Multidimensional Poverty: Theory and Empirics[1]

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Part 1: A Panel Multidimensional Poverty Estimation for Ethiopia

Part 2: Individual Specific Weighting Scheme to a Multidimensional Poverty Measure

Part 3: Preferences in the Multidimensional Poverty Measure

Part-One

A Panel Multidimensional Poverty Estimation for Ethiopia

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Abstract

Estimating the extent of poverty is a preliminary task before implementing any anti-poverty project. This can be done by creating a holistic individual deprivation index for different life dimensions. Currently, there are a growing number of multidimensional poverty index (MPI) studies. However, there exist only few empirical papers for Ethiopia that used country-specific well-being indictors in a panel data framework. This paper estimated the MPI for Ethiopia using the Ethiopian Rural Household Panel Data Survey (ERHS) for the years 2004 and 2009. The study used five dimensions and nineteen country specific well-being indicators to estimate MPI.

The MPI estimation with the counting approach showed that the percentage of multidimensional poor people for the years 2004 and 2009 were 35% and 25% respectively. The paper decomposed MPI across regions, household sizes, and depth and breadth of poverty. The MPI decomposition across time estimate confirmed that the large decrease in the MPI was the result of a significant decrease in the number of poor households among the middle and the large families than a decrease in the number of deprivations. The panel MPI decomposition also showed that, once a household slips into poverty, the probability of exiting from it is very low. Child mortality contributed more for the decrease in the breadth of poverty. Moreover, the decrease in asset deprivation contributed the largest for the decrease in MPI across the two periods. The use of country-specific indicators such as land holding and crop stored for agrarian economy are more likely to identify poor people than indicators used in internationally comparable MPI estimation. This panel based MPI estimation clearly showed the progress or regresses of the household in achieving a particular indicator over time.

Keywords: Ethiopian Rural Household Survey, Multidimensional Poverty Index, Counting Approach, Panel MPI decomposition estimation

1. Introduction

Background and knowledge gaps

Ethiopia has diverse demographic, socio-cultural and natural features, with more than 70 ethnic groups, a population of more than 84 million people and an average annual population growth rate of 2.6% over the period 2004 - 2009 (CSA, 2010). Ethiopia is the second most populous country in Africa next to Nigeria. The population is dominated by young people, with those under 15 years old representing 45% of the population, which results in a high dependency ratio (IBID). Ethiopia's socioeconomic features are mainly rural and agricultural. About 85% of the inhabitants are rural; and agriculture employs more than 80% of the labor force (Ethiopian Economic Association, 2011).

The dependency of the Ethiopian economy on a rain fed agriculture system exposed the country to frequent spells of drought and famine on the past decades. The most recent and severe drought happened in the year 2003/04, which affected roughly 30 million people (Diao *et al*., 2005). According to Bigsten *et al*. (2007), every year, 5 to 20 million people are affected by drought and

wait for food aid. Hence, poverty in Ethiopia is persistent, deep-rooted, multi-faceted, widespread and dominantly structural (Dercon *et a*l., 2009).

Ethiopia's Human Development Index (HDI) value for the year 2009 was 0.406, positioning the country at 173 out of 187 countries. The per-capita income of the country is also the lowest in the sub-Saharan countries, which is USD 392.00 (Human Development Report, 2009). By all available indicators, Ethiopia is one of the poorest countries in the world.

Although Ethiopia remains one of the poorest countries in the world, there has been progress in poverty reduction in recent years. For the past fifteen years, the government of Ethiopia has started putting a series of poverty reduction and development strategies to address extreme poverty. Ethiopia was one of the member states that adopted the Millennium Declaration in 2000. As one of the member states, the country has entered a political commitment to devise and adopt suitable strategies to achieve the development goals. Besides that, the Ethiopian government has developed different Poverty Reduction Strategy Papers (PRSPs) to fight against poverty and ensure rapid and sustainable development (MoFED, 2012).

Following the implementation of different anti-poverty moves, the Ethiopian economy has recorded an impressive average economic growth rate of 11.5 percent yearly over the past six years (MoFED, 2012). Such economic growth contributed significantly to poverty reduction within the country. The International Monetary Fund (IMF) reported in 2014 that Ethiopia was one of the five fastest growing countries in the world. Many studies showed that the income poverty, measured by the percentage of the population living below PPP US$1.25 per day has decreased in the past years (Bigsten and Shimeles, 2007; Alemayehu *et al*., 2007; Dercon *et al*., 2007; Dercon *et.al*, 2011). However, the income poverty measure is not good enough to measure the welfare of the society. This is because, due to externality and imperfect market, income or consumption may not precisely revels what happened to the welfare of the society (Ravallion, 2011). To understand whether welfare of Ethiopians improved or not, a deep investigation of all non-income welfare indicators are also demanding.

Nowadays well-being in general and poverty, in particular, are defined as the shortfall of individuals in a number of life dimensions, such as health, education and standard of living. This aggregate poverty index calculated from the deprivations in different life dimensions is called Multidimensional Poverty Index (MPI).

There have been little efforts made by previous studies to estimate the multidimensional poverty index in Ethiopia. The international comparable MPI estimation for 104 countries is one of the efforts made to estimate MPI in Ethiopia. The estimation put the country on the 103rd position out of 104 countries (UNDP, 2010; see also the revised at Alkire and Conconi, 2013). Similarly, using the Young Live data set Apablaza and Yalonetzky (2011) developed a multidimensional poverty index using the Alkire Foster (AF) decomposition where Ethiopia was also part of the study.

However, having a country-specific indicators and cutoffs is very important for policy interventions. The choices of some indicator for instance crop hold and land are very important indicators of well-being for agrarian economy. For under developed agrarian economy, with the

limited budget of the government, it is much better to provide farmer with oxen than tractors or home cars. One of the assets used on the MPI estimation by Alkire and Conconi, 2013 is whether a household has car or not, which is less likely to identify non-poor person for agrarian economy. This is because the indicator which is important for one region to differentiate poor and non-poor is not equally important in another region.

There are only few country-specific studies on multidimensional poverty in Ethiopia for the past decades. Woldehanna (2014) using data from the Young Live survey tried to create a comprehensive picture of poverty and human well-being in Ethiopia. The paper focused more on social exclusion estimates than the ordinal MPI estimation and used very few life indicators.

Hence, this paper is in response to the limited empirical works using a country specific panel MPI estimation for Ethiopia. To the best of my knowledge, this paper is the first multidimensional poverty estimation for Ethiopia using a panel data framework with a large set of country specific indicators. This study is different from the aforementioned works in two aspects: First, it uses a large set of country-specific indicators for the measurement of MPI. Second, it estimates MPI in two periods and makes different decomposition experiments.

2. Method and data

2.1. The Alkire- Foster counting approach

The method used to measure MPI in this paper corresponds to the Alkire and Foster's (2011) family of multidimensional poverty measures, later called the AF methodology. The AF method is explained as follows:

Let n represent the number of households and $m \geq 2$ be the number of dimensions. Each dimension is represented by wellbeing indicators j where j is between 1 and d. Let $Y = |Y_{ij}|$ denote the $n \times d$ matrix of achievements, where the typical entry $Y_{ij} \geq 0$ is the achievement of houshold i=1,2, …,n in wellbeing indicator j=1,2, …,d. $|Z_j| > 0$ is the indicators cutoff below which a person is considered to be deprived in indicator j.

For any given Y, let $g = |g_{ij}|$ is a deprivation gap, which denote the 0-1 matrix of deprivations associated with Y, whose typical element g_{ij} is defined by $g_{ij} = 1$ when $Y_{ij} < Z_j$, while $g_{ij} = 0$ otherwise. Clearly, $|g_{ij}|$ is an $n \times d$ matrix whose ij^{th} entry is 1 when household i is deprived in the j^{th} indicator, and 0 when a person is not.

After the identification of deprivations, the next step is assigning weights to each dimension. The AF method implicitly assigned an equal weight to each dimension and similar weights to all indicators j within a dimension. This has been done by assuming that the available chosen dimensions are relatively equally important (Alkire and Foster, 2011). Similar to the AF method, this paper used an equal weighting approach to each dimension and similar weights for indicators j within a dimension.

Having the weighted deprivation gap ($w_j g_{ij}$) for each indicator, finding the aggregate deprivation score for each individual (C_i) is the next task. C_i is defined as the horizontal sum of weighted deprivation gaps for each individual, which is written as follows:

$$C_i = \sum_{j=1}^{d} w_j g_{ij} \qquad \text{(eq1)}$$

The last step in the estimation of MPI is identification of those who are poor and not. In a multidimensional framework, there are three types of identification rules: intersection, union and intermediate. Under the union approach a person *i* is said to be multidimensional poor if there is at least one indicator in which the person is deprived. The intersection approach, identifies person *i* as being poor only if the person is deprived in all indicators *j*. AF methodology uses an intermediate cutoff level for C_i that lies somewhere between the two extremes of 1 and *j*. Therefore, AF identification includes the union and intersection methods as special cases of extreme values (Alkire and Santos, 2011). Consider *k* as the poverty cutoff and *q* as the number of poor people, then person *i* is considered poor when the number of indicators in which *i* is deprived is at least *k*. On the other hand, if the aggregate deprivation score falls below the cutoff *k*, then person *i* is non poor and his/her value will be censored to zero. From eq1, if we censored all values of C_i to zero which are located below k, we will get a censored aggregate deprivation score (C_i*). Hence, a person is identified as poor when the aggregate score C_i is above *k* (or equivalently C_i*>0). The main challenging task in the intermediate method is the choice of the appropriate cutoff *k* among a set of *k* poverty cutoffs.

The choice of the appropriate *k* has more of a normative task which is left for the researcher similar to the income poverty (Sen, 1979; Alkire *et al*., 2014). Alkire *et al*, 2014 suggested two methods of choosing the appropriate cutoff from a set of alternatives. The first method to select the appropriate cutoff is to identify the number of poor people based on the available resources. In this case, the policy maker a priori selects the number of poor segment of the society that could be accommodated by the available resources (IBID). The second method is to use 1/3 to 1/5 of the available indicators. From "communication" point of view, those people who are deprived of 1/3 to 1/5 of the available indicators are vulnerable of becoming multidimensionally poor. "In the MPI, a person is identified as poor if he or she has a deprivation score higher than or equal to 1/3. In other words, a person's deprivation must be no less than a third of the (weighted) considered indicators to be considered MPI poor"(Alkire and Santos, 2011).

Following this, the AF family of multidimensional poverty computation has two main parts: The first one is multidimensional headcount ratio (*H*) which is the proportion of incidence (depth) of people who experience multiple deprivations.

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

The second one is the intensity or breadth of poverty (*A*) is the average deprivation score of those poor segments of the population:

$$A = \frac{\sum_{i=1}^{n} \frac{1}{d}(C_i *)}{q}$$

Therefore, multidimensional poverty is the product of the above two terms.[1]

$$M(Y) = H \times A = \frac{1}{n}\sum_{i=1}^{n}\frac{1}{d}(C_i *)$$

2.2. Decomposing by population sub-groups

Decomposability posits that overall poverty is a population share weighted average of subgroup poverty levels. The methodology is based on Shorrock's decomposition (Shorrocks, 1999). Overall poverty can be decomposed across different population subgroups and create maps for visual policy analysis. Suppose the population size of achievement matrix Y is denoted by n. Matrix Y is divided into two population subgroups: Y' with population size n_1 and Y'' with population size n_2 such that $n = n_1 + n_2$.

Population Subgroup Decomposability: A poverty measure is additive population subgroup decomposability if:

$$M(Y) = \frac{n_1 M(Y')}{n} + \frac{n_2 M(Y'')}{n}$$

Then, one can calculate the contribution $S(Y')$ of each group to overall poverty, which can be calculated as follows:

$$S(Y') = \frac{n_1 M(Y')}{nM(Y)}$$

2.3. Decomposition by indicators

The AF methodology decomposes deprivations by indicators. This decomposition is based on the censored headcount (*CH*), which is the headcount for each indicator after censoring those who are poor to zero and the raw headcount (*H*), which is the headcount for each indicator without censoring those who are poor to zero. Hence, the censored headcount for indicator *j* is defined as $CH_j = \sum_{i=1}^{n} g_{ij}(C_i > k)$, and similarly, for raw headcount the decomposition is defined as $H_j = \sum_{i=1}^{n} g_{ij}$

[1] The methodology satisfies a number of important properties of multidimensional poverty measures such as, poverty and dimensional focus, symmetry, normalization, decomposability, weak monotonicity for α > 0, weak rearrangement, replication invariance and scale invariance (Alkire and Foster, 2011).

2.4. Decomposition over time

Decomposing poverty level across time is important to understand the dimensions were most people are deprived or showed progress. Following a similar decomposition of the change in Foster Greer Thorbecke (FGT) income poverty measure (Ravallion and Huppi, 1991), the variation in poverty level can be broken down into three components:

1) Changes due to intra-sectoral or within-group poverty effect,
2) Changes due to demographic or inter-sectoral effect, and
3) The interaction effect which is changing due to the possible correlation between intra sectoral and inter-sectoral

So the overall change in the adjusted headcount for groups r = 1… R between two periods, t (1 and 2) can be expressed as follows:

$$\Delta M = \sum_{r=1}^{R} n_{r1}(M_{r2} - M_{r1}) + \sum_{r=1}^{R} M_{r1}(n_{r2} - n_{r1}) + \sum_{r=1}^{R} (M_{r2} - M_{r1})(n_{r2} - n_{r1})$$

Following Shorrocks, 1999; Trannoy, 1999, after applying Shapley decomposition:

$$\Delta M = \sum_{r=1}^{R} \frac{(n_{r1} + n_{r2})}{2}(M_{r2} - M_{r1}) + \sum_{r=1}^{R} \frac{(M_{r1} + M_{r2})}{2}(n_{r2} - n_{r1})$$

2.5. Decomposition by incidence and intensity

Since the adjusted headcount MPI can be expressed as the product of the incidence of poverty and the intensity of poverty at time t, $M_{ot} = H_t * A_t$, one might also want to decompose variation in the adjusted headcount by changes in these two components to obtain:

1) Changes due to variation in the incidence of poverty, and
2) Changes due to variation in the intensity of poverty

Close to Apablaza and Yalonetzky (2011) and following a Shapley decomposition (Shorrocks 1999), changes in the adjusted headcount can be decomposed as follows:

$$\Delta M_0 = \frac{(A_1 + A_1)}{2}(H_2 - H_1) + \frac{(H_1 + H_2)}{2}(A_2 - A_1)$$

2.6. Decomposition of the variation in intensity of poverty by indicators

In a similar way to Apablaza and Yalonetzky (2011), the absolute change in intensity can be decomposed as follows:

$$\Delta A = \sum_{J=1}^{d} (w_{j2}A_{j2} - w_{j1}A_{j1})$$

Where w_{jt} denotes the indicators weight at time t and A_{jt} is the share of the poor that are deprived in indicator j at time t. The intensity of poverty can also expressed in terms of censored headcount at time t (CH_{jt}) and the raw headcount at time t (H_t)

Thus, $A_{jt} = {CH_{jt}}/{H_t}$, the decomposition result is similar to the above expression, which is given as follows:

$$\Delta A = \sum_{j=1}^{d} \left(w_{j2} \frac{CH_{j2}}{H_2} - w_{j1} \frac{CH_{j1}}{H_1} \right)$$

3. Data and description of wellbeing dimensions

3.1. Data source

Ethiopia is a federal country divided into nine regions. Each region is sub-divided into Zones and the Zones into Woredas. Woredas are in turn divided into Peasant Associations (PA), or Kebeles, an administrative unit consisting of a number of villages.

The study used the Ethiopian Rural Household Survey data, which is a panel survey conducted seven times between 1994 and 2009. [2] The survey encompasses 1313 households from 15 representative PA, which were drawn from the four main regions of the country: Oromia, Amhara, Tigray and Southern Nation and Nationality People (SNNP), which accounts 90.5 percent of the total population (CSA, 2010). As part of the survey design and extension that took place in each round, the sample was re-randomized by including an exact proportion of newly-formed or -arrived households in the villages. For comparability reasons, the dropped out households were replaced by a representative household broadly similar to the dropped ones in terms of demographic and wealth, by the consultation of village elders and officials (for detailed information about the sample and the data set see Dercon and Hoddinott, 2004 and Bevan and Pankhurst, 1996)

This paper used only the 2004 and 2009 surveys for the sake of accuracy; the previous surveys do not have the wellbeing information that is needed for the estimation of multidimensional poverty. These two years also encompass a community data for better understanding of the regions under study.

3.2. MPI dimensions and indicators

The Millennium Development Goals (MDGs) have been the most successful global anti-poverty push in history. As part of developing countries, Ethiopia has been implementing different anti-poverty policies and strategies. The MDGs was the most marvelous policy that has been implemented in the country. One of the main targets of the Millennium Development Goals was to halve the number of people living in extreme poverty by 2015. Generally, the overall objective of the MDGs is to improve the quality of life in terms of education, health, standard of living, empowerment and asset holding of the poorest part of the society (UN, 2013). Therefore, any

[2] These surveys were conducted jointly by the Economics Department at Addis Ababa University, the Centre for the Study of African Economies, University of Oxford and the International Food Policy Research Institute.

poverty analysis should have to incorporate and explore whether those dimensions of the MDGs are achieved or not.

This paper used five dimensions to measure multidimensional poverty: health, standard of living, asset endowment and income, education and empowerment. The selections of these dimensions are based on the Millennium Development Goals (MDGs), Growth and Transformation Plan of Ethiopia (GTP) and other poverty reduction strategies. It appears that the choice of indicators for each dimension in some cases has led by experience and availability of data. The following table shows those indicators with the associated cutoffs used to identify deprived households.

Table 1: A summary report of well-being indicators and the associated cutoffs

Dimensions of MPI	**Indicators in each dimension**	**Indicators cutoff (Values for not being deprived)**
Asset endowment and income	Asset owned	Having 1/3 of important durable assets.
	Crop stored	Having a stored crop
	Land owned	Own one hectare of land
	Income	$1.25 per person
Education	School completed of hh head	Eight years of schooling
	Highest grade of children	At least five years of schooling
	School dropout	No one dropout school for more than 12 months
Empowerment	School for girls or boys	Educating girls is equally important as of educating boys.
	School for girls vs. marriage	Allow a girl to go to school than force for marriage
	Women right to decide	If a woman has the right to decide on the incomes come from the sale of crops, charcoal or homemade products.
Health	Child mortality	0
	Stand up after sitting	For childeren aged above 7 can walk for 5km or can stand up after sitting
	Walk for 5km	
	Illness days	Anyone sick or weight loose for not more than three weeks
	Weight loose days	
Standard of living	construction material of house	The house is not made up of Mud/dung (‘Chika/Ebet’) and thatch (‘Sar’).
	Toilet use	Using flush toilet or latrine
	Garbage disposal	Using at least one of the following: green manure, buried, periodically collected by a particular authority, or dumping at a specified point.
	Access to clean water	Using one of the following sources of water: piped water, borehole or pump, protected well, protected spring or rain water.

Detail explanations of each indicator and the associated cutoffs are discussed hereafter.

Health

Health is a very crucial affluence which would help for the development of an economy. Be that as it may, it had been contended that global governments fulfilled their citizens health not because they realize that human resource is important for development, rather due its being a basic essential human right. As a result, provision of medical care service has become a top rating agenda of all governments (Mekonnen *et.al*., 2012). It has also been identified as a key part of the MDGs and GTP of Ethiopia under goal one, four, five and six.

The paper used five indicators to check whether the country has achieved poverty reduction goals under the health dimension or not. Those indicators are selected based on the internationally agreed measures of health improvement performance of a country and the availability of data. Child mortality, nutrition and availability of health services are some of the indicators (UNDP, 2010). These indicators are also part of the MDGs and GTP of Ethiopia. The first indicator used for this study is child mortality. Most of the time child mortality is related to infectious diseases or diarrhea, which are easily preventable. In the MPI, each household member is considered to be deprived if there has been observed at least one child death (of any age) in the household for the past 12 months. The second indicator is nutrition. For children, malnutrition can have lifelong effect in terms of cognitive and physical development (Sawaya, 2006). Adults or children who are malnourished are also susceptible to other health disorders; they are less able to learn and to concentrate and may not perform as well at work. Due to the absence of data on calories intake, the paper used two proxy variables to understand the nutrition status of the household; Standup after sitting and Walk for 5km as proxy variables for nutrition. Nutritional deficiency is highly related with loosing energy to walk and to do very small tasks (Riordan, 2012). Therefore, each household member is considered to be deprived if there has been at least one observed person (of any age except those who are under age 7) in the household cannot walk for 5km or cannot stand up after sitting. The last indicator is related to health service. In the country with poor sanitation and health services, people are highly exposed for diseases and ill for a long time and experienced significant weight loss. The paper used illness period and significant weight loss only for diseases that are easily treated by modern medicine. It rarely happens that, people in rural areas may not prefer to go for modern medicine due to cultural or demographic barriers and might be sick for a long time. According to Ravallion (2011), this is the sign of being poor.

"Sometimes people have no interest in earning good things while they can afford it due to culture or demographic deference where they are considered as poor" (Ravallion, 2011).

An individual may experience prolonged sickness and significant weight loss due to the following reasons. First, the person may not have enough money to afford treatments at modern medical services. Second, though the person has the ability to pay to get medical treatments, he/she might not be willing to visit modern medical services due to religious or cultural barriers. Third, having poor immune system of the person; this is highly associated with the nutritional intake of a person. Fourth, the absence of health care service providers around the peasant association (See the distribution of health services at table A in Appendix). In all cases, it is a sign being poor.

Similar to other indicators, each household member is considered to be deprived if there has been at least one observed person (of any age) in the household ill for more than a week and experienced a significant weight loss for more than a week.

Standard of living

Standard of living is identified as one of the major parts of Millennium Development Goal (MDGs) under goal seven. The term standard of living is to express the quality of life which comprises; the availability of clean water, good wastage disposal, good toilet services and clean and well-constructed houses. Standard of living dimension can have many indicators, though their importance to a person is different. For instance, it worth much for the household to have access to clean water than to have post office or telephone service. The paper classified the standard of living into three parts based on their importance to the society. The first category of standard of living comprises of those indicators that are closely related with the health status of the society. This includes access to clean water, good wastage disposal, clean home and availability of toilets. The second category of standard of living includes those activities that are supposed to facilitate the day to day activities of human beings; for example, access to electricity and post office. The last category of standard of living includes those services related with prestigious and comfortable life. In the third category, the number of holidays per year can be considered as a good example.

For this paper, only the first category of standard of living was used since it is an important indicator of standard of living for developing countries. The first indicator is access to clean water. It is believed that clean water is a crucial thing to sustain human life. The person has access to clean drinking water if the water source is any of the following types: piped water, borehole or pump, protected well or protected spring. If the source of water fails to satisfy those conditions, then the household is considered deprived of access to clean water. The second indicator is access to a clean toilet service. Most of the communicating diseases are due to poor toilet sanitation. A household is considered to have access to improved sanitation if the household has some flush toilet or latrine. If the household does not satisfy those conditions, then it is considered deprived in sanitation. The third indicator is poor wastage disposal practices. Poor wastage managment is also another reason for having poor health status of the households. A household is considered as having good wastage disposal if the household uses the waste as green manure, buried or periodically collected by a particular authority or dumping at a specified point. If the household does not satisfy these conditions, then each household member considered deprived in sanitation. The fourth indicator is construction materials used to build the house. Many houses in rural areas are built from Mud/dung (‘Chika/Ebet’) and thatch (‘Sar’). Houses built with these materials have many side effects on health and living standard of the households. Houses made up of these materials could create bad smells during rainy season and expose a person for airborne diseases such as pathogens. Moreover, it also attracts some dangerous insects in the summer such as mosquitoes, spider, ants, cockroaches and flies to the house which would have side effect for the health status of the household by transmitting communicable diseases. A household is considered to have access to improved sanitation if the household’s house is not made up of Mud/dung (‘Chika/Ebet’) and thatch (‘Sar’). If the household’s house is made up of those materials, then it is considered deprived in sanitation.

The second and the third category of standard of living have not been included in this paper though they are believed important. Hence, to have a better understanding of the study areas, figures for some indicators are presented in table B of appendix.

Asset endowment and income

Asset endowment and income is another dimension of poverty used in this study. This dimension is chosen since it is related to the first MDGs and its relevance to fulfill other dimensions of poverty. This paper used four indicators to identify whether the household is deprived in asset endowment and income or not: asset held by the household; crop stored, land owned and monthly income of the household.

The first indicator, assets held by the household includes any durable goods owned by any household member. The data set has 30 listed asset indicators, some of the indicators are: jewelry/Gold/wrist watches, cellphone, radio/tape recorder, chairs/bench, fanos/gas, stove (medija), table, beds wooden/metal (alga), plough (maresha), hammer (fas or martelo)/saw(megaz), TV, bike, motorbike or refrigerator. If a household own more than one third of the listed assets, then each person in it is considered non-deprived. There is no internationally or nationally agreed cutoff for asset holding. The cutoff is based on the researcher's judgement of what and how much asset should a household need to have to classify them as deprived or non-deprived. The researcher should consider the purpose of the study, the status of the society and the lists of assets included in the basket to choose the appropriate cutoffs (Alkire, Santos, 2011). Alkire and Santos, 2011 used a deprivation of one asset (durable good) as a cutoff out of 7 durable goods. In generic term, the use of 1/3 of the available listed assets could be optimal since most poor people are deprived at least 1/3 of the available assets.

The second indicator is crop owned by households. The rural households in Ethiopia base their livelihood on agriculture sector, which is highly dependent on rainfall. Hence, households need to save some crops, till the next harvest time to sustain their life. These crops are used as a temporal asset for the household. These types of precautionary crop saving practices are common in rural Ethiopia. This crop saving custom is not only practiced by farmer households, but also by non-farmer segments of the rural households. Non-farmer segments of the society in rural areas prefer to buy important crops in advance due to three reasons. The first reason is that, after harvesting time, crops are available rarely in the market since markets in rural areas are periodic. The second reason is that a rational household wants to avoid unnecessary expenses results due to the rise in the price of crops after the harvest time. Lastly, it appears that in rural Ethiopia, having a stored crop is considered as a sign of being rich. So, it is the motive of both farmers and non-farmers to keep or store crops for future uses. Therefore, understanding whether a household has crop stored or not could help us to distinguish who is poor or not. Hence, if a household does not own any stored crops, then each person in it is considered deprived.

The third indicator used in this study is land. Land is imperative wealth, especially for those who are living in rural areas since their livelihood is highly attached to land. Land is not only used to construct houses, but it is the source of their livelihood. The government of Ethiopia gives a minimum of one hectare of land for a farmer whose livelihood bases on agriculture with a lease elapsing in 99 years. As more than 85% of the households base their livelihood on cultivation of

agriculture, the importance of land is unquestionable. The study used the minimum land size per household to determine whether the household is deprived or not. Hence, if a household does not own one hectare (equivalently one thousand care square meters) land, then each person in it is considered deprived.

The last indicator is the income of the households. Income is a means that helps to fulfill our basic needs; for instance food, cloth, medical expenses and transportation. One of the primary goals of the Millennium Development Goals is to increase the per day income of every person to higher than one US Dollar. The paper includes all sources of income in monetary form: Income from rent land and oxen, from selling of crop residue, crops and livestock (net of all costs), animal products, income from off-farm activities (net of all costs), the monetary value of crops produced for home consumptions, remittance, income from selling of home made products such as the selling of beverage or bread and income from selling of charcoal. Hence, if the average per capita income in the household is less than one dollar per day, then each person in it is considered deprived.

Education

Achieving universal primary education is the second goal of the MDGs and developing countries primary goal. This paper used three indicators to identify whether a person is deprived of access to education or not: completed years of schooling of the household head, the highest grade obtained by the children and school attending.

Completed years of schooling of the household heads have a great impact on their capacity of administrating their households. If the household head does not have enough knowledge, it will adversely affect the well-being of the whole members of the household since the household head makes all decisions in rural areas. Studies also confirmed that, household head's educational status is the main determinant of income poverty in Ethiopia (Amsalu, 2012; MoFED, 2002; Dercon *et al*., 2011). The growth and transformation plan of Ethiopia (GTP) has framed to foster educational achievement for all up to primary school or grade eight (MoFED, 2012). Hence, if the household head has not eight years of schooling, then all persons in the household are considered deprived. The second indicator is the highest grade obtained by the children. Educating children is a pillar for the development of a country. Similar to Alkire and Santos, 2011, if at least one child (in the age below 15) in the household has completed five years of schooling then the household is not deprived. People living in households with no school-aged children are considered non- deprived. The last indicator is school dropout. Children are forced to quit their study due to many problems. The first reason is the absence of access to school near by the peasant association (see the distribution of schools in appendix, table c). The second reason which takes the highest share is refusal of the household head to send his/her child to school in the expense of domestic work or personal interest. Hence, if any, school attending children have dropped out their school for at least for more than a year, all members of the households are considered deprived.

Empowerment

The importance of empowerment has become increasingly recognized in recent years, especially in the wake of the recent food price and global economic crises. It is often assumed that cash or

asset transfer programs and public work schemes target women since empowering women is a key to poverty alleviation. This drawing on evidence that women are more likely to invest additional income in family well-being. However, there has been little attention to the role that gender plays in the implementation and effectiveness of antipoverty policies. Empowering women and reducing gender inequalities are the two key objectives of development policies. In the MDGs, the third goal was developed to promote gender equality and empower women. These are not only goals in themselves, but have been shown to contribute to improving productivity and increasing efficiency (Alkire *et a*l., 2013). Three indicators selected in this paper to understand whether women in a given household are deprived or not: women participation in decision making, girls equal school attending right with boys and forced marriage of girls in the expense of their school. These indicators are selected to show the existence of gender equality and women empowerment. Alkire, *et al*., 2013, found that, a woman who is empowered to make decisions regarding what to plant and what (and how many) inputs to apply on her plot will be more productive in agriculture. So this paper used women right in decision making on what to do with the income from the sale of crops, charcoal and home-made products as one of the indicators. All persons in the household are deprived if women in the household have no right to make any decision on the income comes from the sale of crops, charcoal or homemade products. The second indicator is girls right to attend school relative to boys. The study used household head's answer to the following question "Schooling is more important for girls than boys? Boys than girls? Equally important?" Due to the absence of data about the number of boys and girls attended within the household, the study used a proxy variable of household head answer to the above question since household head is the one who decide who should attend and who should not. Therefore, household members are deprived if the household head thinks that educating boys are much more important than educating girls.

The third indicator is 'school for girls or marriage'. This indicator is elegantely important, especially in rural areas than urban regions where girls are forced for early marriage. Early marriage of girls hinders their school attendance relative to boys. It also has adverse effect on their physical health and psychology. Moreover, it is also another obstacle for the efforts undertaken by governments to empower girls. Due to the absence of data on the number of girls who are forced to quit their study due to forced marriage, the study uses a proxy variable of household head's perception or attitude to the following question "Imagine that someone in the village has a daughter who is a student. He would like for her to leave school and get married, but she wants to put off marriage and stay in school. What should he do? Allows the child to stay in school? Forces the child to leave school? Or Allow child to stay in school for primary school only?" In rural Ethiopia, the role of family, especially the head of the household is prominent in every activity. It is the household head, which decides whether a girl should have to marry or not. In rural areas, even the marriage is not by the choice of a girl or the boy rather the household head is the one who chooses or decides to whom and when to marry. Therefore, the answer from the household head to this question can be a good proxy to understand woman empowerment. Hence, each household member is considered to be deprived if the household head says "Force child to leave school".

4. Results and discussions

4.1. Deprivations and MPI estimation

This section presents the descriptive statistics and different poverty estimation results. The study used five dimensions and nineteen indicators for the estimation. Table 2 presents household's deprivation in different indicators.

Table 2: Number of households' deprivation in different indicators

Dimensions of MPI	Indicators in each dimension	Number of deprived households.		Percentage of deprivation	
		2004	2009	2004	2009
Asset endowment and income	Asset owned	973	419	74.8%	31.9%
	Crop stored	450	279	34.3%	21.2%
	Land owned	48	37	3.7%	2.8%
	Income	716	495	54.5%	37.7%
Education	School completed of hh head	734	342	55.9%	26.0%
	Highest grade of children	524	138	39..5%	10.9%
	School dropout	326	767	24.8%	58.4%
Empowerment	School for girls or boys	168	76	12.8%	5.8%
	School for girls vs. marriage	122	37	9.3%	2.8%
	Women right to decide	209	182	15.9%	13.9%
Health	Child mortality	30	14	2.3%	1.1%
	Stand up after sitting	291	354	22.2%	27.0%
	Walk for 5km	479	361	36.5%	27.5%
	Illness days	484	528	36.9%	40.2%
	Weight loose days	234	289	17.8%	22.0%
Standard of living	Construction material of house	1226	868	93.4%	66.1%
	Toilet use	907	602	69.1%	45.8%
	Garbage disposal	267	173	20.3%	13.2%
	Access to clean water	1067	1086	81.3%	82.7%

Source: Own computation

The above table showed that, in both years, the largest number of households deprived the construction material of the house indicator, and child mortality appeared the lowest one in both years. The reduction of child mortality was also reported by some other studies. The annual report of UN implies that child mortality has decreased by 2/3 in the past ten years (UN, 2013). In terms of dimension, most of the households deprived less of empowerment's indicators. This indicates that there has been huge work made by the government to narrow down the gender gap and foster gender equality. One of the measures used to foster gender equality is by improving access for education. For the education dimension, two of the indicators showed that access for education has improved in the past few years. The study by Young Live in 2012 showed that access for primary education increases by five-fold from the year 2000. On the contrary, school dropout showed a significant increase in 2009. Having the minimum five years of schooling for

children is not enough to measure people capability of doing something. It is also important to understand whether a school aged child is still able to continue his study or not. Though the increase in access to education improves the maximum years of schooling of children, it also contributes for the rise in school dropouts. It is obvious that, when there is no access for education there could not be any dropout issue. The issue of dropout rose when access for education expands. The increase in school dropout in the year 2009 is also related with household's economy difficulty. The rise in food shortage in many parts of the region is also another reason for the increase in school dropouts in the year 2009. Children were forced to leave their school and join the job market. A study by UNHCR (2009) showed that, 50.1 % of children aged 5-15 in rural areas were engaged in productive activities in 2008. The other important indicator is income, which experienced a significant decrease from 54% to 37% and which implicitly confirms the decrease in income poverty. The headcount income poverty estimate of uni-dimensional measure for the year 2004 and 2009 also corresponds with this finding; it was about 52 % and 35% respectively (Dercon *et al*., 2011).

After the identification of deprivations for all indicators, the paper attaches equal weights to all dimensions and calculates the aggregate deprivation score. Based on the aggregate deprivation score, the study estimates the multidimensional headcount ratio (H), the intensity of poverty (A) and the adjusted multidimensional headcount ratio (MPI) for different cutoffs. The result of the estimation is presented in the following table.

Table 3: MPI estimation with different cutoffs

Different poverty cutoffs sets at *k*=number of deprived indicators.	**2004 year**			**2009 year**		
	H	A	MPI	H	A	MPI
***k* =19 (Intersection approach) (C_i =1)**	0.000	0.000	0.000	0.004	6.226	0.024
***k* =7 (C_i >0.33)**	0.585	0.433	0.253	0.271	0.492	0.133
***k* =6=3(C_i >0.25)**	0.839	0.390	0.327	0.530	0.393	0.208
***k* =5 (C_i >0.2)**	0.930	0.374	0.348	0.711	0.351	0.249
***k*=1(Union approach) (C_i >0.05)**	0.999	0.360	0.360	0.975	0.297	0.289

Source: own computation

At all poverty cutoffs, with the exception of the intersection cutoff, the estimated MPI values in the year 2004 are higher than the 2009, which showed the improvement of social welfare. The AF methodology suggests the appropriate poverty cutoff to be between 1/3 to 1/5 of the available indicators (Alkire and Santos, 2011). This study opts *k*=4 or a deprivation of 1/5 of the available indicators. This paper used the maximum appropriate poverty cutoff value for the identification of poor. If we choose lower values of poverty cutoffs than 1/5 of the indicators, the probability for a person to be non-poor will increase since we have many indicators.

Based on the selected poverty cutoff, *k=5* (C_i > 0.2) the headcount ratios for 2004 and 2009 were 93% and 71%, respectively. Moreover, the adjusted headcount MPI that considers the intensity of poverty are 34.8% and 24.9% for the years 2004 and 2009 respectively. This result is expected since in the year 2003/04 roughly 30 million people were affected by severe drought (Diao *et al*., 2005).

4.2. Censored and raw headcount estimation

The other major contribution of AF methodology is the possibility of calculating the raw and censored headcounts. The estimation of raw and censored headcount are crucial for policy implication to identify the indicators in which many households are deprived. The following table showed the estimated results for each indicator.

Table 4: Censored and raw headcount for households

	2004		2009	
Indicators	Raw Headcount ratio indicators	Censored Headcount ratio	Raw Headcount ratio indicators	Censored Headcount ratio
Asset owned	0.0371	0.0358	0.0160	0.0145
Crop stored	0.0171	0.0166	0.0106	0.0099
Land owned	0.0018	0.0017	0.0014	0.0013
Income	0.0273	0.0269	0.0188	0.0169
School completed of hh head	0.0375	0.0373	0.0175	0.0166
Highest grade of children	0.0267	0.0265	0.0166	0.0158
School dropout	0.0166	0.0163	0.0391	0.0327
School for girls than boys	0.0086	0.0085	0.0039	0.0037
School for girls than marriage	0.0062	0.0062	0.0110	0.0109
Women right to decide	0.0107	0.0107	0.0093	0.0088
Child mortality	0.0009	0.0009	0.0004	0.0003
Stand up after sitting	0.0089	0.0088	0.0108	0.0101
Walk for 5km	0.0146	0.0144	0.0110	0.0102
Illness days	0.0147	0.0143	0.0161	0.0142
Weight loose days	0.0071	0.0071	0.0088	0.0080
construction material of house	0.0467	0.0440	0.0391	0.0333
Toilet use	0.0345	0.0335	0.0229	0.0187
Garbage disposal	0.0102	0.0101	0.0066	0.0059
Access to clean water	0.0406	0.0387	0.0414	0.0323

Source: Own computation

The raw headcount estimate for asset 0.0160 for 2009 is interpreted as 1.6% of the households are deprived in asset indicator. Similarly, the censored headcount estimate 0.0145 is interpreted as 1.45% of poor households are deprived asset indicator. The other important result from table 4 is the censored headcount ratio for the year 2009 for school dropout is 8% lower than the raw headcount ratio estimates. This indicates that, from the total increase in the school dropout deprivation, 8% of them are from the non-poor households.

4.3. Static Decomposition

4.3.1. Decomposition across regions and family sizes

One of the main contributions of the AF methodology is the possibility of decomposing MPI by regions. This is very important from policy implication point of views to identify the neediest segment of the society. The following tables show some results from the MPI decomposition with family sizes and regions.

Table 5: Decomposition by family size

Family size	2004			2009		
	H	mpi	Share	H	mpi	Share
small hh member(1-5)	0.087	0.035	0.099	0.363	0.127	0.511
Middle (6-10)	0.473	0.177	0.510	0.325	0.101	0.405
Large hh member (> 10)	0.370	0.136	0.392	0.022	0.021	0.084

Source: own computation

Households having a small family-size registered the highest MPI for the year 2009 and its contribution to the overall poverty was extremely high compared to the year 2004. In 2009 all three family size groups experienced a decrease in the number of household members. Due to a significant decreases in household members, those who were in the large family size in 2004 entered into the middle family size group in 2009. Similarly, those who were in the middle family size group in 2004 entered into the small family size group in 2009. This increases the number of small families more than double in 2009. However, the decrease in the number of the middle families is not as of the large families since it has compensated by the newly entered households in to the group. Many households experienced a decrease in two or more household members due to different reasons. The first reason is some members of the family left their family and start their own life due to different reasons such as for marriage. The other main reason is migration in many parts of rural areas due to shortage of rainfall in the year 2004/5 and 2007 (Dercon *et al*., 2009). High global food prices pushed about 100 million more people into hunger in 2007, of which 24 million were from sub-Saharan Africa (FAO, 2008). Those households which had large family-size were tending to migrate more than those households having a small number of family-size due to economic difficulties. This was mostly experienced in Amhara and SNNPR regions.

There are basically two reasons for having a low MPI estimate for the large family-size group than the small family-size group in 2009. Those who were poor in the year 2009 in the small family-size group were the same households who were categorized under the middle or the large family-size groups in 2004. So in average only those good performing households are left in the large family-size group. The second reason is the probability for the large family-size groups to get at least one individual who is non-deprived in one indicator is higher than the small family-size category. Hence, everyone in the large household size gets benefited from this positive externality (Alkire and Foster, 2011).

Table 6: Decomposition by regions

Region	2004			2009		
	H	mpi	contribution of each group to the aggregate	H	Mpi	contribution of each group to the aggregate
Tigray	0.092	0.039	0.111	0.094	0.032	0.130
Amhara	0.268	0.098	0.282	0.202	0.062	0.250
Oromya	0.262	0.095	0.273	0.162	0.048	0.194
SNNPR	0.308	0.116	0.334	0.253	0.106	0.427

Source: Own computation

Out of the nine regions in Ethiopia, Tigray, Amhara, Oromya and SNNPR regions comprises more than 90% of the total population (CSA, 2010). Hence, things happening in these regions will affect the overall poverty of the country. With the exception of Tigray in 2004 year, on average the overall poverty was equally distributed among the three regions. Tigray region, having a small number of inhabitants, compared to other regions, had a small contribution to the aggregate poverty. The highest proportional poverty was registered in SNNPR. In 2009, all regions experienced a significant decrease in the level of poverty. The first reason for the decrease in the poverty estimates is the decrease in household sizes as discussed in Table 5. The second reason is the growth of the country's economy by double digit starting from early 2007, which improved asset holding and income of households (MoFED, 2012, IMF, 2012, Dercon *et al*., 2011). To understand whether the decrease is due to a decrease in the intensity of poverty or incidence (within-group or demographic) we need to perform the over-time decomposition, which is presented in the next section.

4.4. Decomposition over time

Analyzing poverty over time is important to understand the effect of some existing shocks and policies happening during the study period. From the ERHS panel data set, out of 1313 households in 2004, 53 (4%) of them dropped out in the year 2009. For comparison reason, representative households broadly similar to the dropped ones in terms of demographic and wealth, have been identified and substituted after consultations with village elders and officials (Dercon and Hoddinott, 2004 and Bevan and Pankhurst, 1996). The estimated MPI measure showed that, 94% of the dropped out households are multidimensional poor households. On the other hand, all the substituted households in 2009 are multidimensional poor people. The discrepancy due to the substitution of those dropped out households on the MPI measure is insignificant with a value of 0.0011. Hence, it allows us to compare MPI across time. The distribution of poor households in the two periods is presented in the following table.

Table 7: Deprivation score of households over time

Entry and Exit to Poverty	Numbers	Share
Non poor all periods	17	0.01
Exit from poverty	243	0.19
Survival but within poverty	291	0.22
Fail in to poverty	14	0.01
Failure within poverty	724	0.55
Poor but no change in both periods	24	0.02
Total	1313	1.00

Source: Own computation

From the above table 7, one percent of households were non poor in both periods, and a significant number of deprived households, about 19%, improved some indicators and exit from poverty in the year 2009. Besides, 22 percent of households improved their deprivation scores, though they were still under the poverty line. This indicates that there is a decrease in the intensity of poverty. On the other hand, 55 percent of poor households were again deprived in one or more indicators and experienced an increase in the poverty measure. This key result is similar to the findings of Bigsten *et al*. (2007). Using the ERHS data set from 1994 to 2004, they showed that once a household slips into poverty, the probability of exiting from it is very low. In general, if we are comparing entry-to and exit-from poverty results, it appears that 18% of households become non-poor. Here, we might be interested to know whether the intensity of poverty or the incidence of poverty contributes more to these changes. The following table shows the change in the MPI measure for both years and changes across the two periods.

Table 8: Over time poverty measures

	2004	2009	Absolute Change	Relative Change	Contribution (%)
H	0.930	0.711	-0.219	-0.235	0.793
A	0.374	0.351	-0.023	-0.061	0.207
MPI	0.348	0.249	-0.099	-0.284	1.000

Source: Own computation

As it is shown in the above table, there was a large decrease in the headcount ratio between the two periods. The intensity of poverty decreased slightly. In average, those poor people were deprived 37.4 percent and 35.1 percent of the weighted indicators in the year 2004 and 2009 respectively. This implies that, those poor people were not in sever situation of simultaneous deprivations since at least in average they could met 60% of indicators. The intensity of poverty contributed 20.7 percent for the decreases in poverty, while the incidence of poverty contributed 79.3 %. Hence, the absolute MPI decreased by approximately 9% across the two periods.

To understand further which regions or dimensions contributed to the decrease in poverty level, it is possible to decomposes the change in poverty across time into regions and dimensions.

4.4.1. Decomposition of the change in poverty

Based on Shapley decomposition over time, the following tables present the regions or family sizes that contribute to the decrease in the level of poverty. From the previous discussion on table

7, 55% of the poor households had shown improvement in their status. Do these changes relate with the decrease in the member of households or rather it is because of the improvement in the intensity of poverty? To answer this question decomposition within-group effect and demographic is necessary.

Table 9: Region decomposition for the change in poverty over two periods

Region	Within-group	Demographic	ΔM_0
Tigray	0.007	0.023	0.030
Amhara	0.105	0.202	0.307
Oromya	0.127	0.198	0.325
SNNPR	0.035	0.303	0.338
Overall Population	0.275	0.725	1.000

Source: Own computation

SNNPR region contributed the most to the overall poverty reduction, which was due to demographic effect, but part of the effect was due to reducing within-group. Amhara region contributed nearly as much as Oromya region, but almost exclusively due to demographic effect. Demographic effect contributed a lot to the decrease in poverty in Oromya region. Despite Tigray region had experienced a decrease in the poverty level, its contribution to the decrease in aggregate poverty was small. This is because, the contribution of the region to the aggregate poverty was small as depicted before in table 6.

Table 10: Family-size decomposition for the change in poverty across the two periods

Hh	Within-group	Demographic	ΔM_0
Small	-0.137	-0.090	-0.227
Middle	0.260	0.439	0.699
Large	0.231	0.296	0.528
Overall Population	0.355	0.645	1

Source: Own computation

For the small household category, the negative demographic effect and within group effect increased the poverty estimates. As shown on table 10, a negative demographic effect was registered for the small family size grup. This implies that there was an increase in the number of small family size housholds. As discussed on table 5, this is due to a decrease in size of large (middle) families where they exit the large (middle) family class and enter the mid-size (small-size) class. This decreament in the number of housholds is due to migration specially it was observed in the SNNPR region. The increased in the number of households with small family-size increases the level of poverty for small family-size groups whereas for the large and middle families MPI decreases. The expansion of family planning in the rural areas helped the member of large and the mid families sizes from increasing. A study by Guttmacher (2010) showed that, in the year 2009 the use of the family planning program in rural Ethiopia had shown big improvement compared to the year 2005.

4.4.2. Decomposition by incidence and intensity

To understand briefly which regions or family sizes experienced a decrease in the depth or breadth of poverty, the paper decomposes the MPI estimate over time in to incidence and intensity for all groups and family sizes.

Table 11: Decomposition by incidence and intensity for family size

HH categories	Incidence	Intensity	ΔM_0
small hh member	-1.037	0.102	-0.935
Middle	0.510	0.263	0.772
Large hh member	2.336	-1.174	1.163
	1.809	-0.809	1.000

Source: Own computation

Poverty reduction in all family-size groups is mainly driven by a reduction in the incidence of poverty than the reduction in the intensity of poverty. A high positive contribution was made by the large family-size group, which is exclusively by the reduction in population. However, those individuals in the large family-size suffer from sever deprivations as represented by the intensity of poverty. This confirmed that, having a large household size contributes negatively to the decrease in the extent of poverty.

Table 12: Decomposition by incidence and intensity for regions

Region	Incidence	Intensity	ΔM_0
Tigray	-0.007	0.071	0.064
Amhara	0.225	0.137	0.362
Oromya	0.334	0.137	0.471
SNNPR	0.221	-0.119	0.102
	0.773	0.227	1.000

Source: Own computation

Poverty reductions in all regions are mainly driven by a reduction in the incidence of poverty than the reduction in intencity of poverty. For the first three regions, there is a positive intensity of poverty. However, SNNPR region contributes to the decrease in poverty solely by the decrease in the incidence of poverty. In Tigray region, there is a slight increment in the number of poor people though outweighed by the positive effect of intensity of poverty.

4.4.3. Decomposition of the variation in intensity of poverty by Indicators and dimensions

The raw and censored headcount ratios tell us about the number of deprived individuals for each dimension. The study computes the contribution of each indicator to the changes in the intensity of poverty.

Table 14: Contribution of indicators to changes in intensity

Indicators	Contribution
Asset owned	0.037
Crop stored	0.023
Land owned	0.010
Income	0.054
School completed of hh head	0.039
Highest grade of children	0.034
School dropout	0.122
School for girls or boys	0.033
School for girls vs marriage	0.008
Women right to decide	0.045
Child mortality	0.125
Stand up after sitting	0.027
Walk for 5km	0.030
Illness days	0.046
Weight loose days	0.046
construction material of house	0.057
Toilet use	0.097
Garbage disposal	0.060
Access to clean water	0.108
ΔA	1

Source: Own computation

From the previous discussion on table 6, we found that, the largest decrease in the censored headcount ratio happened for school dropout and child mortality indicators. The panel decomposition estimation of table 14 also showed similar result. For these two indicators, the estimated change in the intensity of poverty is significantly large because, those deprived individuals in these two indicators become non poor in 2009. School dropout contributed a lot for the decrease in the intensity of poverty approximately by 12% since some deprived households become non-poor.

5. Conclusion

Using the AF methodology this paper estimated the multidimensional poverty for Ethiopia for 2004 and 2009 years. The paper used country-specific indicators and cutoffs considering internationally and nationally agreed criterions. Five dimensions and nineteen indicators used for the estimation. The study estimated that the multidimensional headcount ratios for the years 2004 and 2009 are 93% and 71% respectively. Moreover, the MPI estimation results were 35% and 25% respectively for the year 2004 and 2009. The use of country-specific indicators has brought a significant difference in the measurement of MPI. The international comparable MPI measures by UNDP, 2011; and Alkire and Conconi, 2013 reported a higher MPI estimates than the one calculated in this country specific study. The international comparable MPI estimate found that the MPI for Ethiopia for the years 2005 and 2010 are 60% to 55% respectively. The main difference of this paper from the country specific study is the intensity of poverty estimate. In this country-specific measure, on average the poor are deprived a small number of indicators whereas the international comparable measure reported a large number of indicators. Given a

different data set and different indicators have used in these papers, having a country-specific indicators and cutoffs is very important for policy interventions. The paper found that, the choices of some indicator for instance crop stored and land hold are very important indicators of well-being for agrarian economy which had not considered in the international comparable MPI estimate. One of the assets used on the MPI estimation by Alkire and Conconi, 2013 is whether a household has car or not, which is less likely to identify non-poor person for agrarian economy. On the contrary, in this country specific estimation we used other representative assets such as having horse, camel or other livestock since they are common means of transportation and considered as household's wealth in agrarian economy. This is because the indicator which is important for one region to differentiate poor and non-poor is not equally important in another region. Nevertheless, there is a difference in the estimated figures; both estimations confirmed a decrease in MPI measures for the past decades (UNDP, 2011; Alkire and Conconi, 2013). Furthermore, many income poverty studies also confirmed that poverty in Ethiopia has declined in the past 10 years (Bigsten and Shimeles, 2007; Alemayehu *et al*., 2007; Dercon *et al*., 2007; Dercon *et.al*, 2011; IMF,2011, 2014)

To understand the regions and indicators which contributes more to the decrease in MPI, decomposition exercises were made across regions, family sizes and indicators. The decomposition results showed that, in average, all regions' decrease MPI with 50%. Specifically, the decrease in MPI was found to be as a result of a decrease in the member of households within the large and middle family size groups; especially the reduction in SNNPR was significant.

Moreover, the results from the panel MPI estimation showed that once a household slips into poverty, the probability of exiting from it was very low. On contrary, the probability for the non poor households to slip into poverty was very small. The MPI decomposition across time estimate confirmed that, the large decrease in MPI was the result of a significant decrease in the number of poor household's family size than a decrease in the number of deprived dimensions.

Finally, the panel MPI estimation result showed that more than half of the poor households succeeded in achieving some indicators. Moreover, the indicator which contributed to the decrease in the intensity of poverty is not the one with large decreases in the number of deprivations; rather it is the one with a low censored headcount ratio. The school dropout indicator contributes the largest portion for the improvement of the intensity of poverty over time. This panel based MPI estimation clearly indicates the progress or regresses of the household for a particular dimension over time. The results from this study could be extended by broadening the information set of individual's deprivation gap and by using a varying weighting scheme.

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Appendix

Table a Health service distribution in the study area

Peasant Associations	Year	No.of Government hospital	No.of private hospital	No.of Govt. Clinics/health post	Num of private clinic	No.of pharmacy within PA
Haressaw	2004	0	0	0	0	0
	2009	0	0	2	0	0
Geblen	2004	0	0	0	0	0
	2009	0	0	1	0	0
Dinki	2004	0	0	0	0	0
	2009	0	0	1	0	0
Yetmen	2004	0	0	0	1	0
	2009	0	0	2	1	1
Shumshea	2004	0	0	1	0	0
	2009	0	0	2	0	0
Sirbana	2004	0	0	1	0	0
Goditi	2009	0	0	1	1	0
Adele Keke	2004	0	0	0	0	0
	2009	0	0	0	0	0
Korodegaga	2004	0	0	0	0	0
	2009	0	0	1	0	0
trirufe	2004	1	0	1	2	1
	2009	0	0	1	0	0
Imdibir	2004	1	0	1	1	1
	2009	0	0	1	2	2
Azedeboa	2004	0	0	0	0	0
	2009	0	0	1	0	0
Adado	2004	0	0	1	0	0
	2009	0	0	1	0	0
Gara Godo	2004	0	0	1	0	0
	2009	0	0	1	0	0
Doma	2004	0	0	1	0	0
	2009	0	0	0	0	0
D.Berhan	2004	0	0	0	0	0
	2009	0	0	1	0	0

Source: ERHS data

Table b: Standard of living indicator services

Peasant associations	year	road to the nearest town	electricity	water	number of telephone services	number of post office	number of bank
Haressaw	2004	No	No	yes	0	0	0
	2009	yes	No	no	1	0	0
Geblen	2004	yes	No	No	0	0	0
	2009	no	Yes	no	1	0	0
Dinki	2004	yes	No	No	0	0	0
	2009	yes	No	yes	1	0	0
Yetmen	2004	yes	Yes	yes	1	0	0
	2009	no	Yes	yes	1	1	0
Shumshea	2004	yes	Yes	yes	0	0	0
	2009	yes	Yes	no	0	0	0
Sirbana	2004	No	Yes	No	0	0	0
Goditi	2009	yes	Yes	Yes	2	0	0
Adele Keke	2004	yes	No	No			
	2009	yes	Yes	Yes	1	0	0
Korodegaga	2004	No	No	No	0	0	0
	2009	yes	No	No	0	0	0
Trirufe	2004	yes	No	Yes	2	1	4
	2009	yes	Yes	Yes	1	0	0
Imdibir	2004	yes	No	No	1	1	0
	2009	yes	Yes	No	1	1	1
Azedeboa	2004	yes	No	No	0	0	0
	2009	yes	No	No	0	0	0
Adado	2004	No	No	No	0	0	0
	2009	no	Yes	No	1	0	0
Gara Godo	2004	No	No	Yes			
	2009	yes	Yes	No	0	0	0
Doma	2004	No	No	Yes	1		
	2009	no	No	No	1	0	0
D.Berhan	2004	No	No	No	0	0	0
	2009	no	Yes	no	0	0	0

Source: ERHS data

Table c: distribution of primary and secondary school in different peasant associations

	Year 2004			Year 2009		
Peasant association	Nu of primary school	Nu of Junior school	Num of high school	Nu of primary school	Nu of Junior school	Num of high school
Haressaw	1	0	0	1	1	0
Geblen	1	0	0	2	1	0
Dinki	1	0	0	1	0	0
Yetmen	1	1	0	2	0	0
Shumshea	1	1	0	3	0	0
Sirbana Goditi	1	1	0	2	1	0
Adele Keke	1	0	0	3	0	0
Korodegaga	1			1	0	0
trirufe	2	1	1	2	2	0
Imdibir	1	1	2	3	1	1
Azedeboa	0	1	0	1	1	1
Adado	1	1	0	1	1	0
Gara Godo	1	1	1	1	1	1
Doma	2	1	1	1	0	1
D.Berhan	1	0	0	1	0	0

Source: ERHS data

Part-Two

Individual Specific Weighting Scheme to a Multidimensional Poverty Measure

Individual Specific Weighting Scheme to a Multidimensional Poverty Measure

Abstract

Weights in the estimation of multidimensional poverty have a central role by showing the relative importance of dimensions. This paper proposed two different weighting schemes: endowment and distributional based weighting schemes. The later weighting scheme gives more weight to the dimension with small number of deprived individuals. On the other hand, the endowment based weighting scheme gives more weight to the dimension with large number of deprived individuals. The proposed weighting schemes consider both distributional equity and simultaneous deprivations of indicators. Using the Ethiopian rural household survey (ERHS) data for the year 2004, the paper compared the proposed weighting schemes with the equal weighting scheme approach.

The empirical result showed that, the multidimensional poverty index (MPI) estimation using endowment based equity weight has a lower estimate than the equal weighting approach. This happened because the indicators that have a small number of deprived individuals have got a higher weight under the equal weighting approach.

Key words: Endowment and distributional based weighting schemes, equal weighting scheme, Ethiopian rural household survey (ERHS), multidimensional poverty index (MPI)

1. Introduction

The thought that income or consumption could not be a good indicator of individual well-being because of market failure motivated researchers to discover an alternative method for measuring well-being. The spearheading original papers of Sen (1976) and Foster-Greer-Thorbecke (1984), has moved the standardizing methodology of poverty estimation to the multidimensional case. Right on time in the 1980s, the work of Townsend (1979), Streeten (1981) and Sen (1985) demonstrated that the well-being of an individual is relying on different life dimensions. Henceforth, many multidimensional poverty indexes have been developed (Tsui, 2002; Chakravarty and Bourguignon, 1999, 2003; Alkire and Foster, 2011; Ravallion, 1996, 2011; Data, 2013; Decancq *et.al.*, 2014; Sen 1987, 1992; Atkinson 2003).

Sen (1976) presented a new poverty measure and described a three-step procedure for deriving it. The first step is calculating a normalized shortfall of incomes. In the second step weights based on the rank order of poor incomes, which later called an 'ordinal approach' should be attached. The last step is the aggregation of the normalized shortfall, and followed by identification of poor. This paper focused to address issues related with the second step of multidimensional poverty estimation, which is the selection of a weighting scheme.

One of the important controversial issues in the existing MPI measure is the weights that are attached to different indicators of well-being (Ezzrari and Verme, 2012). The weighting schemes that are attached to different dimensions could have two advantages. First, those weights could capture the relative importance of each dimension to a person's overall well-being (Atiknson, 2002; Takeuchi, 2014; Alkire and Foster, 2011). Second, similar with the income poverty, weights can be used as an instrument to bring equity in the poverty measurement (Sen, 1976).

Sen argued that poverty estimates need to have an absolute deprivation component (as represented by the normalized gap) and a relative deprivation component represented by equity based weight (Sen, 1976; Foster *et al*., 1998).

A number of weighting schemes have been developed for the past few decades. Some of the weighting schemes adopted an equal weighting scheme across dimensions (Atiknson, 2002; Alkire and Foster, 2011); thereby avoiding the need for attaching different importance to various dimensions. However, many scholars criticize equal weighting approach by arguing well-being dimensions could not have similar importance (Ravallion, 2011). One of the options as an alternative method is to use individual preference as a weighting scheme (Decancq *et al*., 2014; Notten and Roelen, 2012; Watson *et al*., 2008; Takeuchi, 2014). In the individual preference weighting scheme, all decisions regarding the relative importance and trade-off among dimensions are left to the individual. The problem to this approach is individuals may not reveal their real preferences (Takeuchi, 2014; Kahneman and Krueger, 2006).

The other option which has been used in previous literature is the statistical weighting approach. The methods used frequencies of deprivations and other statistical computation using the data set to show the relative importance of a dimension or to reflect the underlying data quality of the variables (Njong and Ningaye, 2008; Ezzrari and Verme, 2012; Agbodji *et al*., 2013)[1]. However, those approaches do not consider multiplicative deprivations and equity among individuals. Sen (1976) suggested the relevance of attaching a higher weight to a person who is suffering from extensive deprivations and suggested a relative equity measure under the income poverty. This implies two important things that have to be included in the weighting scheme of multidimensional poverty: first, the share that each individual has from each dimension which is termed as distributional equity (Decancq and Lugo, 2013; Rippin, 2013). Second, we also need to consider the number of deprivations for each individual which shows the extent of deprivations across dimensions is called multiplicative deprivations (Roche, 2013).

A statistical weighting scheme in MPI measure that considers both the relative importance of a dimension and equity simultaneously does not appear throughout the literature to the best of my knowledge. Hence, this paper will contribute to the existing literature by developing a weighting scheme that is sensitive both for simultaneous deprivation and distributional equity.

2. Notation and defining a state of variables

Let n represent the number of individuals and $m \geq 2$ be the number of dimensions. Each dimension is represented by wellbeing indicators j, where j is between 1 and d. Throughout this paper we used only indicators to define individual's well-being and to compute MPI. Let $Y = |Y_{ij}|$ denote the $n \times d$ matrix of endowments, where the typical entry $Y_{ij} \geq 0$ is the endowment of individual i=1,2, …,n in wellbeing indicator j=1,2, …,d. Besides, $|Z_j| > 0$ is the indicators cutoff below which a person is considered to be deprived in indicator j.

For any given Y, let $g = |g_{ij}|$ is a deprivation gap, which denotes a 0-1 matrix of deprivations associated with Y, whose typical element g_{ij} is defined by $g_{ij} = 1$ when $Y_{ij} < Z_j$, while $g_{ij} = 0$ otherwise. After having the deprivation gap g_{ij} , this paper proposed a weighting scheme w_{ij} which is individual-specific weight. The next section discussed how to develop an individual-

[1] Detail discussions can be found at Decancq et and Lugo, 2013

specific weighting scheme. Besides, the adjusted deprivation gap (g_{ij}**) is defined as the product of g_{ij} and w_{ij}.

Finally, C_i is defined as the aggregate deprivation score, which is the sum of g_{ij}** across indicators. The paper also defines a poverty cutoff *k*, which identifies whether a person is poor or not based on the aggregate deprivation score C_i. Moreover, C_i* is defined as the adjusted aggregate deprivation score after censoring all values of C_i below *k* to zero. Hence, if C_i is lower than *k* (or C_i* = 0), then the person is considered non-poor.

According to Alkire and Foster (2011) MPI measure, multidimensional poverty index can be defined as follows[2]

$$MPI = \left(\frac{\sum_{i=1}^{n} C_i *}{n} \right)$$

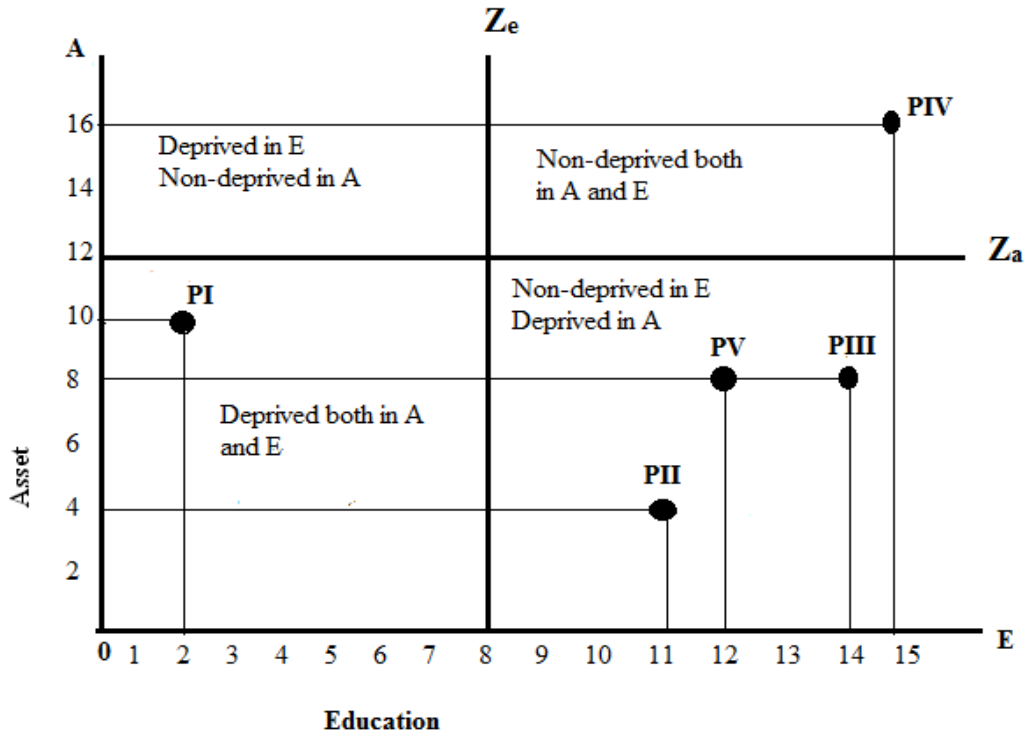
3. Conceptual framework for the individual specific weighting scheme

The paper proposed an individual specific weighting scheme for MPI estimation. To make the discussion smoother, let's see the following graphical explanation. Consider a two-indicator five-individual economy. The two indicators are asset (A) and education (E); and the five individuals are PI, PII, PIII, PIV and PV. Besides, Z_a and Z_e are deprivation cutoffs for asset and education indicators respectively. The following figure shows the deprivation status of each individual. [3]

[2] For detail discussion of the estimation process see Alkire and Foster 2011.

[3] The graph is drawn to scale

Fig 1: Education and asset indicators endowment for the five individuals



The first step in the estimation of MPI is to find the deprivation gap g_{ij} for each individual. From fig (1), points located below (or to the left of) the indicator's cutoff Z_a (Z_e) are considered deprived. The following table shows the deprivation status of each individual using the endowments and deprivation cutoffs given at fig (1).

Table 1: Asset and Education deprivations for the five individuals

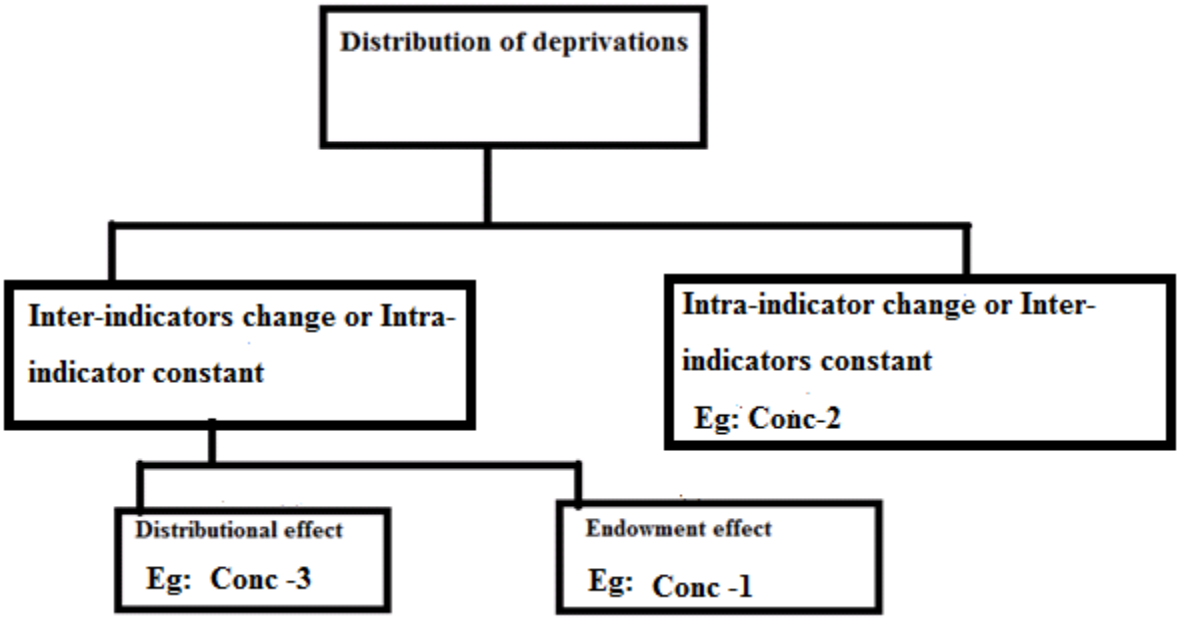
Deprivation gap for the two indicators (g_{ij})*	Individuals					Sum of deprivations by i ($\sum_{i=1}^{n} g_{ij}$)
	PI	PII	PIII	PIV	PV	
Asset	1	1	1	1	0	4
Education	1	0	0	0	0	1
Sum of deprivations by j ($\sum_{j=1}^{d} g_{ij}$)	2	1	1	1	0	5

*Values in the table represent deprivations (g_{ij}), 1 means deprived or located below the threshold Z and 0, otherwise.

Following Table 1, we can draw three important conclusions: First, looking at the aggregate deprivation score for each indicator, most of the individuals deprived the asset indicator than education. Second, looking at the aggregate deprivation score of each individual, person PI deprived both dimensions simultaneously, but others do not. Third, concerning the relationship between individual's deprivation and those two indicators, person PI found to be the only person

deprived the education dimension. Based on the above three conclusions (Conc 1-3), three effects can be identified as shown in the following figure about the nature of distribution of deprivations.

Fig 2: Different effects from deprivation's distribution



The intra-indicator effect or change tries to incorporate simultaneous deprivation of indicators or multiplicative deprivations for each individual. This implies that, for an individual there is no difference on weights attached to each indicators. In another word, for an indicator individuals might attach different weights. On the other hand, the inter-indicators effect or change shows the deprivation differences between two or more indicators. This implies that, all individuals attach the same weight within an indicator but may vary between indicators for an individual. Again, this could be classified into two parts: distributional effect and endowment effect. The distributional effect identifies the indicator where a small number of individuals are deprived whereas the endowment effect identifies the indicator where a large number of individuals are deprived.

These two effects are going to be used to construct a new weighting scheme that considers multiplicative deprivations and equity between individuals across different indicators. Hereafter, the paper discusses these two types of effects in detail with the illustrative example that is provided in table (1), and finally it compares different weighting schemes using the Ethiopian data.

4. The Individual specific weighting scheme

The individual specific weighting scheme has two parts: the inter-indictors effect and the intra-indictor effect.

A. Inter-indicators or between indicators effect

The works of Rippin (2013) on the distributional justice and Banerjee (2012) on the multidimensional inequality are some of the contributions about the relevance of considering resource distribution in the measurements of well-being. Following the work of Sen (1976), on equity based weights for income poverty estimation, this paper proposed an inter-indicators weighting scheme in the multidimensional poverty framework. This weighting scheme tries to show how endowments are distributed fairly across individuals or indicators. This approach again classified into two parts: distributional effect or equity between individuals and endowment effect or equity among indicators.

a) Equity among individuals or distribution effect

Sen (1976) suggested an Ordinal Rank Weight axiom to incorporate inequality among individuals to the measurement of poverty. The proposed axiom aimed to bring equity in the measurement of income poverty. Following the work of Sen (1976), some studies have considered equity in the measurement of poverty (Tsui, 2002; Chakravarty, 2009). Those studies suggested that, the poverty measure and distribution of resources are inversely related. This implies that, the aggregate poverty should be lowered when resources distributed evenly among individuals.

One of the methods to consider equity of distributions to the measurement of poverty is by giving more weights to unequal distributions using frequency of deprivation. The frequency of deprivation for an indicator and the weight attached to it are found to be inversely related (Decancq and Lugo, 2013). Fewer frequent deprivations get a higher weight. This idea is emanated from the fact that individuals attach a higher importance to the shortfalls in indicators where majorities do not fall short. A person might feel less deprived if majorities also deprived in similar indicator.

From fig 1, person PI is the only deprived individual in the society for education indicator. Hence, from equity ground the person gives more weight to his shortfall. On the contrary, for asset indicator, out of the five individuals four of them are deprived and hence, person PI will attach less weight to his shortfall since his deprivation also shared by others. This is because when some rights are restricted for all people, they may not give more recognition for their deprivations. Khader (2011) argues that in the society where there exists gender inequality, women developed adaptability characteristics, and they might even not recognize their deprivations. The probability for the girl to think of her deprivation is less if all girls in the society are experiencing similar deprivations. On the contrary, a girl who is living within a society where she is the only person who is deprived access to water, she will attach more weights to her shortfall. The study proposed the following distributional equity weighting scheme for each deprived individual:

$$EI_j = \frac{\left(1-a_j\right)}{\sum_{j=1}^{d}\left(1-a_j\right)} \text{ where } a_j = \left(\frac{\sum_{i=1}^{n} g_{ij}}{\sum_{j=1}^{d}\sum_{i=1}^{n} g_{ij}} \right)^{\phi} \qquad \text{eq(1)}$$

Φ is a distributional sensitive parameter which is set to 1/ *n*. This parameter is included in the estimate to make the measure in the favor of those indicators which have a small number of deprived individuals and to penalize weights attached to indicators which have a large number of deprived individuals. Moreover, the inclusion of the parameter also helps to make the estimate sensitive for the changes in *n*. The above eq (1) tells us two important things. First, at any condition, a deprived person from an indicator that has *r* number of deprived individuals has always a higher value of weight than a situation where the same person deprived an indicator that has *r +1* number of deprived individuals. Second, when *n* increases the weight attaches to an indicator that has a small number of deprived individuals' increases but at a decreasing rate. In another word, this implies that when *n* increases the sum of the weights for an indicator that have small number of deprived individuals would be outweighed by an indicator that have large number of deprived indicators. The intuition is when the space of the analysis is very wide or when *n* increases, the estimate identifies an increasing number of poorer from the poor segments of the society. Following the previous example, the weight attached to each individual for asset indicator is as follows.

$$EI_{asset} = \left(\frac{1-4/5}{(1-4/5)+(1-1/5)} \right)^{\frac{1}{5}} = 0.136883$$

In similar fashion, we can calculate the EI weight for education. The ED weights for asset and education to each individual respectively are 0.1368 and 0.86. For those who are deprived, the deprivation weight should decrease as the number of deprived individuals' increases.

b) Equity among dimensions or endowment's effect

Based on the relevance of dimensions, there is a need to attach weight to show whether resources or budgets are equally distributed among indicators or not (Takeuchi, 2014). For policies targeting to decrease the number of deprived individuals, the best strategy could be boosting accessibilities of resources for the indicator where majorities are deprived.

The relevant information required to derive this weighting scheme is the number of deprived individuals for each indicator. Fewer frequent deprivations get smaller weight. The information from this weighting scheme gives policy makers the indicators where most are deprived. Unlike the distributional effect weighting scheme, which gives emphasis for the achievement of individual well-being (care for minorities), the endowment effect weighting scheme focuses more on the aggregate welfare of the population (care for majorities). Following that, the study gives more weight to the most deprived indicators.

$$ED_j = \left(\frac{1}{n}\right)\frac{\sum_{i=1}^{n} g_{ij}}{\sum_{j=1}^{d}\sum_{i=1}^{n} g_{ij}} \qquad \text{eq(2)}$$

From Fig 1, one can see that many individuals deprived the asset indicator. Hence, using this weighting scheme more weight should be given to those individuals who are deprived asset indicator than education. Following the previous example, the weight attached to each individual for health indicator is as follows.

$$ED_{\text{asset}} = \left(\frac{1}{n}\right)\frac{\sum_{i=1}^{n} g_{\text{iasset}}}{\sum_{j=1}^{d}\sum_{i=1}^{n} g_{ij}} = \left(\frac{1}{5}\right)\frac{4}{4+1} = 0.16$$

In similar fashion, we can calculate the ED weight for education. The ED weights for asset and education to each individual respectively are 0.16 and 0.04. For those who are deprived, the deprivation weight should increase as the number of deprived individuals' increases.

B. Intra indicator effect or Multiple deprivations:

People are not always comparing their deprivation status with others. People attach a higher weight to indicators where they faced shortfalls without any comparison with other individuals. Sometimes, due to imperfect information, an individual may not have information on other's deprivations, and thus will give more weights to those indicators in which he/she faced shortfalls. It is very important to consider multiple deprivations in the estimation of MPI. Naturally, it is not the same to be deprived in one indicator only as to be deprived in all three at the same time (Roche, 2013). For instance, from table 1, person PI is more deprived than other individuals since he/she is deprived both dimensions. Hence, a higher weight should be attached to PI deprivations. This emanates from the theory of equality of opportunity (Ferreira, Lugo and Brunori, 2013). Sen viewed deprivation as an essentially relative concept and later termed as "relativist" view of poverty (Sen, 1976; 1983). The lower a person is in the welfare scale, the greater his sense of poverty, and his welfare rank among others, maybe taken to indicate the weight to be placed on his income gap (IBID). Following the Relative Equity axiom of Sen's (1976), a higher weight should be attached to a person who is under the worst condition compared to others. This implies that more weight should be given to a person who has multiple deprivations than a person who is deprived only one indicator since multiple problems are bigger than the sum (Yoshida, 2011).

Multiple deprived people need particular attention due to the following two reasons. First, those people are unable to trade-off indicators due to shortage of endowments. Second, any efforts to make trade among indicators put a higher cost to the person if the indicators are less substitutable. Hence, the incidence of deprivation is very big for multiple deprived individuals. The weighting scheme for multiple deprivations is given as follows:

$$EM_i = \frac{1}{d}\left(\frac{1}{(d+1)-\sum_{j=1}^{d} g_{ij}}\right) \qquad \text{eq(3)}$$

Following the previous example, the weight attached to each indicator for person 1 is as follows.

$$EM_1 = \frac{1}{d}\left(\frac{1}{(d+1)-\sum_{j=1}^{d} g_{ij}}\right) = \frac{1}{2}\left(\frac{1}{(2+1)-2}\right) = 0.5$$

In similar fashion, we can calculate the EM weight for education. The EM weights for each individual respectively are 0.5, 0.25, 0.25, 0.25 and 0.167. For those who are experienced multiple deprivations, the deprivation weight should increase as the number of deprived dimensions increases.

In general, the maximum weight that could be attached in all three methods could not be higher than one or lower than zero. For a person who is deprived all indicators will have a weight of one in each weighting scheme. So, the aggregate weight that is going to be attached for this particular person should not exceeds from one similar to the counting AF methodology approach (Alkire and Foster, 2011). This individual specific weight could be feasible by taking the averages of the weighting schemes derived from inter-indicators effect and intra-indicator effect weights. For the case of inter-indicators effect, we first need to choose one of the weights (ED or EI); depending on the interest of the study, whether to foster equity in the distribution of resources or to foster accessibility of resources in general.
Therefore, the aggregate weight that is going to be attached to each individual is the sum of the inter-indicators effect and the intra-indicator effect.

$$w_{ij} = \frac{1}{2}(EI(or..ED) + EM)\ ,\ 0 \le \sum_{j=1}^{d} w_{ij} \le 1$$

This gives the normalized equity based individual specific weight. Hence, the sum of the weights attached to each individual could not exceed 1.

The adjusted deprivation gap g_{ij}** could be written as the product of the weight and the deprivation gap

$$g_{ij}^{**} = g_{ij} w_{ij} \qquad \text{eq(4)}$$

Using the above example the weights attached to each individual is given in the following table using EM and EI weights.

Table 2: illustrative example to calculate adjusted deprivation gap

Individuals	$\mathbf{g_{ij}EM}$		$\mathbf{g_{ij}EI}$		$\mathbf{g_{ij}w_{ij}}$		$C_i = \sum_{j=1}^{d} g_{ij} w_{ij}$
	A	E	A	E	A	E	
PI	0.5	0.5	0.137	0.86	0.35	0.65	1
PII	0.25	0	0.137	0	0.225	0	0.225
PIII	0.25	0	0.137	0	0.225	0	0.225
PIV	0.25	0	0.137	0	0.225	0	0.225
PV	0	0	0	0	0	0	0

$C_i = \sum_{j=1}^{d} g_{ij} w_{ij}$ is the aggregate deprivation score for each individual. Estimation of MPI is based the aggregate score of each individual. For detail discussion of MPI estimation see Alkire and Foster (2011).

The weight applied in the above example confirmed that the maximum aggregate deprivations score (C_i) could not exceed 1 if the person deprived all indicators.

5. Data and description of dimensions

The study used the 2004 Ethiopian Rural Household Survey (ERHS) data, which is a panel survey conducted seven times between 1994 and 2009. [4] The survey encompasses 1313 households from 15 representative communities, which were drawn from the four main regions of the country: Oromia, Amhara, Tigray and Southern Nation and Nationality People (SNNP), which accounts 90.5 percent of the total population (CSA, 2010). (for detailed discussion about the sample and the data set see Dercon and Hoddinott, 2004 and Bevan and Pankhurst, 1996). For demonstration purpose, the study used the 2004 ERHS data set. The study used five dimensions and 19 indicators. The following table shows the lists of dimensions and their respective indicators with the associated cutoff.

[4] These surveys were conducted jointly by the Economics Department at Addis Ababa University, the Centre for the Study of African Economies, University of Oxford and the International Food Policy Research Institute.

Table 3: Description of indicators and cutoff's

Dimensions of MPI	Indicators in each dimension	Indicators cutoff (Values for not being deprived)
Asset endowment and income	Asset owned	Having 1/3 of important durable assets.
	Crop stored	Having a stored crop
	Land owned	own one hectare of land
	Income	$1.25 per person
Education	School completed of hh head	Eight years of schooling
	Highest grade of children	At least five years of schooling
	School dropout	No one dropout school for more than 12 months
Empowerment	School for girls or boys	Educating girls is equally important as of educating boys.
	School for girls vs. marriage	Allow a girl to go to school than force for marriage
	Women right to decide	If a woman has the right to decide on the income comes from the sale of crops, charcoal or homemade products.
Health	Child mortality	0
	Stand up after sitting	For childeren aged above 7 can walk for 5km or can stand up after sitting
	Walk for 5km	
	Illness days	Anyone sick or weight loose for not more than three weeks
	Weight loose days	
Standard of living	construction material of house	The house is not made up of Mud/dung ('Chika/Ebet') and thatch ('Sar').
	Toilet use	Using flush toilet or latrine
	Garbage disposal	Using at least one of the following: green manure, buried, periodically collected by a particular authority, or dumping at a specified point.
	Access to clean water	Using one of the following sources of water: piped water, borehole or pump, protected well, protected spring or rain water.

The selections of all dimensions are based on the Millennium development Goals (MDGs). Each dimension again represented by indicators of life. For instance, the first dimension, asset and income represented by per capita income of individual and individual's asset holding. For each indicator a set of thresholds are selected to identify whether a person is deprived or non-deprived.

6. Results and discussion

The following table presents the five dimensions and the associated indicators that are chosen to estimate MPI. To develop the proposed weighting scheme the paper used individual's deprivation for each indicator as presented in table 4 and simultaneous deprivations as presented in fig 3.

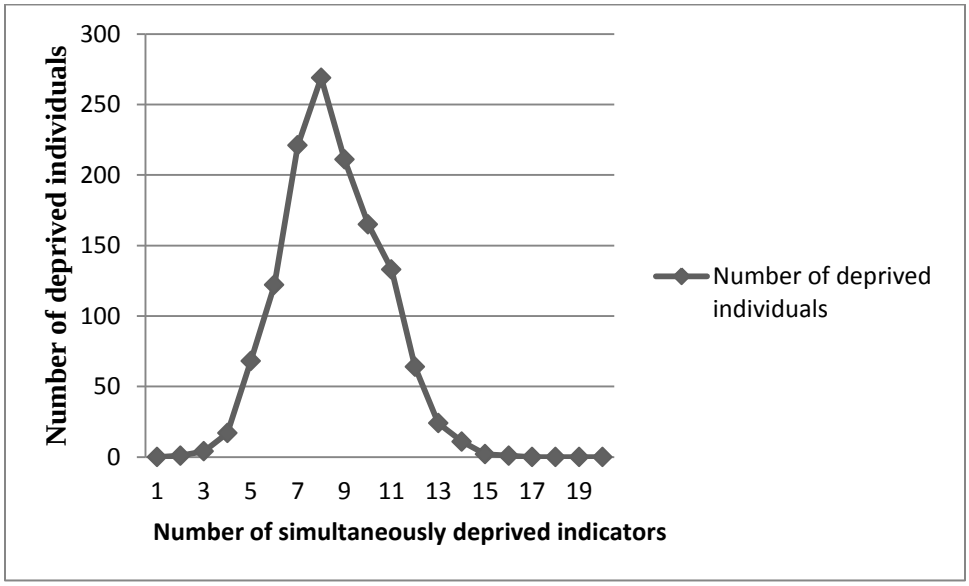
Table 4: Five life dimensions with their respective indicators

Dimensions of MPI	Indicators in each dimension	Deprived numbers	Deprivation percentages
Asset endowment and income	Asset owned	973	74.8%
	Crop stored	450	34.3%
	Land owned	48	3.7%
	Income	716	54.5%
Education	School completed of hh head	734	55.9%
	Highest grade of children	524	39..5%
	School dropout	326	24.8%
Empowerment	School for girls or boys	168	12.8%
	School for girls vs. marriage	122	9.3%
	Women right to decide	209	15.9%
Health	Child mortality	30	2.3%
	Stand up after sitting	291	22.2%
	Walk for 5km	479	36.5%
	Illness days	484	36.9%
	Weight loose days	234	17.8%
Standard of living	Construction material of house	1226	93.4%
	Toilet use	907	69.1%
	Garbage disposal	267	20.3%
	Access to clean water	1067	81.3%

Source: survey result

Table 4 showed that many individuals deprived construction material of the house indicator, and the least one is mortality. The table also showed that most of the individuals deprived many indicators of the standard of living dimension. This implies that, there are simultaneous deprivations. The following figure shows individuals status about simultaneous deprivations.

Fig 3: Multiple deprivations of indicators



Source: survey result

From the sampled respondents, 270 individuals deprived nine indicators simultaneously. On the contrary, only three individuals faced simultaneous deprivation of 14 indicators. Moreover, the above graph also showed that all individuals are deprived at least one indicator. In general, multiplicative deprivation is unevenly distributed among individuals and its inclusion in the estimation would have an advantage to understand the severity of poverty that arose due to multiple deprivations. This severity due to multiplicative deprivations is different from the severity of an indicator that captured by the deprivation gap. The later considers only the distance that an individual's endowment is far from indicators cutoff and which do not consider the burden that each individuals suffer from a deprivations in two or more indicators at the same time. As illustrated in fig (3), those 3 individuals who are deprived 14 indicators simultaneously are suffering more than any other individuals in the sample.

6.1.Weighting and estimation of MPI

For the aggregation of indicator's deprivations and for computation of MPI, the study used the counting approach. To understand the proposed weighting schemes and for a comparison reason, the equal weighting approach has also discussed. For the equal weighting approach, each dimension allotted 20% as a weight; and then each 20% weight is allocated equally to indicators within each dimension. Following the Alkire and Santos (2011) method of choosing appropriate poverty cutoff, the paper used 1/5 of the available indicators as a poverty cutoff. The estimation results with endowment focused and distributional equity focused of individual specific weighting schemes and equal weighting scheme is presented in the following table.

Table 5: MPI estimation using the three approaches

Estimates	Endowment focused Individual specific weight	Distributive equity focused Individual specific weight	Equal weight
H	0.932	0.293	0.930
A	0.321	0.244	0.374
MPI	0.299	0.072	0.348

Source: survey result

From the estimated results, the endowment focused weighting scheme and the equal weighting schemes approximately registered a similar value of unadjusted multidimensional poverty index (H). However, the distributional equity based method identified small number of individuals as poor. This happened because the distributional equity identified only some part of poor people who are in worse situation relative to others or those who are suffering from chronic poverty. The estimated MPI under the distributional focused weighting scheme is only 7.2%. On the contrary, the endowment focused weight includes all individuals who could not achieve the minimum poverty threshold. If we are comparing based on the MPI estimates between endowment focused weight and equal weighting approaches, there is a significant difference. Around 30% of individuals are identified as multidimensionaly poor under the endowment focused weighting approach and with the equal weighting approach 35% of them are considered multidimensionaly poor. This happened because the dimensions that have a small number of deprived individuals have got a higher weight under the equal weighting approach.

6.2.Decomposition across indicators

Similar with other data-driven weighting scheme methods, the proposed individual specific weighting scheme does not satisfy the strong sub-group decomposability axiom across population. However, it could satisfy the weaker definition of decomposability, which is a backward decomposability. With the backward decomposability, the contributions of sub groups are identified from the beginning. From policy perspective which is enough to make comparisons between a set of groups (Chakravarty and Bourguignon, 1999; Njong and Ningaye, 2008; Ezzrari and Verme, 2012; Agbodji *et al*., 2013).

On the contrary, similar to Alkire and Foster (2011) the individual specific weighting scheme satisfies the strong sub group decomposability across indicators. The following table shows the decomposability results from the raw and censored headcount measures to understand indicators where most individuals are deprived.

Table 6: Raw and censored headcount estimates

Indicators	Endowment		Distributive equity		Equal weight	
	Raw H	Censored H	Raw H	Censored H	Raw	Censored H
Asset owned	0.053	0.054	0.017	0.018	0.044	0.044
Crop stored	0.009	0.009	0.009	0.013	0.017	0.017
Land owned	0.000	0.000	0.001	0.002	0.001	0.001
Income	0.020	0.021	0.012	0.018	0.025	0.026
School completed of hh head	0.020	0.021	0.011	0.016	0.034	0.035
Highest grade of children	0.032	0.034	0.014	0.017	0.044	0.045
School attendance	0.005	0.005	0.008	0.011	0.019	0.019
School for girls than boys	0.001	0.001	0.004	0.010	0.008	0.009
School for girls than marriage	0.001	0.001	0.003	0.008	0.005	0.006
Women right to decide	0.002	0.002	0.005	0.011	0.010	0.010
Child mortality	0.000	0.000	0.001	0.002	0.001	0.001
Stand up after sitting	0.004	0.004	0.006	0.013	0.009	0.009
Walk for 5km	0.010	0.010	0.010	0.017	0.015	0.015
Illness days	0.011	0.011	0.010	0.016	0.016	0.016
Weight loose days	0.003	0.003	0.006	0.013	0.007	0.008
construction material of house	0.060	0.061	0.017	0.018	0.047	0.047
Toilet use	0.032	0.034	0.014	0.015	0.033	0.034
Garbage disposal	0.003	0.003	0.006	0.009	0.009	0.009
Access to clean water	0.046	0.047	0.016	0.017	0.040	0.041

Source: Own computation

All three estimates identified that many households deprived the construction material of the house indicator. For the case of a distributional focused weighting scheme, besides the construction material of the house indicator, many households deprived income and asset indicators too. Hence, from distributional equity point of view, to decrease those who are suffering from chronic poverty, providing those resources could improve the situation. On the other hand, from resource provision point of view, improving the construction material of the house indicator may push some poor individuals out of poverty.

Conclusion

Weight under multidimensional poverty estimation has a crucial role by showing the relevant dimensions. The paper argued that, any weighting scheme for multidimensional poverty needs to incorporate three essential elements: multiplicative deprivation, resource provision and distributional equity. The paper proposed two different individual specific weighting schemes: first, the endowment focused weighting scheme, which is the sum of endowment effect weight and intra- indicator effect weight. The second one is distributional focused weighting scheme, which is the sum of distribution effect weighting and intra- indicator effect weighting schemes. The later weighting scheme aimed to identify those who are suffering from extreme deprivation. On the other hand, the former tried to identify all individuals who are unable to achieve the minimum achievable thresholds. The proposed weighting scheme satisfies the weaker definition of decomposability across population (Chakravarty and Bourguignon, 1999), and the strong decomposability across indicators (Alkire and Foster, 2011).

The illustrated example using Ethiopian data showed that, the distributional weighting scheme reported a lower MPI estimate than the endowment focused weighting scheme. Compared to the equal weighting approach, for instance, the Alkire Foster, 2011, the endowment focused weight registered a lower MPI estimate.

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Part-Three

Preferences in the Multidimensional Poverty Measure[1]

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Preferences in the Multidimensional Poverty Measure

Abstract

One of the most challenging issues in the measurement of multidimensional poverty is the selection of appropriate weight attributed to each dimension. The paper proposed an observed preference weighting scheme based on four domains: happiness, importance, perceived deprivation and easiness to achieve. Those domains discussed with rank and scaling methods to check consistency of choices and to create a holistic weighting scheme. The proposed weighting scheme is sensitive to equity and efficiency. To elicit individual preferences to well-being dimensions the paper used a survey that has collected from Ethiopia.

The paper estimated multidimensional poverty index (MPI) using six preference models and compared them with the equal weighting approach. The estimated results showed that the MPI measure with preference based weighting approach is higher than the equal weighting approach. The inclusions of all domains in the preference based weighting scheme have a significant difference on MPI estimates compared to the situation where only one domain used as a weight. Besides, it is also found that, getting relatively similar MPI estimate is not a guarantee for having the same poor individuals across models. Furthermore, the paper founds that the MPI estimate varied a lot when dimensional cutoffs are set by individual's subjective threshold than an objective threshold. The result from the survey showed that most of the respondents believe that they are less poor than what the objective measure identifies. The findings from the regression result also confirmed that individual's well-being improves more with people's perceived deprivations than the observed deprivations used as explanatory variables. Hence, the paper suggests that considering people's perception about dimensional threshold and weights could help to identify the dimensions which improve people's welfare.

Key words: Multidimensional Poverty Index, Domains, Observed preference weighting scheme, equal weighting approach, perceived deprivations, happiness, importance, perceived deprivation and easiness to achieve

1. Introduction

The critique that income or consumption could not be a good indicator of individual well-being provoked researchers to discover an alternative method (Ravallion, 2011). The idea behind the critique is that the deprivation in income has a multiplicative impact on other indicators of individual's well-being. Henceforth, many scholars have started developing a multidimensional poverty measure that considers deprivations in many welfare indicators, though there have been difficulties of measuring it (Tsui, 2002; Chakravarty and Bourguignon, 1999, 2003; Alkire and Foster, 2009, 2011; Ravallion, 1996, 2011; Data, 2013; Decancq *et al.*, 2014; Sen 1987, 1992; Atkinson 2003).

One of the major issues in the measurement of MPI is the weight that is attributed to different dimensions of well-being (Ezzrari and Verme, 2012). Some of the weighting schemes may category a person as multidimensionally poor and some others may identify the same person as non-poor (Decancq *et al*., 2013). This would clearly have implications for a policy that targets

poor segments of the society. The problem becomes more severe if there is limited budget allocated for such types of programs. Therefore, choosing an appropriate weighting scheme is mandatory to identify the needy segments of the society. This paper claims that the selection of appropriate weighting scheme should have to have two phases: the first phase is the selection of appropriate weighting scheme; and the second phase is the selection of prioritizing criterions or domains.

Regarding to the selection of weighting schemes, in general, literature identifies three weighting schemes: equal weighting, data-driven weighting and preference weighting schemes. The equal weighting scheme attaches similar weight across dimensions of life (Takeuchi, 2014; Atkinson, 2002; Alkire *et al*., 2011). Although it makes comparisons of a state of world much easier, attaching similar weight to all dimensions is far from truth (Ravallion, 2011; Decancq *et al*., 2013). On the other hand, the data-driven weighting scheme such as statistical and frequency methods attach different weights across dimensions (Njong and Ningaye, 2008; Ezzrari and Verme, 2012; Agbodji *et al*., 2013; Decancq and Lugo, 2013). However, similar to the equal weighting approach, the weights obtained from data-driven do not necessarily reflect people's preferences and could hide intra-group diversity. The best alternative to these two approaches is the preference based weighting scheme such as life satisfaction, stated, observed and reveled preferences (Decancq *et.al*, 2014; Notten and Roelen, 2012; Watson *et al*., 2008). The observed preference ask people directly by using observed preference methods. The observed preference approach aims to obtain weights from individuals' responses to hypothetical scenarios. In this framework, individuals are asked to state the preferred dimensions among a set of dimension bundles.

A weighting scheme based on an observed preference method has the following advantages over the equal and data-driven weighting approaches: First, it acknowledges preferences diversity among individuals. It is true that individual's attitudes to different dimensions are not supposed to be the same, and hence, it may be relevant to compare how different groups assess their priorities to different dimensions. Second, it enriches the model by providing heterogeneous information since individuals have possibly different preferences over dimensions. Third, preference based weight is a vital means for incorporating people's values in development interventions (Takeuchi, 2014). Finally, it makes the weighting decisions more transparent and more responsive to people's perceptions about what is more or less important to their well-being. Although preference is a powerful method to measure people's welfare, there are certain issues that should be addressed. First, to what extent responses from individual preferences are consistent? Second, how elicitation questions are managed? If choices are not consistent, it could not be possible to deduce weights from them (Takeuchi, 2014; Decancq *et.al*, 2014; Kahneman and Krueger, 2006). There are only few empirical papers that used individual's observed preference for the measurement of MPI (Notten and Roelen, 2012; Watson *et al*., 2008). Those studies have not tried any effort to consider the issue of consistency.

The second important phase in the selection of appropriate weighting scheme is the selection of prioritizing criterions or domains. It appears that the purpose of weight in the multidimensional poverty is to prioritize dimensions which then help to identify the needy segments of the society, and also to inform policy makers the dimensions where interventions are needed. This paper claims that, prioritizing dimensions could be plausible with the following four criterions

or domains: importance, happiness, deprivation and easiness to achieve. The first domain, importance domain, captures the relative importance of the components of well-being. The largest weight should be attributed to the most important dimension (Decancq *et al*., 2014; Notten and Roelen, 2012; Watson *et al*., 200). This implies that an increase in a more important dimension will improve the overall well-being more than a similar change in a less important one. The second domain that has been used to prioritized different dimensions is happiness domain (Fleurbaey *et al*., 2009). From policy perspective it is essential to give more weight to the dimension which gives more happiness to the people. For that reason, a policy decision should be elastic in happiness in order to boost people's welfare. A dimension which is elastic in happiness should be more responsive than the less elastic one for a similar change in the percentage of endowments or for a policy shocks. The third domain that has been used to prioritized dimensions is deprivation (Njong and Ningaye, 2008; Ezzrari and Verme, 2012; Agbodji *et al*., 2013). The aim of any anti-poverty reduction policy is to eradicate poverty. One of the means to do so is by providing the dimensions where majorities are deprived. It is still debatable whether policies should rely on actual deprivation or perceived deprivation to prioritized dimensions (Asselin, 2009). The intuition is what we observe about poor's deprivation (actual deprivation) and what those poor people think about their deprivation (perceived deprivation) may not be necessarily the same. Fleurbaey *et al*., 2009 found that there is high correlation between what people perceive about their satisfaction to a dimension and their happiness in life. It is clear that people's satisfaction for a dimension is highly determined by their perceived deprivation (Asselin, 2009). This implies that perceived deprivation could affect the well-being of an individual. However, there is no any literature evidence so far which has used perceived deprivation as one way to prioritized dimensions. The last domain which is still relevant equivalent to the other domains is achievability of a dimension. Easiness to achieve domain tries to investigate the extent to which whether dimensions are easy to achieve or not. A dimension which is difficult to achieve could affect poor's well-being in two different ways. First, it affects their wellbeing adversely by elongating the period that they could achieve it. Second, it requires large share of their resources and by which it affects the wellbeing that they would derive if they were spent it on an easily achievable dimension. Giving more weight for the dimension which is difficult to achieve could help policy makers to identify the dimension which is inelastic in achievability for the poor. However, this domain has also not appeared in any literature so far as a method to prioritized dimensions.

In general, all domains in the weighting schemes are relevant to prioritized dimensions since they could have effect on the welfare of the society. However, the existing literature in the observed preference MPI measure used only importance domain to construct weights (Notten and Roelen, 2012; Watson *et al*., 2008). Happiness, deprivation and easiness to achieve domains have not appeared in the observed preference weighting schemes so far to the best of my knowledge. An appropriate weighting scheme need to answer how different domains are chosen and aggregated to create a holistic measure of preference based weighting scheme.

Incorporating people's preferences over dimensions based on a wide range of well-being domains such as based on their importance, happiness, easiness to achieve and deprivation could tell policy makers the dimensions where interventions are needed. The intuition for this argument is that, the inclusions of all domains increases the choice set of prioritizing and allow people to make their choices independently. From technical point of view, it also helps to

enrich the information set of the model (Decancq *et.al*, 2014). Hence, developing a weighting scheme that considers those well-being domains could help for the measure to be more equity based, efficient and policy-imperative (Banerjee 2012; Rippin, 2013). Furthermore, considering people's value judgments about their deprivation should be incorporated in the poverty estimation as it is the main determinant of their wellbeing (Fleurbaey *et al*., 2009).

The aim of this paper is to estimate MPI using individual's preferences and to analyze individual preferences to different well-being domains. To the best of my knowledge, there is no empirical paper that investigates people preferences for MPI dimensions with different well-being domains. Moreover, weights for the estimation of MPI using observed preference that considers importance, happiness, deprivation and easiness to achieve do not appear in any literature so far, which makes this paper unique. The paper discussed how the information collected from observed preferences in different domains could be used and aggregated to construct a holistic weighting scheme.

2. Data and method

The study used a primary data that has been collected in Ethiopia. The survey was conducted in the four major universities, which are located in the four major capital cities of the country: Addis Ababa University, Bahirdar University, Adama University and Hawassa University. These regions accommodate more than 85% of the total population. The data were collected only from third-year Economics students for the following four reasons: first, for the interest of the data clarity and reliability as some of the questions are not familiar. Second, we think that to answer some of consistency questions they could perform better than ordinary people. Third, as the aim of the paper is to propose a new preference based weighting scheme and to show a way on how to resolve consistency issues in the individual preference, those third year Economics students are enough to hit the target of the paper. Fourth, most of the questions are designed in such a way that students to tell us about their families wellbeing indicators. Since students are coming from families with different living standards, it could raise the degree of its representativeness. From each university, 50 questionnaires were administered by the researcher and department heads of the universities. Due to high proportion of male students in the Department of Economics, it was impossible to use quota method based on sex. However, the survey tried to include all the available female students in the survey. In total, 200 questionnaires were distributed randomly on a quota basis to each class within the department. This does not provide any representative sample of Ethiopia's population, so there is no intention to make any statements about poverty of Ethiopian population. However, the inclusions of students in the survey who are coming from different regions with different living-standards could help us say something about the general poverty status of the country and the choice decisions.

To make the main survey less time-consuming and more attractive to the respondents, a pilot survey was conducted. Important adjustments were made on the formats and the number of questions before undertaking the main survey. Before distributing the questionnaire, detail explanation of what MPI measure is, and important instructions on how to complete the questionnaire was delivered. Respondents were given five dimensions of life: asset and income, health, education, quality of life and employment; and four domains including importance, happiness, deprivation and easiness to achieve. The structured questionnaire was designed to collect five types of important information. The questionnaires were distributed

separately and at different time. In order to get the next questionnaire they should return the preceding questionnaire first, so that once they have finished the first part and pass to the next, they would not have the chance to make correction. This has been done to avoid information collected from the successive questions not to affect their actual choices that they have made on the preceding questions. The five parts of the questionnaires are as follows: The first one is designed to elicit individual's perception about their deprivations and to locate their satisfaction rate for each dimension and for the overall wellbeing. The second one is to make choices among two dimensions. This was intended to collect information on how respondents are making choices between two dimensions. The aim of these questions is to let respondents adapted with preference choice making behavior which make the task of comparing and choosing for more than two dimensions easier. The third one is to collect information about respondent's preferences to dimensions in different well-being domains. Respondents were asked to rank the five dimensions based on the four domains: importance, happiness, perceived deprived and easiness to achieve (see appendix part 4 for detail). The fourth question is aimed to collect data to weight different dimensions in different domains. The last part of the questionnaire was asked to elicit information on household's observed deprivation. This question asked to respondents at the last stage not to be informative about their actual deprivation status. In this part, most of the questions are household questions since students are basically dependent on their families' income. Respondents were asked to locate their household's well-being status in five dimensions of life: Asset and income, health, education, quality of life and employment; which are presented below in table 1.

Table 1: Description of indicators and cutoff's

Dimensions	Indicators	Indicator's cutoff (minimum threshold for non-deprivation) for households
Asset and income	Income	$1.25 per person
	Asset	Having three out of the following list: TV, Radio, Sofa, Mobile, Bed, Our own house, your own land
Health	Underweight	BMI 17***
	Mortality(<3 years old)	0
	Prolonged sickness for communicable disease	Anyone sick for not more than three weeks
	Access to enough food	All can eat 3 times per day
Education	School attendance	Missing classes not for more than three consecutive months ***
	Father's schooling	At least 8 years of schooling
Quality of life	Water	Using one of the following sources of water: piped water, borehole or pump, protected well, protected spring
	Toilet service	Using flush toilet or latrine
	Garbage disposal	Using at least one of the following: green manure, buried, periodically collected by a particular authority, or dumping at a specified point.
	Electricity service	Having electricity service
Employment	Permanent employed	At least one permanently employed person

*** Underweight and school attendance are individual data

As depicted in the above table, based on the internationally agreed criterion, minimum achievable thresholds have been provided to the respondents, and they were asked whether they (their households') are located above or below the threshold. Except for underweight and school attendance indicators, all indicators are household based questions. Hence, respondents were asked to answer whether their household's member could achieve the minimum threshold or not. As the above table showed, each dimension has represented by indicators of life. For instance, the first dimension, asset and income represented by per capita income of the household and household's asset holding. For aggregation of dimensional deprivations and for computation of MPI, the study used the counting approach.[2]

[2] For detail discussions of the counting approach or the Alkire Foster MPI estimation model, please refers to Alkire and Foster, 2011

3. Results and Discussions

3.1. Descriptive about deprivations

The following table presents respondents deprivation for the five dimensions and the associated indicators that are selected to estimate MPI.

Table 2: Five life dimensions with their respective indicators

Dimensions	Indicators	Number of Deprivation
Asset and income	Income	120
	Asset	19
Health	Under weight	63
	Mortality	11
	Prolonged sickness for communicable disease	29
	Access to enough food	65
Education	School attendance	33
	Father's schooling	113
Quality of life	Water	48
	Toilet service	96
	Garbage disposal	121
	Electricity service	78
Employment	Permanent employed	142

Source: survey result

From the above table, most of the respondents deprived employment indicator, and the least one was registered for child mortality. For the income and asset dimension, most of the respondents deprived more of the income indicator than the asset indicator. This happened because for income indicator the study used per capita income of the households whereas for asset indicator the household's asset hold used without distributing to each member.

Observed and perceived deprivations

In economics and phycology literature there are two types of deprivations: the observed (actual) and the perceived deprivations (Rippin and Pogge, 2015; Asselin, 2009). Individual is deemed as deprived with the observed deprivation, if individual's resource endowment for a dimension is below the minimum achievable threshold, which is determined by an objective criterion. On the other hand, the perceived deprivation tells us how people think about their deprivation in all dimensions of life. People have their own thresholds for each dimension and classify themselves as whether they are deprived or not. Those thresholds could be emanated from their expectations from each dimension or in comparisons with the society. Respondents were asked to locate whether they are deprived or not for the five dimensions (See part 2 of appendix). To compare individuals perceived and observed deprivation, we need first to consider simultaneous deprivations of indicators within each dimension for the observed deprivation of table-2.

One way to account simultaneous deprivations is to use the union approach definition of identifying the poor (Tsui, 2002; Alkire and Santos, 2010). The study adopted the union definition of identifying poor to the dimensional level to identify whether a person is deprived in a dimension or not. Hence, if a person is deprived at least one of the indicators in a dimension, then the person is considered deprived in that dimension. Hence, comparisons between individual's perceived responses about their deprivation and their actual deprivation is possible. The following table presents the number of individuals' deprived for each dimension.

Table 3: Number of deprived individuals in each dimension

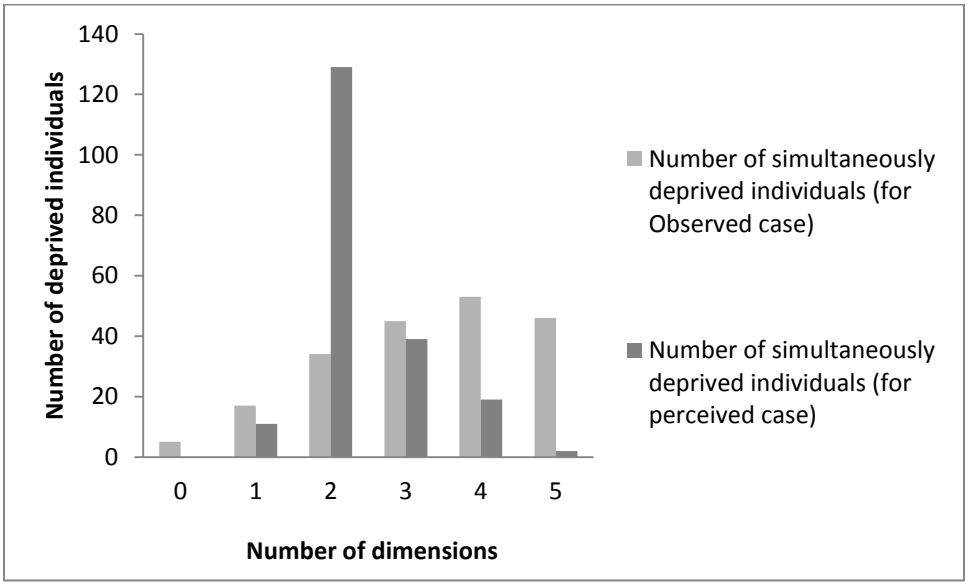
Deprived individuals	**Dimensions of life**				
	Asset and income	Health	Education	Quality of life	Employment
Observed	124	115	123	158	142
Perceived	153	86	23	117	93

Source: survey result

The above table showed that, most of the individuals actually deprived quality of life dimension, and the least one was registered for health dimension. However, for the perceived deprivation, most of the respondents think that they deprived the asset and income dimension and the least one was education dimension. This difference happened due to the fact that we have used different cutoffs to identify their deprivation status. For the perceived deprivation each individual set their own subjective dimensional cutoff and for the observed deprivation it is based on internationally agreed thresholds as explained on table-1. It is still debatable whether one should rely on the objective threshold or to use a more relative threshold for the estimation of poverty.

The other most important difference between the observed and perceived deprivations is on the number of simultaneous deprivations. Table-3 showed that, most of the individuals were deprived in one or more dimensions at the same time. The following figure shows the number of individuals deprived in one or more dimensions at the same time.

Fig 1: Simultaneous deprivation of dimensions



Source: survey result

With the observed deprivation, out of 200 respondents, 46 individuals deprived all dimensions whereas only five individuals who were not deprived in any of the dimension. Beside, 53 individuals were deprived in four dimensions simultaneously. For the perceived deprivation case, more than140 individuals think that as they are deprived at most two dimensions. From fig-1 we can deduce two conclusions. First, around half of the respondents were suffering from multiple deprivations at least for three dimensions. This implies that depth of poverty is intense in the sampled respondents. Second, what people think of their deprivation and their real deprivation is quite different. Most of the respondents think that they deprived small number of dimensions though they deprived more based on objective thresholds.

3.2. Estimation of MPI

The use of individual preference in the measurement of multidimensional poverty is getting more acceptances though reliability of responses are demanding (Takeuchi, 2014; Decancq *et.al*, 2014). Kahneman and Krueger (2006) argue that people make inconsistent choices, fail to learn from experience, and depart from the standard model of the rational economic agent. Hence, before using individual's preferences to construct a weighting scheme, checking whether individuals are consistent or not in their choices are important. One of the methods to check preference consistency is to use ordinal and scaling elicitation methods together (Arrow, 1952; Gradstein and Agterberg, 1999). The order method asks each individual to rank different alternatives based on some criterion or domains. Specifically, respondents are asked to rank the five dimensions from the most to the least one based on importance, happiness, easiness to achieve and perceived deprivation domains. The second method is scaling or cardinal method, in which individuals are asked to scale how much different alternatives are worth to them. Respondents were asked to state how much each dimension is important, difficult to achieve, perceived deprived, gives happiness for them out of 100 (see appendix part 4 and 5 for the

questionnaire). The cardinal method conveys more information than the rank order method by showing the extent difference between dimensions. The aim of the scaling method is to attach weight to different dimensions whereas the ranking method is basically presented to check preference consistency and to aid in the selection of appropriate domains. Hence, if preferences are consistent, the correlation between responses made with order and cardinal methods should be equivalent on average. Detail discussion of the order method is presented below.

3.2.1. Ordering method

Following the work of Davis *et al*. (1972) on the majority of rule and Black (1958) on social preference ordering, when voters have three or more distinct alternatives (options) a ranked preference could be developed if the preference is a single-peaked preference. In the single-peaked preference, voters should pick only one dimension at a time from the available alternatives and hence, a social preference ordering could be reached. Hence, with a single-peaked preference, the following three criterions of Arrow (1952) will be satisfied:

- If majority of voters prefer dimension X over alternative Y, then the group prefers X over Y
- If majority voter's preference between X and Y remains unchanged, then the group's preference between X and Y will also remain unchanged (even if voters' preferences between other pairs like X and Z, Y and Z, or Z and W change).
- There is no "dictator" or no single voter possesses the power to always determine the group's preference, what matters is the majority preference

Therefore, if the majority of the group chooses X over Y dimension in the important domain, then X dimension is the most important over Y dimension. For comparisons of a set of alternatives and for the interest of policy interventions, the role of majority's rule is tremendous (Davis *et al*., 1972).

The ordinal method has three distinct aims in the preference analysis: to understand how people's choices are consistent in different domains, to select the appropriate domains based on a majority rule and to see the relationship between different well-being domains.

I. Individual ranking elicitations in the four domains

Voters have given the chance to choose only one dimension at a time from the five dimensions of life for each domain. In total, respondents have given four domains: importance, perceived deprivation, happiness and easiness to achieve. There are two types of choices: choices between dimensions within a domain (to prioritize dimensions within each domain) and choices across domains (to prioritize domains). Hereafter, the paper discussed the four ordering well-being domains.

a. Importance

Respondents were asked to rank the five dimensions based on their importance. From policy perspective, it is good to provide a dimension where most people think the most important dimension than the one with the least. The following table shows respondent's order ranking for different dimensions based on the importance of each dimension to them.

Table 4: Individual's response to rank dimensions based on their importance to them.

Dimensions	Importance level				
	1st	2nd	3rd	4th	5th
Asset and income	8	50	62	36	44
Health	177	17	3	3	0
Education	10	125	44	6	15
Quality of life	2	2	36	86	74
Employment	3	6	55	69	67

Source: survey result

Most of the respondents argued that education is the second important dimension next to health. The least important dimensions are employment and quality of life. Hence, one could expect that, if respondents are rational in their ordering, they should give more weights to health and education than employment on the scaling part of individual preference elicitation.

b. Perceived deprived

Individuals are asked to rank dimensions from the most deprived to the least deprived. In addition to the observed deprivations, the perceived deprivation also tell us something key information from policy perspective. So, if people are thinking that they are not deprived a dimension, policy makers may not need to give much attention for it. Similarly, if people's perceived deprivation is much higher than its observed deprivation, a special attention might be given to that dimension to boost their welfare. The following table shows individual's ranking responses to each dimension based on perceived deprivation.

Table 5: Individual's response to rank different dimensions based on deprivation extent.

Dimensions	Perceived Deprivation extent				
	1st	2nd	3rd	4th	5th
Asset and income	91	51	24	25	11
Health	36	23	18	40	82
Education	10	14	36	69	68
Quality of life	38	68	60	21	14
Employment	25	44	62	45	25

Source: survey result

Most of the respondents reported that as they are deprived more of the asset and income dimension and the least one was health.

c. Happiness

Information on happiness is essential to understand the dimensions that are making people happiest. This information is essential in the sense that sometimes people may think that the first ranked important dimension may not be the happiest one. In such cases, some people may choose first to be provided the happiest one and some others might choose the important dimension. Respondents are asked to rank dimensions based on the happiness they derived from each dimension. The following table shows respondents ranks of dimensions based on happiness.

Table 6: Individual's response to rank different dimensions based on happiness it gives to them.

Dimensions	Happiness rank				
	1st	2nd	3rd	4th	5th
Asset and income	12	47	56	28	56
Health	136	34	13	13	5
Education	27	82	36	24	30
Quality of life	17	29	56	67	35
Employment	8	8	39	68	74

Source: survey result

For most of the sampled respondents, health is the dimension that most are happy with, and employment is the least one.

d. Easiness to achieve

After identifying the dimensions where most are deprived or the most important, the next relevant question is to know which dimension is easily achievable and which one is difficult for the respondents. Knowing the dimension that is easily achievable with the available limited resources is important from policy perspective. Should the policy maker first intervene to a dimension that is easily achievable or to a dimension that is the difficult one if both are equally important with equal number of deprivation? This information let policy makers to focus on the dimension that is less elastic or rigid for respondents on the achievability of a dimension. Respondents were also asked to rank different dimensions from the easiest to the difficult one.

Table 7: Individual's response to rank different dimensions based on their easiness to achieve.

Dimensions	Easiness to achieve				
	1st	2nd	3d	4th	5th
Asset and income	36	30	53	36	48
Health	41	49	18	22	69
Education	94	47	25	16	16
Quality of life	20	32	52	76	19
Employment	9	42	52	50	48

Source: survey result

As showed in the above table, the two easily achievable dimensions were health and education, and the two difficult achievable dimensions were quality of life and employment. So, policy makers need to focus more on the provision of services which could improve quality of life of the people and provision of job opportunities.

e. Ordering among domains

The other important question is how could we aggregate the information that are derived from the above four domains. The main question is which domain should get more priority? Are those four domains are equally relevant for the respondents or not? In another word, this refers to, for instance, whether an important dimension is equally relevant to a dimension that is

difficult to achieve or not? Respondents were asked to rank or to prioritize the four domains based on their relevance for them (see part 4 of appendix).

Table 8: Individual's response to rank different domains based on which one should come first

Dimensions	**Prioritizing scenarios**			
	1st	2nd	3rd	4th
Importance	115	70	15	200
Happiness	60	110	30	200
Perceived deprivation	25	20	155	200
Easiness to achieve	0	0	0	200

Source: survey result

Many individual voted that, a dimension that is important is better than a dimension that gives them more happiness. Happiness is the second domains that most respondents voted for. Respondents also voted that they prefer first to be provided a dimension that they deprived more than the dimension which is difficult to achieve.

II. Selection of appropriates domain

The above four ranking domains are very informative from policy perspective as they showed the domains that have high demand by the people. Besides, it could tell us the domains that have to be used to prioritized dimensions which later help to construct a weighting scheme. Importance domain has found to be a vital domain to prioritized dimensions compared to other domains, but it is not the only dominant domain as shown on table-8. The justification is that sometimes an important dimension may not bring happiness as of the less important dimension, and investment on the dimension that couldn't bring happiness would not bring efficiency (Banerjee, 2012). In addition, the importance domain may not tell us anything about people's perceived deprivation, and which might not consider equity (Rippin, 2013).

In the case where the importance domain could not tell us anything about the other three domains, we may need to consider other domains in the weighting scheme. However, if the important domain represents those three domains for an average number of people then using only the important domain could be enough. These would guarantee the weighting scheme to be efficient, equity based and policy-oriented. This could be checked by looking the relationships among the four domains using the majority of rule of Black (1958) on social preference ordering. The paper used two methods of majority rule: average rule and individual concordance rule to check whether the prioritized domain could represent others or not and to see the existing relationship among domains.

a. Average rule

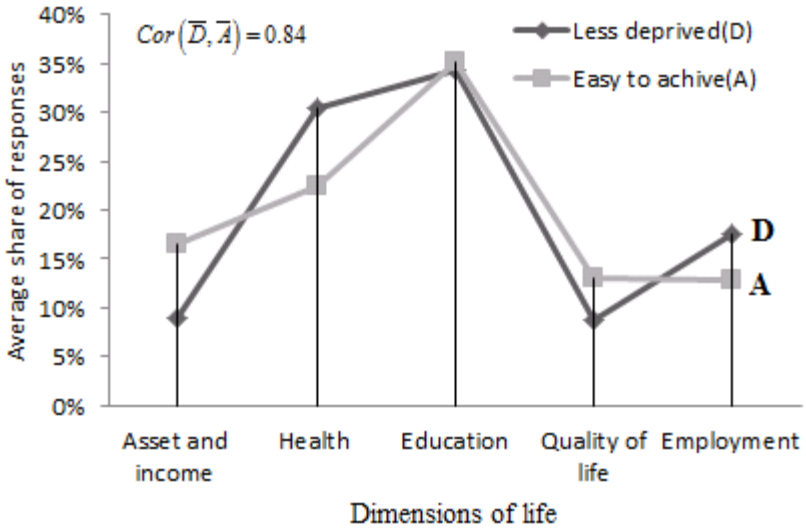
From policy perspective, a policy maker might be interested to know only the dimensions where majorities chooses. The most important information for the average rule is to know whether the dimension which has large number of votes in one domain has also an equivalent votes in another domain or not. To see the existing relationship among domains we can

calculate the average correlations among similar dimensions across domains. The following graphs try to show the relationship between different domains for the average responses only. [3]

Observation 1: Perceived deprived Vs difficult to achieve: The dimension where most perceive deprived is the one which is difficult to achieve

As presented in the above tables (table 5 and 7), the highest number of votes was given for health dimension in the criterion of the least perceived deprivation and easily achievable domains. The relationship confirmed that for an easily achievable dimension, many individuals are less likely deprived. In another word, if the dimension is difficult to achieve, then people might be easily deprived. As it can be seen from the following figure, the distributions of responses between those domains are more or less similar. This could be checked by calculating the correlation between those responses.

Fig 2: Average elicitation on deprived and easily achievable dimensions

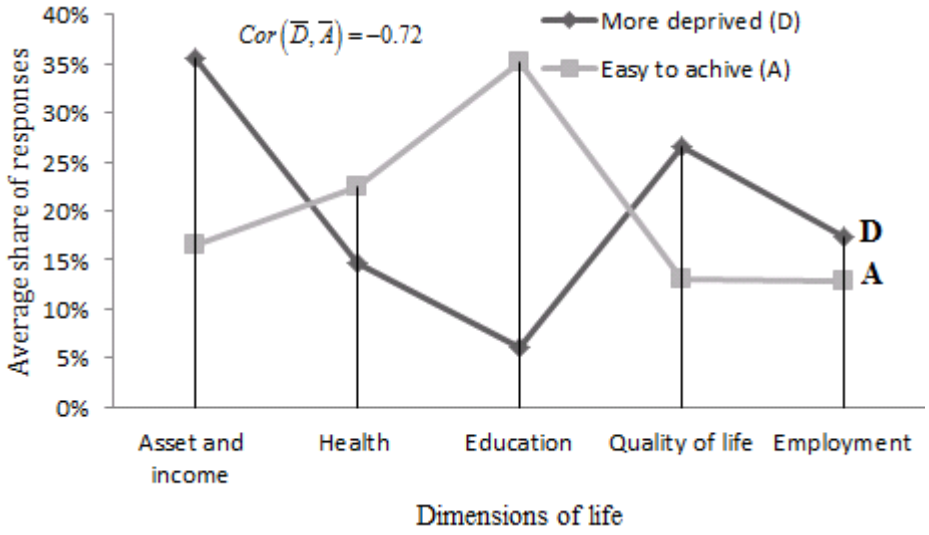


Source: Own survey

Fig 2 showed that, the dimension where a small number of individuals deprived, and the easiest achievable dimension are on average similar with 84 percent. From the survey result, the small number of deprivation registered for the health dimension and that is an easily achievable dimension on average next to education. However, this could not go in the other round; for example, the number of respondents who vote a dimension that they deprived the most, and the easiest achievable dimension could not have fitted distribution (see fig 3).

Fig 3: Average elicitation for the most deprived and easily achievable dimensions

[3] All these observations are made based on the illustrated example and may not work for other data set



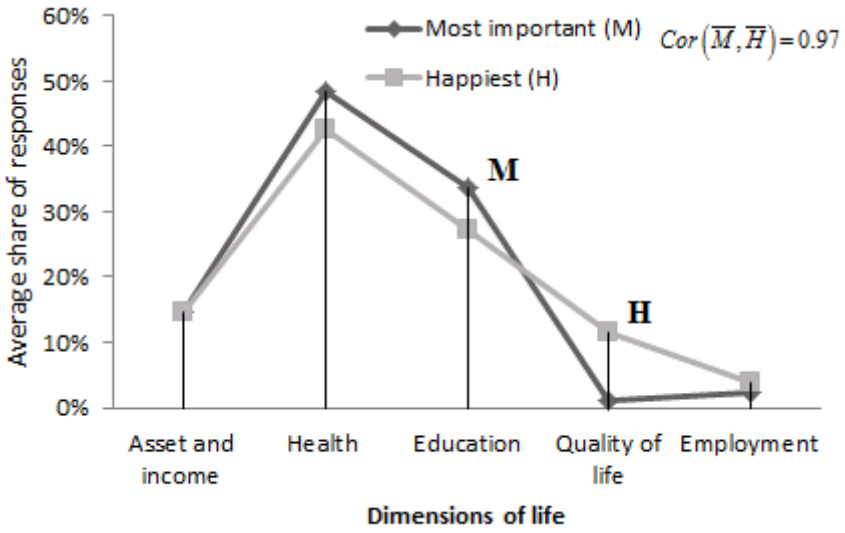
Source: survey result

The above fig 3 showed that based on the perceived deprivation domain the highest vote registered for the asset and income dimension, whereas the first easily achievable dimensions are education and health.

Observation 2: Importance Vs happiness: The most important dimension is the one that gives happiness the most

As discussed in the above tables (table 4 and table 6), the dimension that is most important for the respondents is also the one that gives them more happiness. This could be checked by calculating the average distribution of the two responses in the following figure.

Fig 4: individual elicitation on the important and happiness



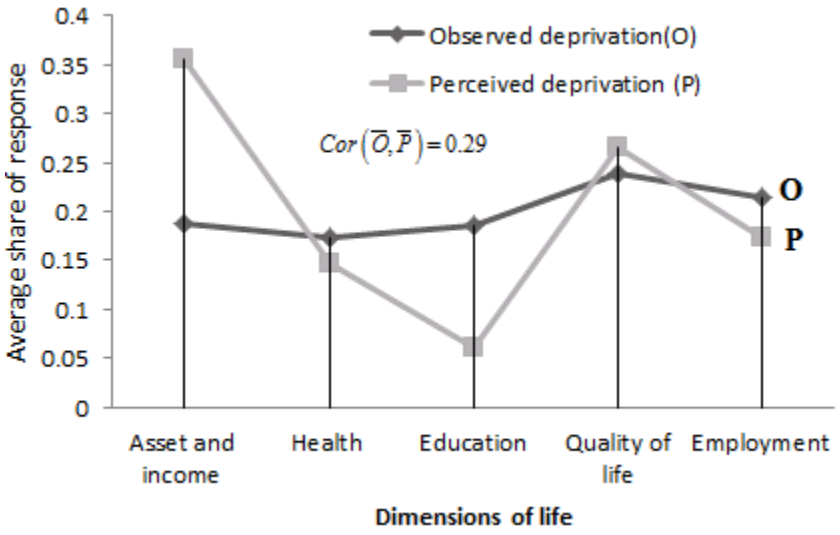
Source: survey result

The graph showed that the distributions of responses for importance and happiness are similar on average with an average correlation of 0.972. For example, the first highest vote for importance has given for health dimension and the same for happiness.

Observation 3: Observed Vs perceived deprivation: The number of people for the observed and the perceived deprived dimensions are more or less similar

Economic studies on observed and perceived deprivations such as Rippin and Pogge (2015) and Asselin (2009) ; and from psychology studies such as Fulcher (2009) argues that what people perceive about their deprivations should be similar with the observed deprivations. This implies that, if people are rational in ranking different dimensions what they perceived, and their actual or observed deprivation for each dimension is expected to be similar on average.

Fig 5: Average elicitation on the perceived and actual deprivation



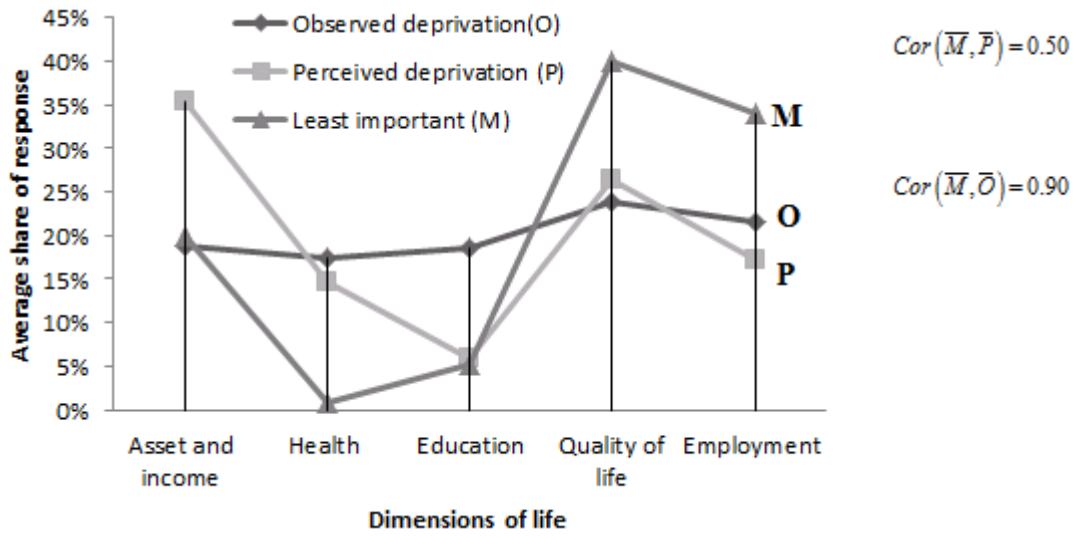
Source: survey result

The table showed that, except for asset and income and education dimensions the other dimensions are on average similar. The case of Education is a bit tricky. The observed deprivation number includes both the respondent's father education level and her/his years of schooling whereas the perceived one includes only the respondent's years of schooling. For asset and income dimension, the following observation 4 will make it clear.

Observation 4: Importance and perceived deprivation: For the less important dimension, people's perceived deprivation will be less even though their actual observed deprivation is high

Sometimes it appears that, though the observed deprivation score is very high for a dimension, if they do not think that it is important for them, they do not realize their deprivation.

Fig 6: Average elicitation on the perceived deprivation, important and actual deprivation



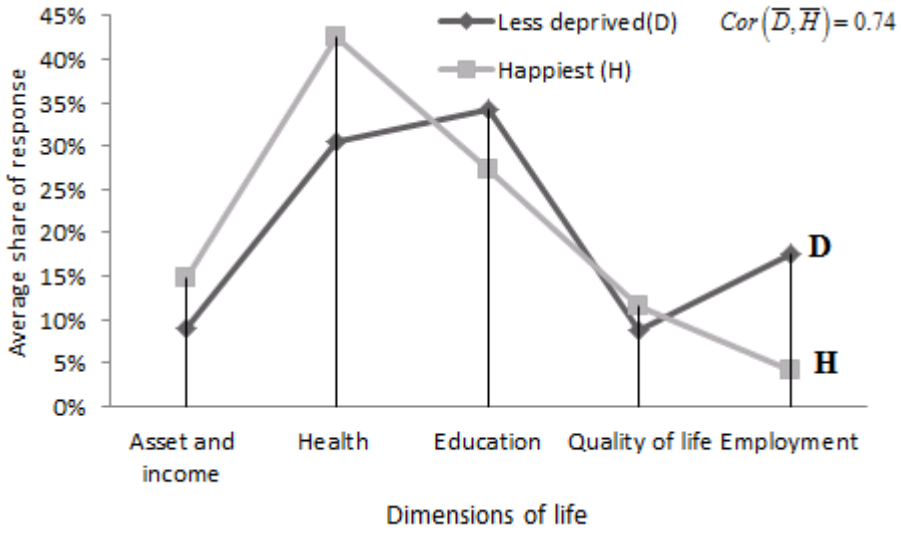
Source: survey result

For most of the respondents, the most perceived deprived dimension is asset and income; however, in reality, most of them are deprived quality of life and employment dimensions. As we can see from fig 6, quality of life is the first least important dimension and followed by employment. Hence, for these two dimensions, the respondents have lower perceived deprivation than asset and income dimension.

Observation 5: Happiness and perceived deprivation: The less a person's perceive deprived, the more he/she will be happy on that dimension

People measure their happiness from what they expect and what they have currently. In average those who are happiest in a dimension are deprived less of that dimension. Conversely, the more an individual deprived a dimension the less happiness he/she derived from it. If most of the people deprived health dimension, they could not be satisfied or happy with their health. However, being less deprived of a dimension may not bring happiness always if the dimension is not important to the person. A person may be less deprived of a less important dimension may be because it is an easily achievable dimension. Hence, if the dimension is less important it may not give him/her happiness.

Fig 7: Average elicitation on happiest and deprivation



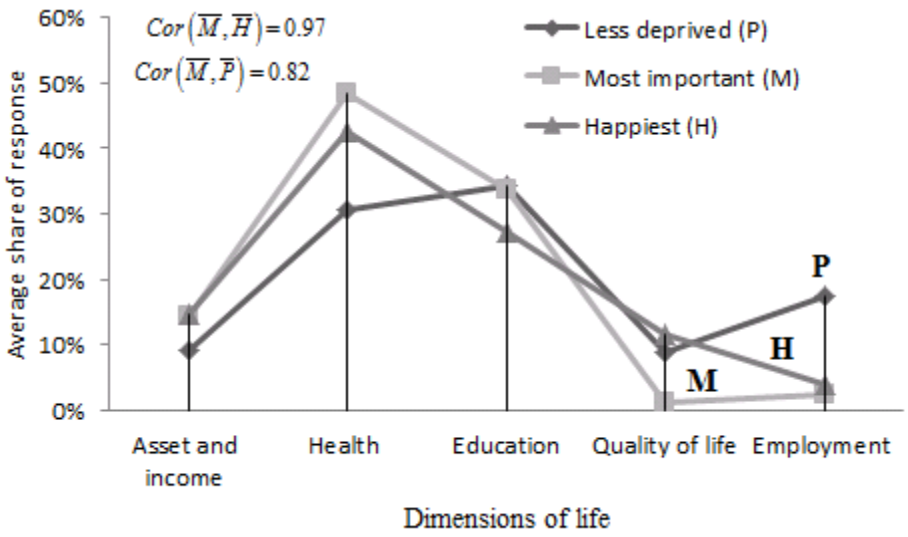
Source: survey result

The average correlation between the number of people who are less deprived and happiest is significantly large and positively related, which is 0.74.

Observation 6: Important Vs happiness – perceived deprived: The dimension that is most important for most of the respondents is the one that gives more happiness than the one which is less deprived

From policy perspective, should the government provide the dimension where most are happy with or the one where most are deprived? Though, providing the most deprived dimension is necessary, from welfare point of view, it is more beneficiary to provide the happiest one. This is also confirmed on table 8 from individual responses among the choices of domains. As we have seen in the observation 5, if a dimension is not important, its deprivation extent does not matter for welfare improvement of the society.

Fig 8: Average elicitation to importance, happiness and deprivation



Source: survey result

From the above graph, most of the people deprived quality of life dimension than asset and income whereas most are happy with asset and income dimension than quality of life. Hence, the more preferred domain is the one which has lower distance from the important domain, which is the happiness domain. The average correlation between the important and the happiest domains is higher than the correlation between the deprived and the important domains.

In general, the above six relationships could be summarized with the two prioritizing elicitation scenarios: Prioritizing between dimensions within domains and across domains. The between dimensions prioritizing is designed to rank dimensions from the most to the least in each domain. On the other hand, the across dimensions prioritizing is designed to prioritize the four domain. In another word this implies that, for instance, whether a dimension that is important or the dimension which is perceived deprived should get the first rank. The following table summarizes all the above six- observations with average rule.

Table 9: average rule summery table of respondents

Rank	Importance	Happiness	Perceived Deprivation	Difficult to achieve	Prioritizing domains
1st	Health	Health	Asset	Quality of life	Importance
2nd	Education	Education	Quality of life	Employment	Happiness
3rd	Asset	Asset	Employment	Asset	Deprivation
4th	Quality of life	Quality of life	Health	Health	Difficult to achieve
5th	Employment	Employment	Education	Education	

Source: survey result

The importance dimension got the highest vote among the four domains. This implies that, the importance domain should have to be used to prioritize those dimensions with the average rule. In another word, the first ranked dimension in the important domain, which is health, should get the first rank on the happiness domain and the 5th rank in the perceived deprivation and difficult to achieve domains. However, if we see table- 9, the importance domain could represent only the happiness domain, not the perceived deprived and difficult to achieve domains. Hence, from the average rule we found that, the first prioritized dimension could represent some parts of other domains. In such a case it could be relevant to see the individual correspondence rule.

b. Individual correspondence rule

The individual correspondence rule is useful since the average rule might discards heterogeneity of choices. Having a good correlation with average rule is not a guarantee for having concordance choices among dimensions for each individual. If we are considering individual correspondence choices across domains the findings are quite different.

Table 10: Individual concordance correlation coefficient estimate for the first ranked choices in all domains

Domains	Domains			
	Importance	happiness	Perceived deprivation	Easiness to achieve
Importance	1	0.62	0.018	0.08
Happiness	0.62	1	0.123	0.011
Perceived deprivation	0.018	0.123	1	0.281
Easiness to achieve	0.08	0.011	0.281	1

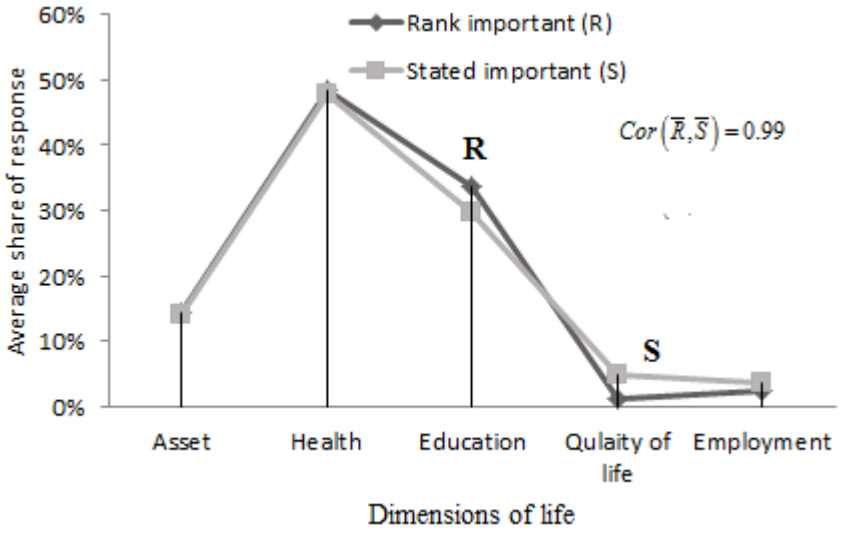
Source: survey result

Table-10 shows that, 62% of individuals who chooses the first ranked dimension in the important domain are also the same individuals who ranked the same dimension on the first place for happiness domain. However, the correlations for all other relationships are not as such strong. This implies that, those domains are antagonistic and all domains should be considered in the construction of a weighting scheme.

III. Checking consistency

Before using the scaling method to attach weights for each dimension, first let's check whether respondent's preferences for all domains under ordering and scaling methods are consistent or not. If individuals are consistent in their choices, the most ranked dimension should get the highest cardinal vote in all domains. For instance, for the importance domain the correlation result with the average rule is highly significant.

Fig 9: stated and ranked preference



Source: survey result

The survey result showed that almost all respondent's ranking and stating elicitations are similar. A little discrepancy happened for education and quality of life. However, in general 99.4% was the same.

Table 11: consistency checking

Majority rule methods	The correlation coefficients between the first ranked dimension under ordinal and for the highest percentage share dimension under scaling			
	Importance	happiness	Perceived deprivation	Easiness to achieve
Average rule	0.99	0.98	0.94	0.90
individual rule (concordance used)	0.97	0.93	0.82	0.86

Source: Own computation

In both majority rules, the average rule and the individual concordance, the correlation results are strong enough which allow us to proceed to the estimation of MPI.

3.2.2. MPI estimation results

a. MPI estimate with each domain alone

The results derived from the scaling preference are used to attach weights to the aforementioned dimensions. Each individual has asked to weight or scale each dimension out of 100 percent based on the four domains (see appendix part 5 to understand how the weights are derived). Before using all domains altogether to construct a single weighting index, first lets estimate MPI with each domain alone. This could help us to know the domain that identifies the largest or the smallest number of multidimensionally poor individuals. For comparison reason, the paper also estimates MPI with the standard equal weighting approach. The equal weighting approach attached equal weights (20%) for each dimension. The estimation of MPI is based on Alkire and Foster methodology.

Let $I = |I_{ij}|$ denote the $n \times d$ matrix of deprivation, where the typical entry $I_{ij} = 0$ if the individual i=1,2, …,n in the wellbeing dimension j=1,2, …,d is non-deprived and 1 otherwise. Sw_{ij} is the scaling weight that each individual attach to each dimension j. Moreover, C_i is the aggregate deprivation score which is defined as $Sw_{ij}(I)$.

$$MPI = \frac{1}{n}\sum_{i=1}^{n} C_i$$

The estimated results with AF methodology with different cutoff levels are presented below.

Table 12: MPI estimation with all domains alone

Different poverty cutoffs	**MPI estimates with different domains**				**Equal weighting**
	Importance	Happiness	Deprivation	Easiness to achieve	
C_i >0.2(Union approach)	0.61	0.62	0.66	0.67	0.64
C_i >0.4	0.57	0.57	0.62	0.62	0.57
C_i >0.6	0.46	0.46	0.54	0.54	0.44
C_i >0.8	0.34	0.35	0.41	0.44	0.23
C_i >1 (Intersection approach)	0	0	0	0	0.00

Source: Own computation

As it is depicted in the above table, the MPI estimates in the four domains and equal weighting approaches identified different number of individuals as multidimensionally poor. For instance, at the poverty cutoff of C_i > 0.6, the equal weighting approach identifies 44 % of the respondents as multidimensionally poor, which is lower than all other MPI estimates. The highest MPI score is registered for the perceived deprivation domain. The number of poor people identified by importance and happiness domains is on average similar. However, a huge variation registered if we compare the importance domain with perceived deprivation and

achievement domains. Hence, we need a weighting scheme that could compromise these differences and consider all domains in the weighting scheme which could be feasible by aggregating the weights from all domains.

b. MPI estimation with all domains together

To aggregate the weights that each individual gives for each dimension in the four domains, respondents were asked to state how much each domain is relevant out of 100%. In another word, for instance whether they prefer the dimension that is important or the dimension that gives them happiness. Let's assume that, D_{if} is defined as the weight attached to domains 1,..f for i individual and w_{ij} is defined as the weight attached to each dimension j for each individual. The aggregated holistic preference weighting scheme is given as follows:

$$w_{ij} = \sum_{f=1}^{r} D_{if} Sw_{ijf} \text{ where, } \sum_{J=1}^{d} Sw_{ijf} = 1 \text{ and } \sum_{f=1}^{r} D_{if} = 1$$

$$\text{hence, } \sum_{j=1}^{d} w_{ij} = 1$$

Let's assume that an individual gives 70% for importance domain and 30% are equally divided for the other three domains. If the person thinks that health has a share of 90% votes in all domains, then the weight attached to the health dimension for this individual is as follows:

$$(90\% \times 70\%) + (90\% \times 10\%) + (90\% \times 10\%) + (90\% \times 10\%) = 0.90$$

The MPI estimate with the aggregated single weighting schemes that consider all domains is presented in table 13. For comparisons reason, the paper presented two alternative models. The first one is the ordinary equal weighting model which is also presented on table 12. The second model is the preference based weighting scheme which is derived from the four domains but the weights to aggregate four domains (the case where domains are equally relevant) are distributed equally, which means 25% for each domain.

Table 13: MPI estimate with all domains

Different poverty cutoffs	**MPI: Observed preference with aggregation based on equal weight (25% for each)**	**MPI: Observed preference with aggregation based on preference**	**MPI :Equal weighting method**
C_i >0.2(Union approach)	0.65	0.63	0.64
C_i >0.4	0.60	0.59	0.57
C_i >0.6	0.49	0.48	0.44
C_i >0.8	0.35	0.35	0.23
C_i >1 (Intersection approach)	0	0.00	0.00

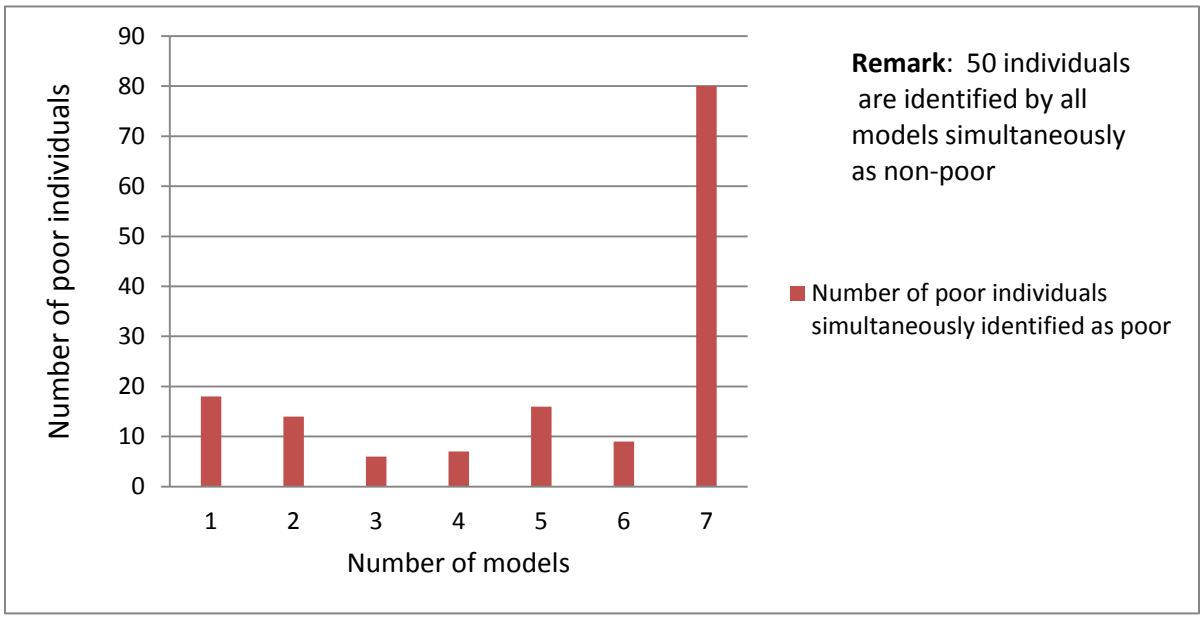
Source: Own computation

Table 13 showed that, on average the lowest MPI is registered under the equal weighting approach. This happened because the dimensions where most people deprived, most are happy with, the most important dimension and the difficult achievable dimensions got a lower weights under the equal weighting approach. The two MPI estimates with preference weighting schemes registered the highest values at all poverty cutoffs. For instance, at the poverty cutoff of $C_i > 0.6$ or a deprivation of 3/5 of the available indicators, the MPI estimate under the equal based weighting is 44% and under the observed preference with aggregation by preference weighting scheme is 48%. Table 13 also showed that, the MPI estimate with preference is almost similar when we aggregate domains based on equal weight or based on individual's preference. However, when we compare MPI estimates with domains separately and with domains together, the result is quite interesting. The MPI estimate with the aggregated domains identifies an average number of multdimensionally poor people than the number of poor identified by other MPI estimates which used a single domain. The choice of the best model; therefore, depends on the interest of the policy makers, whether they want to ensure bringing equity or efficiency; and on the availability of budget. From theoretical point of view the MPI estimate with aggregated domains with preference is much more preferable since it is sensitive for equity, efficiency and policy imperative. Besides, the model is preferable since it is on average robust in comparison with other models. The model which is robust is the one which has small number of divergent from other models in the identification of poor people. The next topic briefly discusses this concept.

c. Do the same people identified as poor across different weighting schemes?

The other most important result from table 12 and table 13 is that we might be interested to know whether the same person is identified as poor in all weighting methods or not. Which model deviates more from others in the identification of poor? To compare different models, from the five poverty cutoffs which is given in table 12 and table 13, the paper chooses $C_i > 0.6$ or one –third of the available dimensions as a poverty cutoff (see for detail explanation how to select the appropriate poverty cutoff on Alkire and Santos, 2011). At this poverty cutoff, the number of poor individuals which are identified as multidimensionally poor in the seven models is discussed in the following graph.

Fig 10: overlapping identification across models



Source: Own computation

All seven models identified 80 individuals as multidimensionally poor and 50 individuals as non-poor. This implies that 70 individuals are identified as poor in at least one model and at most in six models. Out of those 70 individuals, 18 individuals are identified as poor only by one model while others do not. This implies that there are many individuals who are entering and exiting from poverty when we change the weighting schemes to measure MPI. The intuition behind this fact is that, getting relatively similar MPI estimate is not a guarantee for having the same individuals which are identified as poor across models. Though the MPI estimate is similar for some of the models, the individuals who are identified as poor may vary when we change the models.

Table 14: identification of overlapping poor

Models	Percentages variation of multidimensionally poor individual						
	Equal	Importance	Happiness	perceived deprivation	Easiness to achieve.	Preference aggregated by equal	Preference aggregated by preference
Equal	0	0.37	0.37	0.6	0.43	0.3	0.27
Importance		0	0.25	0.62	0.58	0.3	0.21
Happiness			0	0.65	0.64	0.32	0.24
perceived deprivation				0	0.64	0.5	0.52
Easiness to achieve					0	0.37	0.35
Preference aggregated by						0	0.14

equal	
Preference aggregated by preference	0

Source: Own computation

From fig 10 we have found that 70 individuals (35% of the respondents) are identified as poor at least in one model but not by all models simultaneously. From table 14, for instance, shifting the model from equal weighting to importance domain weight or Vis a Vis affects 37% of 35% poor individuals (which is equivalent to 12% of the respondents). From table 13, the preference model aggregation with equal and preference based weighting schemes identifies almost the same number of poor individuals. However, changing the model from preference aggregated by equal weight to preference aggregated by preference model, results 14% of variations in the identification of multidimensionally poor individuals. The highest percentage variation happened when we change the model from perceived deprivation to other weighing schemes or Vis a Vis. The lowest variation occurred for the preference weighting scheme that aggregate domains with individual preference. Majority of poor individuals identified by the preferences aggregated domains model are also the same individuals which are identified by other models. This implies that, this model is much better in representing all other models. The correlation between this model and the rest six models is higher than other relationships. These result confirmed that considering preference in the measurement of multidimensional poverty would have a great advantage. However, to what extent should we use individual preference to the measurement of poverty? Could policy makers use individual perception about their deprivation beyond the weighting scheme? Is it possible to use individual value judgment about their deprivation as a poverty cutoff to calculate MPI? What is the relationship between individual's satisfaction and their subjective poverty cutoff? The following topic discusses this issue.

d. An extended topic on preference: the objective and subjective poverty cutoffs

The use of preference to construct weighting scheme is admissible as we have discussed in table 13 and 14. However, it is questionable whether we can extend the role of preferences to the case of dimensional cutoffs or not. There are some literature which are suggesting that the objective and perceived deprivations are equally important (Rippin and Pogge, 2015; Asselin, 2009; Fulcher, 2009). However, there is no literature that supports on the extent role of preferences in the estimation of MPI. There are two methods so far which used to set dimensional cutoffs. The first one is the absolute method which is based on the internationally agreed thresholds that anyone needs to achieve to be non-deprived. The second one is the relative method where dimensional cutoff is set relative to the achievement of the society (Sen, 1976). To what extent these absolute and relative methods predict individual's perceived deprivation? And to what extent they are reflected to individual's life satisfaction? To answer these questions, the paper estimated the MPI with objective and subjective dimensional cutoff for each individual. For comparison reason we used arbitrary equal weighting method to both approaches, hence the difference is on the dimensional cutoff (see part 1 and part 6 of the questionnaire in appendix).

Table 15: objective and subjective poverty cutoffs

Different poverty cutoffs	MPI in Equal weighting method with objective dimensional cutoff	MPI in Equal weighting method with subjective dimensional cutoff
Ci >0.2(Union approach)	0.64	0.46
Ci >0.4	0.57	0.20
Ci >0.6	0.44	0.09
Ci >0.8	0.23	0.01
Ci >1 (Intersection approach)	0.00	0.00

Source: Own computation

The findings on table 15 showed that the equal weighting MPI estimates using people's perceived deprivation is much lower than the MPI estimates with the objective dimensional cutoff. This finding is similar with the result of table-3 where large number of respondents reported as less deprived compared to the observed deprivation. This indicates that, respondents believe that they are less poor than what the objective measure identifies. The intuition behind this fact is that, most of the respondents are satisfied by the endowments they own. This might also be the case that, most of the respondents are satisfied or happy in their life. This could be checked by run two independent regressions for observed (OD) and perceived (PD) deprivation on the satisfaction (S) function as given in the following equation:

$$S_i = \beta_0 + \beta_1 ODAsset + \beta_2 ODHealth + \beta_3 ODEducation + \beta_4 ODQualityoflife + \beta_5 ODemployment + \varepsilon$$

$$S_i = \alpha_0 + \alpha_1 PDAsset + \alpha_2 PDHealth + \alpha_3 PDEducation + \alpha_4 PDQualityoflife + \alpha_5 PDemployment + \eta$$

Where, ε and η are error terms associated with the satisfaction function. The satisfaction values are deduced from individuals satisfaction elicitations which are measured from zero to ten (see part 3 of the appendix). The result of the estimation is given as follows.

Table 16: an OLS regression of satisfaction rate on perceived and observed deprivation responses

	Dependent variable: Satisfaction	
	Model-1 for perceived responses	Model-2 for Observed responses
	Coefficients	Coefficients
Asset and Income	-3.634 (.396)***	-.287 (.463)
Health	-2.637 (.298)***	-.299 (.430)
Education	-3.086 (.523)***	-.848 (.455)
Quality of life	-2.927 (.319)***	-.257 (.556)
Employment	-2.201 (.308)***	-.386 (.485)
Constant	12.345 (.496)***	6.689 (0.000)
N	200	200
R^2	0.54	0.04

Standard errors in parentheses Source: Own computation

** p < 0 : 05, ** p < 0 : 01, *** p < 0 : 001*

The coefficients from the above table interpreted as when a person moves from non-deprivation status to deprivation status, keeping other things constant; in average his/her satisfaction decreases by the value of the coefficient. For instance, for asset dimension, when a person moves from non-deprived status to deprived, his/her satisfaction decreases by 3.6 values measured from a scale of 10 or equivalently it means a decrease with 36%. All dimensions for the perceived deprivation are significant at one percent whereas for the observed deprivation all dimensions found to be insignificant. Previous studies confirmed that individual satisfaction rate is one of the predictor of individual wellbeing (Fleurbaey *et al.*, 2009). The findings from table-16 showed that individual's well-being has improved by what people think about their deprivation than the observed deprivation. Hence, provision of resources based on what they perceived deprived might improve welfare more than what we provide them based on their observed deprivations. This individual's behavior also could be indirectly considered in the observed preference based weighting schemes.

Conclusion

Weight under multidimensional poverty estimation has a crucial role by showing trade-off among dimensions. The paper argues that, any weighting scheme for multidimensional poverty should incorporate individual preference. The use of individual preferences makes the estimation more transparent and more responsive to people's perceptions about what is more or less important to their well-being. The paper proposed an individual preference weighting schemes that accounts a wide range of information in four domains: happiness, importance, deprivation and easiness of achievability of a dimension.

To elicit individual preferences to well-being dimensions the paper used a survey that has been collected from Ethiopia. The questionnaires were designed in such a way that enables us to investigate consistency of people's choices in different domains. Besides, an in depth information has been collected from respondents which is imperative for the construction of a weighting scheme.

Using the two majority rules: average and individual correspondence correlation, the paper tried to see the correlation between dimensions within and across domains to select the appropriate domain. The findings showed that, there is no single domain which could represent all domains. Although there is a significant correlation values registered with the average rules between some domains, the individual correspondence correlation coefficient is insignificant. Regarding to the relationship between domains, the importance domain could represent only the health domain. Moreover, the number of people deprived in average is also smaller for the important dimension and that is easily achievable. Likewise, what people perceived of their deprivation and the observed deprivations are in average the same if we remove the dimension that is less important. This findings match with other previous literature (Rippin and Pogge, 2015; Asselin, 2009).

To check consistency of preferences, the paper used scaling and ordinal method. The result showed that, responses both with average and individual concordance correlation coefficients are significant. Using respondents scaling preference, the paper estimated seven models and compared them to show the relevance of accounting individual preferences. The result showed that the MPI measure with individual preference is much higher than the equal weighting approach. The equal weighting approach deflated the measure of poverty compared to the individual preference approaches because it does not account individual preferences. This result confirmed the argument given by Ravallion, 2011 and Decancq *et al*., 2013 that equal weighting approach gives equal importance to different dimensions and, which is far from truth. Besides, the MPI estimate with the aggregated domains identifies an average number of multdimensionally poor people than the number of poor identified by other MPI estimates which used a single domain. The paper also found that there are similarities in the MPI estimates among the models. However, the paper founds that getting relatively similar MPI estimate is not a guarantee for having the same poor individuals across models. Though the MPI estimate is similar for some of the models, the individuals who are identified as poor may vary when we change the models. Majority of poor individuals identified by the preferences aggregated by preference model are also the same individuals which are identified by other models. This implies that, this model is much better in representing all other models. The correlation between this model and the rest six models is higher than other relationships. The

inclusion of all domains in the constructions of weight makes the estimate to be sensitive for equity, efficiency and policy imperative.

Besides the role of preferences for weighting scheme, the paper tried to show the implication of preferences on MPI and life satisfaction by calculating MPI and run a satisfaction regression. The MPI estimate of equal weighting using perceived deprivation and the regression result showed that individual's well-being improved more by what people think about their deprivation than what is observed. Hence, provision of resources based on what people perceived deprived improves welfare more than what we provide them based on their observed deprivations. This individual's behavior also could be indirectly considered in the observed preference based weighting schemes.

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Appendix: questionnaire

Elicitation of public responses to multidimensional poverty attributes

Name of the Enumerator: _____

Date: _____

Time Started: _____

Time Ended: _____

Place: _____

My name is X I am coming from Milan University (LASER) and I am working on a project financed by the Roberto Franceschi under the supervision of Prof …Y.. We are carrying out this survey to estimate well-being in different approaches. Understanding the existing deprivations in different wellbeing indicators and people's preference to different wellbeing indicators will provide useful insights to policy making towards the design of efficient and effective anti-poverty programmes.

We would be most grateful if you could take about 30 minutes to complete this questionnaire. Responses are strictly confidential and there are no correct or wrong answers; we just want your opinion. This is an academicals paper and will be used only for academic purpose. Thank you in advance for your cooperation.

Region	Zone	Woreda	Kefele Ketema	Kebele	code (given by the enumerator to identify respondents)

I. Demographic characteristics of the individual

1. Sex
    - Male
    - Female
2. Marital status
    - Never married
    - Married
    - Currently married
    - Divorced
    - Separated
    - Widowed
3. Your Age : _____years old
4. Your Weight: _____ kg
5. Your height: _____ meter

II. Choices of dimensions

Instructions:

You have given the following five life dimensions and four scenarios

<u>Dimensions:</u>

a. **Asset and Income (Code- A): Asset holding and monthly income**
b. **Health(Code- B): Nutrition intake, having access to medication easily**
c. **Education(Code- C):: Having enough educational ground**
d. **Quality of life (Code- D):: Access to services and having clean toilet, clean water, good garbage disposal, electricity, telephone and the like**
e. **Employment (Code- E):: Permanent employment and being satisfied**

<u>Domains:</u>

1. **Importance: This domain is designed to ask, how much each dimension is important for you**
2. **Happiness: how much each dimension is giving you happiness?**
3. **Perceived deprived: how much do you think that you are deprived of those five dimensions**
4. **Easiness to achieve: To what extent you could achieve those dimensions by yourself to reach to the level you expect to be**

1. Perceived deprivation status

Considering the above information, please could you tell us your opinion about the deprivation status of your household for each dimension?

a. Is your household deprived in asset and income dimension?
   - o Yes
   - o No

b. Is your household deprived in health dimension?
   - o Yes
   - o No

c. Is your household deprived in education dimension?
   - o Yes
   - o No

d. Is your household deprived in quality of life dimension?
   - o Yes
   - o No

e. Is your household deprived in employment dimension?
   - o Yes
   - o No

2. Happiness and satisfaction

Please could you tell us how you are satisfied with the following dimensions? Circle one

a. How do you consider yourself in terms of income and asset hold

○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○

0 1 2 3 4 5 6 7 8 9 10

Dissatisfied More Satisfied

b. How do you think yourself in health (being health, eat health foods, having access to medication easily)

○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○

0 1 2 3 4 5 6 7 8 9 10

Dissatisfied More satisfied

c. How do you think yourself in education?

○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○

0 1 2 3 4 5 6 7 8 9 10

Dissatisfied More satisfied

d. How do you consider yourself in terms of access to different quality services

○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○

0 1 2 3 4 5 6 7 8 9 10

Dissatisfied More satisfied

e. How do you measure yourself in terms of employment deprivation

○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○

0 1 2 3 4 5 6 7 8 9 10

Dissatisfied More satisfied

f. In general, with the following dimensions altogether: Health, education, asset and income, quality of life, and employment; would you describe yourself as

○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○

0 1 2 3 4 5 6 7 8 9 10

Dissatisfied More satisfied

g. Please could you rate 1 to 10 your happiness in life?

○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○

0 1 2 3 4 5 6 7 8 9 10

Very unhappy Very happy

3. Choices between dimensions

Imagine you have two choices: Choice A and choice B. Which scenario would you prefer? Circle it

a. Choice between asset and health

○ Choice A			○ Choice B	
Poor in asset	Rich in health		Rich in asset	Poor in health

b. Choice between asset and education

○ Choice A			○ Choice B	
Poor in asset	Rich in education		Rich in asset	Poor in education

c. Choice between asset and employment

○ Choice A			○ Choice B	
Poor in asset	Rich in employment		Rich in asset	Poor in employment

d. Choice between asset and amenities or quality of life

○ Choice A			○ Choice B	
Poor in asset	Rich in amenities		Rich in asset	Poor in amenities

e. Choice between health and education

○ Choice A			○ Choice B	
Poor in health	Rich in education		Rich in health	Poor in education

f. Choice between health Vs employment

○ Choice A			○ Choice B	
Poor in health	Rich in employment		Rich in health	Poor in employment

g. Choice between health and amenities or quality of life

○ Choice A			○ Choice B	
Poor in health	Rich in amenities		Rich in health	Poor in amenities

h. Choice between education and employment

○ Choice A			○ Choice B	
Poor in education	Rich in employment		Rich in education	Poor in employment

i. Choice between education and amenities or quality of life

○ Choice A		○ Choice B

Poor in education	Rich in amenities		Rich in education	Poor in amenities

4. Ranking

Dear respondent you are asked to rank the five dimensions based on the above four domains. You are allowed to pick only one choice at a time. For questions "a" to "d" use only the codes for each dimension

a. Importance
   Please could you rank the five dimensions from the most important to the least?
   - First:_____
   - Second: _____
   - Third: _____
   - Fourth: _____
   - Fifth: _____

b. Happiness
   Please could you rank the five dimensions from the dimension you derived the most happiness to the least?
   - First:_____
   - Second: _____
   - Third: _____
   - Fourth: _____
   - Fifth: _____

c. Perceived deprived
   Please could you rank the five dimensions from the dimension you deprived the most to the least one?
   - First:_____
   - Second: _____
   - Third: _____
   - Fourth: _____
   - Fifth: _____

d. Easiness to achieve
   Please could you rank the five dimensions from the dimension that you can easily achieve to the difficult one?
   - First:_____
   - Second: _____
   - Third: _____
   - Fourth: _____
   - Fifth: _____

e. Compression of domains
   The government wants to provide the dimensions to the society based on the four domains based on their votes. Which domain you prefer first to be provided? Could you please rank the above four domains based on its relevance to you? Or which one you prefer to have in order: the dimension which is important, the dimension which gives

you more happiness, the dimension that you deprived more or the dimension you feel it is difficult to achieve?

A dimension in different domains	Rank(Write 1 to 4)
The dimension which is important	
The dimension which gives more happiness	
The dimensions that you think more deprived	
The dimension you faced difficult to achieve	

5. Scaling

In this section you are asked to scale the five dimensions in different domains. The sum of the allocation must not exceed 100 and no zero allocation is allowed.

a. Importance

	Share out of 100%
Asset and Income	
Health	
Education	
Quality of life	
Employment	

b. Happiness

	Share out of 100%
Asset and Income	
Health	
Education	
Quality of life	
Employment	

c. Perceived deprived

	Share out of 100%
Asset and Income	
Health	
Education	
Quality of life	
Employment	

d. Easiness to achieve

	Share out of 100%
Asset and Income	
Health	
Education	
Quality of life	
Employment	

f. Compression of domains

The government wants to provide the dimensions to the society based on the four domains based on your votes. Which domain you prefer first to be provided? Or which one you prefer to have: the dimension which is important, the dimension which gives you more happiness, the dimension that you deprived more or the dimension you feel it is difficult to achieve? Could you please scale its share out of 100% to the four domains based on its relevance to you?

A dimension in different domains	Share out of 100%
The dimension which is important	
The dimension which gives more happiness	
The dimensions that you think more deprived	
The dimension you faced difficult to achieve	

6. Life dimensions

Based on the criterion given for each questions locate where you or your families are located. Circle yes or no to each question

a. Is your household per capita income is more than 945 Ethiopian Birr?
   - Yes
   - No

b. Does your household have at least three of the following items? TV, Radio, Bed, Mobile, House, Land, Sofa
   - Yes
   - No

c. In the past six months does any child with the age of less than three died in your family?
   - Yes
   - No

d. Do anyone in your household sick for more than a week due to airborne or waterborne diseases?
   - Yes
   - No

e. Are your household members eating at least three times per day?
   - Yes
   - No

f. Do you have more than eight years of schooling?
   - Yes
   - No

g. Does your household head have more than eight years of schooling?
   - Yes
   - No

h. Is your household uses piped water or protected wall or spring for the source of drinking water

- Yes
- No

i. Is your household uses flush toilet or pit latrine for toilet?
   - Yes
   - No
j. Is your household dispose garbage with one of the following menses? used as green manure, periodically collected from house or periodically collected from specified dumping point
   - Yes
   - No
k. Is your household is getting at least one of the following services: telephone, electricity and post?
   - Yes
   - No
l. Is there at least one person in your family who has permanent job?
   - Yes
   - No