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Multidimensional Inequality and Well-being in Pakistan: Evidence from Household Level Data

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Abstract

The present study investigated changes in multidimensional inequality in Pakistan. The study used Pakistan Social and Living Standard Measurement (PSLM) Survey datasets for three years 2001-02, 2007-08 and 2013-14. Three welfare distributions such as household per capita expenditures, access to education and health status are used in the study. The study employed Gini index, generalized entropy and stochastic dominance when inequality is measured for each dimension separately. The inequality is the highest in terms of education access. The stochastic dominance criteria demonstrate different orders for three attributes. The composite index is useful but social evolution function is not easy to construct as different formulations are considered. The pair wise technique has very useful policy implication when different attributes of welfare are distributed. The recommendations are made as specific regions or states should be focused where inequality is high. Moreover, efforts should also be made to narrow the skewed distribution of education.

Keywords: Distribution, Entropy, Inequality, Multidimensional, Pakistan.

Introduction

The main objective of any development policy is to improve the conditions of the poor in a society. This is possible only if different attributes are distributed equally among people. Income or consumption is used as an indicator to measure inequality. The use of non-monetary dimensions such as education and health is increasing when measuring inequality. Some indicators such as education or income are used to measure inequality which are distributed differently and hence have different level of welfare. (Sen, 1985). The inequality dimensions are determined by different factors. For example, employment and wage composition determine income distribution while health and educational outcomes may be determined by public provision and quality of such services or opportunity to access these services (Jensen & Nielson, 1997). These differences divert the research to joint distribution of welfare distributions. Then, inequality is required to be measured along income and non-income distributions. Therefore, to reduce inequality in real terms, a multidimensional approach is essential. Different reports published by international institutions such as global monitoring report (2016) highlight the importance to measure inequality in a multidimensional manner. The sustainable development goals (SDGs) also provide rationale for multidimensional inequality. Since the seminal paper of Kolm (1977), the attention has been converted to multidimensional inequality.

There is much theoretical literature on multidimensional inequality but empirical literature on multidimensional inequality is scarce. Tsui (1995) generalized the inequality indices of Atkinson-Kolm-Sen approach while Tsui (1999) derived axiomatically multidimensional generalized entropy. These indices are parametrically restricted and are not interpretable. Maasoumi (1986) derived a two

stage procedure for multidimensional index. Bourguignon (1999) also proposed multidimensional inequality index. These two inequality indices have been used in the literature for the measurement of multidimensional inequality empirically. Different studies such as (Lugo, 2005; Nilsson, 2010; Aristei & Bracalente, 2011; Decancq & Lugo, 2012; Justino, 2012; Rohde & Guest, 2013) used these indices for the empirical application of multidimensional inequality.

As for as Pakistan is concerned, inequality has been measured along a single dimension such consumption or income distribution. There is a large number of studies (Bergan, 1967; Azfar, 1973; Kruijk & Leuwen, 1985; Jafri & Khattak, 1995; Haq, 1998; Nasir & Mahmood, 1998; Ahmed, 2000; Jamal, 2003; Cheema & Sial, 2010) which used income or consumption to measure inequality in Pakistan. But no study in our knowledge has been conducted on multidimensional inequality in Pakistan. In order to measure changes over time in multidimensional inequality, a comparative analysis is conducted through household level data at national, provincial and regional level. The study used three well-known welfare distributions such as consumption, education and health for the measurement of multidimensional inequality. Three techniques have been employed for the measurement of multidimensional inequality. First inequality is examined for different distributions using different inequality indices. In the second technique, multidimensional index developed by Maasoumi (1986) is used while in the third technique pair wise joint distribution has been used. The present paper contributed in different ways. Firstly, it is an empirical application of theoretical literature currently growing on multidimensional inequality and we use different distributions and techniques. Secondly, we used household level data for the empirical application at country level which is more informative. Thirdly, the paper has a wide range of dataset over 14 year in Pakistan and uses multiple dimensions which are more reliable and useful for policy purposes rather focusing on only monetary perspective.

Materials and Methods

The study followed Justino (2012) to measure multidimensional inequality by employing three approaches as dimension-by-dimension, aggregative strategy and non aggregative strategy.

Dimension by Dimension Approach

Lorenz is the pioneer of the famous 'Lorenz curve' to measure inequality graphically and Gini (1912) extended the work of Lorenz and introduced the Gini index which is related to Lorenz curve. The numerical value of Gini ranges from zero to one or (0<G<1). The statistical value of zero indicated perfect equality whereas one implies perfect inequality. The Gini index satisfies different properties such as population independence principle, anonymity, scale independence principle and the Pigou-Dalton transfer principle (Lugo, 2005). The Gini index may be is represented by the formula as by (1).

$$G = \frac{1}{2n^2\mu}\sum_{i=1}^{n}\sum_{m=1}^{n}\left[x_i - x_m\right] \quad (1)$$

Theil index and the mean log deviation (MLD) family of measures by selecting the different values of inequality aversion parameter α and weights allow checking the stability of welfare rankings. The general formula of the GE class of inequality indices may be written as (2).

$$G(\alpha) = \frac{1}{\alpha^2 - \alpha}\left[\frac{1}{n}\sum_{1}^{n}\left(\frac{x_i}{\mu}\right)^{\alpha}\right], \alpha \neq 0,1 \quad (2)$$

When $\alpha = 0$ and $\alpha = 1$ the general form mentioned above becomes (3) and (4)

$$G(0) = \left[\frac{1}{n}\sum_{i=1}^{n}\log\left(\frac{\mu}{x_i}\right)\right] \quad (3)$$

$$G(1) = \left[\frac{1}{n}\sum_{i=1}^{n}\left(\frac{x_i}{\mu}\right)\log\left(\frac{\mu}{x_i}\right)\right] \quad (4)$$

Where $G(0)$ refers to as MLD, $G(1)$ corresponds to Theil's T inequality index and $G(2)$ refers to Theil's L inequality index, which show sensitive to low values in the distribution, assign equal weight to all values in the distribution and give more weight on the differences in the distribution of the upper tail respectively. This inequality measure ranges from zero to infinity. The lower value represents the lower level of inequality while higher values corresponds the higher levels of inequality.

The alternative approach has been widely used and is becoming popular during the recent years (Atkinson, 1970; Formby, Smith & Zheng, 1999). This approach can be used for inequality comparisons between units, groups or over time or space. Comparisons based on orderings for example first or higher order stochastic dominance conditions by employing a single variable at a time (Justino, 2004). First-order stochastic dominance condition between two distributions can be compared by their respective CDFs. The CDF to the right or below dominates the other one provided that two curves did not cross each other.

Aggregative Strategies

This study employed Maasoumi (1986) index is for multidimensional measurement of inequality. Maasoumi index is based on information theory. The index has two step procedures, first attributes are aggregated for each individual then an inequality measure is applied as in the case of the univariate analysis. General entropy measures are chose on the basis of information theory at both the stages as it is better than axiomatic approach. This measure has some normative differences but some decisions have to be made to arrive at some conclusions such as functional form of social welfare functions, weights, degree of complementarity or substitution between attributes and transfer sensitivity or inequality aversion parameter.

The identification of S_i is a 'well-being' function in which all the attributes are aggregated with analogous characteristics is the step one of Maasoumi (1986) index. The distribution of $S = (S_1, S_{2,}...S_n)$ that minimizes D_β with respect to S_i and such as $\sum S_i = 1$ which offer an 'optimal' aggregation functions. When $\beta = 0$, then S_i function may have the following form:

$$S_i \propto \begin{cases} \left(\sum_{m=1}^{M} w_m x_{im}^{\beta} \right) \\ \prod_{m=1}^{M} x_{im}^{w_m} \end{cases} \qquad (5)$$

Where, $w_m = d_m \Big/ \sum_{m=1}^{M} dm$ represents the weight allotted to the attribute m in the entire aggregator function. It is simple that S_i implies the general weighted mean with formulation of the well known CES and Cobb-Douglas functions as the special cases. The final form of Maasoumi (1986) measure and may be written as.

$$I_M = \frac{1}{\alpha(\alpha - 1)} \frac{1}{n} \sum_{i=1}^{n} \left[1 - \left(\frac{S_i(S_{ij}, \beta, W_j)}{\bar{S}} \right)^{\alpha} \right] \qquad (6)$$

Where S_i has previously determined and $\bar{S} = \sum_{i=1}^{n} s_i / n$ is the mean value for n individuals of a wellbeing indicator and refers to the parameter of 'inequality aversion' which shows that at lower value of α more sensitive changes will occur at the lower end of the distribution.

Non Aggregative Strategy

Multidimensional inequality indices are attractive which combine information of each distribution into summary index. But it is criticized that these multivariate indices leads to the loss of information in the process of aggregation. Moreover, these indices are hard to reach any conclusion

and some decisions have to be made regarding the functional form, weights, degree of substitution and inequality aversion. These concerns have been deals with discrete welfare attributes approach. If whole the population is divided into N exhaustive and exclusive subgroups. These subgroups, for example, a literate is superior to illiterate, a healthy person is better than an ill one, income in the fifth quintile is better than the first, second, third or the fourth income quintiles. The social welfare function for all groups may be written as.

$$W = \sum_{n=1}^{T} n_i \int_0^a u^i(x) f^i(x) dx \quad (7)$$

Here $f^i(x)$ refers to the distribution within group i of the concerned welfare attribute and normalization of the distribution.

The attributes to be substitutes is the key objective among the class of utility functions which shows the cross partial derivative $u_{12} \leq 0$ which indicated that it is restricted to the negative sign. This identified that attribute decreases in marginal utility with the level of the other and can be well described as.

$$u_1 = \left[u_1, u_2 \geq 0, u_{12} \leq 0\right] \quad (8)$$

Chipman (1977) presented the more powerful property of substitution of the Auspitz-Lieben-Edgeworth-Pareto (ALEP), u_1 version of the above mentioned condition. This for example, requires that if an individual is becoming richer then the marginal utility in relation to all other welfare attributes must decrease.

$$u_{ALEP} = \left[u_1, u_2 \geq 0, u_{11} \leq 0, u_{22} \leq 0, u_{12} \leq 0\right] \quad (9)$$

Now, if the ALEP utility functions has two subsets income and health. If first attribute is regarded as income and health is the second attribute (Muller & Trannoy, 2003). In the first subset where compensating attribute is income while health is the compensated attribute. This can be written as.

$$u_{MT1} = \left[u_1, u_2 \geq 0, u_{11} \leq 0, u_{22} \leq 0, u_{12} \leq 0, u_{112} \geq 0\right] \quad (10)$$

Now, the attribute income becomes the compensated attribute in the 2nd subset.

$$u_{MT2} = \left[u_1, u_2 \geq 0, u_{11} \leq 0, u_{22} \leq 0, u_{12} \leq 0, u_{211} \geq 0\right] \quad (11)$$

When there is variation in marginal utilities, the above mentioned conditions can be used for the comparison purpose between two distributions, *x* and *y*. If the income distribution amongst the uneducated (unhealthy) is worse in *x* than *y*, then inequality in the multidimensional context is said to be greater in distribution *x* than *y* and the distribution of education or health is worse in *x* than *y* amongst the poor people. The subset one has been planned when someone is interested to assess the income distribution among the uneducated or unhealthy. It is presumed that u_{112} has positive sign which indicates decrease of marginal utility in income is smaller among the literate (or healthy) than among the illiterate (or unhealthy). Whereas the subset two shows that difference in education or health's marginal utilities among the poor are larger as compared to the rich. The comparison of distributions of income (non-income) attributes across 'equals' was the major idea behind this (for those that are uneducated or have chronic illness).

The study used PIHS/PSLM data sets 2001-02, 2007-08 and 2013-14 collected by Pakistan Bureau of Statistics (PBS). The data has information about population weights for every primary sampling unit so that the collected data can be made representative at national level. The households at national level along with the rural and urban domains have been divided into four provinces. These survey adopted two stage stratified sampling technique. At the first stage, enumeration blocks and villages are selected randomly with Probability Proportional to the Size (PPS) technique as Pri-

mary Sampling Units (PSUs). At stage two, households within PSUs are selected as Secondary Sampling Units (SSUs). These data sets have 14565, 15512 and 17989 households for three years 2001-02, 2007-08 and 2013-14, respectively.

The study used three welfare attributes such as adult equivalent per household expenditure, education and health risk index (HRI). Health risk index is combination of four indicators such as crowding, sanitation drinking water and gas connection. Sanitation, is yes if $I_t = 1$, and $I_t = 0$, otherwise. Drinking water, yes if $I_w = 1$ and $I_w = 0$, otherwise. The third indicator, gas connection, defines $I_g = 1$ if a household has gas connection and $I_g = 0$ otherwise. The last indicator is per person room (crowding) $I_c = M_n / R_n$. Equal weights have been applied. The higher the value of health index mirrors the better quality of health by equation (12).

$$HRI = \frac{1}{4} I_w + \frac{1}{4} I_t + \frac{1}{4} I_c + \frac{1}{4} I_g \qquad (12)$$

Results and Discussion

Dimension By Dimension Approach

In dimension by dimension approach inequality is measured across each dimension separately. As shown in Table 1 that monetary inequality in Pakistan revealed a significant population is living under acute types of poverty and destitution, while a small minority have controlled over most of the nations' wealth. Furthermore, income inequality levels in Pakistan have changed little over time which recommends that these problems are structural not the short-term transitional effects. The monetary inequality increased in 2007-08 then decreased in 2013-14 at all levels in Punjab and KPK. Balochistan is the most equal province followed by KPK, Punjab and Sindh while inequality is lower in rural areas than the urban region. The GE inequality measures have analogous patterns to the Gini coefficient. This designates that the estimates of inequality by the Gini coefficients are robust to different weights in Pakistan. The distribution of consumption revealed slow changes in the consumption growth of whole sample and the poorest relative to the richest households between 2001-02 and 2013-14. The income distribution becomes equal when extra weight is placed on the observations of the distribution in the lower tail and increases with α.

Table 1. Monetary Inequality in Pakistan

	Pakistan	Punjab	Sindh	KPK	Balochistan	Urban	Rural
2001-02							
Gini	0.34	0.34	0.40	0.27	0.24	0.39	0.25
GE(0)	0.19	0.19	0.27	0.12	0.10	0.25	0.10
GE(1)	0.25	0.24	0.38	0.14	0.12	0.32	0.11
GE(2)	0.52	0.41	0.89	0.22	0.22	0.61	0.16
2007-08							
Gini	0.35	0.36	0.39	0.30	0.26	0.40	0.26
GE(0)	0.21	0.21	0.26	0.15	0.11	0.26	0.11
GE(1)	0.28	0.27	0.39	0.19	0.13	0.34	0.13
GE(2)	0.62	0.54	1.02	0.29	0.20	0.72	0.18
2013-14							
Gini	0.31	0.33	0.29	0.30	0.25	0.34	0.26
GE(0)	0.16	0.18	0.14	0.15	0.11	0.19	0.11

	Pakistan	Punjab	Sindh	KPK	Balochistan	Urban	Rural
GE(1)	0.20	0.21	0.16	0.18	0.15	0.23	0.12
GE(2)	0.34	0.37	0.26	0.30	0.38	0.39	0.16

Source: Author's calculations.

Figure 1 explores the relationships further by drawing Lorenz curves across different distributions. The results of monetary inequality are compared with other studies (Jamal, 2003; Ahmad, 2000, Anwar, 2010) conducted in Pakistan have almost same results and trends.

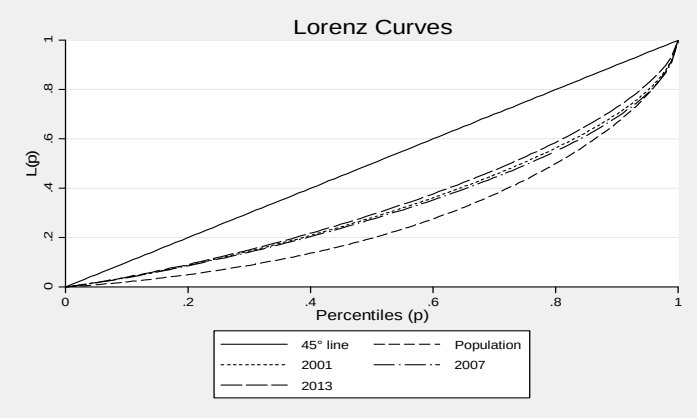

Figure 1. Expenditure Lorenz Curves in Pakistan

The literature revealed that without investment in humans, sustainable economic growth cannot easily gained. Health and education and are the core aspects of human investment (Gakidou, Murray & Frenk, 2000; Mincer, 1958). However, education achievement and education distribution is more unequal across population and even groups or across countries (Checchi, 2000). This fact motivated the interest in the analysis of education and health distributions (Basu & Foster, 1998). The two welfare dimensions such as education and health are less examined in Pakistan. Cross country studies revealed that average education Gini in South Asia is 0.66. As Table 2 clearly depicts that education inequality in Pakistan is high as compared to monetary inequality. The education inequality decreases slowly, is validated by other indices, decreases with higher weight places to distances in the upper tail of distribution. The decrease in education inequality is larger between 2007 and 2014 than between 2001 and 2008 when GE (2) is examined. The education inequality is the lowest in Punjab followed by Sindh, KPK and Balochistan.

Table 2. Education Inequality in Pakistan

	Pakistan	Punjab	Sindh	KPK	Balochistan	Urban	Rural
2001-02							
Gini	0.47	0.44	0.46	0.50	0.55	0.34	0.54
GE(0)	0.11	0.10	0.12	0.11	0.08	0.09	0.11
GE(1)	0.09	0.09	0.10	0.09	0.07	0.07	0.09
GE(2)	0.36	0.31	0.33	0.42	0.51	0.19	0.49
2007-08							
Gini	0.42	0.38	0.40	0.45	0.49	0.30	0.48
GE(0)	0.10	0.09	0.10	0.10	0.10	0.08	0.10

	Pakistan	Punjab	Sindh	KPK	Balochistan	Urban	Rural
GE(1)	0.08	0.08	0.09	0.09	0.09	0.07	0.09
GE(2)	0.27	0.23	0.26	0.32	0.39	0.15	0.37
2013-14							
Gini	0.41	0.35	0.46	0.42	0.52	0.26	0.48
GE(0)	0.09	0.08	0.09	0.09	0.12	0.06	0.10
GE(1)	0.08	0.07	0.08	0.07	0.10	0.05	0.09
GE(2)	0.27	0.19	0.34	0.28	0.45	0.11	0.38

Source: Author's calculations.

Figure 2 further explains the Lorenz curves of education which explains that education inequality decreased as the Lorenz curve shifted inward and increased when Lorenz curve shifted outward.

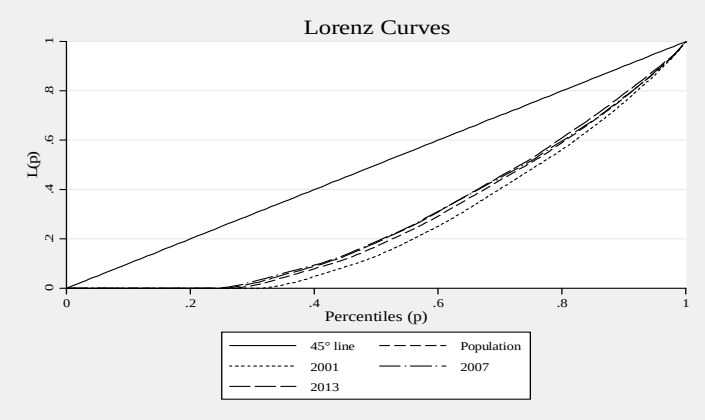

Figure 2. Education Lorenz Curves in Pakistan

Table 3 shows that the health status is relatively homogenous in households resulting in a rather low health inequality level in Pakistan. However, health Gini coefficient decreased slowly overtime. This decrease in inequality over time has also been authenticated with changes in GE (α) class of measures.

Table 3. Health Inequality in Pakistan

	Pakistan	Punjab	Sindh	KPK	Balochistan	Urban	Rural
2001-02							
Gini	0.23	0.23	0.23	0.23	0.24	0.20	0.25
GE(0)	0.09	0.08	0.08	0.08	0.09	0.06	0.11
GE(1)	0.09	0.08	0.08	0.09	0.09	0.06	0.10
GE(2)	0.09	0.09	0.09	0.09	0.10	0.07	0.11
2007-08							
Gini	0.21	0.20	0.21	0.21	0.20	0.18	0.22
GE(0)	0.07	0.07	0.07	0.07	0.07	0.05	0.08
GE(1)	0.07	0.06	0.07	0.07	0.06	0.05	0.08
GE(2)	0.08	0.07	0.08	0.07	0.07	0.06	0.09

	Pakistan	Punjab	Sindh	KPK	Balochistan	Urban	Rural
2013-14							
Gini	0.20	0.19	0.19	0.20	0.22	0.17	0.22
GE(0)	0.07	0.06	0.06	0.07	0.09	0.04	0.08
GE(1)	0.07	0.06	0.06	0.06	0.08	0.04	0.08
GE(2)	0.07	0.06	0.06	0.07	0.09	0.05	0.08

Source: Author's calculations.

The health inequality is the lowest in KPK and the highest in Balochistan in 2001-02 while least in Balochistan and the highest in Sindh in 2007-08 and 2013-14 distributions and fall over time. However, health inequality is higher at rural level as compared to urban level and the relationship has also been explored through Figure 3. When results are compared across dimensions, health inequality is shown as the lowest while education inequality is the highest. Education and health inequalities are higher at rural level while monetary inequality is higher at urban level.

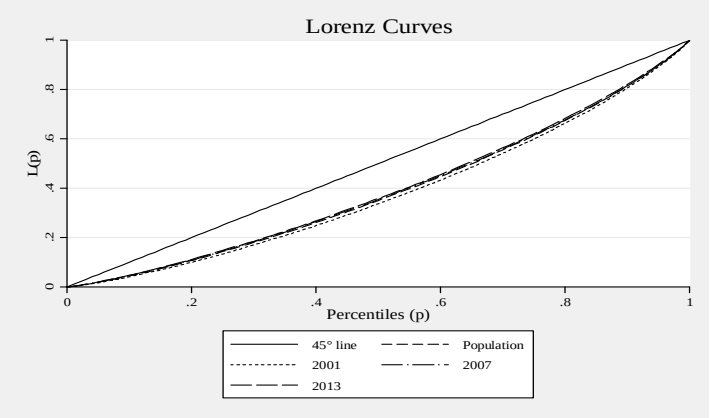

Figure 3. Health Lorenz Curves in Pakistan

A general inference from this exercise reveals that there are disparities in the pattern of inequalities across different welfare distributions. The inferences which have been drawn from the dimension by dimension approach support the notion of multidimensional inequality to combine the different dimensions of welfare into a single index. However, monetary and nonmonetary inequalities show different magnitudes, divergent trends and patterns in changing inequality over time. Moreover, it motivated to examine complementarities among different dimensions into a single measure.

Stochastic Dominance

The first and second order criteria is tested by second alternative approach by using the cumulative distributions functions of welfare attributes. First order stochastic dominance indicated by comparing the CDFs of 2001-02, 2007-08 and 2013-14 distributions of the respective attributes. Figure 4 shows the CDFs of adult per capita consumption expenditure distribution and revealed that 2013-14 stochastically dominated the other two 2001-02 and 2007-08 distributions. Figure 5 shows the CDFs of the highest level of education achieved by any household member of three distributions. It is clear that the CDFs crosses the each other which means that 2013-14 does not first order stochastically dominates the other two distributions. Figure 6 reveals that the CDFs of health risk index of three distributions also has not clear dominance and curves cross each other which shows that first order stochastically dominant conditions is not fulfilled.

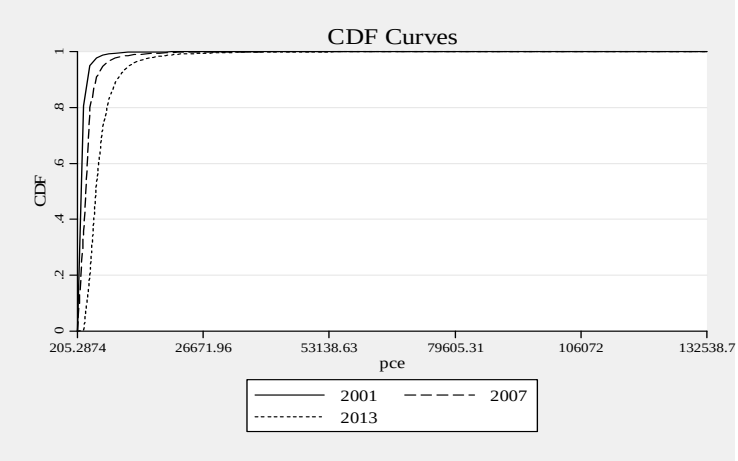

Figure 4. CDFs of consumption expenditure

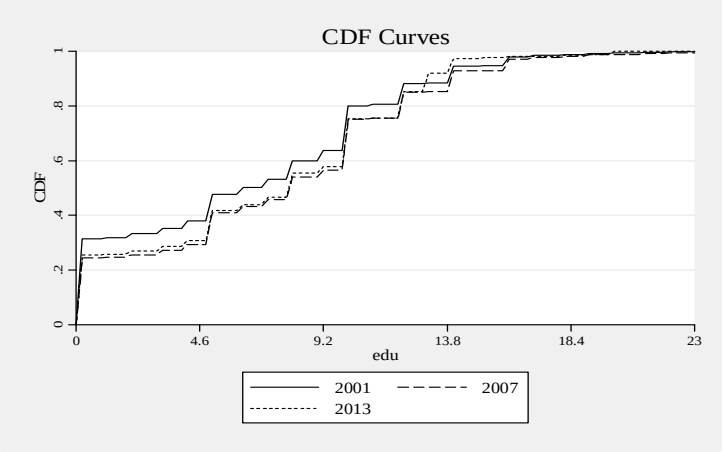

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Figure 5. CDFs of highest level of education achieved

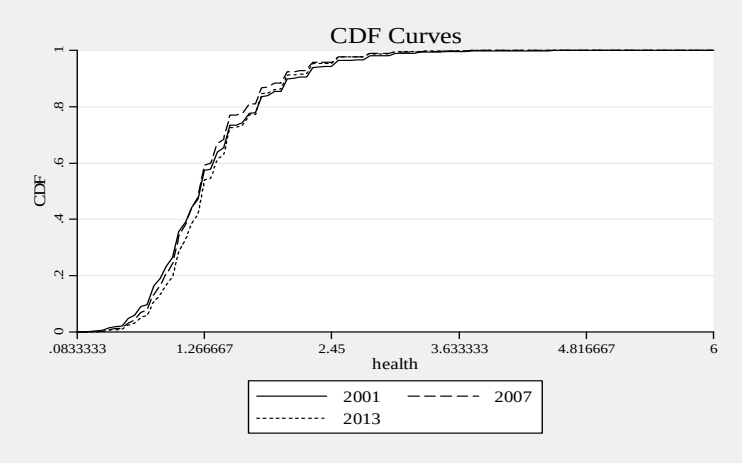

Figure 6. CDFs of health risk index

Aggregative Strategy

The interrelationships and possible correlations have been ignored among different attributes in a single dimension approach as estimated in the previous section. For instance, in a society where one person is at the top in rank for all dimensions while the other person may be ranked the second and third person may be ranked third and so on. The second society is more unequal than the first one if the second society has same distributional profile in each and every attribute. But where a few persons are top-ranked in some attributes while the other persons in other attributes and if do not care about these interrelationships then it is deviation from the basic objective of the multidimensional inequality (Decancq & Lugo, 2012). This section has incorporated these concerns and used multidimensional index for the measurement of inequality. The study used equal weights, different values of β and value of inequality aversion parameter α. First of all, data is normalized on the same scale for the comparison purpose among the three attributes which based on (UNDP, 1995) technique is used in HDI formula as shown by (13).

$$N_{im} = \frac{x_{im} - \min x_{im}}{\max x_{im} - \min x_{im}} \tag{13}$$

Where $i = 1, 2..., n$ and $m = 1, 2, 3$ while i refers to individuals or households, m represents attributes or number of dimensions. The study estimated multidimensional inequality only for M(0) in order to abridge the discussion. The results of the four (N4 to N7) multidimensional N functions have been included and these results are also compared with the other one dimensional household distributions such as consumption (N1), education (N2) and health (N3). The welfare function N4 which consists of two indicators by education and consumption expenditure; N5 is determined by health and consumption expenditure; N6 is determined by education and health status while N7 adds consumption, education and health status of household welfare dimensions. Before the application of three attributes for the construction of a multidimensional index, the analysis is carried out for each distribution across household. The Gaussian Kernel density is used for each attribute separately. The Kernel density is estimated by following the Goerlich-Gisbert (2003).

$$\hat{f}(\hat{x}) = \frac{1}{\vartheta}\sum_{m=1}^{M} d_m k\left(\frac{x_m - \hat{x}}{\vartheta}\right) \tag{14}$$

Where $d_m \geq 0$ and $\sum_{m=1}^{M} d_m = 1$, k implies the density of normal distribution. The bandwidth ϑ is estimated as $\vartheta = 0.9M^{1/\kappa} X \min\{sd(x), irq(x)\}$, however $\kappa < 0$ while $sd(x)$ and $irq(x)$ implies standard deviation and interquartile range of x respectively. Figures 7 to 9 reveal the estimates of kernel density. The expenditure per adult equivalent has unimodal while other two attributes education and health densities have not. The reason may be that many households in Pakistan that have no adult member who have completed even one year of education. It illustrated the existence of left mode in the kernel density of highest level achieved by any adult member in the household. The health risk index has more than two modes which is an index of dichotomous and continuous variables and clump is possible. The reason may be that a large number of households have access to gas and it has 25 percent weight. There may be some households who have good performance in safe drinking water and high performance in other indicators too and other group of households which have access to drinking water but not have high performance in other indicators.

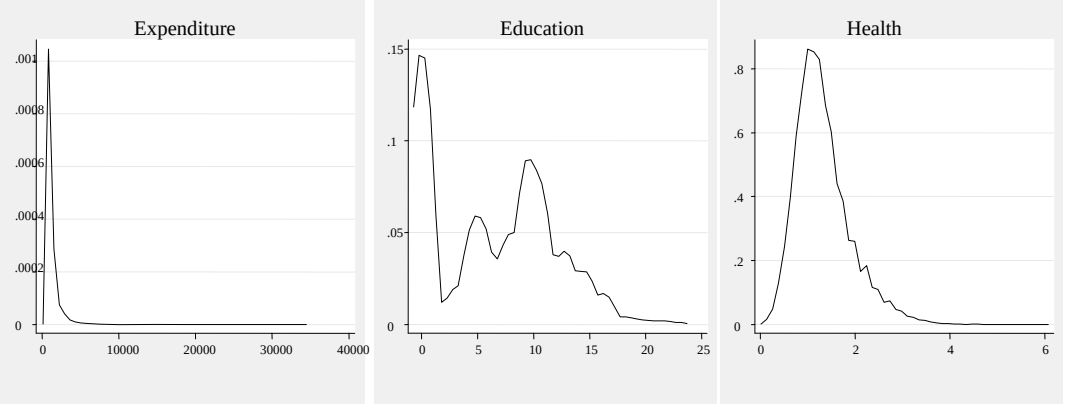

Figure 7. Kernel density estimate for three attributes (2001-02)

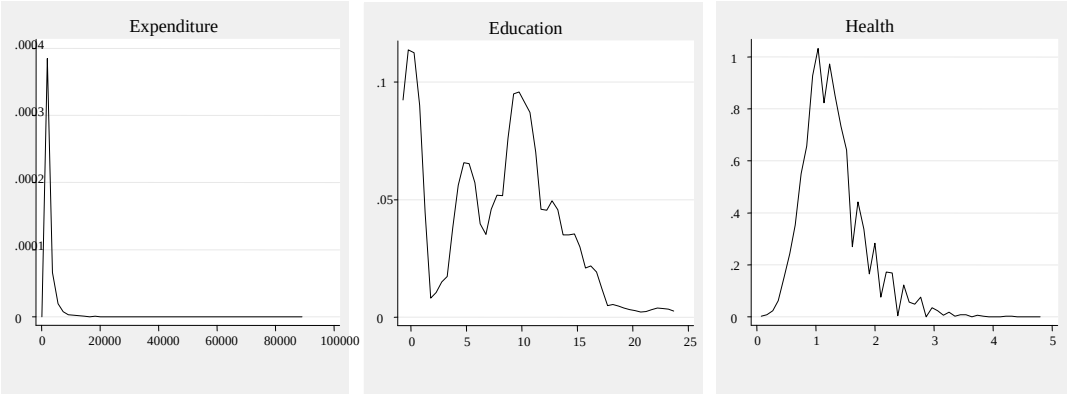

Figure 8. Kernel density for three attributes (2007-08)

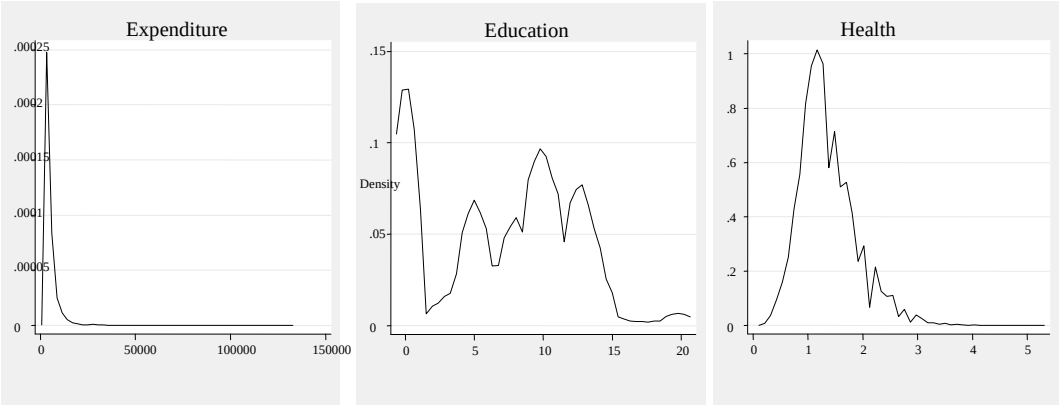

Figure 9. Kernel density for three attributes (2013-14)

Table 4 shows different functions which employed equal weights for each household welfare distribution while degree of substitution parameter assumes different values in the range (0.3 to 1). Conclusions are drawn on the basis of these results which are largely dependent on transfer sensitivity coefficient and the social welfare function. As a traditional point of view, initially the Maasoumi multidimensional inequality index is examined by employing the monetary and other education and health attributes in turn. As a result, the study discovers additional insights when multidimensional approach is employed and compared with the monetary inequality exclusively. The results exhibit that when important different ranges of economic conditions such as health and educa-

tion are ignored and results in underestimation if attributes are supposed to be complements, if elasticity of substitution is lower and overestimation if attributes are assumed to be lower.

Table 4. Masuumi index of multidimensional inequality M (0)

Variable	N1	N2	N3	N4	N5	N6	N7
2001-02 β=1.0	0.60	0.27	0.53	0.77	0.52	0.56	0.55
β=0.8				0.87	0.59	0.63	0.60
β=0.5				1.12	0.79	0.84	0.73
β=0.3				1.53	1.08	1.20	0.82
2007-08 β=1.0	0.59	0.30	0.52	0.75	0.51	0.54	0.53
β=0.8				0.84	0.59	0.61	0.58
β=0.5				1.09	0.79	0.80	0.68
β=0.3				1.48	1.08	1.14	0.79
2013-14 β=1.0	0.58	0.28	0.51	0.89	0.51	0.54	0.54
β=0.8				1.00	0.61	0.61	0.59
β=0.5				1.30	0.87	0.82	0.73
β=0.3				1.74	1.22	1.15	0.89

Source: Author's calculations.

When changes are examined in multidimensional inequality over time, it is clear that one combination including expenditure and education (N4) significantly increased between 2001-01 and 2013-14. When the combination of expenditure and health are included together then M(0) decreased over time. This provided motivation to include other set of combinations of three attributes with this particular variable. This set of combination of three attributes (N7) demonstrate increased dispersion then decreased in the second period but overall inequality decreased between 2001-02 and 2013-14 with the choice of β. Figure 10 explains that the non monotonous growth of multidimensional inequality across different values of β instigates a detail examination with the choice of substitution parameter. In theoretical literature the degree of substitution, different weights and inequality aversion parameter do not take a predominant role; however in the above context it plays a major role across choice of degree of substitution parameter (Anand & Sen, 2003). All the combinations point to the same inference that inequality is sensitive to degree of substitution and emphasis that not to be concluded from one or two point estimates but test an array of β while examining inequality multidimensionally.

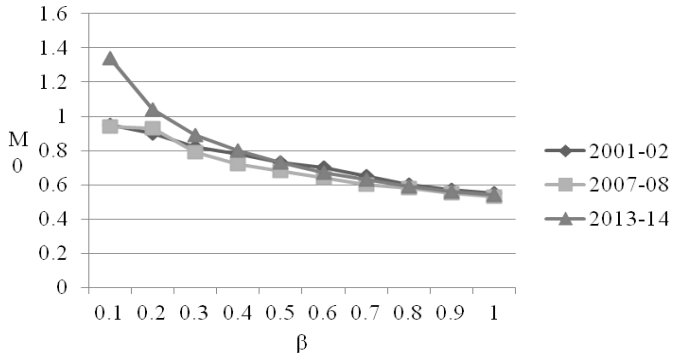

Figure 10. Changes in M (0) across different degree of substitution

The change in inequality aversion parameter so that α=1 and all the housed in the combining distributions do not change the results much. Moreover, in this setting, variations in inequality aversion parameter resulted in negative values over time when different attributes are combined into a single index. Moreover when the value of inequality aversion parameter is set (α=0.5 or α=0.3) then multidimensional inequality increased when we move from lower to higher inequality aversion parameter so that multidimeional inequality increased with increased in α.

Non Aggregative Strategy

In the previous sections, the extent of inequality in Pakistan has been examined along four separate dimensions and across population groups. The results revealed rather similar patterns of horizontal and vertical inequalities between all three attributes of welfare. Although, some multidimensional inequality indices (Lugo, 2005) for theoretical analysis have been built up for m attributes but at the empirical level such analysis becomes extremely cumbersome. The issue can be dealt with by comparing two distributions, when one of the attribute is discrete. The analysis has been executed directly with the extent of pair-wise measures of inequality such as by the GE (α) family of measures.

Table 5. Expenditure inequality across education quintile

	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
2001-02					
Gini	0.25	0.25	0.26	0.29	0.41
GE (0)	0.11	0.10	0.11	0.14	0.28
GE (1)	0.12	0.12	0.13	0.17	0.34
GE (2)	0.18	0.17	0.18	0.27	0.62
2007-08					
Gini	0.26	0.26	0.28	0.34	0.41
GE (0)	0.11	0.12	0.13	0.20	0.28
GE (1)	0.14	0.16	0.17	0.26	0.33
GE (2)	0.23	0.41	0.38	0.55	0.58
2013-14					
Gini	0.25	0.23	0.26	0.27	0.36
GE (0)	0.11	0.09	0.11	0.12	0.21
GE (1)	0.13	0.10	0.13	0.13	0.24
GE (2)	0.22	0.13	0.21	0.19	0.38

Source: Author's calculations.

The consumption inequality per education quintiles results are presented in Table 5. The monetary inequality increased in all quintiles from 2001-02 to 2007-08 then decreased between 2007-08 and 2013-14. The change in the first period is small in all the quintiles except in the forth quintile where absolute change is large. When evaluation is taken across quintiles, the consumption inequality is the highest in the fifth quintile or among the well educated population group followed by fourth, first (illiterates), third and second quintiles in 2001-02. The monetary inequality is the highest in the fifth quintile followed by fourth, third, second and first or uneducated population group in 2007-08. While inequality is the least in the second quintile followed by first, third, fourth and fifth quintiles in 2013-14. This approach has very useful policy implication that uneducated or illiterate should be prioritized at the provision of funds transfer.

Table 6. Education inequality across consumption quintile

	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
2001-02					
Gini	0.60	0.51	0.48	0.42	0.31
GE (0)	0.12	0.10	0.10	0.09	0.08
GE (1)	0.10	0.08	0.08	0.07	0.06
GE (2)	0.62	0.43	0.36	0.28	0.15
2007-08					
Gini	0.54	0.45	0.40	0.35	0.26
GE (0)	0.10	0.09	0.08	0.08	0.06
GE (1)	0.09	0.08	0.07	0.07	0.05
GE (2)	0.50	0.33	0.26	0.19	0.11
2013-14					
Gini	0.58	0.46	0.41	0.33	0.23
GE (0)	0.11	0.10	0.08	0.07	0.05
GE (1)	0.10	0.09	0.07	0.06	0.04
GE (2)	0.57	0.34	0.26	0.18	0.10

Source: Author's calculations.

The education inequality decreased between 2001-02 and 2007-08 and then between 2007-08 and 2013-14 increased in first three quintiles but decreased fourth and fifth consumption quintiles. The analysis across consumption quintiles reveals that the education inequality is the highest in first quintile or among the poorest population group followed by second, third, fourth and fifth quintiles. The results of education inequality per consumption quintiles are shown in Table 6. The education inequality reduced over time in all the quintile, but the absolute reduction is the highest in the third quintile from 0.42 to 0.33 by 0.09 points during the study period 2001-02 and 2013-14. This approach therefore has practical policy implication that the poorest should be prioritized at the provision of education. This analysis can be extended to bidimensional inequality for different pair wise set of attributes such health and education; education and housing; land and consumption and for other pair of distribution.

Conclusion

The results of the study reveal that patterns of inequality are different across different distributions. The Gini coefficient, generalized entropy (GE) and stochastic dominance criteria are used to analyze inequality across single dimension. The Masuumi (1986) index has been employed to measure multidimensional inequality. The stochastic criteria have revealed different orders for three distributions such as consumption, education and health. The consumption expenditure fulfills the first order dominance conditions and shows unambiguous ranking of three distributions in Pakistan. But the same is not the case with other two attributes such as education and health which have ambiguous orders as no distribution stochastically dominates the other. The results of pair-wise joint distribution show that consumption inequality across education quintiles has different patterns as inequality first decrease between 2001-02 and 2007-08 and then increase from 2007-08 to 2013-14 in first quintile while inequality first increase and then decrease in all other quintiles. The education inequality across consumption quintiles has quite smooth patterns across quintiles it decreases as we move from lowest to the highest or the richest quintile over time. The aggregative strategy results

revealed that multidimensional inequality increases as the substitution or value of substitution between attributes decreases which indicated that the three attributes are complimentary goods.

The present study recommended that the basis of these results that to reduce inequality policies should be dimension oriented and area specific. Government should formulate such policies that give better infrastructure like education institutions, hospitals, sanitation condition and provision of employment opportunities. Reducing inequality of opportunity and provision of equal opportunities across the board would help to reduce inequality and poverty in Pakistan.

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