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STATISTICAL MEASURES OF POVERTY WITH REFERENCE TO ETHIOPIA

A THESIS SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES ADDIS ABABA UNIVERSITY IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR DEGREE OF MASTER OF SCIENCE IN STATISTICS

BY

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ABSTRACT

This paper is a project on the measurement and analysis of poverty in Ethiopia. Various statistical techniques of measuring poverty are applied. Therefore, in this paper, different measures of poverty will be reviewed and discussed, and apply them to Ethiopian setting to compute the results and recommend the one that is appropriate for Ethiopia.

In particular, among others, two measurements, namely Deficiency Risk Estimate and Gini-Coefficient, are applied to measure poverty indicators of the country. They are used to identify the percentage of under-nourished in a community in Ethiopia and the distribution of social services of different administrative regions of the country, like health services and education, respectively.

Where as the other measures discussed in this paper, that is, the head-count ratio, the poverty-Gap, Sen's Index and Foster, Greer and Thorbecke measures are used to measure the incidence, intensity and severity of poverty in Ethiopia using income distribution.

CHAPTER 1

INTRODUCTION

By all conventional measurements, a large number of African States, specially our country Ethiopia, fared so poorly in their economic activities from time to time that a frustrated academics commented: "Africa is falling-off the map". The nature of poverty in Africa and its correlates have not received an exhaustive and complete treatment they deserved. Much of the poverty alleviation efforts made by the international communities was treating the symptoms instead of the underlying causes.

Poverty has become a major issue throughout the world in general, and Africa in particular. Various countries are adopting policies aimed at poverty alleviation. However, there are certain methodological issues related to measuring the extent of poverty.

There are various statistical techniques of measuring the extent of poverty. Some of the techniques are simple and applicable to any country, while others are based on rigorous theoretical foundation and their robustness depends on some underlying assumptions. Some require little few aggregate data set to measure while others require an extensive data set that is difficult to obtain in developing countries. In this paper, therefore, we will review and discuss selected methods, compute the results and suggest the one that may be appropriate for Ethiopia.

1.1 DEFINITION OF POVERTY

There is no agreement on the meaning of poverty. The debates on what constitutes poverty , how many (or few) poor people there are in a society and how little resource is required through redistribution to close the gap between the income of the poor and the not-poor have been going on for a very long time, and have not come to any conclusion.

Some analysts define poverty as a situational syndrome in which the following are combined: underconsumption, malnutrition, precarious housing conditions, either unstable participation in the production system or restriction to its more primitive stratam, little participation and possible adherence to a particular scale of values different from that held by the rest of the society.

The concept of poverty is based on value judgements as to what the minimum adequate levels of welfare and the absolutely essential basic needs are, and what degree of deprivation is intolerable. Such judgements consequently imply a reference to some norm of the basic needs and their satisfaction which makes it possible to distinguish between those who are poor and those who are not. The concept of poverty is essentially normative, and its actual content varies as does the norm of basic needs or welfare on which it depends. But judgements on the satisfaction of basic needs are individual and subjective. It is only through a consensus or the exercise of power by those who share them that they are transformed into social valuations.

Yet, it may be more useful for research and development strategies to limit the concept of "poor" to those who have, materially speaking, a difficult life. The "very poor" (extreme or ultra poor) would then be those people with a deprivation so severe that the basic needs of life can scarcely be met with a minimum required for survival. Their life is characterized by malnutrition, disease and illiteracy as to be beneath any reasonable definition of human decency.

The causes of poverty are the same things that cause inequality in the distribution of income. The poor are poor because of their limited amount of human capital, and luck, discrimination and conscious choice. The poor are poor because their capacity to earn a "sufficient" income is for some reason impaired.

Defining poverty is not an easy task, because establishing poverty levels of income requires important judgements on the part of the analyst. There will always be disagreement over what extent constitutes a poverty of income. Some analysts define poverty in terms of the amount of income necessary to provide a family of a certain size with the minimum essentials of food, clothing, shelter, and education. This approach provides an absolute measure of poverty. An absolute measure of poverty establishes a specific income level for a given sized household below which the household is judged to be living in a state of poverty. Poverty can, after all, be relative. One's sense of poverty depends upon the incomes of

others in the community. If one's income is 10 percent of every one else's one may feel poor even if that income is above that required to purchase the minimum essentials. A second approach to poverty, therefore, is to measure it in relative terms. A relative measure, for example, might classify a household as poor if the household's income is 25 percent of an average household's income.

The choice of a poverty definition will determine to a great extent the number of poor and the rate at which poverty is perceived as being eliminated. If the absolute standard is selected, rising real living standards will push more and more families above the poverty line. If, however, the relative standard is used, poverty can be eliminated only by equalizing the distribution of income. If the rich and the poor both experience equal percentage increases in income, the poor will not have improved their relative position. Therefore, the war on poverty would be unwinable by relative definition. What most writers consider is that, a household or people who are poor in one country, however, would not necessarily be considered poor by some other countries.

Furthermore, it may be essential find out the degree of seasonality of poverty. Some groups of people are only poor part of the year , while others are chronically poor. Poverty may also affect a family only during certain stages of its life-cycle when children are small and many and in old age or during illnesses. Even in a narrow basic needs sense of poverty(food, clothing and shelter), the developing world may

be said to experience mass poverty, that is covering a large part of the population in a country, such as one third or more. In countries with mass poverty, political decisions of redistribution, reform and change will have little effort on the total problem of poverty in the short term. These countries can be said to be in "primary poverty".

1.2 POVERTY INDICATORS

For the purpose of this paper, poverty is assumed to be defined in terms of many broad indicators of economic resources. These include undernutrition, malnutrition, education, health, income level of a household, etc. If the concern about poverty takes the form of concern about basic needs, such as food, housing, and clothing, the focus should be on individual items of consumption, and poverty would need to be measured in a multidimensional way, rather than in terms of a single indicator.

A household is then said to be poor if its total consumption is below a specified amount. But most studies of poverty in advanced countries record poverty on the basis of total income rather than consumption. Income is in fact the basis for all the studies of poverty in any country. Why is income used? The first answer is that it is taken as a proxy for the overall measures of living standards, some of which are hard to quantify. As such assessments of poverty based on income have to be quantified, because income may understate or overstate the level of living. If a family can not save or

borrow, its current level of living is not constrained by current income. A family that can share in the consumption of others may have higher living standards than its income would permit. An elderly person living with his or her children may benefit from their expenditure. Conversely, income may overstate the level of living when money alone is not sufficient to buy the necessary goods, for instance, during time of crisis rationing may be in place because basic necessities may not be available. An obvious implication is that one would have to be careful in measuring poverty for countries with different market structures.

The second reason for using income rather than consumption is that it may be seen as intrinsically preferable as an indicator of resources in the measurement of poverty. One argument is that people may choose a low level of consumption, whereas income is closer to a measure of the opportunities open to a family and not influenced by the consumption decisions made: the concern then is with budget constraint, not with consumption choices.

The concept of poverty adopted will in-turn affect more detailed choices about how best to measure it. If income is being used as a proxy for consumption, permanent income may be a closer match than current income, so that in practical terms annual income may be a better indicator than income in a week or month. The definition of poverty chosen will also affect the way income is defined. A standard of living definition will include an estimate of income in kind. [Home production

of food is an example, as is the receipt of transfers in kind such as food stamps.] But a minimum rights interpretation might not count income in kind, because it may be cash income that is necessary for people to participate in society.

CHAPTER 2

MEASUREMENTS OF POVERTY

There are different measures of poverty. Some are simple and easy to understand but are not based on solid theoretical framework. Others are complex and consider various conseptual and methodolgical issues. Some are easy to measure while others are not. Some are applicable to individuals or households while others are applicable with their broad macroeconomic framework. In this paper we will consider several measures - from the easiest to the one that is relatively complex. The measures we will consider are

1) Deficiency Risk Estimate
2) Gini-coefficient
3) Poverty line
4) Sen's index
5) Foster - Greer - Thorbecke measures of poverty.

2.1 DEFICIENCY RISK ESTIMATE

A large proportion of the world, especially the third world countries, suffer from both malnutrition and under-nutrition of various degrees. Ethiopia is one of the third world countries whose population suffers extremely from malnutrition and under-nutrition. A simple measure, the Deficiency Risk Estimate, is applied to nutrition survey

conducted in any country to estimate the percentage of a community which is undernourished.

Under-nutrition, as one type of absolute poverty, may in some cases be the result even when the income or resources at the household level are insufficient to cover dietary needs. In other words, it is one indicator of poverty that covers cases when the family income is not enough to secure adequate food supply. A modern variant of the primary poverty concept is the notion of "a state of indigence" at the household level. By this is meant that a household would be unable to cover the nutritional needs of its members when its entire income is spent on food. On the basis of this concept data, from Ethiopian Nutritional Institute, of calorie intake and calorie requirement is taken to measure the percentage of under-nutrition. There is also another more comprehensive absolute poverty concept which includes in addition to a varied diet-basic needs, such as clothes and shelters.

Nutritionists define malnutrition as imbalance or inadequacy in the quality of the diet while under-nutrition is the inadequate daily intake of diet, measured in calorie intake. If such inadequate calorie intake is allowed to take place over a continuous span of time, the result will be lack of sufficient physical development and less activity on the part of the children, and this could result in reduction of body weight or physical activity or both in case of the adult groups. The main cause for inadequacy of calorie intake and quality of the diet for most households of our country is the

incapability to purchase the minimum and basic needs or goods because of earning or getting less income (Asmerom, 1978).

The majority of the third world population suffers from mild and severe under-nutrition. Lorstad introduced a new method of estimating under-nutrition that incorporates both forms of under-nutrition. His method is known as the Deficiency Risk Estimate and he develops it as follows:

Let x_i represent the actual intake of the i^{th} individual and y_i represent his requirement. Lorstad along with Sukhatme assumes that individual requirements are normally distributed with a given mean μ_y and standard deviation σ_y. Lorstad then imposes cut-off points at both extremes of the normal curve. Values beyond the two cut-off points, referred to as Y(min) and Y(max) are clear cases of under-nutrition and the lack-of-it. In other words, all individuals whose intakes are below Y(min) are assigned a probability of one $\{P_i(U)=1\}$ while those individuals whose actual intakes are above Y(max) are assigned a probability of zero $\{P_i(U)=0\}$. Note that $P_i(U)$ represents the probability that an individual is under-nourished. The remaining intakes are assigned various values of probability the numerical value of which will decrease as X_i moves from Y(min) to Y(max).

The probabilities assigned to various intake groups are based on the assumption that requirements are normally distributed and independent of intake and are readily obtained from standard normal tables. Once probabilities are assigned

to various intake classes, they are multiplied by the corresponding relative frequencies of actual intakes and then added up. This expected value is what Lorstad defined as the Deficiency Risk Estimate namely:

$$I(U) = \sum_{i=1}^{n} \{p_i(U)\} f_i$$

where $\{P_i(U)\}$ = probability that a particular intake class is undernourished.

f_i = relative frequency of the i^{th} intake class, assuming that there are a total of n classes.

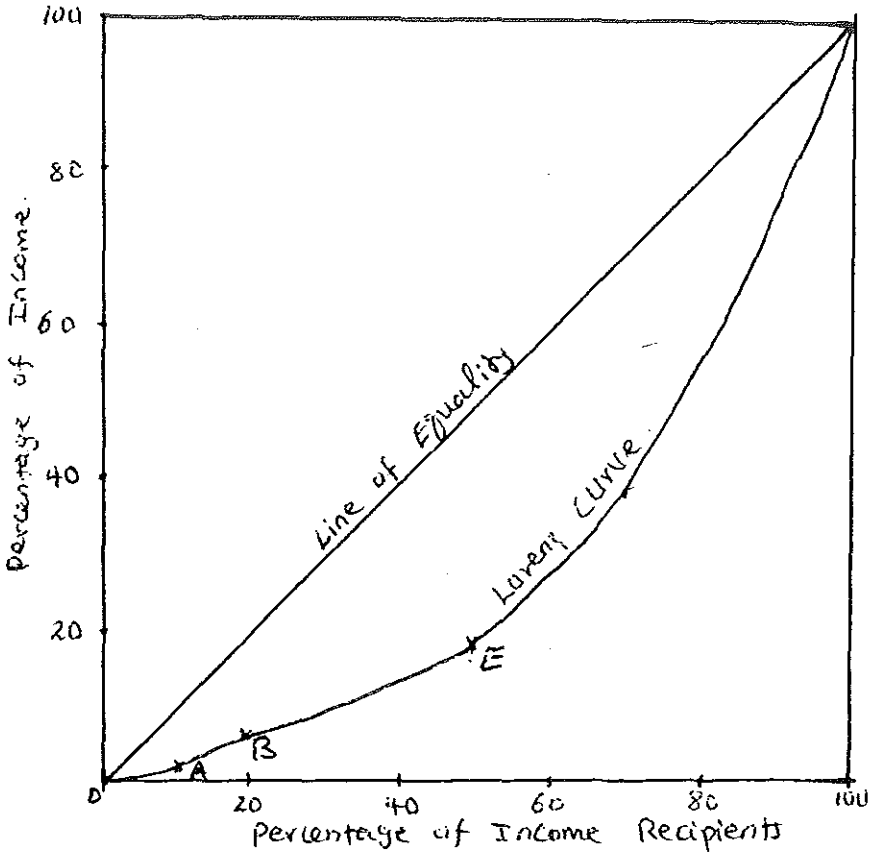
Two points need to be investigated; namely, the assumption of normal distribution of requirements and the implied independence between intake and requirement. Requirement may not be independent of intake; they will have to be empirically tested. In this paper we apply this measure to a nutrition survey carried out in an Ethiopian Community. We will first test the assumptions of normality and independence. Incidently Lorstad mentions the possibility of dependence between intake and requirement but states that such independence is unlikely to affect the result.

2.2 GINI- COEFFICIENT AND LORENZ CURVE

2.2.1 LORENZ CURVE

A common method of analyzing personal income statistics is to construct what is known as a Lorenz curve. The number of income recipients are plotted on the horizontal axis, not in absolute terms but in cumulative percentages. For example, at point 20 we have the lowest (poorest) 20% of the population, at point 60 we have the bottom 60%, and at the end of the axis all 100%, so that both axes are equally long. The entire figure is enclosed in a square, and a diagonal line is drawn from the lower-left-hand corner (the origin) of the square to the upper-right-hand corner. At every point on the diagonal, the percentage of income received is exactly equal to the percentage of income recipients. In other words the diagonal line in the figure is representative of "perfect equality" in size distribution of income.

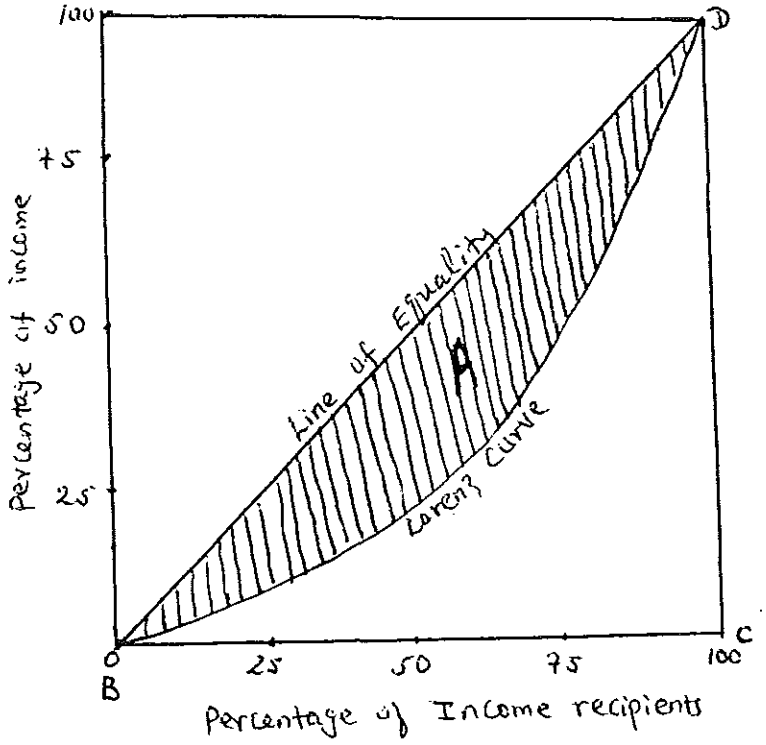
The Lorenz curve shows the actual quantitative relationship between the percentage of income recipients and the percentage of the total income they did receive during say, a given year. In the figure given below , point A shows that the bottom 10% of the population receives only 1.8% of the total income. Point B shows that the bottom 20% is receiving 5% of the total income and so on for each of the other of cumulative decile groups. Note that the half way point E shows that 50% of the population infact receives only 19.8% of the total income.



The more the Lorenz curve deviate from the diagonal (perfect equality) line, the greater the degree of inequality represented. The extreme case of perfect inequality (i.e. a situation in which everybody else receives nothing) would be represented by the coexistence of the Lorenz curve with the bottom horizontal and the right-hand vertical axes. Since no country exhibits either perfect equality or perfect inequality in its distribution of income, the Lorenz curve for different countries will lie somewhere below the diagonal of the square figure. The greater the degree of inequality, the more "bend" and the closer to the bottom horizontal axis will be the Lorenz curve.

2.2.2 GINI-COEFFICIENT

A very convenient shorthand summary measure of the relative degree of income inequality in a country is the Gini-coefficient. There are two different ways of calculating the Gini-coefficient. One way of looking at it is by calculating the ratio of the "area" between the diagonal and Exhibits Curve divided by the total area of the half-square in which the curve lie. In the Figure given below, this is the ratio of the shaded area A to the total area of the triangle BCD.



Gini-Coefficient = Shaded Area A / Area of triangle BCD

The second way of calculating the Gini-coefficient is from the following formula when observations are reported/made for n individuals.

$$G=\frac{1}{n^2\bar{X}}\sum_{i=1}^{n}\sum_{j>i}^{n}|x_i-x_j|$$

Where, $\bar{X}$ is overall mean

X_i is the value of i^{th} observation

X_j is the value of j^{th} observation

In case of grouped data, the Gini-coefficient lower and upper bounds are given by:

$$lower\ bound:\ G_L=2\sum_{i=1}^{k}\sum_{j>i}^{k}\frac{n_i n_j}{n^2\bar{x}}|\mu_i-\mu_j|$$

$$Upper\ bound: G_U=G_L+\sum_{i=1}^{k}\sum_{j=1}^{k}\frac{n_i^2}{n^2\bar{x}}\lambda_i[\mu_i-l_i]$$

where, k is number of classes or groups

n_i and n_j are numbers of observations in groups i and j, respectively

μ_i and μ_j are mean values of group i and group j, respectively

$\bar{X}$ overall mean

l_i is the lower limit of group i

λ_i is proportion of the population in group i getting income l_i.

The compromise value for the Gini-Coefficient which works for most theoretical distributions, is approximated by:

$$\frac{2}{3}G_U + \frac{1}{3}G_L$$

The expression given above was found by Cowell (1977).

There are many criticisms of the Gini-coefficient. As Simon Kuznets argued the standard Gini-coefficient is a summary that can conceal as much as it reveals and can obscure some of the major underlying factors that influence income distribution over time. Also where relationships among the distribution of different economic variables are to be examined concentration curves of which the Lorenz Curve is a special case may be preferred.

Gini-coefficients are aggregate inequality measures and can vary anywhere from 0 (perfect equality) to 1 (perfect inequality). In actual fact, the Gini coefficient for countries with highly unequal income distributions typically lie between 0.50 and 0.70, while for countries with relatively equitable distributions, it is of the order of 0.20 to 0.35.

It should have to be known that the above described method is not the only method used for computing Gini-Coefficient. There is another method used for approximating Gini-Index proposed by Ayenew Ejigu (1976) which is described in Appendix A. This method measures Gini-Coefficient by the application of numerical analysis.

2.3 POVERTY LINE

Poverty lines are those normative cut-off lines on the economic welfare dimension of the social pyramid. They represent levels of living below which a household or a person is regarded as poor, and therefore, serve to identify the poor. The conceptual and operate problems surrounding the measurement of poverty are the degree to which households satisfy their needs in accordance with their performances.

Poverty may be measured through the actual access to goods that satisfy needs or through the resources disposable for the acquisition of those goods. The first implies the direct identification of situations of deprivation with regard to each group of needs, since it does not call for particular assumptions on consumption behaviour [Sen, 1976]. However, individual preferences are passed over in the ranking of the different needs, and therefore, also in the maximization of individual utility. On the other hand, the measurement of poverty from the stand point of resources does give this flexibility but assumes that the household optimizes its welfare under conditions of perfect information. From the point of view of measurement, poverty, too, is a multidimensional concept, which would be applied ideally by establishing normative standards of satisfaction or adequacy for each representative indictator.

To measure poverty the extended use of income or total expenditure on consumption as isolated indicators of levels of living, and the drawing of poverty lines interms of income. From this point of view, income may be considered as an indicator that combines different dimensions of the level of living. From the needs stand point, it is a combination of the different satisfiers at market prices, assuming perfect substitutability among them. From the resources stand point, it is a combination of all types of resources in accordance with their current or imputed market yields, also assuming perfect substitutability among them.

People in each country are classified as poor if their consumption expenditure is below a specific poverty line for that country. Sometimes, the adjustment of the poverty line in some countries may take an intermediate form; for example, in some countries the line has been adjusted regularly for price increases, with additional real increases from time to time as a result of a special case. As it has been said earlier, poverty lines can thus be interpreted as deflators that establish the welfare comparability of nominal expenditures [or incomes] across the poverty profile. How should one set a poverty line? If the standard of living is the concern, then the most straight forward way to determine the poverty line is to specify a basket of goods, denoted by a vector X^*, purchasable at prices P, and to set the poverty standard as a subsistence standard:

$$(1+h)P.X^*$$

where h is a provision for inefficient expenditure or waste, or a provision for items not included in the list X^*. This was in effect the method followed in the United States of America in the derivation of the official poverty line, where X^* represented food requirements and h made allowance for spending on other goods. Therefore, when countries establish a poverty line, normally calculate the cost of a basket of food and then increase the sum by a factor of 3 (United states of America) or 2 (most developing countries). Even though this the way to set poverty line, the use of poverty line doesn't provide any information on how far below the line most poor people are, and it is necessary to identify the distribution of the poor fall below the line from starvation to a broad basic - needs understanding of poverty for strategy purposes.

The utilization of income in measuring poverty is founded on its undoubted property for synthesizing the household resources base which dictates the family level of living. On moving directly from resources to needs, additional constraints appear. To take income as a composite indicator of needs satisfaction involves major assumptions, which become particulary rarefied in poverty situations. The poor may be confronted with prices different from those paid by other group and with special difficulties of access to specific goods and services.

The drawing of poverty lines in terms of income or total consumption expenditure, therefore, implies the setting of norms for the minimum quantum of resources required, whether as a function of coverage community welfare, if a relative definition is adopted, or in terms of the satisfaction of a set of basic needs, if an absolute definition is employed. In both instances, the poverty lines synthesize a judgement as to what the minima would be below which only unacceptable situations of deprivation would exist.

If poverty lines are to fulfil their discriminating function adequately, it is obviously necessary to draw sets of lines for different groups, indicating the basic needs in households with different characteristics and whose levels of living of each groups are not directly comparable. Such sets should at least include the various lines produced by application of the same normative and estimative criteria to households of different sizes in urban and rural areas.

As stated earlier, definition of poverty in relative terms based on income or total consumer expenditure endeavour to put into operation an idea of welfare that is minimally adequate in relation to the average values prevailing in the particular society.

2.4 SEN'S INDEX

In the measurement of poverty two distinct problems must be faced:

i) Identification of the poor among the total population, and

ii) Constructing an index of poverty using the available information on the poor.

The former problem involves the choice of a criterion of poverty, eg. the selection of a 'poverty line' in terms of real income per head, and then ascertaining those who satisfy that criterion, eg. fall below the poverty line, and those who do not. In the literature on poverty significant contributions have been made in tackling this problem, but relatively little word has been said on problem (ii) with which Sen (1976) was concerned.

The most widely used measures of poverty are supposed to have the following properties.

1. (Monotonocity) Other things remaining the same, a reduction in income of a person below the poverty line must increase the poverty measures.

2. (Transfer) Other things remaining the same, a pure transfer of income from a person below the poverty line to anyone who is richer must increase the poverty measures.

The most common procedure for handling problem (ii) seems to be simply to count the number of the poor and check the percentage of the total population belonging to this category. This ratio, which is called the head-count ratio H, is obviously a very crude index which lacks the above two properties. The measure is also completely insensitive to the distribution of income among the poor. A transfer of income from the poorest to those who are better off will either keep H unchanged or make it go down.

If z is defined as the poverty-line income level and $y_1<y_2\ldots ,y_q<z$ as income of the poor below the poverty line in ascending order, we define, $H = q/n$ as a ratio of people with an income level below the poverty line. This measure of poverty, while obviously simple to estimate and interpret it has a serious draw back in meeting the above criterion. The head count ratio H simply measures the prevalence of poverty.

Another common measure is the so-called "poverty gap" which is the aggregate short-fall of the income of all the poor taken together from the poverty line. This gives a good indication of the depth of poverty, in that it depends on the distances of the poor below the poverty line. The poverty gap ratio, therefore, is the sum of the difference of each income of the i^{th} poor person from the poverty-line income, z. More formally, it is defined as:

$$PG = \frac{1}{n}\sum_{i=1}^{q}\frac{(Z - Y_i)}{Z}$$

assuming that a total of n persons/households have been considered. PG satisfies the monotonocity axiom but violates the transfer axiom. Consider the following example given by Ravallion (1992). Suppose there are two types of distributions for four persons with distribution A being {1,2,3,4} and distribution B being {2,2,2,4}. For distribution A and B, H is 0.75 and PG is 0.25. But the poorest in A earns half of the poorest of B. Therefore, PG defined above is invariant to transfer from the poorest to the less poor.

Though Sen has not used formally the monotonicity axiom and the transfer axiom in deriving the new poverty measure, the motivation of Sen for a new measure can be understood by noticing the violation of these elementary conditions by the poverty measures currently in wide use.

Consider a community S of n people. The set of people with income no higher than x is called S(x). If z is "the poverty line", i.e., the level of income at which poverty begins, S(z) is the set of the poor. S(∞) is, of course, the set of all, i.e., S. The income gap g_i of any individual i is the difference between the poverty line z and his income y_i.

$$g_i = z - y_i \quad - - - - - \quad (1)$$

obviously, g_i is non-negative for the poor and negative for others.

For any income configuration represented by an n-vector $\underline{y}$, the "aggregate gap" Q(x) of the set S(x) of people with income no higher than x is a normalized weighted sum of the income gaps g_i of every one in S(x), using non negative weights $v_i(z,\underline{y})$ is given as

$$Q(x) = A(Z,\underline{Y}) \sum g_i V_i(z,\underline{Y}) \ldots . (2)$$

The specification of A which signifies and v_i will depend on a set of axioms to be proposed presently. It should, however, be noted at this stage that the form of (2) is very general indeed, and that v_i has been defined as a function of the vector $\underline{y}$, and not of y_i alone. In particular no requirement of additive separability has been imposed.

The index of poverty P of a given income configuration $\underline{y}$ is defined to be the maximal value of the aggregate gap Q(x) for all x:

$$P = \underset{\text{For all x}}{\text{Max}}\ Q(x) \ldots \ldots \ldots (3)$$

Since the weights v_i are all non-negative, it is obvious from (1) and (2) that:

$$P = Q(Z) \quad - - - - - - - - (4)$$

That is, the index of poverty P of a community is given by the value of the weighted aggregate gap of the poor in that community.

In the above discussions, references were made to two measures of poverty currently in use. The head count ratio H and the other measure is the poverty gap PG. PG is silent on the number of people who share this gap, but can be easily normalized into a per person percentage gap I, which we shall call the "income-gap ratio".

$$H = \frac{q}{n}$$

$$I = \frac{1}{q} \sum_{i=1}^{q} \frac{g_i}{Z}$$

While the head count ratio tells us the percentage of people below the poverty line, the income-gap ratio tells us the percentage of their mean short-fall from the poverty level. H is completely insensitive to the extent of the poverty short-fall per person, the income-gap ratio is completely insensitive to the numbers involved. Both should have some rule in the index of poverty. But H and I together are not sufficiently informative either, since neither gives adequate information on the exact income distribution among the poor. Further, neither measure satisfies the transfer axiom, or the

requirement of putting a greater weight on the income-gap of the poorest person.

However, in the special case in which all the poor have exactly the same income level $y^* < z$, it can be argued that H and I together should give us adequate information on the level of poverty, since in this special case the two together can tell us all about the proportion of people who are below the poverty line and the extent of income short-fall of each. To obtain a simple normalization, we set

$$P = HI$$

To determine one poverty index uniquely, the index should satisfy the following axioms.

Axiom 1: (ordinal rank weight): The weight v_i (z,y) on the income gap of person i equals the rank order of i in the interpersonal welfare ordering of the poor.

Axiom 2: The relation greater than defined on the set of individual welfare numbers $\{w_i:(y)\}$ for any income configuration $\underline{y}$ is a strict complete ordering, and the relation greater than defined on the corresponding set of individual income $\{y_i\}$ is a sub-relation of the former, i.e., for any i,j: If $y_i > y_j$, then $W_i(y) > W_j(y)$.

Axiom 3: (Normalized poverty value): If all the poor have the same income, then P=HI.

It is easier to state that index if we number the persons in a non-decreasing order of income, i.e.,

$$Y_1 \leq Y_2 \leq - - - - - - - - \leq Y_n$$

Theorem: For large numbers of the poor, the only poverty index satisfying Axioms 1,2 and 3 is given by

$$P = H\,[\, I + (1-I)G \,]$$

where G is the Gini-coefficient of the income distribution of the poor.

Interpretation of P

The poverty index proposed here turns out to have quite an easy interpretation. The measure is made up of the head-count ratio H multiplied by the income gap ratio I augmented by the Gini-coefficient G of the distribution of income among the poor weighted by (1-I), i.e. weighted by the ratio of the mean income of the poor to the poverty-line income level.

One way of understanding its rationale is the following: I represents poverty as measured by the proportionate gap between the mean income of the poor and the poverty line income. It ignores distribution among the poor, and G provides this information. In addition to the poverty gap of the mean

income of the poor reflected in I, there is the "gap" arising from the unequal distribution of the mean income, which is reflected by the Gini coefficient G of that distribution multiplied by the mean income ratio. The income-gap measure thus augmented to take note of inequality among the poor, i.e., I+(1-I)G, is normalized per poor person, and does not take note of the number of people below the poverty line, which could be minute or large. Multiplying [I+(1-I)G] by the head count ratio it now produces the composite measure P.

2.5. THE FOSTER-GREER-THORBECKE MEASURES OF POVERTY

A class of additively decomposable measures is that proposed by Foster, Greer, and Thorbecke (1984, hereafter FGT), and it is this which we will employ as another method of measuring poverty perfectly. The FGT class contains a number of other commonly used poverty measures as has been case of the head-count index, which gives the proportion of the population with standard of living below the poverty line. But it doesn't indicate how poor the poor are: It is unchanged if a poor individual becomes poorer. One index that does reflect changes in the degree of poverty among the poor is the poverty-gap index. This is the average, over all households, of the gaps between poor households' standards of living and the poverty line, as a ratio of the poverty line. This gives a good indication of the depth of poverty. But the poverty gap index is not sensitive to the distribution of the standard of living indicator among the poor, and as it does not capture the

severity of poverty. The FGT class of measures subsumes the two measures and provides a distributionally sensitive measure, through the choice of a non-negative parameter α : the larger is α , the greater the weight given by the index to the severity of poverty.

The FGT class of measures treats poverty as dependent on the poverty-gap ratio, the parameter α entering as a power of that ratio. Let y_i denote consumption per capita for the i^{th} person's if households are ranked in ascending order of consumption. The poverty line is z and the poverty gap for individual j is $g_i = z-y_i$. If the total population size is denoted by n, and q is the number of poor people, then the FGT class of measures may be written as:

$$P_\alpha = \frac{1}{n} \sum_{i=1}^{q} \left(\frac{g_i}{z} \right)^\alpha$$

where g_i/z is the poverty-gap ratio.

Three members of the FGT class are considered here.

1. The FGT poverty measures for $\alpha=0$. This is simply the head-count index, given by the proportion of the population with a standard of living below the poverty line. $P_o = q/n$. For example, if 40 percent of the population are deemed to be poor, then $P_o = 0.4$.

2. The measure for α=1. This is the average poverty gap in the population, expressed as a proportion of the poverty line:

$$P_1 = \frac{1}{n} \sum_{i=1}^{q} \frac{g_i}{Z}$$

Thus a value $P_1 = 0.1$ means that the aggregate deficit of the poor relative to the poverty line, when averaged over all households, represents 10% of the poverty line. (P_1/P_o is the mean poverty-gap of the poor as a proportion of the poverty line:

$$\frac{P_1}{P_o} = \frac{1}{q} \sum_{i=1}^{q} \frac{g_i}{Z}$$

3. The measure for α=2. unlike the other two, this measure is sensitive to the distribution of income among the poor. It satisfies the main axioms for a desirable poverty measure in literature, including Sen's (1976) "transfer axiom", which requires that when a transfer is made from a poor person to some one who is poorer, the measure indicates a decrease in aggregate poverty. Its desirable properties make it a preferable measure.

CHAPTER 3

ECONOMETRIC APPROACH TO POVERTY ISSUES: THEORETICAL FRAMEWORK

Public expenditure choices play a fundamental role in poverty alleviation through their effects on the supply response of adjusting economies and their contribution to human capital formation. Public investment and recurrent spending are important determinants of the quality and quantity of economic and social infrastructure which, in turn, affect human resources and labour productivity as well as producers' ability to take advantage of adjustment-related changes in relative prices. Resource constraints and the need to control inflation by means of more conservative monetary and fiscal policy are motivating public finance reform in many countries today. The objective of these processes of reform is to bring spending more closely in line with revenue and to raise the efficiency and effectiveness of the government's participation in the economy in support of a specified development path and redistributive (including poverty alleviation) goals.

It is convenient to think of the problem of poverty conscious public expenditure restructuring as follows. For a given total of public expenditure, the policy instrument available to us is to alter the composition of expenditure between relatively broad sectors and programs within sectors. While the answer to the question "how broader?" is country

specific, we would like to retain the sense that we are not here discussing very fine micro management of individual programs.

The analysis of public expenditure patterns focused on two policy variables, these are the flow of funds to certain sectors and programs, and the factors which determine the efficiency and effectiveness of expenditures (i.e. the functional composition of expenditures and public expenditure management). In this section we will focus on the first of these variables. We hope to contribute the formulation of poverty sensitive public expenditure choices and effects. This is complicated, among other reasons, by the fact that the various dimensions of the standard of living of households and individuals are affected individually and jointly by the different components of a governmental spending program. Thus, public expenditure restructuring will have complex effects with many interactions, and difficult choice will have to be made from the various trade-offs. The purpose of the analysis that follows is to develop a framework in which some of these trade-offs can be clarified.

The multi-dimensionality of the standard of living has to be faced head on in assessing the consequences of public expenditure restructuring. The standard focuses on income or expenditure based measures of walefare must be complemented by the concept of basic needs which was introduced in the 1970s. The basic needs literature stresses a number of indicators (in particular, life expectancy, literacy, health, nutrition, and

housing). A closer reading reveals several arguments for basic needs strategy:

i) Thinking of basic needs requirements as entering the standard of living directly, it is argued that the standard of living of the poor can be raised more efficiently by focusing on basic needs. There are, in turn, two sub - arguments here. One is that for any poor person a dollar spent directly on basic needs will be better than a dollar spent directly on income raising (which will then, indirectly, influence basic needs). Another is that basic needs spending could be better targeted toward the poor;

ii) Thinking of basic needs achievements as being inputs into income generation, it is argued that the rate of return to such investment is higher than that, for example, in directly productive physical capital. Thus, even if income/expenditure were the ultimate aim, a basic needs strategy is superior. There is once again a targeting argument to supplement and bolster the basic needs.

The "social sectors" in a governmental expenditure program display all of these considerations, but they lie along a spectrum. In the case of housing we come closest to the pure assumption end of the spectrum. Health and nutrition are located toward the middle of the spectrum. They enter the standard of living directly as well as indirectly through productivity effects.

Income on the other hand is a function of basic needs achievement and productive expenditure I:

$$Y = \beta_o + \beta_B B + \beta_I I \quad \ldots\ldots\ldots (2)$$

There is a budget constraint

$$G = E + I \quad \ldots\ldots\ldots\ldots (3)$$

and the valuation of B and Y to give the true standard of living W is,

$$W = \gamma_o + \gamma_B B + \gamma_y Y \quad \ldots\ldots\ldots (4)$$

The government faces the choice of restructuring by changing the balance between E and I. In which direction should it move? In order to answer this question let us first solve (1) and (2) to give the values of B and Y for any given values of E and I:

To give value for B from equation (1), substitute equation (2) into equation (1) and solve for B:

$$\begin{aligned} B &= \alpha_o + \alpha_e E + \alpha_y Y \\ &= \alpha_o + \alpha_e E + \alpha_y \beta_o + \alpha_y \beta_B B + \alpha_y \beta_I I \\ (1 - \alpha_y \beta_B) B &= (\alpha_o + \alpha_y \beta_o) + \alpha_e E + \alpha_y \beta_I I \qquad \ldots (5) \\ \Rightarrow B &= \frac{(\alpha_o + \alpha_y \beta_o) + \alpha_e E + \alpha_y \beta_I I}{1 - \alpha_y \beta_B} \end{aligned}$$

Similarly we can give value for Y from equation (2) as

$$Y = \frac{(\beta_o + \beta_B \alpha_o) + \beta_B \alpha_e E + \beta_I I}{1 - \alpha_y \beta_B} \quad \ldots\ldots (6)$$

Substitute expression in equation (5) and (6) into (4) we get

$$W = \frac{\gamma_o + \gamma_B(\alpha_o + \alpha_y \beta_o) + \gamma_y(\beta_o + \beta_B \alpha_o)}{1 - \alpha_y \beta_B}$$

$$+ \frac{1}{1 - \alpha_y \beta_B}\left[(\gamma_B \alpha_E + \gamma_y \beta_B \alpha_E) E + (\gamma_B \alpha_y \beta_I + \gamma_Y \beta_I) I\right] \cdots (7)$$

At the margin, therefore, the choice between putting one more dollar in E versus I depends on the comparison of

$$\alpha_E(\gamma_B + \gamma_y \beta_B) \gtrless \beta_I(\gamma_Y + \gamma_B \alpha_Y) \ldots\ldots (8)$$

The comparison depends on a combination of productivity and valuation considerations. For example, suppose that we were interested only in basic needs achievement, so that $\gamma_y = 0$. Then the choice between E and I depends on

$$\alpha_E \gtrless \beta_I \alpha_Y \ldots\ldots (9)$$

If basic needs had no productivity effects, so that $\beta_B = 0$ then (8) collapses to

$$\alpha_E \gamma_B \gtrless \beta_I [\gamma_Y + \gamma_B \alpha_Y]$$
$$\text{or} \quad (\alpha_E - \beta_I \alpha_Y)\gamma_B \gtrless \beta_I \gamma_Y \cdots\cdots (10)$$

Finally, is basic needs had only productivity effects and there were no feedbacks via income to basic needs, say that $\gamma_y = 0$, and basic needs were not valued for themselves but only for the income they generate, so that $\gamma_B = 0$, then (8) collapses to

$$\alpha_E \beta_B \gtrless \beta_I \ldots . (11)$$

Thus we see that many of the strands of the arguments surrounding basic needs fall out as special cases of (8).

The above discussion highlights some of the interactions between different categories of public expenditure in their impact on the standard of living of a typical household or individual. We now turn to the extent to which the policy actions affect the poor. As noted earlier, an implicit argument in some of the literature is that certain types of expenditure are to be performed because they are or can be better targeted. The argument needs to be made explicit, to be made precise, and to be quantified.

Suppose that there are n units in the economy, indexed by $i = 1,2,\ldots,n$. Out of the total expenditures E and I, let E_i and I_i be the amounts that reach unit i. Clearly,

$$\sum_{i=1}^{n} E_i = E \quad , \quad \sum_{i=1}^{n} I_i = I \ldots\ldots (12)$$

The individual counterpart to (7) is thus given by

$$W_i = \frac{\gamma_O + \gamma_B(\alpha_o + \alpha_Y\beta_O) + \gamma_Y(\beta_O + \beta_B\alpha_O)}{1 - \alpha_Y\beta_B}$$

$$+\left[\frac{\gamma_B\alpha_E + \gamma_Y\beta_B\alpha_E}{1 - \alpha_Y\beta_B}\right]E_i + \left[\frac{\gamma_B\alpha_Y\beta_I + \gamma_Y\beta_I}{1 - \alpha_Y\beta_B}\right]I_i \ldots (13)$$

Equation (13) gives the effect on individual income of expenditures E_i and I_i reaching individual i. We now need to formalize and focus on poor units, so as to gauge the impact of restructuring on them. Given a poverty line z which delineates poor from not-poor, one index that is becoming quite commonly used forwarded by FGT is

$$P_\alpha = \frac{1}{n}\sum_{i=1}^{q}\left[\frac{Z - W_i}{Z}\right]^\alpha ; \alpha \geq 0 \ldots\ldots (14)$$

Suppose now that a marginal budgetary shift from E to I occurs in the aggregate. How does this feed through to individuals? One might entertain different possibilities. One is that individuals gain or lose in proportion to their current levels of E and I. Let each E_i become $E_i(1+\theta)$ and each I_i become $I_i(1-\sigma)$. Clearly, from budget constraint (3)

$$\theta E = \sigma I \ldots\ldots\ldots (15)$$

Differentiating (14) with respect to and using (15) we get

$$dP_\alpha = -\frac{1}{n}\sum_{i=1}^{n}\left(\frac{\alpha}{z}\right)\left[\frac{Z-W_i}{Z}\right]^{\alpha-1}\left[C_E E_i d\theta - C_i I_i d\sigma\right]$$

$$= -\frac{E}{n}\sum_{i=1}^{q}\left(\frac{\alpha}{Z}\right)\left[\frac{Z-W_i}{Z}\right]^{\alpha-1}\left[C_E\left(\frac{E_i}{E}\right) - C_I\left(\frac{I_i}{I}\right)\right]$$

Where

$$C_E = \frac{\gamma_B\alpha_E + \gamma_Y\beta_B\alpha_E}{1-\alpha_y\beta_B} \quad , \quad C_I = \frac{\gamma_B\alpha_Y\beta_I + \gamma_y\beta_I}{1-\alpha_Y\beta_B}$$

As might be expected, the impact on poverty depends on the current shares of total expenditure of each type reaching the poor. Thus, when α=1, we get

$$dP_1 = \left(\frac{E}{nz}\right)\left[C_E\left(\frac{E^P}{E}\right) - C_I\left(\frac{I^P}{I}\right)\right]$$

Where E^P and I^P are expenditures of each type reaching the poor. Thus, with this framework the targeting case for certain categories of expenditure relies on high values of ratios of the type Ep/E and Ip/I. These are in principle verifiable and quantifiable.

CHAPTER 4

SOURCE OF DATA AND ANALYSIS FOLLOW THE PROCEDURE IN CHAPTER 2

4.1 SOURCE AND ANALYSIS OF DATA FOR GINI-COEFFICIENT

The population size of the year 1979/80 is based mainly on the National sample survey second round (N.S.S.II 1969-1977) which covered over 80 percent of the population. The CSA has made use of the experience of N.S.S.I prepared better sample design, deployed better quality and quantity of human resources... etc. Hence, it is believed that the resulting data are more reliable than the data from the N.S.S.I.

Similarly, the population for the year 1989/90 is also an estimate size given by the Central Statistics Authority (CSA) on the results of the May 1984 population and Housing census results. And also, the total number of students, doctors, nurses and hospital beds distribution of different regions of the country for the two years 1979/80 and 1989/90 is an information obtained from the statistical abstract of CSA.

The data that has been utilized in this paper which was published by CSA has undergone all the necessary stages. This is to say, that the data are collected by well-trained enumerators and under careful supervision to meet many objectives at a national level. Moreover, important part of

data processing, such as editing, coding, verification data entry and tabulation was done at the head office so as to ensure the quality of the data.

Inequality measures of social services, like hospital activities, i.e number of hospital beds, number of doctors, and nurses and students of different administrative regions in comparison with population size are measured using the Gini-coefficient.

TABLE 4.1: NUMBER OF HOSPITAL BEDS, DOCTORS, NURSES AND STUDENTS OF THE COUNTRY FOR DIFFERENT ADMINISTRATIVE REGION IN 1979/80

Regions	Population (in '000)	No. of Doctors	No. of Nurses	No. of Hospital beds	No. of Students
Bale	879.2	6	25	189	54,229
Arssi	1,149.4	5	28	168	97,095
Gamo Gofa	1,003.4	4	31	131	65,380
Sidamo	2,808.3	12	57	470	249,275
Wello	2,612.6	18	60	449	137,128
Gojjam	2,037.9	13	52	248	90,901
Wellega	2,019.2	14	64	306	273,940
Gonder	2,053.2	14	55	336	63,389
Illubabur	810.8	7	29	155	84,516
Keffa	1,615.4	13	34	218	117,310
Eritrea	2,426.2	35	158	2,432	82,520
Shewa	5,085.1	21	122	838	431,232
Hararge	3,125.2	27	78	930	94,836
A.A	1,277.1	237	607	2,923	272,872
Tigrai	2,162.1	7	48	410	67,929
Total	31,065.3	433	1448	10,203	2,182,552
Gini-co.		0.6189	0.5180	0.1059	0.0124

TABLE 4.2: NUMBER OF HOSPITAL BEDS, DOCTORS, NURSES AND STUDENTS OF THE COUNTRY FOR DIFFERENT ADMINISTRATIVE REGIONS IN 1989/90.

Regions	Population	No. of Doctors	No. of Nurses	No. of hosp. bed	No. of students
Bale	949,551	15	70	118	108,416
Arssi	1,928,226	28	88	205	217,206
Gamo G.	2,969,090	31	99	260	207,240
Sidamo	3,314,149	40	148	353	199,610
wello	3,842,077	41	125	433	142,631
Gojjam	3,867,129	43	116	414	265,331
Wellega	2,902,761	49	168	444	256,511
Gonder	3,491,413	57	149	561	117,928
Ill &ke.	3,990,199	66	177	562	311,828
Eritrea	3,485,633	77	314	2,954	225,595
Shewa	8,725,114	83	316	958	672,086
Hararge	5,081,531	102	159	1,030	223,947
A.A.	2,291,137	1,020	1,646	3,257	496,011
Tigrai	2,677,962	----	----	557	88,136
Total	49,515,969	1,658	3,575	12,106	3,532,476
Gini-Co.		0.6322	0.5050	0.1057	0.1162

As we can see from the above two Tables, we can compare the growth of education and health activities in ten years interval, in 1979/80 and 1989/ 90, of Ethiopia. The number of students (primary,Junior and senior secondary schools) increased from 2,182,552 in 1979/80 to 3,532,476 in 1989/90. For the above mentioned years the growth of health centres of the country, that is the total number of Doctors, Nurses and Hospital beds are provided in Tables 4.1 and 4.2.

The rural areas of the country are much less developed. In rural areas the population is still mostly illiterate. Specially, the female population makes the larger part of the illiterate both in urban and rural areas. For instance, in

1974 only 18% of all children of primary school age went to school and in rural regions not more than 1% (E.N.I.,1980).

Like many of the developing countries, the communities in Ethiopia also suffer from a wide range of health problems. The main causes of these problem in Ethiopia are too many. Some of these are:

1. The number of hospitals are very small when we compare it with the population size of the country. If we compare the growth of the number of hospitals within ten years interval from 1979/80 and 1989/90, the hospitals grew from 86 to 89 for the same years. Therefore when we compute the growth of number of health institutions in the country with the population growth it is insignificant. In 1979/80 the ratio of hospitals to population size of the country is 1:361,224 and in 1989/90 it is 1:556,359.

2. Like the type and number of health institutions available in Ethiopia, the other cause of health problems for the population in Ethiopia can be attributed to the distribution of doctors and nurses working in health institutions (or hospitals) of different administrative regions of the country in comparison with the population size.

4.2 SOURCE AND ANALYSIS OF DATA FOR DEFICIENCY RISK ESTIMATE

Ethiopian Nutritional Institute had made a series of studies to identify diet and consumption patterns by estimating calorie intake and requirement. A nutrition survey on several communities of Ethiopia were conducted and Ijaji was one part in which nutrition survey were conducted. The data were collected on a standard scientific method of stratified sampling with a carefully prepared questionnaire.

A sample of 47 households was selected and the age as well as the sex of each household member was identified. Each household was then observed for three days and the daily family intake of calories was estimated. Since almost every household consumes food from the same dish, there was no way of identifying an individual's actual in-take. The best one can do is to divide daily household calorie in-take by the number of household members giving mean individual in-take per day. The same was done to estimate mean daily individual requirement (Asmerom, 1978).

The Table given below is calorie in-take and requirement for survey conducted in Ijaji community and summarized by Prof. Asmerom kidane.

TABLE 4.3: RELATIVE FREQUENCIES OF CALORIE INTAKE AND REQUIREMENT FOR IJAJI.

Class	Intake (X_i)	Requirement (Y_i)
300 --	12.80	0.00
500 --	14.90	0.00
700 --	23.50	0.00
900 --	6.40	2.10
1100 --	8.50	0.00
1300 --	2.10	0.00
1500 --	8.50	2.10
1700 --	17.00	17.00
1900 --	2.10	19.10
2100 --	0.00	21.30
2300 --	0.00	19.20
2500 --	0.00	6.40
2700 --	2.10	8.50
2900 --	2.10	4.30
	100	100

source: Asmerom Kidane (1978)

As it is said earlier, the assumption that in-take requirements are normally distributed must be tested, and using the χ^2 distributions it can be shown that requirements are normally distributed for the Ijaji data. The value which was estimated to be 12.7 with 12 degrees of freedom (number of classes less one) tend to suggest that one cannot reject the assumption that in-take requirements are normally distributed. Therefore, Deficiency Risk Estimate was then applied on the relative frequency distribution and the following results are obtained.

TABLE 4.4: DEFICIENCY RISK ESTIMATE (DRE) OF CALORIE SUPPLIES FOR IJAJI COMMUNITY.

$\overline{Y}=2204 \qquad S_Y=390$

CLASS	RELATIVE FREQUENT. f_i	prob. of under nutrition $p_i(U)$	DRE $f_i\ P_i(U)$
300	12.80	1.0000	12.80
500	14.90	1.0000	14.90
700	23.50	1.0000	23.50
900	6.40	1.0000	6.40
1100	8.50	0.9949	8.46
1300	2.10	0.9803	2.06
1500	8.50	0.9394	7.98
1700	17.00	0.8508	14.46
1900	2.10	0.6985	1.47
2100	0.00	0.5398	0.00
2300	0.00	0.3085	0.00
2500	0.00	0.1539	0.00
2700	2.10	0.0630	0.13
2900	2.10	0.0207	0.04
	100.00		92.20

Source: Asmerom Kidane (1978)

Thus applying the Deficiency Risk Estimate 92.20 percent of the sampled households in Ijaji suffer from both mild and extreme forms of under nutrition. When FAO'S definition of under nutrition, namely, mean requirement minus three standard deviations (1034 calories) was applied, 57.7 percent of Ijaji residents are undernourished. The above results suggest that 57.7 percent of the residents will be classified as seriously undernourished while 34.5 percent of the residents suffer from a milder form of under-nutrition.

4.3. *SOURCE AND ANALYSIS OF DATA ON OTHER MEASURES OF POVERTY*

There has been a large amount of work in the literature that is devoted to the formulation of aggregate measures of poverty indices (Hagenaars, 1987). In theory, a poverty index is expected to reflect a number of desirable properties that are in most cases based on normative judgements. Most are extensions of properties commonly found in income inequality indices.

In terms of empirical applications, those indices which have attracted the attentions of researchers are the class of the Foster-Greer- Thorbecke (FGT) indices. They take the Head-count Ratio, the Poverty-Gap indices as special cases. In addition, they have the advantage of sub-group consistency in the analysis of poverty profiles among different sections of a community or society. This paper, therefore, follows the general trend by considering the FGT indices, and for the sake of comparison the Sen index is applied to Ethiopian data set.

In order to ascertain the living standard of the population of Ethiopia, a survey has been conducted in the Awasa region. The survey was used to collect data on family size and their income. The data was obtained from the field survey on 265 households and it was collected by enumerators employed for the same purpose. From these the relevant information and values related to variables on income and household size have been extracted to meet the objective of the study. It should be noted that the income data obtained from

each household of the sample members in the region could be formal or informal or both.

The data are collected exclusively in the Awassa region. However, as it is mentioned earlier the objective of the study was to identify and estimate the living standard of the population of Ethiopia in relation to their income and expenditure to satisfy basic needs, i.e., to compute the overall poverty line and calculate other measures of poverty on the basis of the estimated poverty line. But, this couldn't be done due to time constraint to collect a primary and current data for this project. The researcher has tried to obtain a sample of income data and household size from the CSA. Because the authority is processing the data collected on the housing and population survey conducted in October 1994, it was not possible to apply and utilize different measures of poverty on these data. The editing, verification, data entry and tabulation process in the authority has not yet been completed.

The different measures of poverty, described in chapter 2, were utilized on the income data and household size of 265 households in the Awassa region so as to get relevant picture about absolute poverty and related ideas about population in that region. The computation of absolute poverty line on these data has been carried out by two different approaches, the first, by considering the household composition of the region and the second, without considering the household composition.

Step 1: The average calorie requirement per day of one individual in that region has been identified to be 1899 calorie/day (Luzzi et al, 1990).

Step 2: The calorie per day consumption (1899 calorie/day) of an individual is converted to its barley mass equivalent and is computed as:- 334 calorie = 100gms of barley and found that

1899 calorie/day = 0.569kg/day.

Step 3: The above daily calorie consumption of an individual has been converted into a monthly consumption volume of barley to obtain the minimum calorie requirement of an individual per month by multiplying the calorie per day consumption of barley by 30 days, and the current price of barley has been considered in order to obtain food poverty line of the region.

Step 4: Based on the method described in Chapter 2, Section 2.3, for computing poverty line and, the step described above in calculating the food poverty line, it was possible to estimate the poverty line, Z, for the region.

Based on the above procedures for computing absolute poverty line and measures of poverty discussed in Chapter 2 Sections 4 and 5 have been utilized to treat the data collected in the Awassa region. The results of the analysis are described in Tables 4:5 and 4:6:

TABLE 4:5 : RESULTS OF MEASURES OF POVERTY ON THE AWASSA DATA BY CONSIDERING HOUSEHOLD COMPOSITION.

Poverty Measures	Calculated Value
Head - Count Ratio (H)	0.6000
Poverty Gap (PG)	0.3223
Sen's Index (P)	0.3243
Foster - Greer - Thurbecke (FGT)	0.2191

TABLE 4:6: RESULTS ON DIFFERENT POVERTY MEASURES ON AWASSA DATA WITHOUT HOUSEHOLD COMPOSITION.

Poverty Measures	Calculated Value
Head - Count Ratio (H)	0.8981
Poverty Gap (PG)	0.5859
Sen's Index (P)	0.5878
Foster - Greer - Thurbercke (FGT)	0.4455

Estimated poverty indices are expected to offer enough information on the attributes of the poor as much as possible.

The FGT indices measure the incidence (through H), intensity (through poverty Gap) and severity (when α=2) of poverty (Ravallion, 1992). According to Table 4:5, the incidence of absolute poverty in the Awassa Town during the survey period was about 60%. This figure tells us the percentage of the population living below the absolute poverty. The estimate takes into account the effects of household

composition (age and size) by taking adult equivalent scales commonly applied in the literature. When these factor is not considered (See Table 4:6) the incidence of poverty jumps as high as 90%.

The intensity of poverty as measured by the Poverty-gap and the Sen's Index came up respectively with 32.23% and 32.43%. with the effect of household composition taken into account. In the case when household composition is assumed intensity of poverty was estimated to be 58.59% and 58.78% respectively for the same indices.

It is interesting to note here that in both cases the Gini- coefficient among the poor was very close to zero, indicating that most poor earned similar incomes during the survey period. Poverty is expected to be intense as the index measuring it approximates the value of one. In our case, intensity of poverty was in the neighbourhood of 33% when household composition was taken into account, which compared to other estimates is a very high one (Ravallion et al, 1991). Indeed, the estimate of incidence of poverty is very high, too. Likewise, the severity of poverty, captured by the FGT index (see Tables 4:5 and 4:6) is quite high by the standards of other estimates.

CHAPTER 5

DISCUSSION AND CONCLUSION OF THE RESULT

Health indicators, such as the number of doctors, nurses, hospital beds are believed to supplement the profile of living standard in a given community that is derived from income or expenditure data. In fact, they constitute the correlates of poverty. At the level of a community, if individuals are not provided with better health and education facilities, even if their income is above the poverty line, they certainly experience low standard of living.

The age old controversy (Anand and Ravallion,1993) that whether or not income or its proxy such as consumption or expenditure better reflects a person's standard of living has made a significant empirical turn in recent years by changing the statistical convention in measuring human development through per capita GDP alone. The newly introduced measure known as the Human Development Index (UNDP, 1992) is one major stride towards the incorporation of health and education factors in the measurement of wellbeing.

The preceding analysis on the state of health service distribution in Ethiopia indicates one very important fact. That is, existing services are severely regionally biased so that people living in various regions are provided with varying

degrees of health services. It is well known that until very recently, even up to now, health services are public goods provided by the government. The regional disparities largely are the result of underdevelopment typical of poor countries such as Ethiopia, where dualism in many respects in the future of the economy. Therefore, the government alone cannot be held accountable to such distortions for itself is the victim and perpetrator above.

Throughout the decade that passed between the 1979/80 to 1989/90, no significant change has been observed in the degree of regional inequalities for health services in Ethiopia. We may conclude, therefore, that relative poverty, would remain invariant to the distribution of health services across the regions. In terms of plain common sense, the availability of health service a person in Ethiopia may get depends on exactly where he lives. This is not to deny that urban areas are far better than suburban in health services even in industrial societies. But, the Ethiopian case is serious in that the indicators used are basic health facilities, not quality of health services. In addition, the cost of traveling to places that have health services is an additional barrier because of the undeveloped infrastructure in the country. Therefore, the regional inequality in the health services is a clear indication of poor facility, and its persistence, a symbol of deterioration.

In regard to the estimates of poverty indices explained in Chapter 4, Section 4.3, we justify our results by considering

the fact that Ethiopia is among one of the poorest country in the Sub-Saharan Africa, and constitutes a mass of poor and vulnerable households. It could therefore be no coincidence if estimated poverty indices pointed at mass poverty with an extreme degree of intensity and severity.

Our estimates have a clear message to policy makers. That is poverty in Ethiopia is not a problem of a particular group, class or community. But it is on the mass scale affecting a large percentage of the population. In addition, most are unfortunately far from the poverty line border in that the kind of poverty existing in the country is extreme in intensity and severity. Poverty alleviation therefore has to be a priority in the formulation of any economic policy. And it cannot be relegated as an addendum to economic growth, industrialization and other issues.

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APPENDIX

APPENDIX A: ALTERNATIVE METHOD OF ESTIMATING THE GINI-INDEX

Gini - Index is a parameter used by economists to asses the extent of inequality of the distribution of income data of which are usually published in grouped form. The estimation procedure consists of establishing a point estimate of Gini - Index that always lies between the lower and upper bounds. Suppose the income groups available for the estimation are K in Number. Let:

X_i = Cumulative proportion of recipients

Y_i = Cumulative proportion of income corresponding to X_i

If we denote the i^{th} observed point of the Lorenz-Curve by (X_i, Y_i), i= 1,2,...,K, then a line can be passed through the order points (X_{i-1}, Y_{i-1}) and (X_i, Y_i), and this line may be represented as:

$$Y = a_i + m_i X \quad ,i=1,2,\ldots,k \quad \ldots(A-1)$$

where

$$a_i = \frac{(X_i Y_{i-1} - X_{i-1} Y_i)}{X_i - X_{i-1}} \ldots\ldots\ldots\ldots(A-2)$$

$$m_i = \frac{Y_i - Y_{i-1}}{X_i - X_{i-1}} \quad ,i = 1,2,\ldots,k \quad \ldots.(A-3)$$

Using relation (A-1), the lower bound of Gini Index is given as:

$$G_L = 2\sum_{i=1}^{k} \int_{x_{i-1}}^{x_i} (X - a_i - m_i X)\, dX \qquad \ldots\ldots (A-4)$$

$$= 2\sum_{i=1}^{k} \frac{(\overline{x_i} - \overline{y_i})}{(x_i - x_{i-1})}$$

where

$$\overline{X_i} = \frac{x_i + x_{i-1}}{2} \quad and \quad \overline{y_i} = \frac{y_i + y_{i-1}}{2}$$

The procedure of estimation assumes the availability of some observed points of the implied Lorenz Curve. Thus if (0,0), (X_1, Y_1) and (X_2, Y_2) are the first three observed points of the implied Lorenz Curve, one may construct lines joining any pair of consecutive points as in (A-1). Hence, if M_1 is the slope of the line through (0,0) and (X_1, X_1), and M_2 is the slope of the line through (X_1, Y_1) and (X_2, Y_2), then it is clear that:

$$m_2 > m_1 \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (A-5)$$

Further, if we consider the slop, γ_1 of the implied Lorenz Curve at (X_1, Y_1), then we see that

$$m_1 < \gamma_1 < m_2 \ldots\ldots\ldots\ldots\ldots\ldots (A-6)$$

Such a value of γ_1 is obtained by fitting a parabola:

$$Y=bx+Cx^2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (A-7)$$

through the points (0,0), (X_1,Y_1) and (X_2,Y_2). If this curve is taken to be a portion of the Lorenz Curve implied by the given data, then the slope, γ_1, at (X_1,Y_1) is readily given as:

$$\gamma_1 = \frac{d_1}{D_1}\cdot\frac{D_2}{D_1+D_2}+\frac{d_2}{D_2}\cdot\frac{D_1}{D_1+D_2} \ldots\ldots\ldots (A-8)$$

where

$$D_j=(x_j-X_{j-1}) \quad ,d_j=(y_j-y_{j-1}) \quad ,j=1,2$$

and

$$\frac{d_j}{D_j}=m_j \quad , \; j=1,2$$

so that γ_1 is a weighted average of m_1 amd m_s and it satisfies the constraint in (A-6).

In general, consider a convex parabola:

$$Y=a_i+b_iX+c_iX^2 \ ,i=1,2,\ldots,K-2 \ldots (A-9)$$

that passes through the points (X_i,Y_i) and (X_{i+1},Y_{i+1}) with slopes γ_i, γ_{i+1}, a_i, b_i and c_i have to satisfy the following:

Substituting for a_i, b_i and c_i from the relevant relation in (A-14) to (A-17), A_i ,i = 0,1,...,K-1, can be explicitly determined and an expression for G now follows as:

$$G=1-2\sum_{i=0}^{k-1}A_i \quad \ldots\ldots\ldots (A-19)$$

This can also be written in terms of the slopes and the observations as:

$$G=1-\frac{1}{3}[d_1(4y_1-\gamma_1 x_1)+$$
$$\sum_{i=1}^{k-2}\{d_{i+1}^2(2\gamma_i+\gamma_{i+1})+6y_i d_{i+1}\}+$$
$$d_k(6-4dk+d_k\alpha_{k-1}) \quad \ldots\ldots\ldots\ldots (A-20)$$

Further, using (A-17), the estimator, G, in (A-20) may be re-cost as:

$$G=1-Q-\frac{Q_1\alpha_1}{3} \quad \ldots\ldots\ldots (A-21)$$

where

Income Distribution Data in Ten Groups

Income Intervals (Dollars x 10^3)	Cumulative % of Recipients	Cumulative % of Income
0 - 1	4.824	0.323
1 - 2	13.077	1.815
2 - 3	20.292	3.994
3 - 4	27.194	6.925
4 - 5	33.809	10.550
5 - 6	41.407	15.618
6 - 7	49.254	21.813
7 - 10	70.658	43.763
10 - 15	80.769	71.857
over 15	100.010*	100.011*

* *overflow due to rounding errors.*

Using relation (A-21) on these same data, we find that with γ_1 as compute from (A-8),

$$G = 0.3985$$