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Economic Development and Welfare: Some Measurement Issues

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Economic Development and Welfare: Some Measurement Issues[1]

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Introduction

The concept of economic development has undergone a major change over the past few decades. Up to the sixties, the dominant strand of developmental thought was capital fundamentalism - a belief that a massive capital accumulation and investment would result in expansion of the production base and hence growth of income. More importantly, it was believed that the effect of income growth through large investment programs would spread across board and trickle down to the poorest in the society and ensure an equitable distribution of the fruits of economic development in the society at least in the long run. In this line of thought thus the concern for equity was only marginal. Simon Kuznets, who directly addressed the issue of relationship between income growth and income inequality, put forward essentially this view through the famous inverted U hypothesis, viz., in the early years of economic development the inequality of income distribution would rise, but beyond a point of time income inequality would go down with income growth.

The developmental experiences of many countries of the developing world, however, proved the trickle down hypothesis to be untrue. Countries in Latin America and Sub-Saharan Africa experienced rising poverty and inequality without much growth, in spite of investment efforts financed mostly through aid and borrowing. This led to a shift in the orientation of the concept of economic development and brought in notion of Redistribution with Growth (RWG) mostly under the World Bank initiative. Developmental Programs no longer remained restricted to investment for expansion of productive capacity, but direct interventions for improving the conditions of the poor through basic human needs programs (BNP), structural adjustment and social security schemes became principal components of developmental efforts. The BNP, which is a major ingredient of RWG, is targeted to the poor in the society and aims at fulfillment of basic needs relating to food and nutrition, health, education and housing and thus documents how the concern for welfare has become synonymous with development.

The paradigm of economic development thus got shifted from the so-called capital fundamentalism to human development as the basic objective of development. The rationale for such a direct concern for welfare as the primary agenda for economic development is provided, among others, mainly by Professor Amartya Sen in his various writings explaining interrelationship among entitlement, capabilities and functioning as necessary ingredients for individual welfare.

In what follows, we explain the conceptual and methodological framework based on which one may be able to assess social welfare and its change as a necessary metric for economic development. Section 2 introduces the concept of a social welfare or social evaluation function and explains the properties such a function should possess in order to be usable for the purpose of measurement of developmental changes. The relationship between social welfare and relative distributional inequality of individual wellbeing is discussed in Section 3. In Section 4, an

1 Professor Binoy Kumar Sarkar Memorial Lecture delivered at the Department of Economics, Calcutta University on 13 February 2004.

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illustrative analysis of the pattern of distributional inequality in the food consumption and associated nutrient intake for the rural population of West Bengal based on the NSS 55th round (July1999-June 2000) data is presented. Finally, the paper is concluded in Section 5.

Social Welfare and Development

Let us accept that the ultimate objective of economic development is improvement of the level of welfare of the population. The question now is how to define and measure welfare and living standard. This question does not have an unequivocal answer. Welfare or living standard is essentially a multi-dimensional phenomenon. One may use approximate indicator(s)/measures of it, like, say, (1) level of per capita income, (2) level of aggregate consumer expenditure, (3) levels of consumption of an array of goods and services like food, health, education, housing, communication etc., some of which may be public goods.

For the purpose of the present discussion, let us treat an individual's living standard and his welfare to be synonymous and denote by x (which may represent his/her income, consumer expenditure or some such variable) or for that matter per capita welfare of a household, if the household is the micro-unit under consideration. Suppose the society consists of n individuals. At a point of time, the society thus has a welfare distribution

$$\tilde{x} = (x_1, x_2, \ldots, x_n) \quad (1)$$

We may say, $\tilde{x}$ is the outcome of the country's development efforts. In other words, the effect of development on welfare has to be studied by examining the change in the welfare distribution over time or by comparing for different regions, population groups etc. at a point of time (Deaton, 1997).

There are two approaches that can be adopted to study the welfare distribution - viz., a statistical approach and a welfare theoretic approach. Under the statistical approach, the distribution of x and its change over time or difference across regions, population groups etc. are examined using statistical measures of central tendency, dispersion and relative dispersion. Thus, for example, if the per capita mean consumer expenditure at constant prices of India increased in the year 2001-02 from what it was in the year 1991-92, we would say that the level of welfare of the Indian population improved over time. If, in addition, the coefficient of variation of per capita consumer expenditure at constant prices for the year 2001-02 is found to be smaller than what it was in the year 1991-92, we would conclude that welfare distribution has become more equal or less unequal. These statistical measures are called *positive* measures as these do not have reference to any normative standard (i.e., what should have happened ideally).

An alternative to the positive approach to welfare measurement based on statistical measures would be the welfare theoretic approach (Atkinson, 1970). In this approach, the notion of a Social Evaluation Function (SEF) is used to facilitate comparison of *overall/aggregate* welfare levels of two or more situations. The SWF is defined as a function of the welfare level of every individual of the population and written as

$$W = V(x_1, x_{2,} \ldots, x_n) \quad (2)$$

Note that W is used like a statistical aggregator, which converts the welfare distribution in to a scalar and thus helps think coherently about welfare and its distribution. In the context of development policy, it may be said that W is not an objective function of a planner or policy maker. Rather, it is a convenient tool for examining the effect of a policy on the welfare distribution.

Three assumptions are made to specify a reasonable SEF. These are as follows:

Monotonicity - *V(.)* is increasing in its individual arguments. That means, an improvement of one individual's welfare, other individuals' welfare remaining unchanged, should lead to a greater overall welfare;

Anonymity - *V(.)* is symmetric in $x_1, x_2, \ldots, x_n$. That is, if the welfare levels of individuals are interchanged, the overall welfare level should not change; and

Principle of Transfer (POT) - It is assumed that a more equal distribution of x always gives a greater overall welfare. Consider, e.g., a x-distribution $_0$= (20,30) in which the poorer person gets 20, the richer gets 30 and the total is 50. Suppose a redistribution is made by transferring 2 units from the richer to the poorer person. The x-distribution is now $_1$= (22,28). The POT requires the *V(.)* function to be such that *V(22,28)>V(20,30)*. In other words, the POT asserts that any *rank preserving transfer* from the richer to the poorer should improve overall welfare level.

From Social Welfare to Inequality

We shall next see how one may pass from the notion of social welfare to the measure of inequality in the distribution of individual welfare level. As we know, the concept of relative inequality in the distribution of a size variable like income, consumer expenditure etc. is essentially related to the relative rather than the absolute levels of the values of x's. It is therefore convenient that the social welfare be measured in the same unit as individual welfare such that a proportionate change in all x's may change the social welfare W by the same proportion. That is, we require the *V(.)* function to be such that if all its arguments are multiplied by some λ>0, then correspondingly *W* will also get multiplied by the same factor. If this property holds for *V(.)*, then *V(.)* is said to be a *homogeneous of degree one function* of the x's.

Suppose, *V(.)* is homogenous of degree one. We may then write the SEF as

$$W = \bar{x} V\left(\frac{x_1}{\bar{x}}, \frac{x_2}{\bar{x}}, \ldots, \frac{x_n}{\bar{x}}\right), \qquad (3)$$

where is the mean of x's. This shows that the social welfare now neatly gets factored into two components, viz., one is the mean value of x's and the other relating to

, which is the relative distribution of x's. Since

$V\left(\frac{x_1}{\bar{x}}, \frac{x_2}{\bar{x}}, \ldots, \frac{x_n}{\bar{x}}\right)$ is to measure the relative inequality of the distribution of x, we require that *V(.)* satisfies the normalization property, viz., *V(1,1,…,1)=1* - i.e., when x is equally distributed, there is perfect equality and hence *V(.)=1* and the social welfare is equal to the mean welfare $\bar{x}$. Incidentally, it may be mentioned that, as this discussion suggests, just by observing to have increased, we may conclude that the social welfare has also improved provided relative inequality of the distribution of x has not worsened.

Since *W*= when x is equally distributed, by the POT any unequal distribution of x cannot have a greater social welfare than . Thus, we may write

$$W = \bar{x}(1 - I) \qquad (4)$$

where *I* is a relative inequality measure. The exact form of *I* will depend on the form of *V(.)* function chosen. Let us next consider an example. In a two-person society let $x_1, x_2 > 0$ be the income of the two persons. We specify the SEF to be

(5)

where is the arithmetic mean of x and

$I = 1 - \frac{1}{\bar{x}}\sqrt{x_1 x_2} = 1 - \frac{GM(x)}{AM(x)}$ is the relative inequality measure, *GM(x)* being the geometric mean of *x*. Continuing with the above example, let us consider a distributional situation where $x_1 \neq x_2$ and the corresponding social welfare level is $W_a = \sqrt{x_1 x_2}$. Thus, a specific distribution of the total $X(=x_1 + x_2)$ generates the social welfare level W_a. Let us find out the equal distribution (x_e, x_e) corresponding to the given distribution $\tilde{x} = (x_1, x_2)$ such that $W_a = \sqrt{x_e x_e}$. Clearly, for the present case, we have $x_e = GM(x)$. This x_e is called the Equally Distributed Equivalent (EDE) level of *x* corresponding to the given distribution $\tilde{x}$. Note that total value of *x* required to generate the same social welfare level W_a as given by the observed distribution through an equal distribution is $X_e = 2x_e = 2GM(x) < X$. In other words, equal distribution of a smaller total than X would generate the same observed social welfare level W_a. Formally, given any SEF that obeys the assumptions laid down above, one can work out, in principle, the EDE level of x corresponding to any given observed distribution . Consequently, one has a relative inequality measure, known as the Atkinson-Sen-Kolm (AKS) measure, for the distribution defined as

$$I_{AKS} = 1 - \frac{x_e}{AM(x)} \qquad (6)$$

given a well-defined SEF (Atkinson,1970; Sen, 1973, Kolm, 1969).

The AKS approach as explained above has at least two distinctive features. First, it highlights the fact that relative inequality and social welfare are distinctly different phenomena. In this context it may be mentioned that often the words *inequality* and *social welfare* are used

interchangeably and by observing a rise/fall in relative inequality (of the income distribution, say) one tends to conclude *erroneously* that the social welfare level has deteriorated/improved. On the contrary, relative inequality and social welfare may increase/decrease simultaneously - e.g., in a situation where every one gets more and at the same time the share of rich increases, both relative inequality and social welfare will increase.

Next, the AKS approach is fairly general in two different senses. Using this approach, one may give welfare theoretic justification to the statistical/positive relative inequality measures of size distribution. The other sense in which this approach is general is the following. Suppose some one takes a Rawlsian view of social welfare, which recognizes only the welfare of the poor population of the society. Thus, social welfare increases if and only if the welfare of the poor population rises. Suppose, x_p is the average welfare/income of the poor, poor being defined suitably and the

SEF is . Thus, in this case

$I = (1 - \frac{x_P}{\bar{x}})$ is the appropriate relative inequality measure which is known as the Rawlsian Inequality measure. Note that as x_p goes to zero, the inequality *I* goes to unity and as x_p goes to $\bar{x}$, the relative inequality *I* goes to zero. This type of SEF is known as the Basic Need SEF.

Atkinson (1970) considered the following SEF:

$$\text{for } \varepsilon \neq 1, \varepsilon > 0 \text{ and} \qquad (7)$$

It may be noted that this SEF, in addition to satisfying the monotonicity, anonymity and POT properties, is utilitarian, that is additive in form. The social marginal utility of the ith person's income/welfare is

$$\frac{\delta W}{\delta x_i} = \frac{1}{n} x^{-\varepsilon} \text{ for } \varepsilon \neq 1 \quad \text{and is constant for } \varepsilon = 0. \qquad (8)$$

Thus, if $\varepsilon = 0$, the social marginal utility of one unit of income/welfare is the same irrespective of who receives the marginal unit of income/welfare. In terms of inequality, that means the society's inequality aversion is zero when $\varepsilon = 0$. On the other hand, if $\varepsilon > 0$, the social marginal utility of income/welfare is greater if the marginal unit of income/welfare is received by a poorer person. Thus, in this case the society averts inequality and this aversion increases as the value of ε rises. Hence, ε is called the *inequality aversion parameter*.

One may easily pass on to Atkinson's Inequality measure from the SEF specified above. Since social welfare is an ordinal concept, any monotonic increasing transformation of W would also pass as a SEF. Therefore, let us consider

$$I_A = 1 - \frac{GM(x)}{\bar{x}}$$

$$W = [\frac{1}{n}\frac{\sum_i x_i^{1-\varepsilon}}{1-\varepsilon}]^{\frac{1}{1-\varepsilon}} = \bar{x}[\frac{1}{n}\frac{\sum_i (x_i/\bar{x})^{1-\varepsilon}}{1-\varepsilon}]^{\frac{1}{1-\varepsilon}} = \bar{x}.E \qquad (9)$$

where E is a non-normalized index of relative equality. It may be noted that when $x_1 = x_2 = ... = x_n = \bar{x}$, $E = [\frac{1}{1-\varepsilon}]^{\frac{1}{1-\varepsilon}} \neq 1$ and hence E is a non-normalized index. It is easy to see that the corresponding normalized equality index is

$E^* = [\frac{1}{n}\sum_i (x_i/\bar{x})^{1-\varepsilon}]^{\frac{1}{1-\varepsilon}}$. Thus, Atkinson's relative inequality measure is

$$I_A = 1 - E^* = 1 - [\frac{1}{n}\sum_i (x_i/\bar{x})^{1-\varepsilon}]^{\frac{1}{1-\varepsilon}} = 1 - (\frac{[\frac{1}{n}\sum_i x_i^{1-\varepsilon}]^{\frac{1}{1-\varepsilon}}}{\bar{x}}) = 1 - \frac{x_e(\varepsilon)}{\bar{x}} \qquad (10)$$

where $x_e(\varepsilon)$denotes the EDE level of x when the value of inequality aversion parameter is set to ε. Note that I_A=0 when the distribution of x is equal and I_A increases as the distributional inequality rises and approaches 1 when the distribution tends to become completely unequal. Note also that for $\varepsilon = 1$, . A computed value of I_A can be interpreted as follows: Suppose, I_A=03. That means $x_e(\varepsilon) = 0.7\bar{x}$ - i.e., given the degree of inequality aversion, an equal distribution of 70 percent of the total X would give the same social welfare as given by the observed x distribution.

Distributional Inequality of Nutrition intake in Rural West Bengal, 1999-2000: An Illustrative Study

As the above discussion should suggest, at a specific point of time social welfare is synonymous with the relative inequality of the distribution of individual welfare levels (individual welfare being defined suitably), because, given the mean welfare level, a mean-preserving redistribution will change the level of social welfare. In this Section, we shall examine the relative inequality in the distribution of consumer expenditure, associated food expenditure and corresponding nutrient intakes of the rural population of West Bengal as revealed by the household level data thrown up by the NSS 55th Round Consumer Expenditure Enquiry conducted during July 1999-June 2000.

The data set made available by the NSSO, Government of India, contains for each of the 4550 sample households of rural West Bengal information on the following items: Total consumer expenditure, expenditure on all food items, corresponding total calorie intake and intake of major nutrients like protein and fat per 30 days, household size and composition and a number of other household attributes. From this basic data, a household level data set comprising per capita total consumer expenditure (PCE), food expenditure, calorie intake, intake of carbohydrate, protein and fat per 30 days has been compiled. Using this data set, a set of household level implicit prices for carbohydrate, protein and fat has been estimated using the methodology proposed in Coondoo et al (2004)[2].

The present analysis has three parts. In the first part, variation in the mean level of each of the variables across decile groups of the rural population of West Bengal has been examined. More specifically, here we examine the nature of engel curve for food expenditure, calorie intake, intake of carbohydrate, protein and fat. As a complementary analysis, we also examine the pattern of relationship with PCE of each of the three nutrient prices based on the so-called quality equation (Prais and Houthakker, 1955). The extent of relative inequality in the distribution of each of the consumption variable is examined in the second part. Finally, in the third part of the analysis, we have examined the inter-decile group variation in the levels of nutrition and the corresponding nutrient prices based on multilateral index numbers computed on the basis of estimated decile-group specific mean quantity and mean price of the three nutrients, viz., carbohydrate, protein and fat.

Table 1 presents the estimated decile-group specific mean values of PCE, per capita food expenditure and the corresponding intake of calorie, carbohydrate, protein and fat. The corresponding estimated mean prices of the three nutrients are also presented in this Table. A number of interesting observations may be made on the basis of the results of this Table. First, given that the official poverty line for rural West Bengal for 1999-2000 at current prices

2 The estimation of the household level nutrient prices is based on the estimation of a food expenditure function that relates per capita food expenditure to corresponding PCE, household size, per capita intake of the three nutrients, viz., carbohydrate, protein and fat. Table 3 presents the estimated food expenditure function.

is Rs. 350.17 per capita per month, the incidence of poverty works out to be around 25%. Next, given that the reference level of calorie intake underlying the official poverty line for the rural sector is 2240 kcal per capita per day (i.e., 67200 kcal per capita per 30 days), the incidence of poverty in terms of the nutritional norm should be in the range of 35-40%, which is much above the incidence measured in terms of PCE. Coming to the per capita per 30 days intake of the three major nutrients, across decile groups the intake level varies between 9.2 - 16.2 kgs, 1.05-2.39 kgs and 0.39-1.95 kgs for carbohydrate, protein and fat, respectively. Finally, as the estimated nutrient prices indicate, protein turns out to be the most expensive nutrient with the estimated mean price ranging between Rs. 35.22 and Rs. 126.44 per kg. Compared to this, the other two nutrients are much cheaper with the price of carbohydrate and fat varying in the range Rs. 1.88-7.03 and Rs. 4.40-6.76 per kg, respectively.

The empirical engel curves for the three nutrients are presented in Figure 2. As these curves indicate, carbohydrate and protein, having engel elasticity 0.3436 and 0.5056,respectively, are necessary items, whereas fat with engel elasticity 0.9969 is a near luxury good. The empirical quality equations for the nutrients presented in Figure 3 offer an interesting result. For example, the estimated quality elasticity (i.e., the income elasticity of unit value) for fat, protein and carbohydrate works out to be 0.2675, 0.7879 and 0.8125, respectively. It may be mentioned in this context that a larger value of this elasticity for an item of consumption is indicative of availability of a wider variety of the item in terms of quality (and hence in terms of price) for the consumer to choose from as income increases. The above result, thus, confirms availability of a much wider choice to the consumers so far as meeting of the need for carbohydrate is concerned.

Let us next examine the pattern of relative inequality in the distribution of PCE, per capita food expenditure and the associated nutrient intakes. Table 2 presents the value of Atkinson's inequality measure $I_A = 1 - \frac{GM(x)}{AM(x)}$ for each of these variables separately for the bottom p (= 10, 20,…,90) per cent of population and also for the entire population. Corresponding graphs are presented in Figure 4. It may be noted that for the entire population, the intake of fat has relative inequality greater than that of PCE. For the remaining items, the relative inequality is smaller than that of PCE. The relative inequalities for carbohydrate, calorie and protein are found to be smaller than that of food expenditure. As Figure 4 shows, the relative inequality for PCE and fat (and also for food expenditure to some extent) increases monotonically over decile group. For the remaining three items, however, the inequality declines slightly initially and then rises monotonically from bottom 50% group onwards. Thus, for these three items it is the poorer population group that experiences a greater intra-group distributional inequality.

To probe the issue a little further, we have performed a decomposition analysis of inequality. The equality index $E = \frac{GM(x)}{AM(x)}$ corresponding to I_A admits the following exact decomposition: $E = \{\prod_{j=1}^{10}(\frac{AM_j}{AM})^{0.1}\}\{\prod_{j=1}^{10}(E_j^{\ 0.1}\} = E_B.E_W$,

where E: overall equality index for the entire population, AM: arithmetic mean for the entire population and AMj: arithmetic mean for the jth decile group, E_j: equality index for the jth decile group, E_B: between-group equality index and E_W: within-group equality index. Normally, one would expect E_B to be greater than E_W.

The Table below presents the decomposition of the equality index for the individual variables. It may be noted that for three of the nutrient items, viz., calorie, carbohydrate and protein, the value E_B is larger than that of E_W. That means, the relative dispersion of the decile-group-specific mean values is smaller than the average of within-decile group relative dispersions.

Equality Index	PCE	Food Exp	Calorie	Carbohyd	Protein	Fat
E_W	0.994	0.988	0.974	0.971	0.973	0.923
E	0.896	0.922	0.955	0.959	0.948	0.831
E_B	0.901	0.933	0.981	0.988	0.975	0.901

Finally, we examine the inter-decile disparity in the levels of per capita nutrition intake and the corresponding nutrient prices. Using the decile group-specific data on mean levels of quantity and price of the three nutrients, viz., carbohydrate, protein and fat, we have compiled multilateral price and quantity index numbers based on the Elteto, Koves and Szule (EKS) formula (Elteto and Koves, 1964; Szule, 1996). The EKS price index number formula is as follows. Let $(p^i, q^i, i=1,2,...,10)$denote the vectors of the mean nutrient prices and quantities for the individual decile groups and let P_{ij}^F denote the Fisher binary price index number for decile group j with decile group i taken as base[3]. The corresponding EKS multilateral price index number is $P_{ij}^{EKS} = (\prod_{l=1}^{10}\sqrt{P_{il}^F.P_{lj}^F})^{\frac{1}{10}}$. 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.

3 The formula for this index number is as follows: $P_{ij}^F = \{\frac{\sum_k p_{kj}q_{ki}}{\sum_k p_{ki}q_{ki}}\frac{\sum_k p_{kj}q_{kj}}{\sum_k p_{ki}q_{kj}}\}^{1/2}$

Tables 4 and 5 present the EKS inter-decile group price and quantity indices for nutrient intake. Two points are noteworthy in these results -viz., the levels of both nutrient prices and quantities monotonically rise over the decile groups and the patterns of inter-decile group differential for nutrient price and quantity are very similar. Thus, for example, the price and quantity levels experienced by the top decile group are around 30% higher than those experienced by the bottom decile group. More important perhaps is the result that for both the indices the extent of increase from one decile group to the immediate higher one decreases over decile group.

Conclusion

In this paper we have discussed the issue of the link between economic development and relative inequality in the distribution of individual welfare or wellbeing. In the first part of the paper we have summarised some of the discussion available in the existing literature that explains how the concept of social welfare can be operationalised and, more importantly, how social welfare can be factored into mean and relative inequality of the distribution of individual welfare or wellbeing. In this context, we have also explained the Atkinson-Kolm-Sen normative approach to the measurement of relative distributional inequality.

In the later part of the paper, we have presented an illustrative analysis of the distributional inequality in nutritional intake of the rural population of West Bengal based on the NSS 55th round (July 1999-June 2000) consumer expenditure survey data. This analysis essentially sought to examine the extent of relative inequality in the PCE, food expenditure, calorie intake and intake of carbohydrate, protein and fat across decile groups of the rural population of West Bengal defined in terms of ranking by PCE. The extent of disparity across decile groups in the levels of nutrient intake and corresponding implicit nutrient prices have also been examined in terms of multilateral EKS price and quantity index numbers. A number of interesting results have emerged from this illustrative analysis. For example, it is found that while carbohydrate and protein intake have engel elasticity much less than unity, intake of fat is a near luxury with an engel elasticity very close to unity. An examination of variation of relative inequality over decile groups have revealed that for the three necessary nutrients, viz., calorie, carbohydrate and protein, the poorer population groups experience a greater intra-group distributional inequality. The deprivation of the poorer population group is brought out more explicitly by the inter-decile group price and quantity indices of nutrients. Thus, while it is found that the levels of both the price and the quantity of nutrient monotonically rise over decile group, the increases from one decile group to the next are larger for the decile groups below the median.

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Table 1: Decile Group-specific means of Per Capita Expenditures and associated Nutrient Intakes and the corresponding estimated Nutrient Prices: West Bengal Rural, NSS 55th Enquiry (1999-2000)

Decile Group	Per Capita per 30 days						Estimated Price (Rs./kg)		
	Total Consumer Exp. (Rs.)	Food Exp. (Rs.)	Calorie (kcal)	Carbo-hydrate (kg.)	Protein (kg.)	Fat (kg.)	Carbo-hydrate	Protein	Fat
1	233	219.10	44534	9.213	1.051	0.387	1.88	35.22	4.40
2	306	246.22	53485	10.985	1.280	0.491	2.32	43.94	4.72
3	354	264.12	57465	11.707	1.395	0.562	2.61	49.11	4.91
4	394	278.75	60735	12.309	1.459	0.629	2.86	53.56	5.06
5	435	296.48	63882	12.847	1.572	0.689	3.12	57.48	5.22
6	481	313.87	66836	13.346	1.641	0.765	3.44	61.76	5.39
7	536	337.23	70081	13.765	1.753	0.890	3.72	67.76	5.53
8	613	370.23	74948	14.669	1.879	0.973	4.21	74.80	5.76
9	741	421.88	78912	15.080	2.036	1.161	4.80	88.12	6.00
10	1186	597.70	92002	16.220	2.390	1.951	7.03	126.24	6.76
all	528	335.00	66282	13.010	1.650	0.850	3.60	65.78	5.38

Table 2: Population Sub-group-specific Relative Inequality Measures for Per Capita Expenditures and corresponding Nutrient Intakes: West Bengal Rural, NSS 55th Round Enquiry, 1999-2000.

Population Group	Value of Atkinson's Inequality Measure (epsilon=0) for					
	PCE	PC Food Exp.	PC Calorie Intake	PC Carboh-ydrate Intake	PC Protein Intake	PC Fat Intake
Decile 1	0.013	0.024	0.030	0.033	0.039	0.065
Up to Decile 2	0.019	0.021	0.029	0.032	0.037	0.073
Up to Decile 3	0.020	0.024	0.029	0.032	0.035	0.073
Up to Decile 4	0.022	0.027	0.028	0.032	0.033	0.077
Up to Decile 5	0.026	0.029	0.029	0.032	0.034	0.080
Up to Decile 6	0.030	0.032	0.031	0.034	0.036	0.082
Up to Decile 7	0.033	0.034	0.032	0.035	0.038	0.094
Up to Decile 8	0.043	0.042	0.034	0.036	0.040	0.100
Up to Decile 9	0.057	0.050	0.036	0.038	0.044	0.111
Entire Population	0.104	0.078	0.045	0.041	0.052	0.169

Table 3: The Estimated Food Expenditure Equation; West Bengal Rural, NSS 55th Round Enquiry, 1999-2000.

West Bengal Rural, NSS 55th Round Enquiry, 1999-2000.

FORM OF FOOD EXPENDITURE EQUATION ESTIMATED:

PCYF = CC+PCCARB*EXP(AL1+BE1*LPCE+GA1*LHHS)
+PCPROT*EXP(AL2+BE2*LPCE+GA2*LHHS)
+PCFAT* EXP(AL3+BE3*LPCE+GA3*LHHS)

WHERE PCYF: PER CAPITA FOOD EXPENDITURE
LPCE: LOG(PCE)
LHHS: LOG(HHS)
PCCARB: PER CAPITA CARBOHYDRATE
PCPROT: PER CAPITA PROTEIN
PCFAT: PER CAPIT FAT

PARAMETERS:

CC,AL1,AL2,AL3,BE1,BE2,BE3,GA1,GA2,GA3+PCCARB*EXP(AL1+BE1*LPCE+GA1*LHHS)

PARAMETER	ESTIMATE	ST. ERROR	T-RATIO
CC	162.18	2.3355	69.442
AL1	-9.0766	0.25556	-35.517
BE1	0.66521	0.35918E-01	18.520
GA1	-0.48795	0.52328E-01	-9.3249
AL2	-8.7332	0.15891	-54.955
BE2	0.87939	0.18688E-01	47.057
GA2	0.33734	0.21423E-01	15.747
AL3	-6.1658	1.3295	-4.6378
BE3	0.20488	0.16655	1.2301
GA3	-0.21866	0.16331	-1.3389

DURBIN-WATSON = 1.5086 VON NEUMANN RATIO = 1.5090 RHO = 0.24409

RESIDUAL SUM = 0.14314E-04 RESIDUAL VARIANCE = 4090.5

SUM OF ABSOLUTE ERRORS= 0.18570E+06

R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.7997

Table 4: Multilateral EKS Nutrient Price Indices by Decile Group: West Bengal Rural; NSS 55th Round Enquiry, 1999-2000.

Dec.Gr.	1	2	3	4	5	6	7	8	9	10
1	1	1.05	1.08	1.1	1.12	1.14	1.17	1.19	1.23	1.3
2	0.96	1	1.03	1.05	1.07	1.09	1.12	1.14	1.17	1.25
3	0.93	0.97	1	1.02	1.04	1.06	1.08	1.11	1.14	1.21
4	0.91	0.95	0.98	1	1.02	1.04	1.07	1.09	1.12	1.19
5	0.89	0.93	0.96	0.98	1	1.02	1.04	1.06	1.09	1.16
6	0.87	0.92	0.94	0.96	0.98	1	1.02	1.04	1.07	1.14
7	0.86	0.9	0.92	0.94	0.96	0.98	1	1.02	1.05	1.12
8	0.84	0.88	0.9	0.92	0.94	0.96	0.98	1	1.03	1.09
9	0.82	0.85	0.88	0.89	0.92	0.93	0.95	0.97	1	1.06
10	0.77	0.8	0.83	0.84	0.86	0.88	0.9	0.91	0.94	1

Table 5: Multilateral EKS Nutrient Quantity Indices by Decile Group: West Bengal Rural; NSS 55th Round Enquiry, 1999-2000.

Dec.Gr.	1	2	3	4	5	6	7	8	9	10
1	1	1.06	1.09	1.11	1.13	1.14	1.16	1.19	1.22	1.27
2	0.94	1	1.03	1.04	1.06	1.08	1.1	1.12	1.14	1.2
3	0.92	0.98	1	1.02	1.04	1.05	1.07	1.09	1.12	1.17
4	0.9	0.96	0.99	1	1.02	1.03	1.05	1.08	1.1	1.15
5	0.89	0.94	0.97	0.98	1	1.01	1.03	1.05	1.08	1.13
6	0.87	0.93	0.95	0.97	0.99	1	1.02	1.04	1.06	1.11
7	0.86	0.91	0.94	0.95	0.97	0.98	1	1.02	1.04	1.09
8	0.84	0.89	0.92	0.93	0.95	0.96	0.98	1	1.02	1.07
9	0.82	0.87	0.9	0.91	0.93	0.94	0.96	0.98	1	1.05
10	0.79	0.83	0.86	0.87	0.89	0.9	0.91	0.93	0.95	1

Figure 1: Fractile Graph of PCE and Per Capita Food Expenditure

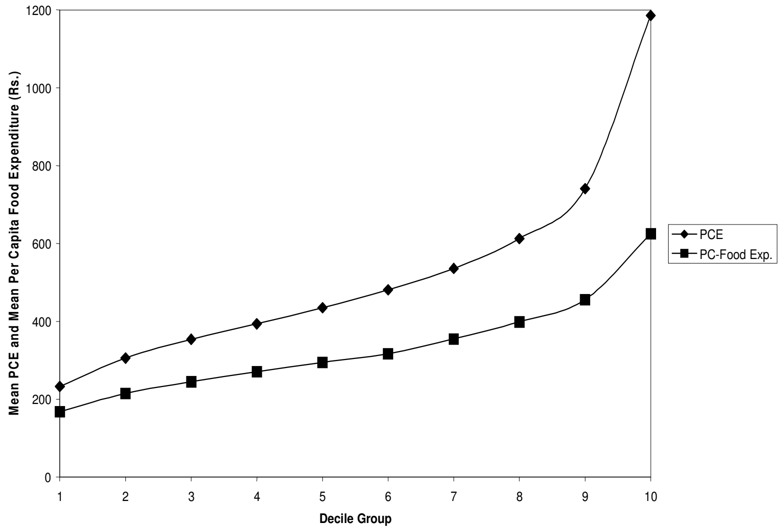


Figure 3: Empirical Quality Equations for Nutrient Prices

Figure 2: Empi

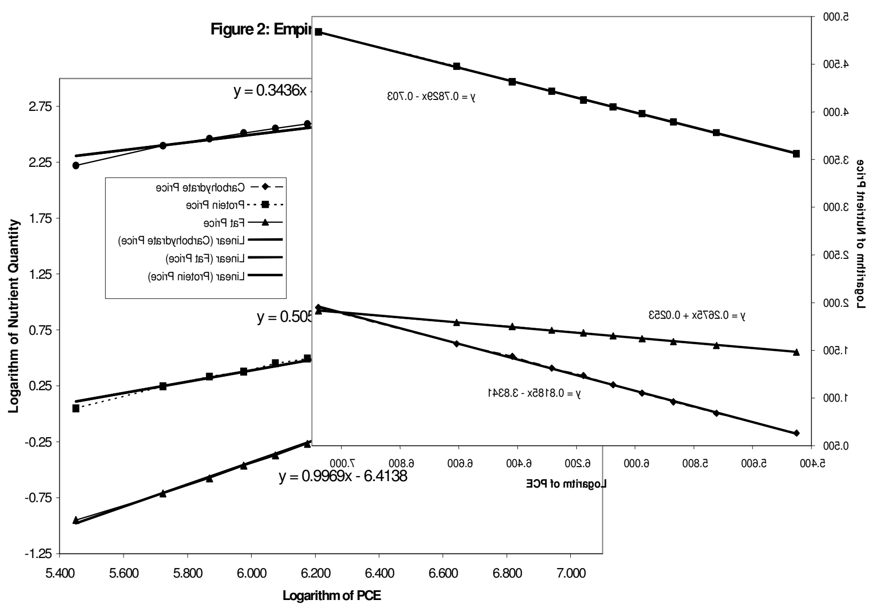
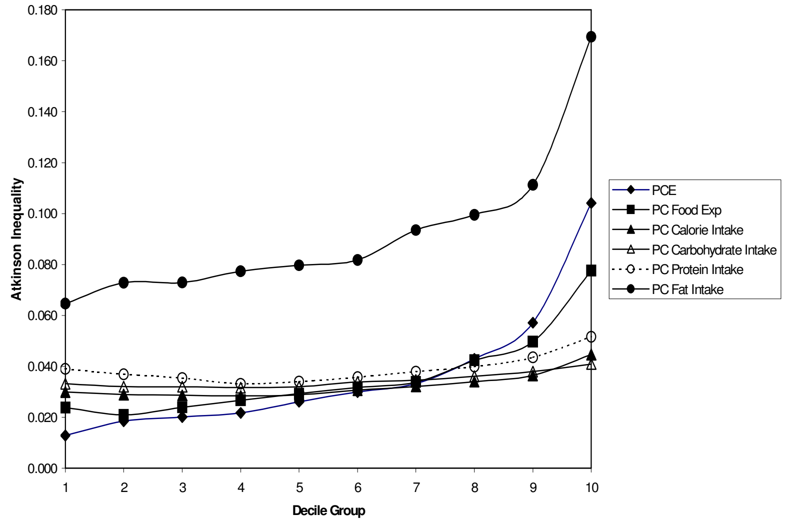


Figure 4: Atkinson's Inequality Measure for Consumer Expenditure and Nutrient Intakes by Population Sub-group, West Bengal Rural, NSS 55th Round (1999-2000)



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