Multidimensional Measurement of Poverty in Pakistan

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MULTIDIMENSIONAL MEASUREMENT OF POVERTY IN PAKISTAN

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Abstract
Since the seminal work of Sen, it has been acknowledged that poverty is a multidimensional phenomenon and the unprecedented availability of relevant data has renewed interest in the multidimensionality of the poverty. The purpose of present study is to estimate the multidimensional poverty in Pakistan by using the data of Pakistan Social and Living Standard Measurement Survey 2005-06. The study used nine dimensions i.e. electricity, asset, water, sanitation, housing, education, expenditures, land, and empowerment. Results indicate that majority of Pakistan's households are deprived in five dimensions: Empowerment, Land, Housing, Sanitation and Asset. Overall 22.8 percent households are living below the expenditure poverty line, and in urban area 11.3% are expenditure deprived and 28.6% are expenditure deprived in rural area.

JEL Classification: I32 -I24 -I14.

Key Words: Pakistan, Multidimensional Deprivation, Regional Analysis.

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1: Introduction

The literature on Multidimensional poverty recognizes three broad classes of measures (Deutsch and Silber, 2005). The axiomatic approach to poverty measure, The Fuzzy set approach, and the information theory approach. Tsui (2002) develops an axiomatic framework for multidimensional poverty and derives two relative multidimensional poverty measures, one was the generalization of Chakravarty's (1983) unidimensional class of poverty indices, and other was the generalization of Watt's (1968) poverty index. Bourguignon and Chakravarty (2003) present a distinct family of multidimensional poverty indices; they distinguish two groups of multidimensional poverty, depending on whether they are treating dimensions to be independent or to have some substitutability or complimentarity. They replace the subgroup consistency of Tsui (2002) with separability axiom. They accept both poverty non-decreasing rearrangement and poverty non-increasing rearrangement. For both group of indices they recommend extension of FGT class of indices. Fuzzy set approach in a multidimensional framework was first used by Cerioli and Zani (1990) who drew inspiration from the theory of Fuzzy sets initiated by Zadeh (1965). Cerioli and Zani's original approach was later developed by sheli and lemmi (1995) giving origin to the so called Totally Fuzzy and Relative (TFR) approach Betti (2007). The distance function approach is widely used in Efficiency analysis. Lovell et al. (1994) were the first who used this for the analysis of household behavior. Information theory was originally developed by engineers in the field of communications. Theil (1967) was probably the first one to apply this theory to economics. One of the basic concepts used in such an approach is the logarithm of a probability [Deutsch & Silber 2005]. Information theory has been applied in Multidimensional inequality by many researchers for the perspective of Multidimensional Poverty this approach has been used by Miceli (1997) and Massoumi (2007). Still there is no consensus that which poverty measure is best one. For example, which measure could allow better targeting of the poor and suggest more effective poverty reduction policies. One easy solution of this problem is that the measure is considered good which clearly distinguish between rich and poor i.e., which has good identification criteria. Traditionally there are two identification approaches exist in literature, one is union and other is intersection approach. Intersection approach requires persons to be poor in each and every dimension which are to be considered in order to qualify for a person to be multidimensionally poor. This approach is often considered as too constricting and generally produces low estimates of poverty. Second approach is union approach which regards someone who is deprived in a single dimension as poor in multidimensional context. This is generally considered as overly inclusive and may lead to exaggerated estimates of poverty (Alkire & Foster 2007).

Alkire & Foster (2007) proposed a counting approach for measuring the multidimensional poverty. This approach has a number of characteristics that deserve mention. First the identification method mentioned in this approach is poverty focused i.e., an increase in the achievement level of a non-poor person leaves its value unchanged. Second, it is deprivation focused, i.e., an increase in any non-deprived achievement leaves the value of the identification unchanged. Third, this approach can be meaningfully used with ordinal data. Fourth, this approach satisfies several desirable properties including decomposability. Fifth, we can also assign different weights to each dimension.

The main objective of the paper is to apply the above mentioned methodology to estimate multidimensional poverty in Pakistan, which would complement the income poverty estimates performed by Planning Commission of Pakistan and other government agencies. This study also highlights the importance of each dimension because the beauty of this methodology is that, we find out the effect of each dimension in overall poverty. This study also gives policy guidelines to the policy makers in order to target each dimension in better way.

Rest of the paper is organized as follows. Section 2 briefly discusses the methodology and data used in the paper. Section 3 presents the selected dimensions, and deprivation cutoff values. Section 4 presents the estimation results. Finally, section 5 present conclusion and policy implications.

2: Data and Methodology

The dataset used in this paper is the 2005-06 Pakistan social and living standard measurement survey (PSLM) conducted by Federal Bureau of Statistics Pakistan. This is the second round of PSLM. The Household Integrated Economic Survey (HIES) [Part of PSLM] is the main source of data for poverty estimates in Pakistan (Arif 2003).The Household Integrated Economic Survey (HIES) has been conducted with some breaks since 1963. HIES Questionnaire was revised in 1990 in order to incorporate the requirements of the new system of national accounts. 1990-91, 1992-93, 1993-94 & 1996-97 surveys were conducted using revised questionnaire. In 1998-99 and 2001-02, the HIES data collection methods and questionnaire were changed to reflect the integration of the HIES with the Pakistan Integrated Household survey (PIHS). The HIES 2004-05 was conducted as part of first round of PSLM survey covering 14708 household taken as sub-sample of the 77000 households of PSLM survey. The current round of HIES has been carried out covering 15453 households. [FBS-2005-06]

In this paper we use a methodology for multidimensional poverty measurement proposed by Alkire and Foster's (2007). First we define the notations which will be helpful to provide an outline of the measure. Let $M^{n,d}$ denote the set of all $n \times d$ matrices, and $y \in M^{n,d}$ represents an achievement matrix of n people in d different dimensions. For every $i = 1, 2, \ldots, n$ and $j = 1, 2, \ldots, d$, the typical entry y_{ij} of y is individual i's achievement in dimension j. The row vector $y_i = (y_{i1}, y_{i2}, \ldots, y_{id})$ lists individual i's achievements and the column vector $y_j = (y_{1j}, y_{2j}, \ldots, y_{nj})$ gives the distribution of achievements in dimension j across individuals. Let $z_j > 0$ represent the cutoff below which a person is considered to be deprived in dimension j and z represent the row vector of dimension specific cutoffs. Following Alkire and Foster's (2007)'s notations, any vector or matrix v, $|v|$ denotes the sum of all its elements, whereas $\mu(v)$ is the mean of v.

Alkire and Foster (2007) suggest that it is useful to express the data in terms of deprivations rather than achievements. For any matrix y, it is possible to define a matrix of deprivations $g^0 = \left[g_{ij}^0 \right]$, whose typical element g_{ij}^0 is defined by $g_{ij}^0 = 1$ when $y_{ij} < z_j$, and $g_{ij}^0 = 0$ when $y_{ij} \geq z_j$. g^o is an $n \times d$ *matrix whose* ij^{th} entry is equal to 1 when person i is deprived in jth dimension, and 0 when person is not. g_i^o is the i^{th} row vector of g^o which represent person i's deprivation vector. From g^o matrix, define a column vector of deprivation counts, whose i^{th} entry $c_i = \left| g_i^0 \right|$ represents the number of deprivations suffered by person i. If the variables in y are only ordinally significant, g^o and c are still well defined. If the variables in y are cardinal then we have to define a matrix of normalized gaps g^1. For any y, let $g^1 = \left[g_{ij}^1 \right]$ be the matrix of normalized gaps, where the typical element is defined by $g_{ij}^1 = (z_j - y_{ij}) / z_j$ when $y_{ij} < z_j$, and $g_{ij}^1 = 0$ otherwise. The entries of this matrix are non-negative numbers less than or equal to 1, with g_{ij}^1 being a measure of the extent to which person i is deprived in dimension j. This matrix can be generalized to $g^\alpha = \left[g_{ij}^\alpha \right]$, with $\alpha > 0$, whose typical element g_{ij}^α is normalized poverty gap raised to the α-power.

After defining the notation, now we provide an outline of the class of multidimensional poverty measure suggested by Alkire and Foster (2007). A reasonable starting point is to identify who is poor and who is

not? Most of the identification method suggested in the literature normally follows the union or intersection approach. According to the union approach a person *i* is said to be multidimensionally poor if there is at least one dimension in which the person is deprived, whereas according to intersection approach a person *i* is said to be multidimensionally poor if that person is deprived in all dimensions. If dimensions are equally weighted then the methodology to identify the multidimensionally poor proposed by Alkire and Foster compares the number of deprivations with a cutoff level *k*. where *k*= 1,2,…,*d*. let us define the identification method ρ_k such that $\rho_k(y_i, z) = 1$ when $c_i \geq k$, and $\rho_k(y_i, z) = 0$ when $c_i < k$. This means that a person is identified as multidimensionally poor if that person is deprived in at least *k* dimensions. This is called dual cutoff method of identification because ρ_k is dependent on both the within dimension cutoffs z_j and across dimensions cutoff *k*. This identification criterion defines the set of the multidimensionally poor people as $Z_k = \{i : \rho_k(y_i; z) = 1\}$. A censored matrix $g^0(k)$ is obtained from g^0 by replacing the i^{th} row with a vector of zeros whenever $\rho_k(y_i, z) = 0$.An analogous matrix $g^{\alpha}(k)$ is obtained for $\alpha > 0$, with the ijth element $g_{ij}^{\alpha}(k) = g_{ij}^{\alpha}$ if $c_i \geq k$ & $g_{ij}^{\alpha}(k) = 0$ if $c_i < k$.

On the basis of this identification method, Alkire and Foster define the following poverty measures. The first natural measure is the percentage of individuals that are multidimensionally poor: the multidimensional Headcount Ratio $H = H(y; z)$ is defined by *H = q/n*, where *q = q(y,z)* is the number of people in set Z_k. This is entirely analogous to the income headcount ratio. This measure has the advantage of being easily comprehensible and estimable & this can be applied using ordinal data. However, it suffers from the disadvantages first noticed by Watts (1969) and sen (1976) in the unidimensional context, namely being insensitive to the depth and distribution of poverty, violating monotonicity and the transfer axiom. Where as in the multidimensional context, it also violates dimensional monotonicity [Alkire and Foster (2007)] . Alkire and Foster explain this as if a poor person already identified as poor become deprived in an additional dimension (in which this person was not previously deprived), *H* does not change.

To overcome this problem of multidimensional headcount, Alkire and Foster (2007) propose the dimension adjusted FGT measures, given by $M_{\alpha}(y; z) = \mu(g^{\alpha}(k))$ for $\alpha \geq 0$. When $\alpha = 0$, the measure is called Adjusted Headcount Ratio, defined by $Mo = \mu(g^o(k)) = HA$, the adjusted headcount ratio is the total number of deprivations experienced by the poor ($|c(k)| = |g^0(k)|$), divided by the maximum number of deprivations that could possibly be experienced by all people (*nd*). It can also be expressed as the product between the percentage of multidimensionally poor individuals (*H*) and the average deprivation share across the poor, which is given by $A = |c(k)|/(qd)$. In words, A provides the fraction of possible dimensions *d* in which the average multidimensionally poor individual is deprived. In this way, M_0 summarizes information on both the incidence of poverty and the average extent of a multidimensionally poor person's deprivation. This measure is easy to compute as H, and can be calculated with ordinal data and it is superior to H because it satisfies the dimensional monotonicity property.

The class of dimension adjusted FGT measure also yields the Adjusted Poverty Gap, give by $M_1 = \mu(g^1(k)) = HAG$, which is the sum of the normalized gaps of the poor ($|g^1(k)|$) divided by the highest possible sum of the normalized gaps (*nd*). It can also be expressed as the product between the percentage of multidimensionally poor persons (*H*), the average deprivation share across the poor (*A*) and the average poverty gap (*G*), which is given by $G = |g^1(k)| / |g^0(k)|$. The poverty measure M_1

ranges in value from 0 to 1. If the dimension of poor person deepens in any dimension, then the respective $g^1(k)$ will rise and hence so will M_1. Consequently M_1 satisfies monotonicity.

Finally, when α = 2, the measure is the Adjusted Poverty Gap, and it is represented by M_2 & $M_2 = \mu(g^2(k)) = HAS$, which is the sum of the squared normalized gaps of the poor ($\left|g^2(k)\right|$) divided by the highest possible sum of the normalized gaps (*nd*). It can also be expressed as the product between the percentage of multidimensionally poor persons (*H*), the average deprivation share across the poor (*A*) and the average severity of deprivations (S), which is given by $S = \left|g^2(k)\right| / \left|g^0(k)\right|$. M_2 Summarizes information on the incidence of poverty, the average range and severity of deprivations and the average depth of deprivations of the poor. If a poor person becomes deprived in a certain dimension, M_2 will increase more the larger the initial level of deprivation was for this individual in this dimension. This measure satisfies both types of monotonicity and also transfer, being sensitive to the inequality of deprivations among the poor as it emphasizes the deprivations of the poorest.

All members of the $M_\alpha(y;z)$ family are decomposable by population subgroups. Given two distributions x and y, corresponding to two population subgroups of size n(x) and n(y) correspondingly, the weighted average of sum of the subgroup poverty levels (weights being the population shares) equals the overall poverty level obtained when the two subgroups are merged:

$$M(x,y;z) = \frac{n(x)}{n(x,y)} M(x;y) + \frac{n(x)}{n(x,y)} M(x;z)$$

All members of the $M_\alpha(y;z)$ family can also be broken down into dimension subgroups. To see this, note that the measures can be expressed in the following way: $M_\alpha(y,z) = \sum_{i=1}^{n} \mu(g^\alpha_{*j}(k))/d$, where g^α_{*j} is the j[th] column of the censored matrix $g^\alpha(k)$. Strictly speaking, this is not decomposability in terms of dimensions, since the information on all dimensions is needed to identify the multidimensionally poor. However, Once the identification step has been completed, and the non-poor rows of g^α have been censored to obtain $g^\alpha(k)$ the above aggregation formula shows that overall poverty is the average of the d many dimensional values μ(g^α_{*j} (k)). Consequently, $(\mu(g^\alpha_{*j}(k))/d / M_\alpha(y,z)$ can be interpreted as the contribution of dimension *j* to overall multidimensional poverty.

The $M_\alpha(y,z)$ family adopts the neutral assumption of considering dimensions as independent. In this way, it satisfies a property, based on Atkinson and Bourguignon (1982), called *weak rearrangement.* The concept is based on a different sort of 'averaging' across two poor persons, whereby one person begins with weakly more of each achievement than a second person, but then switches one or more achievement levels with the second person so that this ranking no longer holds. In other words, we can say that a simple rearrangement among the poor reallocates the achievements of two poor persons but leaves the achievements of everyone else unchanged. This is called an association decreasing rearrangement. Under such rearrangement one would expect multidimensional poverty not to increase. This is postulated by the weak rearrangement axiom and it is precisely satisfied by the $M_\alpha(y,z)$, which will not change under such transformation. Because of its completely additive form, it evaluates each individual's achievements in each dimension independently of the achievements in the other dimensions of other's achievements.

We use same weights for all dimensions but this $M_\alpha(y,z)$ family can be extended into a more general form, admitting different weighting structures.

3: Selected Dimensions and Deprivation cut-offs

This section present the dimensions, indicators and cutoffs for each dimension used in this paper. In the following table, we summarize the question asked in PSLM 2005-06 and the percentage deprivation in each dimension. The previous sub-section introduced the dimensions and indicators used in our poverty analysis in the Pakistan's context. This sub-section explains the cut-offs that we want to apply for each indicator in this paper.

[PLACE TABLE 1 HERE]

4: Result and Discussion

4.1 Aggregate deprivation by dimension

Table 4 present the estimated headcount of overall Pakistan, urban area of Pakistan and Rural area of Pakistan in each dimension.

[PLACE TABLE 2 HERE]

It is evident from the above table that majority of Pakistan's households are deprived in five dimensions: Empowerment, Land, Housing, Sanitation and Asset. There are almost seventy eight percent household in which women are not even consulted in decision about purchase of some basic consumption items, this situation prevails both in rural as well as in urban areas of Pakistan with little difference (77.1% in urban and 78.4% in rural area). There are 65% households who don't have property worth more than 300,000 in aggregate from agriculture land, non-agriculture land, residential building or commercial building like shop or shopping plaza. In rural area this land deprivation is even more than urban area (45% in urban and 75.2% in rural area). More than 56% population of Pakistan lives in a household with three or more person in one room. In rural area more than 60% households are those in which three or more persons are living in one room. More than 40 percent households of Pakistan are still using dry raised latrine, dry pit latrine or even they have no facility of toilet in the house. In urban area though situation is better but almost 58% rural households do not have access to improved sanitation facilities. More than 40% households don't own any of the assets from the list of refrigerator, freezer, air conditioner, geyser, washing machine, camera, movie camera, car/vehicle, TV, VCR, vacuum Cleaner and PC. In urban area 14% are asset deprived whereas in rural area almost 55% are asset deprived. More than 26% Pakistani's are living in the household in which no member has education more than or equal to five year. In urban area this figure is 11.4% whereas in rural area 33.9% are education deprived. Overall 22.8 percent households are living below the expenditure poverty line, and in urban area 11.3% are expenditure deprived and 28.6% are expenditure deprived in rural area. Only 11% do not have access to drinking water in overall Pakistan and in rural area 14.7% household do not have access to clean drinking water. Only 4.2% households in urban area are water deprived. Almost 14% do not have access to electricity in overall Pakistan, only 23% don't have access to electricity in urban area and almost 20% are electricity deprived in rural area. If we include the quality of water and actual availability of electricity after load shading then these two deprivations gives us very different picture. Due to non availability of data we are not able to incorporate these in our analysis.

The analysis above gives us an idea about the deprivation rates in each dimension. However a household who is deprived in one dimension may not be deprived in any other dimension. On the other hand, a household could be deprived in six out of nine dimensions. Both of these households are deprived in at

least one dimension. Does it mean that they are equally poor? The answer is indeed no. The severity of deprivation for the latter household seems more intense. Thus it would be interesting to explore the breadth of poverty among households in Pakistan and different provinces of Pakistan. In the first column of table 5, we present the no of dimensions in which any particular household is deprived. For example, 15% of the sample is deprived in any one dimension and not in any other dimension. The second and third column present the number and percentage of households deprived in exactly that many dimension. Along with table we provide here a pie-chart to diagrammatically visualize the distribution of the breadth of multidimensional poverty.
[PLACE TABLE 3 HERE]
[PLACE FIGURE 1 HERE]

Result shows that 4.5 percent of all households are not deprived in any dimension. If total poverty is based on union approach then 95.5 percent households would live in poverty. According to the union approach a household is considered as poor if this household is deprived in at least one dimension. According to the intersection approach a household is considered as poor if it is deprived in all dimensions. 1.0 percent of households in Pakistan are considered as poor according to the intersection approach.
Alkire and Foster proposed an alternative method of the measurement of poverty using multidimensional headcount ratio (M.D. Headcount ratio) and the adjusted headcount ratio M_o. According to this methodology a household is considered as poor if a household is deprived in a certain number of dimensions. Suppose we select cut-off k=4 this means that a household is considered as multidimensionally poor if this household is deprived in at least four dimensions.
[PLACE FIGURE 2 HERE]

Estimate indicates that almost 61% of the population in overall Pakistan is deprived in three or more out of nine dimensions, and on average they are deprived in 4.8 dimensions, so that the adjusted headcount ratio Mo is 0.3310. Similarly more than 45% of the population in overall Pakistan is deprived in four or more out of nine dimensions, and on average they are deprived in 5.5 dimensions, so that the adjusted headcount ratio is 0.2772. When we use k=5 that is cutoff equal to 5 then 32 % of the households are deprived and on average they are deprived in 6.13 dimensions, so the adjusted headcount ratio in this case is equal to 0.2165. Almost 20% households in overall Pakistan are deprived in six or more out of nine dimensions. Almost 34% and 76% population in urban and rural area respectively are deprived in three or more out of nine dimensions, and their adjusted headcount ratios are respectively 0.1462 and 0.4287. Almost 17% and 60% population in urban and rural area respectively are deprived in at least four dimensions and their adjusted headcount ratios respectively are 0.0880 and 0.3772. When we use K=5 the multidimensional headcount and adjusted headcount ratio's for urban area is 0.0759 and 0.0470 respectively and for rural area these are 0.4455 and 0.3062. Similarly for k=6 almost 2.8% and 29% population in urban and rural area respectively are deprived and their corresponding multidimensional adjusted headcount ratios are 0.0206 and 0.2205.
The situation is worst in rural areas as compared to urban areas. Arif (2006) find out that ownership of land is highly unequal in Pakistan and considered as the main cause of rural poverty. The ownership of farm asset (other than land) among cultivating households is also unevenly distributed. This study also point out that existing tenancy arrangements, particularly sharecropping, have a strong relationship with rural poverty. Gazdar(2004) showed that almost 50% of rural households has no land at all, whereas the top 25 % contains almost 40% of all land. Malik(2005) divide Pakistan into Agro-climatic zones and found out that poverty is highest in those areas in which there is greater inequality. This study also found

out that more than 50% of the farms were found to be smaller than 5 acres in size and it constitutes only 16 % of total farm area. Only 5% of the farms were 25 acre or more in size and their total area was 38%. To study the deprivation in each dimension contributes to the overall multidimensional poverty, we analyses this by breaking down M_o by the dimension.
[PLACE TABLE 4 HERE]

In the above figure it can be seen that land, empowerment, housing, sanitation and asset are the main contributor in overall multidimensional poverty. Inasmuch water and electricity contributes less in this regard. When k=3, land is the one with highest contribution 18%, followed by empowerment 17%, housing 15% and sanitation and assets almost contributed same 14% followed by education, expenditure, electricity and water. When k=4 land contributes almost 17%, empowerment 15.6%, housing, asset and sanitation contributes almost same 14% followed by education, expenditure, electricity and water. When k=5, land contribute 15.59% followed by empowerment 14.55%, sanitation and assets contributed same 14.44%, housing 13.43%, education 9.8%, expenditure 7.5%, electricity contribute 6% and water contribute only 3%. When k=6, land contributes 14.39 followed by sanitation 14.05%, Asset 14%, empowerment 13.46%, housing 12.86%, education 10.61%, expenditure 8.31%, electricity 7.9% and water 4.43%. The analysis shows that land, empowerment, housing, asset and sanitation are the dimensions which are contributing most in the overall multidimensional poverty.

4.2: Overlapping and correlation between dimensions

The general argument in favor of income/expenditure measure of poverty is that income is highly correlated with achievements of other dimensions. In order to check this argument we use a simple Kendall's correlation among different dimensions. However, this doesn't seem to be in the case of Pakistan, as it is indicated in the following table.
[PLACE TABLE 5 HERE]

To confirm this we use another method in which we check whether there is any overlap between the group of poor identified with the multidimensional approach and the group of people identified with the traditional income approach. Ruggeri-Laderchi, saith and stewart (2003) present empirical evidence of significant lack of overlap in the identification by the monetary and the capability approach for the case of India and Peru and Maria Emma & Karma Ura (2008) in case of Bhutan.
[PLACE TABLE 6 HERE]

Table 6 show the percentage of households that are expenditure non-poor but multidimensionally poor, and the percentage of the household that are expenditure poor but multidimensionally non-poor. Result shows that the percentage of expenditure non-poor that are multidimensionally poor decreases as k increases. At k=1, 79.4% households are expenditure non-poor but they are multidimensionally poor, 63.7% when k=2, 45.7% when k=3, 30.2% when k=4, 18.6% when k=5, 9.7% when k=6, 4% when k=7, 0.8% when k=8 and 0% when k=9 this is 0% because all the multidimensionally poor in that case are deprived in every considered dimension, including expenditure. Similarly the percentage of expenditure poor but multidimensionally non-poor increases as we move from lowest value of k to the highest.

5: Conclusion

The main contribution of this paper is that this is the first attempt in the measurement of poverty in multidimensional context in Pakistan. If district level data were available such a methodology could be used at the district level data to identify district level priorities for public investment and hence to inform

multi sectoral planning at district government level. The methodology which we have used in this paper can help the policy makers in allocating the budget at the provincial level, regional level i.e., urban/rural level as well as within each dimension.

CITED REFERENCES

Ali, S. S., and S. Tahir, "Dynamics of Growth, Poverty, and Inequality in Pakistan," *Pakistan Development Review,* 38, 837–858, 1999.

Alkire, S. and J. Foster, "Counting and Multidimensional Poverty Measures", OPHI working paper series, (7), 2007.

Arif, G. M. "Poverty Dynamics in Pakistan: Evidence from the Two Panel Household Survey," In *Pakistan Human Condition Report 2003*. Islamabad: CRPRID, 2003.

Atkinson, A. B. and F. Bourguignon, "The comparison of multi-dimensional distribution of economic status," *The Review of Economic Studies*, 49, 183-201, 1982.

Betti G., Cheli B., Lemmi A., & Verma V, "The Fuzzy Approach to Multidimensional Poverty: the Case of Italy in the 1990s, in Kakwani N. and Silber J. (eds.), Quantitative Approaches to Multidimensional Poverty Measurement," New York: Palgrave Macmillan, 30-48,2007.

Bourguignon, F., and R. Chakravarty, "The Measurement of Multidimensional Poverty", *Journal of Economic Inequality*, 1, 25-49, 2003.

Bover, O. "Wealth Inequality and Household Structure: U.S. vs. Spain," *Review of Income and Wealth,* 56*(2),* 259-290*,* 2010.

Cerioli, A., and S. Zani, "A Fuzzy Approach to Measurement of Poverty", in C.Dagum and M.Zenga (eds), Income and wealth distribution, inequality and poverty: studies in contemporary economics. Berlin: Springer Verlag, 272-284, 1999.

Cheli, B., and A. Lemmi, "A Totally Fuzzy and Relative Approach to the Multidimensional Analysis of Poverty", *Economic Notes*, 24, 115-34, 1995.

Deutsch, J. and J. Silber, "Measuring Multidimensional Poverty: An Empirical Comparison of Various Approaches," *The Review of Income and Wealth*, 51, 145-174, 2005.

Emma, M. and K. Ura, "Multidimensional Poverty in Bhutan; Estimates and Policy Implications," *OPHI working paper series*, 14, 2008.

Federal Bureau of Statistics (FBS). *Pakistan Social and Living standard Measurement Survey 2005-06* Islamabad: Government of Pakistan, 2006.

Gazdar, H. "Labour Market and Poverty in Pakistan: Institutional Arrangements and Policy". In *Proceedings of the Seminar on Employment-based Poverty Reduction Strategy for Decent Work*. Islamabad: PIDE/ILO/UNDP, 2004.

Government of Pakistan, "Poverty Reduction Strategy Paper II", 2008. Available: http://www.finance.gov.pk

Hussain, A. "Pakistan National Human Development Report 2003: Poverty, Growth and Governance," *UNDP/Oxford University Press*, Karachi, 2003.

Jamal, H., A. J. Khan, I. A. Toor, and N. Anwar, "Mapping the Spatial Deprivation of Pakistan," *Pakistan Development Review,* 42, 91–112, 2003.

Klasen, S. "Measuring poverty and deprivation in South Africa," *Review of Income and Wealth*, 46(1), 33–58, 2000.

Luis, A. and A. Jurado, & J. Pérez-Mayo, "Income Poverty and Multidimensional Deprivation: Lessons from Cross-Regional Analysis," *Review of Income and Wealth***,** 57(1), 40-60, 2011.

Maasoumi, E. and M. A. Lugo, "The information basis of multivariate poverty assessments," in (N. Kakwani and J. Silber, eds.) The Many Dimensions of Poverty, Palgrave-MacMillan, 2007.
Malik, S. J., "Agricultural Growth and Rural Poverty: A Review of the Evidence," *Asian Development Bank, Pakistan Resident Mission*, Islamabad, Working Paper No. 2, 2005.
Ruggeri-Laderchi, Caterina, R. Saith, and F. Stewart, "Does It Matter That We Do Not Agree on the Definition of Poverty? A Comparison of Four Approaches," *Oxford Development Studies*, 31, 243-74, 2003.
Sen, A. K., "Poverty: An ordinal Approach to Measurement", *Econometrica*, 44, 219-231, 1976.
--- --, Development as freedom, 1st edition, New York: Knopf Press, 1999.
Summers, R. and A. Heston, "A New Set of International Comparisons of Real Product and Prices: Estimates for 130 Countries, 1950 - 85," *Review of Income and Wealth*, 34, 1 - 26, 1988.
Thon, D. "On Measuring Poverty," *Review of Income and Wealth*, 25, 429-440, 1979.
Tsui, K., "Multidimensional Inequality and Multidimensional Generalized Entropy Measures: An Axiomatic Approach," *Social Choice & Welfare*, 16, 145-158, 1999.
Van den Bosch, K. "Poverty and Assets in Belgium," *Review of Income and Wealth*, 44(2), 215-228, 1998.
Wolff, E. N. "Wealth Holdings and Poverty Status in the US," Review of Income and Wealth, 36 (2), 143-165, 1990.

-----, "Multidimensional poverty indices," *Social Choice & Welfare*, 19, 69-93, 2002.

Zadeh, L.A., "Fuzzy Sets," *Information and Control*, 8, 338-53, 1965.

Table 1: Different dimensions along with questions (Over all Pakistan)

Dimension	Questions in PSLM	Poverty line cut-off (The household is deprived if)
Housing	How many rooms does your household occupy	Three or more than three persons are living in one room
Water	What is the source of drinking water for the household	There is no access of clean drinking water i.e., Piped Water, Hand pump, Motorized pumping/ tube well, closed well)
Sanitation	What type of toilet is used by your household	Uses Dry raised latrine, Dry pit latrine, No toilet in the household
Electricity	Does your household have electricity connection	If no access to Electricity
Asset	Were/Are any of the following items owned by the household. (list is in appendix)	If does not own any of the following assets: Refrigerator, Freezer, Air conditioner, Geyser, Washing Machine, Camera movie, Car/vehicle, Motorcycle, TV, VCR, Vacuum Cleaner, PC
Education	What was the highest class completed/ What class are….currently attending	Maximum year of education completed by any member is less than five years
Land	Did any of the household members own or had owned during the last one year any of the following property. (list is in appendix)	If value of property is less than Rs: 300,000
Expenditure[2]	Expenditure of household on Non-durables and food items	Household per adult equivalent expenditure < Rs. 944.47 per month Pakistan's national poverty line
Empowerment	Who in your household usually make decision about purchase of following consumption items? Food, clothing, medical treatment, recreation and travel	If women is not consulted in basic decision about purchase of some basic consumption item.

[2] A household is considered as expenditure deprived if per adult equivalent household expenditure of this household is less than the poverty line of RS: 944.47 per month given by the Government of Pakistan, according to the Economic Survey of Pakistan 2008.

Table 2: Percentage deprivations of selected dimensions in Pakistan

Dimension	% Deprivation		
	Overall	Urban	Rural
Electricity	13.8	2.3	19.9
Asset	40.6	14.0	54.7
Water	11	4.2	14.7
Sanitation	40.5	6.7	58.3
Housing	56.2	48.4	60.3
Education	26.1	11.4	33.9
Expenditure	22.8	11.3	28.6
Land	64.8	45.0	75.2
Empowerment	77.9	77.1	78.4

Table 3: Percentage of Poor in different dimensions (Pakistan)

Dimensions	Frequency	Percent
0	701	4.5
1	2311	15.0
2	2704	17.5
3	2471	16.0
4	2130	13.8
5	1852	12.0
6	1451	9.4
7	1104	7.1
8	574	3.7
9	155	1.0
Total	15453	100.0

Table 4: Multidimensional Adjusted Headcount Ratio (Mo): Overall Pakistan
Contribution of each dimension at different K

Dimension	k=3	k=4	k=5	k=6
Electricity	0.0456	0.0533	0.0641	0.0789
Water	0.0336	0.0357	0.0382	0.0443
Sanitation	0.1310	0.1412	0.1444	0.1405
Asset	0.1314	0.1419	0.1444	0.1400
Housing	0.1548	0.1424	0.1343	0.1286
Education	0.0835	0.0915	0.0982	0.1061
Expenditure	0.0610	0.0687	0.0751	0.0831
Empowerment	0.1747	0.1560	0.1455	0.1346
Land	0.1845	0.1695	0.1559	0.1439

Table 5: Kendall's correlation among different dimensions: Overall Pakistan

Dimensions	Electricity	Water	Sanitation	Asset	Rooms	Education	Expenditure	Empowerment	Land
Electricity	1	---	---	---	---	---	---	---	---
Water	0.272*	1	---	---	---	---	---	---	---
Sanitation	0.394*	0.267*	1	---	---	---	---	---	---
Asset	0.399*	0.215*	0.526*	1	---	---	---	---	---
Rooms	0.099*	0.042*	0.208*	0.201*	1	---	---	---	---
Education	0.302*	0.147*	0.378*	0.417*	0.122*	1	---	---	---
Expenditure	0.215*	0.106*	0.281*	0.313*	0.283*	0.228*	1	---	---
Empowerment	0.046*	0.067*	0.087*	0.008	0.174*	-0.025*	0.063*	1	---
Land	0.235*	0.106*	0.382*	0.413*	0.249*	0.296*	0.242*	0.054*	1

***Correlation is significant at the 0.01 level (2-tailed).**

Table 6: Lack of overlap between Expenditure and Multidimensional Poverty

%% % of Population k=9	K=1	K=2	K=3	k=4	k=5	k=6	k=7	k=8
Expenditure Non-Poor but Multidimensional Poor 0%	79.4%	63.7%	45.7%	30.2%	18.6%	9.7%	4.0%	0.8%
Expenditure Poor but Multidimensional Non-Poor 19.6%	0%	0%	0.3%	1.5%	4.4%	8.0%	12.2%	16.5%

Figure 1: Percentage of Poor in different dimensions (Pakistan)

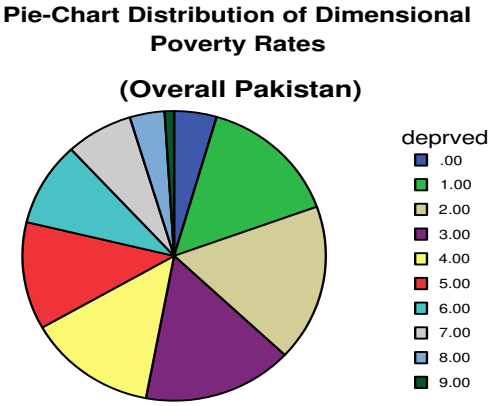

Figure 2: Multidimensional Headcount Ratio (H), Adjusted Headcount Ratio (M_o), Average Deprivation (A) in Rural and Urban areas of Pakistan at different K values

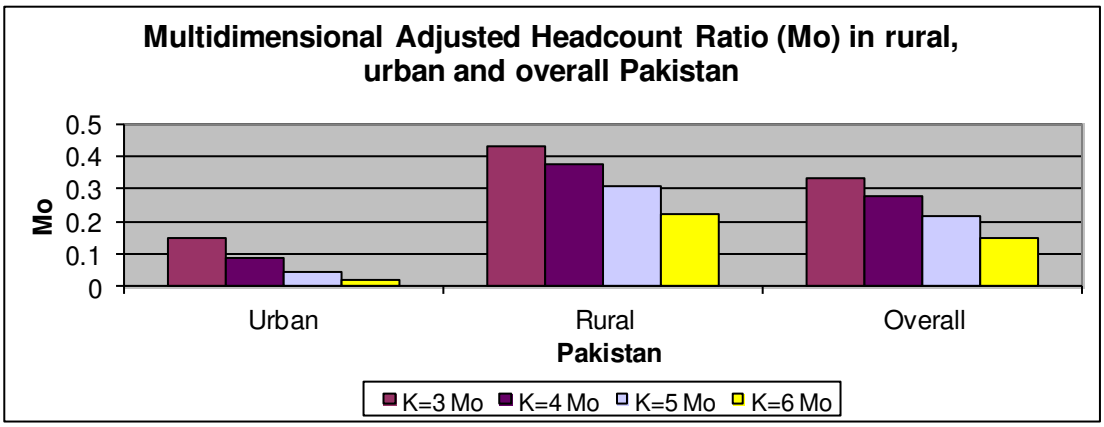

Figure 3: Multidimensional Adjusted Headcount Ratio (Mo): Overall Pakistan Contribution of each dimension at different K