty Lines by Round and Sector



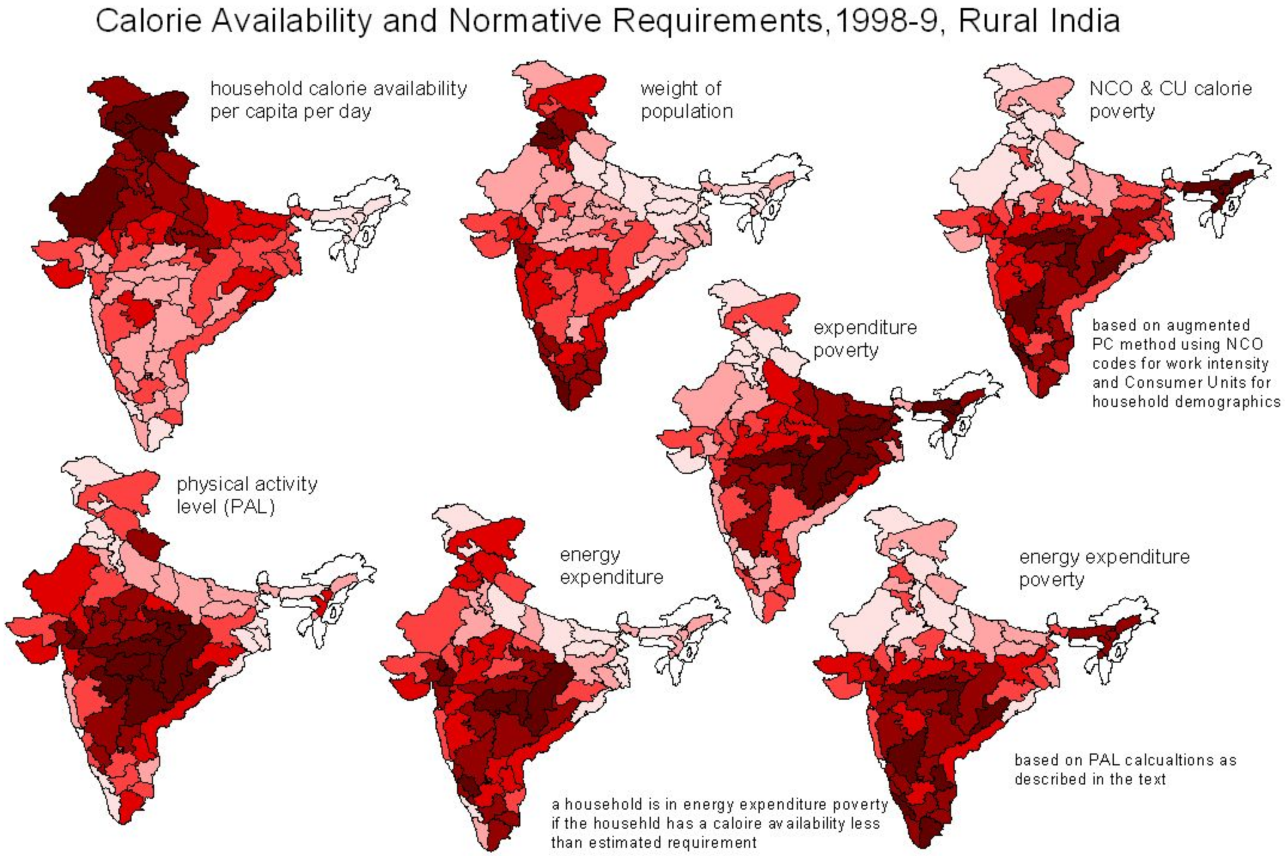
Graph 3 Unconstrained CBN and FEI Poverty Lines



Graph 4 Constrained CBN and FEI Poverty Lines



Graph 5Constrained CBN Compared with Unconstrained FEI Poverty Lines



This figure shows the steps in the calculation of energy requirements by the augmented PC method (as in Deolaliker and Dubey, and also our method using the FAO/WHO/UNU equations for BMR and demographics, and Pal calculated using the NCO codes.

Map 1: Calorie Norms and Calorie Poverty

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