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Nanak Kakwani

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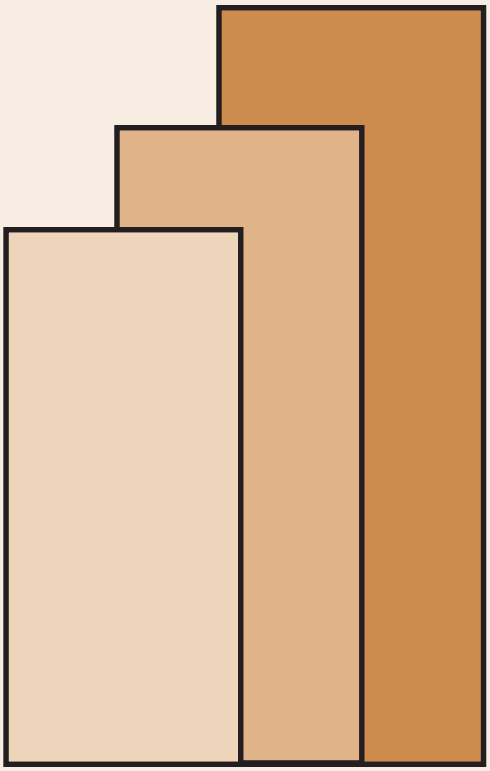

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For comments, suggestions or further inquiries please contact:
The Research Information Staff, Philippine Institute for Development Studies
5th Floor, NEDA sa Makati Building, 106 Amorsolo Street, Legaspi Village, Makati City, Philippines
Tel Nos: (63-2) 8942584 and 8935705; Fax No: (63-2) 8939589; E-mail: publications@pids.gov.ph
Or visit our website at http://www.pids.gov.ph

A NEW MODEL FOR CONSTRUCTING POVERTY LINES

Nanak Kakwani
University of New South Wales
Email: n.kakwani@unsw.edu.au

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Abstract

In this paper, we present a new model for constructing poverty lines. The model uses consumer theory to construct both food and non-food poverty thresholds. Although one cannot completely eliminate the value judgments inherent in the construction of poverty thresholds, this model helps to make the ad hoc assumptions that are generally made more justifiable. The model ensures that poverty line is consistent across regions. The methodology developed in the paper is used to illustrate the construction of poverty thresholds in Pakistan.

Key words: Poverty line, Consumer theory, Consistent poverty Line, Calorie cost, economies of scale and poverty measures.

Introduction

The poverty line is an essential ingredient of any poverty analysis. It specifies the level of income that is just sufficient to maintain the basic minimum standard of living. Rowntree (1901) was the first one to measure the cost of maintaining a minimum standard of living. He first estimated the minimum money costs for food, which would satisfy the average nutritional need of families of different sizes. To these costs, he added the rent paid and certain minimum amounts for clothing, fuel, and sundries to arrive at a poverty line of a family of given size. A family is classified as poor if its total earnings are less than its poverty line. This approach is popularly known as the basic needs approach.

Rowntree's basic needs approach specifies a society's minimum standard of living to which everybody in that society should be entitled. Based on the consumer theory, this minimum standard can be defined by a minimum utility level u*, which allows the individuals to satisfy their caloric requirements and also their basic non-food requirements such as education, housing, health, and so on. Anyone whose actual enjoyment of utility is less than u* is identified as poor. A poverty line is a money metric value of u*.

A poverty line may be defined as consistent if the minimum standard of living u* is exactly the same for all individuals irrespective of their needs and wherever they live in the country.[1] It is important to have a consistent poverty line otherwise we would have horizontal inequity in the identification of the poor.

In this paper, we present a new model for constructing poverty lines.[2] The model uses consumer theory to construct both food and non-food poverty thresholds. Although one cannot completely eliminate the value judgments inherent in the construction of poverty thresholds this model helps to make the ad hoc assumptions that are generally made more justifiable. The model ensures that the poverty line is consistent across regions. The

[1] Two persons enjoying the same minimum standard of living do not have to consume the same basket of goods. The actual baskets they consume depend on their consumption patterns. Two persons can have different consumption patterns but still have the same minimum standard of living measured by the minimum utility level they enjoy.

[2] The World Bank has pioneered the construction of poverty lines in number of papers written by Ravallion, (1994 1998). His methodology is widely used by the World Bank in the construction of poverty lines in developing countries. A paper by Auffret (2006) from the World Bank itself has illustrated the shortcomings of the methodology followed by the World Bank. This paper demonstrates that using the World Bank methodology, different researchers can derive different poverty rates while working on the exact same survey. The model presented here does not suffer from this problem.

methodology developed in the paper is used to illustrate the construction of poverty thresholds in Pakistan.

1. The Model

Individuals have different calorie requirements because of their age and sex, so the food basket will not be the same for all individuals. Similarly, if individuals are living in different regions such as urban and rural areas, their basic non-food requirements will be different. It means that the utility function must take account of these differences.

We may define a utility function as

$$u=u[\frac{q_f}{r},\frac{q_n}{n}] \qquad (1)$$

where q_f and q_n are the quantity vectors of food and non-food items of consumption, respectively; r is the calorie requirement of an individual, and n is a measure of some other non-food basic needs of that individual. If we fix the minimum standard of living at u=u*, then equation (1) will provide the food and non-food baskets for an individual with given caloric requirement r and basic non-food requirement n. The food and non-food poverty baskets will be same for all individuals only if r and n are exactly the same for all individuals. This requirement will never hold, so food and non-food poverty lines will be different for different individuals.

Suppose p_f and p_n are the price vectors of food and non-food items of consumption, respectively, then using the conventional treatment of consumer choice, we maximize the utility function

$$u=u[\frac{q_f}{r},\frac{q_n}{n}] \qquad (2)$$

subject to the budget constraint

$$p_f \cdot q_f + p_n \cdot q_n \le x \qquad (3)$$

where x is the total expenditure or income that is available to the consumer.

This maximization procedure yields the food and non-food demand functions as

$$q_f = rg_f\left(x, rp_f, np_n\right) \qquad (4)$$

and

$$q_n = ng_n\left(x, rp_f, np_n\right) \qquad (5)$$

respectively. These equations are the Marshallian demand functions (Marshall 1930). Substituting (4) and (5) into (3) yields the cost function

$$x = e\left(u, rp_f, np_n\right) \qquad (6)$$

which is the minimum cost of buying the individual utility u at given food and non-food prices.

Further, substituting (6) into (4) and (5) yields the Hicksian food and non-food demand equations (Hicks 1957):

$$q_f = rg_f\left(u, rp_f, np_n\right) \qquad (7)$$

and

$$q_n = ng_n\left(u, rp_f, np_n\right) \qquad (8)$$

respectively.

The food and non-food poverty lines are then obtained by substituting u=u* in (7) and (8), respectively as

$$F = p_f q_f = rp_f g_f\left(u^*, rp_f, np_n\right) \qquad (9)$$

and

$$NF = p_n q_n = np_n g_n\left(u^*, rp_f, np_n\right) \qquad (10)$$

Equations (9) and (10) give the food and non-food poverty lines at the point where the individuals enjoy the same level utility u*. These lines will be different for different individuals because of individual differences in calorie requirements and basic non-food needs. The sum of food and non-food poverty lines gives the total poverty line.

Equations (9) and (10) give the utility consistent food and non-food poverty lines. If we know u*, we can determine both food and non-food poverty lines. The difficult problem is: How do we determine u*? The following solution is proposed.

The food poverty line should satisfy the requirement that calorie intake is equal to the calorie requirement. Suppose c is the vector that converts food quantity vector q_f into calories. $c.q_f$ is the number calories that are obtained from the food basket q_f , which should be equal to calorie requirement r. Thus, using (9), we obtain

$$c.g_f(u^*, rp_f, np_n) = 1 \qquad (11)$$

This equation should hold for all exogenously determined values of r, p_f , n and p_n. This means that the function $.g_f(u^*, rp_f, np_n)$ should not contain rp_f and np_n as its arguments and should depend only on u*. The food poverty line in (11) will then be given by

$$F = p_f q_f = rp_f g_f(u^*) \qquad (12)$$

Since the food poverty line can also be written as the product of calorie requirement and calorie cost (which is the expenditure on food per calorie), which from (12) immediately gives calorie cost function as

$$c\cos t = p_f g_f(u^*) \qquad (13)$$

which shows that the calorie cost depends on two factors, namely, food prices and the utility u*. It means that real calorie cost, which is adjusted for prices, is given by

$$c\cos t^* = g_f(u^*) \qquad (14)$$

Since $g_f(u^*)$) is a monotonically increasing function of u*, it implies from (14) that the real calorie cost is a monotonically increasing function of the utility people enjoy. This proves Lemma1.

Lemma 1**:** *If any two persons have the same real calorie cost at the point where they satisfy the caloric requirements, then they will enjoy the same level of utility.*

This lemma implies that we can determine the minimum standard of living measured by the utility level u* by the real calorie cost. The real calorie cost can be calculated from the data for different quintiles. If for instance we choose the bottom quintile as our reference group, we can use the calorie cost of this group to construct food and non-food poverty lines.

2. Food Poverty Line

The calorie norms are generally available for each country. If they are not available, we can use the Food and Agriculture Organization (FAO) norms. These norms are different for different persons because of differences in age and sex. The household income and expenditure surveys provide information on the age and sex of each individual within a household. Given the caloric norms and information on age and sex of each individual, we can easily calculate the per capita caloric requirement of each household.

The food poverty line can be obtained for each household if we multiply the household's per capita calorie requirement by the calorie cost. To maintain the consistency of poverty lines, we must use the same real calorie cost for all households. From lemma 1, this will ensure that two households will enjoy the same standard of living if their per capita food expenditure is equal to their per capita food poverty line.

The calorie cost that we use must reflect the consumption pattern of the population that we regard to be poor in a given country. In other words, we must choose a reference group. We can calculate the calorie cost for different quintiles of the population formed on the basis of per capita household consumption. It may be reasonable to choose the population belonging to the bottom quintile as a reference group. But the choice of reference group should be determined on the basis of the commitment the governments want to make in terms of allocating resources to poverty reduction programs.

Having determined the calorie cost of the reference group at the national level, we need to adjust for differences in regional costs of living differences. Thus, we need to estimate the regional costs of living indexes for food items of consumption. These estimates can be easily obtained if we know the average prices of different items of food that are consumed by the population. In constructing these indexes, we must use the food basket of the reference group (the population in the bottom quintile). These indexes will allow us to estimate separate calorie costs for each region. Multiplying the regional caloric costs by the household's per capita calorie requirement will immediately give us the per capita food poverty line for each household.

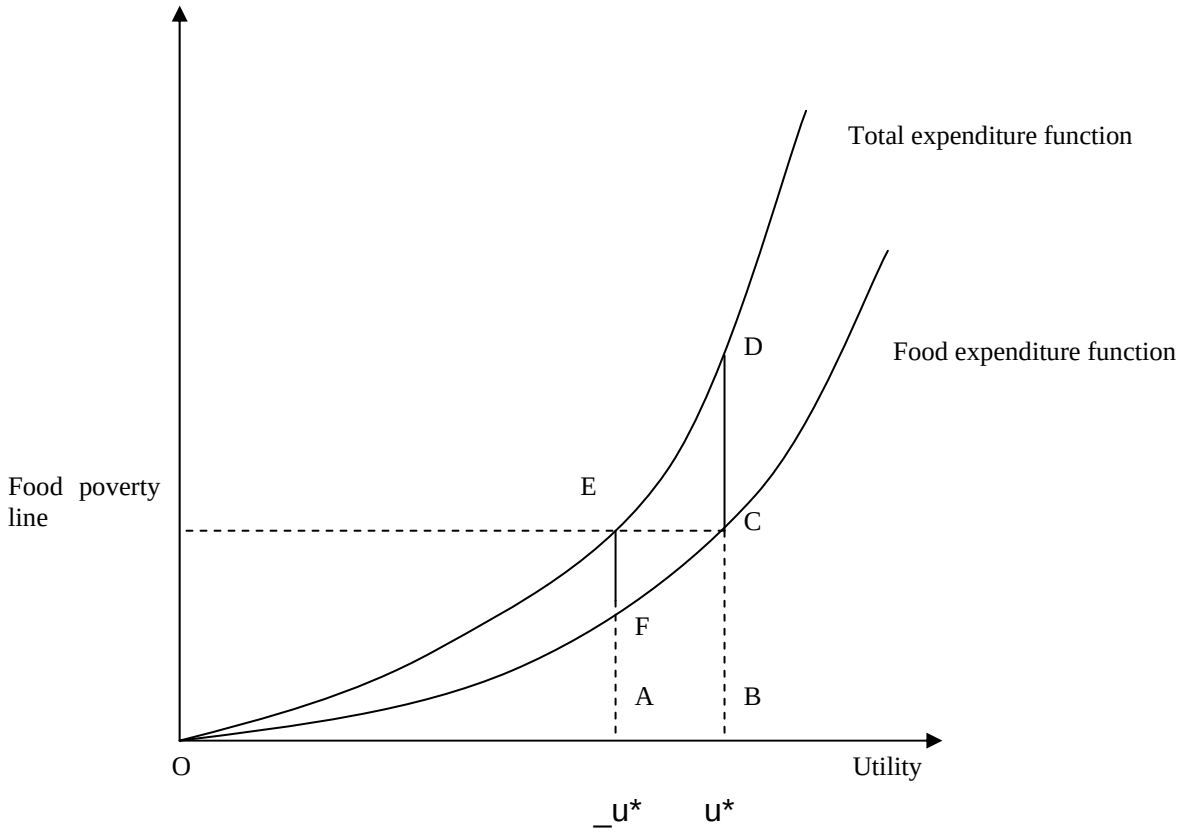
3. Non-food Poverty Line

Suppose we have obtained the food poverty line F on the basis of nutritional requirements. Substituting F into the food expenditure function (derived from the consumer theory), we can solve it for the utility level u*, which will be implied by the food poverty line at the given price vector **p**. Using u* into the total expenditure function, we can obtain the total poverty line, z , which will be consistent with the utility level u*. The non-food poverty line will be equal to z-F. We describe this procedure using a simple diagram.

In Figure 1, the horizontal axis represents the utility level and the vertical axis represents the expenditures. The figure depicts the food and the total expenditure function, both of which are increasing functions of the utility level. C is the point that corresponds to the food poverty line on the food expenditure function. Corresponding to point C, we obtain B on the x-axis, which gives the utility level u* that is consistent with the food poverty line.

Corresponding to point B on the x-axis, we obtain point D on the total expenditure function, which gives BD as the total poverty line that is consistent with the utility level u*. Obviously then, CD will be the non-food poverty line. The non-food poverty line so obtained will be consistent with the standard consumer theory.

Figure 1: Determination of non-food poverty line



Ravallion (1998) suggested estimating the nonfood poverty line using the idea that if a person's total income is just enough to reach the food threshold, anything that a person spends on nonfood items will be considered as basic nonfood needs. According to this idea, the nonfood poverty line is the household's nonfood expenditure at which the household's total expenditure is equal to the food poverty line. At this point, the household's income is just sufficient to buy only the nutritionally adequate food basket so that any expenditure a household incurs on non-food will be absolutely essential.

In the figure, E is the point at which the total expenditure is equal to the food poverty line. At this point, FE will be the non-food poverty line, which will always be less than CD. The non-food poverty line will correspond to the utility level _u*, whereas the food poverty line corresponds to the utility level u*. Thus, the food and non-food poverty lines do not imply the same level of consumer utility. Thus, we call the Ravallion's method as inconsistent with the standard utility theory. We recommend using CD as the non-food poverty line for the whole country. We show below how the average non-food poverty line at the national level can be computed using a national household expenditure survey.

The average non-food poverty line can be decomposed into several components, such clothing and footwear, housing, water, electricity and gas, furnishing and household equipment, health, transport, communication, and education. We show below how these individual components of non-food poverty line can be estimated using a national household expenditure survey. It is possible that some of the items of non-food poverty line will consist of items such as alcohol, tobacco, leisure, and so on. Such items should be excluded from the non-food poverty line so that we keep only the very basic items of consumption.

4. Taking Account of Economies of Scale in Non-food Poverty Line

Households have different needs, so every household cannot have the same non-food expenditures. In the case of food expenditures, the household needs were assumed to be proportional to per capita calorie requirements. In the case of non-food, we do not have any logical basis for allocating expenditures to each household. In the absence of such a basis, we assume that the non-food needs do not vary with the age and sex of household members. But household do incur economies of scale because of their size. A person living alone will incur more per person expenditure than two persons living together sharing the household goods. This happens because of the public goods that members of the household share without affecting their individual welfare. We may make the following adjustment to take account of economies of scale.

Suppose there are k non-food components. The non-food poverty line NFPL is estimated as the sum of the k components:

$$NFPL = \sum_{j=1}^{k} (NFPL)_j$$

where $(NFPL)_j$ is the jth component, where j varies from 1 to k. The different non-food components have different degree of economies of scale depending on their degree of sharing. Suppose θ_j is the economies of scale parameter for the jth component of the non-food poverty line, which takes value 1 if the jth component is a purely private good and takes value 0 if the jth component is a purely public good. Suppose n_i is the size of

the ith household, then the consumption of the jth component by the ith household will be given by

$$(NFPL)_{ij} = c(NFPL)_j n_i^{(\theta_j - 1)}$$

where c is the constant of proportionality. If θ_j is equal to 1, then every household will be allocated the same per capita expenditure of $(NFPL)_j$ implying no economies of scale for the jth component. If θ_j is equal to 0, the ith household will be allocated the per capita expenditure of $(NFPL)_j/n_i$. The parameter k is determined so that the mean of $(NFPL)_{ij}$ across all households is equal to $(NFPL)_j$, which ensures that the adjustment for economies of scale does not change the mean national poverty line of each non-food component. The per capita non-food poverty line for the ith household will then be given by

$$(NFPL)_i = \sum_{j=1}^{7} (NFPL)_{ij}$$

To implement the methodology just outlined, we need to know the economies scale parameters θ_j. The estimation of θ_j is very difficult. There exists no credible methodology. Lanjouw and Ravallion (1994) estimated the economies of scale using Engel's model in which the share of the budget devoted to food correctly indicates welfare between households of different sizes and composition. The main objection against this approach is the implicit assumption that all commodities provide the same degree of economies of scale. Since there are both private and public goods, it is not correct to assume that all goods provide the same economies of scale. We take the view that it is not feasible to estimate the economies scale parameter from the consumption patterns of the households. We determine the values of economies of scale parameter using the judgment about the characteristics of the commodities that are included in the determination of poverty line.

Food is generally a private good but some households can economize on it by making bulk purchases. We do not expect that savings due to economies of scale will be very large so we assume that the economies of scale parameter will be equal to 0.95, which implies a saving of only 5%.

Similarly, clothing is generally a private good attributed to individual members of the household, some sharing of clothing does go on within the households. So θ_j for clothing may be to be equal to 0.9, which means there is a saving of 10% because of economies of scale in clothing. Housing including utilities and furnishing and household equipment are public goods so we may assume θ_j for these goods to be equal to 0. Health services can be regarded as a purely private good (because there cannot be sharing of health services),

so we may assume the economies of scale parameter for health to be equal to 1. Households incur expenditure on education only because of the presence of children in the household so we assume that expenditure on education is proportional to the number of children in the household (divided by household size). Similarly, we may assume that only working adults incur expenditure on transport and communication so expenditure on transport may be made proportional to number of working adults divided by household size.. Fuel and housing rents are public goods and, therefore, are shared by household members so their value of economy of scale parameter is set to 0.0. Medical care is an individual good that cannot be shared among household members so that the economies of scale parameter for medical care is set to 1.0. Table1 presents the values of the economies of scale parameters, which we regard as reasonable. However, one can do some simulations to test the robustness of the poverty counts.

Table 1: Economies of Scale Parameter

Food	0.95
Clothing	0.9
Transport	Share of workers
Personal care	0.8
Recreation	Share of children
Education	Share of children
Fuel	0.0
Rent	0.0
Medical	1.0

Source: Author's suggested values.

5. Updating the Poverty Line

We should update the poverty line so that the minimum standard of living implied by the poverty line remains the same over time. If this requirement is not satisfied, then we cannot make poverty comparisons over time. A number of things may change. For instance, the household size and composition may change, which has important implications for caloric requirements. The changes in household size affect the distribution of non-food poverty line across households because of economies of scale that occur within households. The following procedure may be adopted.

First, we must ensure that the real calorie cost remains the same over time. To achieve this, we must know the regional consumer price indexes for food, which are generally available in most countries. Since we know the nominal calorie cost in each region in the base year, we can estimate the nominal caloric costs in each region in the terminal year by regional consumer price indexes for food.

Given the new household survey in the terminal year, we can estimate the per capita caloric requirement for each household. Multiplying the per capita caloric requirement in the new survey

by the nominal caloric cost for each region, we will immediately obtain the per capita food poverty line for each household.

To maintain consistency, we must ensure that the real average expenditures on various non-food components do not change over time. To achieve this, we will need to know the consumer price indexes for each of the k non-food components. These non-food price indexes can then be used to estimate the average non-food poverty line by components in the terminal period. The average non-food poverty lines so obtained in the terminal period can then be used to determine non-food poverty line by components for each household by making economies scale adjustment as described above.

6. Empirical Illustration: Pakistan

7.1. Calorie Requirements

In constructing the poverty line, we use the caloric norms appropriate for Pakistan, which were obtained from the Ministry of Health. Table 2 presents these norms.

Table 2: Calorie Requirements Per Day for Pakistan

Age groups	Male	Female
Less than 1 year	1,010	1,010
1–4 years	1,304	1,304
5–9 years	1,768	1,768
10–14 years	2,816	2,464
15–19 years	3,087	2,322
20–39 years	2,760	2,080
40–49 years	2,640	1,976
50–59 years	2,460	1,872
Over 60 years	2,146	1,632
Average per capita calorie requirement		
2001–2002	2,154.3	

2004–2005	2,175.9

Source: Calories requirements obtained from Pakistan's Ministry of Health. Average calorie requirements are author's calculations using Pakistan Integrated Household Survey 2001-2002.

As presented in Table 2, the calorie requirements vary with age and gender. Using the information on each household member's age and gender (given in the household survey, called the Pakistan Integrated Household Survey (PIHS), we can compute the per capita calorie requirement for each household. It would be expected to vary across households because of differences in household composition. For each household, the average per capita daily calorie requirement for Pakistan can be obtained by means of its weighted average. From Table 1, the Pakistani population in 2001–2002 required 2,154 kilo calories per person per day on average. This average requirement has increased to 2,176 during 2004–2005. This is due to the fact that the population structure in Pakistan is changing in such a way that the proportion of children in the population is on the decline. This appears also to be true in other parts of the world.

7.2. Calorie Costs

Once the calorie requirements are decided, the next step is to convert the required calories into a food poverty line, which is the expenditure on food required to meet the exogenously determined calorie requirements. If the costs of buying the calories are obtained, the food poverty line is equal to the calorie requirements multiplied by the costs of the calories. Hence, the next step is to determine the costs of buying the calories.

In general, household surveys provide information on quantities of food consumed by households. These food quantities can be converted into calories by means of food calorie conversion factors that are available for typical food items for a nation.

Given the quantities of food consumed by each sample household, we can calculate the actual calorie intake of each sample household by multiplying the quantities by the conversion factors. Dividing the calorie intake of each household by its size gives us per capita calorie intake for each household.

Given the calorie intake and the food expenditure for each household, we can calculate the calorie costs for each household by dividing the food expenditure by the calorie intake. The calorie cost varies with people's standard of living; the richer the household, the higher the cost of calories. To see how the calorie cost varies with the per capita final consumption, the population is divided into five quintiles by ranking the households according to their per capita consumption. Consumption is defined as the sum of all net cash and in-kind expenditures after excluding expenditures on durable goods. Table 3 presents the calorie costs for each quintile.

Table 3: Average Calorie Cost for Pakistan by Quintiles

(in PRs per 1,000 calories)

Quintiles	Calorie cost
Quintile 1	5.72
Quintile 2	6.41
Quintile 3	6.92
Quintile 4	7.65
Quintile 5	9.84
Total	7.56

Source: Author's calculation using PIHS 2001-02

The results report that the households belonging to the first quintile spend PRs5.72 on food to be able to consume 1,000 calories. As would be expected, the calorie costs increase monotonically with higher quintile shares. Richer households have higher calorie costs than poorer ones because rich people tend to consume expensive food items. This result is consistent with our Lemma 1. In practice, the expensive tastes of rich households cannot be accounted for in determining the food poverty line. If we do, the poverty line is likely to be so high that the majority of the population will be classified as poor. When a government adopts a poverty line, it agrees on a minimum standard of living to which everyone in society should be entitled. If the poverty line is too high, then the government will not be able to fulfill its commitment to maintain the minimum standard of living of its population. Similarly, the poverty line should not be so low that almost everyone in society is classified as non-poor. In this case, the government may not be motivated enough to raise the standard of living of those who are unable to meet absolute basic needs. These absolute basic needs are not completely absolute. They are relative to the society's overall standard of living. In this respect, we should use the consumption pattern of a reference group as a base in constructing a poverty line.

Obviously, the reference group should consist of the population representative of the poor in society. Since the incidence of poverty in Pakistan hovers around 30%, the average calorie cost of the bottom two quintiles may be regarded as typical for poor people. Bearing this in mind, we have defined the food poverty line based on the calorie cost of PRs6.07 per 1,000 calories. This calorie costs correspond to the minimum standard of living, below which one can be deemed as poor.

7.3. Spatial Price Indexes[3]

The calorie costs depend upon food prices. The higher food prices, the higher the calorie costs. Since Pakistan is a vast country, food prices will not be uniform across regions within the country. Calorie costs will vary from one region to another due to differences in relative costs of food across regions.

Spatial price indexes capture the relative costs of living in different regions and communities. These indexes are essential for poverty measurement because they allow us to take into account the differences in regional costs of living. Table 4 presents the estimates of the spatial price indexes for food for eight regions in Pakistan. Note that these estimates are derived from unit prices collected from the 2001–2002 PIHS.

Table 4: Spatial Price Indexes for Food and Caloric Costs in 2001–2002

Regions	Spatial price	Caloric cost	Inflation	Calorie cost in 2004
Urban areas	**1.07**	**6.50**	**24.12**	**8.06**
Punjab	1.02	6.21	24.79	**7.75**
Sind	1.15	6.99	23.20	**8.61**
Frontier	1.05	6.39	18.97	**7.60**
Baluchistan	1.13	6.84	26.52	**8.66**
Rural area	**0.97**	**5.90**	**24.19**	**7.33**
Punjab	0.93	5.64	26.73	**7.15**
Sind	0.99	6.02	22.23	**7.36**
Frontier	1.05	6.38	16.93	**7.46**
Baluchistan	1.13	6.84	27.67	**8.73**
Pakistan	**1.00**	**6.07**	**24.32**	**7.54**

[3] See the appendix.

Source: Author's calculations based on PIHS 2001-02

The first column in Table 4 gives the spatial price index for food in the survey year 2001–2002. The national price index for Pakistan is equal to 1. The values of the index for other regions provide the living costs of a region relative to the national costs of living. For instance, the food cost of living in urban areas is 7% higher than the national average, whereas the food cost of living in rural areas is 3% lower than the national average. The most expensive region is Baluchistan, where the food cost is 13% higher than the national average.

To obtain the food poverty line, we need to calculate the caloric cost for each region. As pointed out, we have fixed the caloric costs at the national level, equal to PRs6.07 per 1,000 calories. The caloric costs for the other regions have been calculated as proportional to food costs of living in different regions as shown by the spatial price indexes, presented in the first column of Table 4. The second column in Table 3 presents the caloric costs for different regions. These caloric costs were used to calculate the food poverty line in the survey year 2001–2002.

7.4. Inflation Rates between Survey Periods[4]

Caloric costs in the second survey period (2004–2005) will change depending upon the inflation rate of food prices between the two survey periods, 2001–2002 and 2004–2005. We have used the Tornqvist price index to compute the food inflation rates separately for each region. The inflation rates are presented in the third column of Table 4. The results reveal that food prices in Pakistan increased by 24.3% between the two survey periods. Moreover, the inflation rates are quite different across the regions. The food inflation rate is highest in Baluchistan.

Applying these inflation rates to caloric costs in 2001–2002, we were able to obtain the caloric costs for each region in the second survey period, 2004–2005. These are presented in the fourth column of Table 4.

7.5. Food Poverty Lines

As discussed earlier, the food poverty line is derived by multiplying the calorie requirements by calorie costs. Note that food poverty lines will differ from one household to another depending on factors such as household size, family composition, and location of the household. Table 5 presents the average per capita food poverty lines by different regions. These are weighted averages, where weights are proportional to the population of each region.

[4] See the appendix.

The differences in average food poverty lines across regions reflect two factors: (i) the regional cost of living differences, and (ii) regional differences in household demography. Differences in food poverty lines over time reflect the inflation rates in each region and also changes in household demographics.

Table 5: Per Capita Average Food Poverty Line

Regions	2001–2002	2004–2005	% Change
Urban areas	389	487	25.2
Punjab	373	466	25.1
Sind	416	526	26.3
Frontier	376	447	19.0
Baluchistan	399	521	30.4
Rural area	341	429	25.5
Punjab	328	419	28.0
Sind	345	430	24.5
Frontier	364	430	18.1
Baluchistan	401	519	29.4
Pakistan	355	447	25.9

Source: Author's calculations

7.6. Non-Food Poverty Lines

The following procedure utilizes the household expenditure surveys to calculate the non-food poverty lines for Pakistan.

(i) First, calculate the ratio of a household's per capita food expenditure to the household's per capita food poverty line multiplied by 100. This ratio will be equal to 100 when the household's per capita food expenditure is equal to the household's per capita food poverty line.

(ii) Arrange the households in ascending order of the food poverty line ratio (in [i]) using the household survey data.

(iii) Select the households whose food-poverty line ratio lies ranges from 90 to 110. We should select households whose per capita food expenditure is equal to the food poverty line. This implies that we should select the households at the point where the household's food poverty line ratio is equal to 100. Since it is not feasible to calculate this rate at that point, it is thus reasonable to select households in the neighborhood of 100. In this regard, we have selected a range of food poverty line ratios lying from 90 to 110.

(iv) Calculate the average non-food poverty line for the individuals belonging to these households.

Table 6 presents the average non-food poverty lines for Pakistan. The first column gives the average per capita non-food lines for the survey year 2001–2002. The third column gives the inflation rates for different non-food items as obtained from the consumer price indexes (CPI). Applying these indexes to the first column, we obtain average per capita non-food poverty lines for the survey period, 2004–2005.

Table 6: Average Per Capita Non-Food Poverty Lines

Items	2001–2002	2004–2004	Inflation rate
Clothing	55.26	61.44	11.2
Transport	24.13	28.94	19.9
Personal care	29.70	34.02	14.5
Recreation	1.04	1.06	2.2
Education	26.33	30.08	14.2
Fuel & light	63.30	75.56	19.4
Medical	34.01	36.44	7.1
House rent	85.32	104.85	22.9
Non-food	233.76	372.38	59.3

Source: Author's calculations

It can be seen from the table that housing rent is the major non-food component of household expenditure in Pakistan. The house rent varies substantially across the regions. The rent is always much higher in urban areas compared to that in rural areas, so we cannot have the same poverty line for housing rent for all regions. We determined the rent component of the total poverty in different regions so that households on the poverty line enjoy the same level of welfare. Table 7 provides the per capita rent that the poor households are expected to spend on housing in different regions in 2001–2002. From the CPI we found that the housing rents increased by about 18.5% between the survey periods. Applying this inflation rate on column one in Table 7 we obtained the per capita poverty line for rent in 2004–2005, which is presented in column two of Table 7.

Table 7: Poverty Line for House Rent

	2001–2002	2004–2005
Urban areas	167.7	198.7
Punjab	173.6	205.8
Sind	174.5	206.8

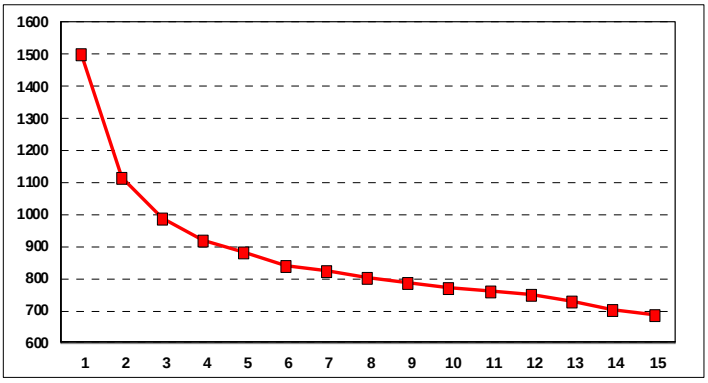
Frontier	87.0	103.1
Baluchistan	168.7	199.9
Rural area	51.7	61.3
Punjab	53.3	63.2
Sind	41.8	49.5
Frontier	44.1	52.3
Baluchistan	102.0	120.9
Pakistan	85.3	101.1

Source: Author's calculations

The adjustment for economies of scale was done as described in Section 5. The values of economies of scale used are presented in Table 1.

Having estimated the minimum required non-food component for each household, we computed the total non-food component of the poverty line by adding each of the eight components to obtain the non-food poverty line for each household. The total poverty is the sum of food and non-food components of poverty line. Figure 2 shows that the per capita poverty line declines monotonically with household size, reflecting that there are economies of scale in consumption.

Figure 2: Per Capita Poverty Line by Household Size



7. Incidence of Poverty In Pakistan

The percentage of poor is commonly used as an aggregate measure of poverty. This measure does not take account of the depth of poverty or in other words this measure does not tell how much lower the average consumption of the poor from the poverty line is. The poverty gap ratio is a superior measure to the percentage of poor because it takes into account both the percentage of poor as well as the gap between the average consumption of the poor from the poverty line. The severity of poverty is even better than both the percentage of poor and the poverty gap ratio; in addition, it takes into account the inequality of consumption among the poor. Tables 8–10 present the empirical estimates of these three measures by provinces and regions. It is evident that Pakistan has

enjoyed a significant poverty reduction in the period 2001–2002 to 2004–2005, which was a period of high growth.

Table 8: Percentage of Poor in Pakistan

	2001–2002	2004–2005	Change
Urban areas	30.5	23.0	–7.5
Punjab	34.2	26.0	–8.2
Sind	25.2	18.5	–6.7
Frontier	27.6	20.5	–7.1
Baluchistan	29.6	26.0	–3.5
Rural area	37.8	26.9	-10.9
Punjab	37.3	27.8	–9.5
Sind	42.1	23.1	–19.0
Frontier	32.4	26.3	–6.1
Baluchistan	41.5	34.6	–7.0
Pakistan	35.7	25.7	–10.0

Source: Author's calculations **based on PIHS 2001-02 and 2004-05**.

Table 9: Poverty Gap Ratio in Pakistan

	2001–2002	2004–2005	Change
Urban areas	6.8	5.0	–1.8
Punjab	8.3	5.9	–2.4
Sind	4.7	3.6	–1.1
Frontier	4.7	3.5	–1.2
Baluchistan	5.6	5.3	–0.3
Rural area	7.6	5.1	–2.5
Punjab	8.0	5.6	–2.4
Sind	8.6	3.9	–4.7
Frontier	5.2	4.4	–0.8
Baluchistan	7.4	7.2	–0.2
Pakistan	7.4	5.1	–2.3

Source: Author's calculations **based on PIHS 2001-02 and 2004-05**

Table 11 Severity of Poverty in Pakistan

	2001–2002	2004–2005	Change
Urban areas	2.2	1.6	–0.6
Punjab	2.9	1.9	–0.9
Sind	1.3	1.1	–0.2
Frontier	1.2	1.0	–0.2
Baluchistan	1.5	1.7	0.2

Rural area	2.3	1.5	–0.8
Punjab	2.5	1.7	–0.8
Sind	2.5	1.1	–1.4
Frontier	1.3	1.3	0.0
Baluchistan	1.9	2.3	0.4
Pakistan	2.3	1.5	–0.7

Source: **Author's calculations** based on PIHS 2001-02 and 2004-05

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APPENDIX

Regional Cost of Living Indexes for Food

Pakistan has four provinces, each of which has rural and urban areas so we computed spatial price indexes for food for its eight regions. From the Pakistan Integrated Household Survey (PIHS) 2001–2002, we found that people consume about 80 food items in all the eight regions. We constructed the budget shares for 80 items for each region. The PIHS also provides the unit prices of different food items for each household. We calculated the median prices of 80 food items from individual households for each region.

Suppose a_j is the population share of the jth region (j varies from 1 to 8) and w_{ij} is the budget share of the ith food item in the jth region, then we obtained the national basket (or budget share) as

$$\overline{w}_i = \sum_{j=1}^{8} a_j w_{ij} \qquad \text{(a.1)}$$

Similarly, if p_{ij} is the median price of the ith food item in the jth region, then one can construct a national price for the ith food item as

$$\log(\overline{p}_i) = \sum_{j=1}^{8} a_j \log(p_{ij}) \qquad \text{(a.2)}$$

Where $\overline{p}_i$ is the national price of the ith food item.

The regional price indexes are constructed relative to the national prices. We can follow two alternative approaches, namely, Laspeyres and Paasche. These approaches are described in Deaton and Zaidi (2002). In the Laspeyres approach, we use the fixed national basket and evaluate it in terms of price relatives of each region:

$$Log(P_j^L) = \sum_{i=1}^{n} \overline{w}_i Log(p_{ij} / \overline{p}_i) \qquad \text{(a.3)}$$

In the Paasche approach, we use the basket of each region and evaluate it terms of price relatives of each region:

$$Log(P_j^P) = \sum_{i=1}^{n} w_{ij} Log(p_{ij} / \bar{p}_i) \qquad \text{(a.4)}$$

Our calculations for Pakistan showed that both approaches gave almost the identical results so we could any of the two approaches.

Regional inflation rate between two time periods

To update poverty line, we need to have an index that captures changes in prices over time. The prices do not change uniformly in all regions so we need to calculate the inflation rates separately for each region. Each region has a different food basket and baskets also vary between the two periods. We propose to use the Tornquist (1936) price index to calculate the inflation rates in the regional and national level.

Suppose w_{ijt} is the budget share of the ith food item in the jth region in year t, then we define the inflation rate from year t-1 to year t as

$$I_{jt} = \sum_{i=1}^{n} \left(\frac{w_{ijt-1} + w_{ijt}}{2}\right)[\log(p_{ijt}) - \log(p_{ijt-1})] \qquad \text{(a.5)}$$

And the inflation rate between the two periods at the national level is given by

$$\bar{I}_t = \sum_{i=1}^{n} \left(\frac{\bar{w}_{it-1} + \bar{w}_{it}}{2}\right)[\log(\bar{p}_{it}) - \log(\bar{p}_{it-1})] \qquad \text{(a.6)}$$

where $\bar{w}_{it}$ is the national budget share of the ith food item in year t and $\bar{p}_{it}$ is the national price of the ith food item in year t.