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Adapting Multidimensional Poverty and Inequality Measures to National and Regional Contexts: Evidence from Ethiopia

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Abstract

This study has designed a national MPI framework adapted to the Ethiopian context. Unlike the global MPI, the national MPI framework includes four dimensions (education, health, income, and living condition) with 10 indicators validated for their relevance in explaining the welfare situation in Ethiopia. A sample of 4954 households and 22296 individuals from the LSMS dataset was utilized. The Alkire-Foster methodology was employed to estimate and decompose the welfare measures. To estimate the multidimensional inequality index (MII), and the relative contribution of dimensions, the Araar (2009) method was employed. The results show that, on average, 81.3% of the Ethiopia population are multidimensionally poor and deprived in 46.6% of the total potential deprivations they could experience overall. The incidence of monetary poverty (22.1%) and nonmonetary poverty (70.5%) were significantly different across regions and areas of residence. The relative contributions of welfare dimensions to total MPI were considerable, income being the first (44%), followed by health, education, and living condition. The MII was 22.9% with significant variation across areas of residence. Monetary inequality was 34.4%, which is twofold higher than the nonmonetary inequality. Decomposition of the total MII shows that income is the first source of inequality (with 46.9% contribution); followed by education (23.8%), health (17.4%), and living condition (11.9%). The findings suggest the need to design and implement relevant welfare interventions based on the welfare measures and the relative role of dimensions adapted to the national context. Moreover, this study shows LSMS as one source of dataset with different indicators to estimate national MPIs for 100 countries having LSMS-based surveys.

Keywords: *decomposition, dimensions and indicators, distributive analysis, Ethiopia, MPI, poverty and inequality*.

1. Introduction

Poverty, as a major indicator of welfare in a society, can be defined as a noticeable deprivation in wellbeing. Poverty measurement is the production of numbers suitable to assess the overall degree of poverty in a given society, and to identify poor and nonpoor members of that society. To decide which measures of poverty to produce, we need a theory about the object we want to measure. The basic challenge in poverty analysis is the approach and methods of measuring poverty. Poverty with its multiple dimensions and approaches has been one of the primary research areas of development economics.

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There are different theories on poverty analysis, of which the dominant are the welfarist school, the basic-needs school, and the capability school. The welfarist school—the dominant approach—sees wellbeing or poverty as an economic wellbeing. For this school, poverty is said to exist in a society when one or more persons do not attain a level of economic wellbeing deemed to constitute a reasonable minimum by the standards of that society (Ravallion, 1994). This poverty concept derives from the assumption that individuals maximize their wellbeing in the essence of preference ordering over goods representable by a utility function.

The basic-needs approach, which is generally ranked second to the welfarist approach in importance, considers 'something' that is lacking in the lives of the poor as a small subset of goods and services identified and deemed to meet the basic needs of all human beings (Asselin & Dauphin, 2001). The focus of basic-needs approach is not utility. Rather, it focuses on individual requirements relative to basic commodities including food, water, sanitation, shelter, clothing, basic education, health services, and public transportation. This is mainly related to multidimensionality of poverty and inequality in a society.

In the third approach, the capability school, the 'something' that is lacking refers to human abilities or capabilities, not to utility or the satisfaction of basic-needs. The capability approach differs from the welfarist or utilitarian evaluation in considering a variety of 'doing and being' as important in themselves. The perspective of capabilities provides a fuller recognition of the variety of ways in which people can be poor or nonpoor (Sen, 1994; Asselin & Dauphin, 2001).

Poverty alleviation is the overriding objective of developing countries, including Ethiopia. Ethiopia has been designing and implementing several development policies and interventions to attain objectives of welfare and equity. However, poverty alleviation is still the primary development problem of the country. The design and implementation of poverty reduction strategies requires new and reliable information on poverty and inequality, their spatial and sectoral distribution, and their possible sources.

The inclusion of multiple dimensions of poverty and inequality in measuring multidimensional poverty and inequality has undergone substantial progress in the methods of welfare analysis at population, country, and regional levels. However, the availability of data for multidimensional poverty and inequality measurement has become a major deterrent to measure multidimensionality of poverty and inequality of countries and regions. Currently, demographic and health survey (DHS) data is the primary source of data for measuring global MPI in about 100 countries in the world. There are many countries without such datasets that require alternative sources of data with alternative welfare dimensions and indicators.

This study primarily tries to identify alternative sources of data for measuring multidimensional poverty and inequality indices with different set of dimensions and indicators adapted to a country context. Previous attempts of measuring

multidimensional poverty and inequality—and the challenges in designing national multidimensional poverty measures—are taken into account to measure the poverty and inequality situation in Ethiopia. This paper has employed different measures of multidimensional poverty and inequality, and decomposed them into their constituent parts, to identify priority areas of intervention and the relative importance of the findings for matching appropriate poverty reduction policy options and strategies.

2. Dataset and Analytical Framework

2.1 Dataset

This study has utilized the third wave of Living Standards Measurement Study (LSMS 2015) for Ethiopia. The LSMS is country-representative, and a multi-topic dataset at different levels (individual, households, farm plots, etc.) collected by the Central Statistical Agency (CSA) of Ethiopia in collaboration with the World Bank. The third wave covers the nine regional states and two administrative towns, with 4954 households and more than 23,000 individuals across the country (see, Table 1). The third wave of the LSMS survey covers 290 rural and 143 urban (43 small towns[1] and 100 large towns) enumeration areas (CSA, 2017).

Table 1: Distribution of Samples Across Regions and Areas of Residence

Region	Rural	Small towns	Large towns	Total	Share (%)
Tigray	1,554	155	708	2,417	10.8
Afar	569	53	37	659	3.0
Amhara	2,927	405	643	3,975	17.8
Oromia	3,273	476	922	4,671	20.9
Somali	1,156	123	163	1,442	6.5
Benshagul-Gumuz	538	58	0	596	2.7
SNNP*	4,083	475	696	5,254	23.6
Gambella	505	42	35	582	2.6
Harari	661	0	154	815	3.7
Addis Ababa	0	0	1,019	1,019	4.6
Dire Dawa	578	0	288	866	3.9
Country level	15,844	1,787	4,665	22,296	100
Share (%)	71.1	8.0	20.9	100	

Note: * SNNP denotes southern nations, nationalities, and peoples' region.

The Ethiopian government monitors regional and national poverty situations by using the Foster-Greer-Thorbecke (FGT) decomposable measures of poverty. However, the design and implementation of poverty reduction strategies requires adequate, reliable, and detailed information on the dimensions and sources of poverty and inequality, and their spatial and sectoral distribution. To generate a new and reliable information on various dimensions and sources of multidimensional poverty and inequality in Ethiopia, this study utilized 22,296 individuals; of which 50.8% were female, and 29% were urban residents.

[1]A small town (termed as semi-urban in this paper) is defined by the CSA as a town with a population of less than 10,000. Large towns include all other urban areas with a population of above 10,000. The survey on urban areas includes 143 urban enumeration areas (43 small towns and 100 large towns, respectively, termed as semi-urban and urban in this paper) (CSA, 2017).

2.2. Designing National MPI for Ethiopia

Like development, poverty and inequality are multidimensional. However, the multidimensionality of poverty and inequality is traditionally ignored in money-metric measures of poverty and inequality. It is only recently that poverty and inequality have been considered for their multidimensional aspects. To account for such limitations of poverty measures developed so far, the global multidimensional poverty index (MPI) was developed in 2010 by the Oxford Poverty and Human Development Initiative (OPHI) and the United Nations Development Program (UNDP). The MPI uses different factors or indicators to determine poverty beyond income-based lists, and was supposed to replace the previous Human Poverty Index (HPI).

The global MPI is an international measure of acute poverty covering over 100 developing countries, which complements the traditional income-based poverty measures by capturing the severe deprivations that each person faces, at the same time with respect to three dimensions of poverty (education, health, and standard of living). It assesses poverty at the individual level, and if someone is deprived in at least one-third of the ten (weighted) indicators, the global index identifies him/her as 'MPI poor'. The MPI can be used to create a comprehensive picture of people living in poverty; and permits comparisons both across countries, regions, and the world; and within countries by subpopulations (OPHI, 2017). The MPI can help effective allocation of resources by better targeting of poverty alleviation policies; addressing some sustainable development goals (SDGs) strategically; and monitoring impacts of policy intervention. The MPI can be adapted to a national-level using indicators and weights that make sense for a region/country for national poverty eradication programs, and be used to study changes over time.

Each dimension included in the global MPI is equally weighted, and each indicator within a dimension is also equally weighted. Though the global MPI is comparable across countries, it does not take into account country contexts in terms of the type and intensity of deprivations and inequality dimensions/indicators, and the weights to be attached to them. To align the global MPIs to the Sustainable Development Goals (SDGs), Alkire and Johan (2018) have proposed a revised global MPI to create a more credible and legitimate measure of multidimensional poverty with five key principles related to data coverage, communicability, comparability, disaggregation, and robustness. The revised global MPI recognizes desirable changes that could not be made due to data constraints; including data on the environment, work, and security.

To account for the limitations arising from data constraints experienced in the global MPI, and to adapt to national contexts, this study has utilized the LSMS dataset and identified four dimensions (education, health, income and living condition) and 10 indicators deemed to be relevant to the Ethiopian context (Fig. 1). All dimensions and all indicators within a dimension are given equal weights.

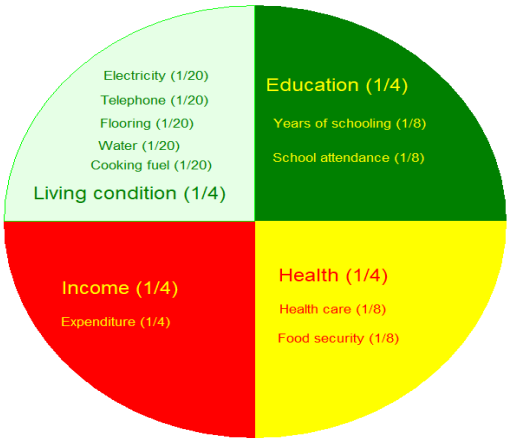

Figure 1: ***Dimensions and Indicators of the National MPI for Ethiopia***
Source: Author's design (2019).

The most important task in the construction of a national MPI is the selection of dimensions and indicators supposed to be relevant to country contexts. Unlike the global MPI with three dimensions (education, health, and standard of living) and 10 indicators, the national MPI for Ethiopia considers four dimensions (education, health, income, and living condition) and 10 indicators. The MPI for Ethiopia uses equal weights of dimensions and the same cut-off point used by the global MPI (33.3%). Accordingly, a person is considered MPI poor if s/he is deprived in at least one-third of the weighted indicators. Table 2 indicates the comparison of included and excluded indicators in the Ethiopian MPI with the global MPI.

Table 2: Comparison of dimensions of the Ethiopian MPI with the global MPI

Dimension/Indicator	**Ethiopian MPI**		**Global MPI**	
	Inclusion (√)	***Weight***	***Inclusion (√)***	***Weight***
Education	√	1/4	√	1/3
Years of schooling	√	1/8	√	1/6
Child school attendance	√	1/8	√	1/6
Health	√	1/4	√	1/3
Health care	√	1/8		
Food security	√	1/8		
Income	√	1/4		
Consumption expenditure	√	1/4		
Living condition	√	1/4		
Electricity	√	1/20	√	1/18
Telephone	√	1/20		
Water	√	1/20	√	1/18
Flooring	√	1/20	√	1/18
Cooking fuel	√	1/20	√	1/18

Source: Author's analysis (2019).

This study has included income as one dimension to the national MPI for Ethiopia, which is captured by real consumption expenditure per capita. Income is becoming an important part of designing national MPI for countries. It has so far been included as a dimension in three national MPIs (Armenia, Ecuador, and Mexico) and in the Latin American region (including 17 Latin American counties) as proposed by Santos et al. (2015). To avoid overlapping measurements, other indicators used to capture income-related indicators (like assets included in the global MPI) are excluded in this study.

The other new dimension included in the Ethiopian MPI is living condition with five indicators. This dimension mainly includes basic services (electricity, telephone, water, flooring/housing, and cooking fuel). The inclusion of basic services in the national MPI has so far been applied by all countries and regions that have employed it to construct their national/regional MPIs (see Santos, 2019, Santos & Villatoro, 2019). Depending on the extent of the provision of basic services in development programs of a country, these basic utilities have been validated for their relevance in explaining the MPI after estimation of the MPIs.

To sum up, the national MPI for Ethiopia differs from the global MPI in that it:

(a) Utilizes the Living Standards Measurement Study (LSMS) dataset[2] (with a sample of 4954 households and 22296 individuals (50.8% female);
(b) Includes four new indicators of MPI (health care, food security, consumption expenditure, and telephone) available in the LSMS dataset;
(c) Drops four indicators of the global MPI (child mortality, nutrition, sanitation, and assets) and replaced them with other proxy indicators available in the LSMS dataset; and
(d) Organizes the 10 indicators in four dimensions deemed to be relevant to the national context.

2.3 Identification

Table 3 indicates the definition and measurement of the 10 indicators included in the Ethiopian MPI. To decide on the unit of identification, choosing the method of aggregation of dimensions or indicators is essential. One option is to aggregate all attributes across individuals to a global measure of wellbeing. This is aggregation of dimensions across individuals to form a dimension-specific measure across all individuals, and to combine all the one-dimensional indices to yield an MPI measure. The other option is the aggregation of individuals focusing either on only on those that are poor according to all attributes, or on all those who are poor in at least one attribute. This second option is a combination of the multiple indicators of deprivation for each individual, and then aggregating them across all individuals. In this study, the aggregation of dimensions/indicators across individuals is used to estimate the MPI.

[2] The global MPI uses the Demographic and Health Survey (DHS) dataset with 16,650 households and 28,371 individuals (55.3% female).

Table 3: Definition and Measurement of Dimensions and Indicators for Ethiopian MPI

Dimensions/ Indicators (weight)	Poverty line (weighted)	Definition of Deprivation
Education (1/4)	**1/12**	**Deprived if intensity of deprivation in education at or above 1/12**
Years of schooling (1/8)	1/24	Deprived if no household member has completed six years of schooling
Child school attendance (1/8)	1/24	Deprived if any school-aged child is not attending school up to class 8
Health (1/4)	**1/12**	**Deprived if intensity of deprivation in health at or above 1/12**
Health care (1/8)	1/24	Deprived if individuals in the households did not consult any medical practitioner in the last 12 months
Food security (1/8)	1/24	Deprived if the household faced difficulty satisfying food needs in the last 12 months
Income (1/4)	**1/12**	**Deprived if intensity of deprivation in income at or above 1/12**
Consumption expenditure (1/4)	**1/12**	Deprived if individuals living in the households below absolute poverty line (ETB 14758)
Living condition (1/4)	**1/12**	**Deprived if intensity of deprivation in living condition at or above 1/12**
Electricity (1/20)	1/60	Deprived if the household had no electric source of lighting
Telephone (1/20)	1/60	Deprived if the household had no private telephone services
Water (1/20)	1/60	Deprived if the household had no access to safe drinking water
Flooring (1/20)	1/60	Deprived if the household had a dirt, sand, or dung floor
Cooking fuel (1/20)	1/60	Deprived if the household cooks with dung, wood, or charcoal
MPI (1.00)	**1/3**	**MPI poor if intensity of deprivation at or above 1/3**

Source: Author's definitions based on literature (2019).

2.4 Validation of Dimensions and Indicators

Methods of selecting dimensions and indicators for constructing a national MPI is based on different methods. The major methods of selecting dimensions and indicators of MPI may be identified from different perspectives, including human rights approach, national legislation, national development plans, participatory processes, consultations with experts and different stakeholders, and statistical methods (Santos, 2019). This study has identified the dimensions and indictors mainly based on the development programs undertaken by the country, and exposing the proposed dimensions and indicators to rigorous statistical analysis for their relevance and suitability to the Ethiopian context.

The weights attached to the welfare dimensions in this study are validated by their contribution to the MPI obtained after estimation. The pairwise correlation between the weighted intensity of deprivation in each indicator/dimension, the weighted intensity of multidimensional deprivation, as well as the tetrachoric correlation of

deprivations at indicator/dimension and multidimensional level were estimated (Table 4). All the indicators are found to be strongly significant and positively correlated with the intensity of multidimensional deprivation and incidence of adjusted multidimensional deprivation. The linear correlation between the adjusted intensities and the nonlinear correlation between the adjusted deprivations verify that deprivation, at indicator and dimension level, positively varies with the intensity and incidence of multidimensional deprivation. The tests confirm that all the dimensions and indicators included in the analysis are relevant sources of multidimensional poverty and inequality in Ethiopia.

Table 4: Linear and Nonlinear Relationships Between Indicators and MPI Measures

Dimension/Indicator	Correlation with intensity of deprivation (weighted)*	Tetrachoric correlation with adjusted deprivation*
Education	**0.494**	**0.456**
Years of schooling	0.41	0.659
Child school attendance	0.133	0.131
Health	**0.548**	**0.444**
Health care	0.309	0.463
Food security	0.467	0.644
Income	**0.693**	**0.584**
Consumption expenditure	0.693	0.860
Living condition	**0.693**	**0.944**
Electricity	0.510	0.626
Telephone	0.507	0.623
Water	0.376	0.509
Flooring	0.480	0.773
Cooking fuel	0.361	0.683

Note: *The correlations between the indicators/dimensions and the MDP measures are strongly significant at 1%.

Source: Author's computation (2019).

2.5 Estimation of Multidimensional Poverty

To estimate the MPIs in this study, the Alkire-Foster (AF) methodology was employed. The construction of an MPI that uses the AF is based on the M0 measure (also called the adjusted headcount ratio) proposed by Alkire and Foster (2011). The study employed the LSMS data as exposed to rigorous analysis using Distributive Analysis Stata package (DASP) developed by Araar and Duclos (2013).

To specify the method, consider a population of individuals, $i = 1, \dots, n,$ with income y_i, and sampling weight w_i. Let $f_i = \frac{w_i}{N}$, where $N = \sum_{i=}^{i=n} w_i$.

Suppose that $j = 1, \dots, K,$ denotes the j_i^{th} dimension of poverty and z_i denotes the poverty line for dimension j. A general form for additive multidimensional poverty indices can be written as (Araar & Duclos, 2013):

$$P(x,z) = \frac{1}{n}\sum_{i=1}^{i=n} f_i\, p(x_i,z)$$

where $p(x_i,z)$ is the individual poverty function that determines the contribution of individual i to total poverty p.

The Alkire and Foster MPI is estimated as (Alkire & Foster, 2011):

$$p(\alpha,x_i,z) = \frac{1}{N}\sum_{i=1}^{N}\frac{1}{J}\sum_{j=1}^{J} w_j \left(\frac{z_j - x_{i,j}}{z_j}\right)_+^{\alpha} I(d_i \geq d_c)$$

where I (i is poor) = 1 if $\sum_j^J w_j I(z_j > x_{i,j}) \geq d_c$, zero otherwise; N is the total sample size; J is the number of poverty dimensions/indicators; z_j is the poverty line for indicator j; $x_{i,j}$ is the intensity of poverty of individual i in indicator$j$; and d_c is the dimensional cut-off point to identify the poverty status.

Following the algorithm for computing the Shapley value developed by Araar and Duclos (2009), the total MPI poverty indices were decomposed into their constituent components or dimensions (education, health, income, and living condition).

2.6 Estimation of Multidimensional Inequality

The estimation of multidimensional inequality (MI) and identification of its possible sources is imperative for designing and implementing policy interventions related to equity. The MI in this study was estimated using the Araar MI index. The Araar MI index for the K dimensions of wellbeing takes the following form (Araar, 2009):

$$MI = \sum_{i=1}^{i=K} \varphi_k\, [\lambda_k I_k + (1-\lambda k) C_k]$$

where φ_k is the weight attributed to the dimension k (may take the same value across the dimensions or can depend on the averages of the wellbeing dimensions). I_k and C_k, respectively, are the relative–absolute-Gini and concentration indices of component k. The normative parameter λ_k controls the sensitivity of the index to the inter-correlation between dimensions.

The total multidimensional inequality measured by the Gini coefficient was also decomposed to the four dimensions based on the method of decomposition developed by Araar (2006).

3. Findings and Discussion

3.1 Relevance of Dimensions and Indicators

The weighted intensity of additive multidimensional deprivation in the 10 indicators was plotted with the weighted ordinal data to illustrate their relative

effects on the intensity of MPIs (Fig. 2). As expected, deprivations in the 10 indicators were above the mean value of the intensity of multidimensional deprivation compared to their non-deprived counterparts. The lengths of the vertical lines between deprived (labelled by their weights) and the non-deprived (labelled as 0) in the indicators suggest the intensity of the differential effects they have on mean intensity of deprivation in the MP measure. All the deprivations are above the multidimensional mean deprivation indicated at 0.43. However, the effects of child school attendance on the intensity of deprivation is exceptionally low. These positive correlations between deprivations in the 10 indicators and the intensity of deprivation indicates that all the indicators considered are relevant sources[3] of multidimensional poverty in Ethiopia.

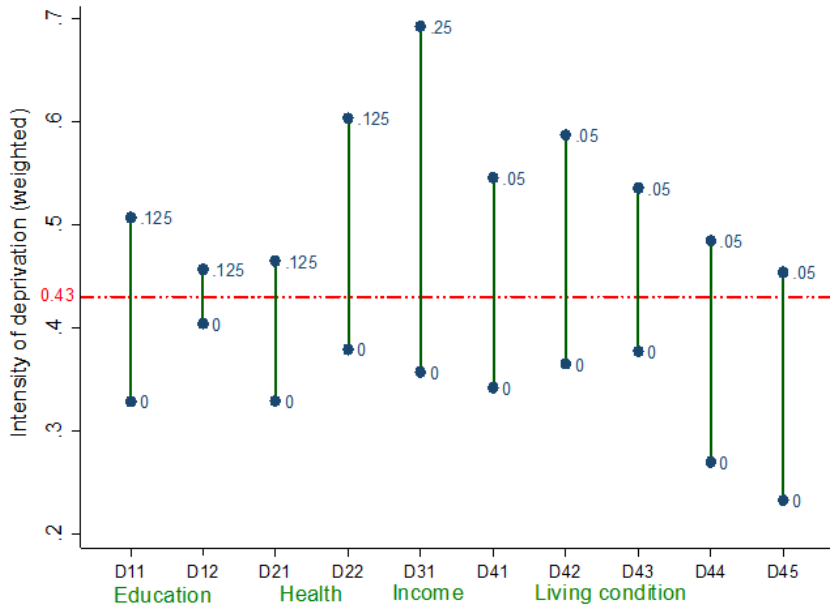

Figure 2: ***Interdependence of Intensity of Multidimensional Deprivation and Incidence of Dimensional Deprivation***

Note: The notations D11 to D45 denote the 10 indicators under the four dimensions. The first and the second subscripts, respectively, represent the number of the indictors and the dimension.

Source: Author's commutation (2019).

3.2 Multidimensional Deprivation

The incidence of multidimensional deprivation for the 10 indicators is reported in Table 5.

[3] The tetrachoric correlation coefficients of all the binary indicators and dimensions are also significantly and positively correlated with incidence of additive multidimensional poverty headcount index and severe poverty index.

Table 5: Incidence of Deprivation in the MP Indicators (%)

Indicators	Rural	Semi-urban	Urban	National
Education	**0.874**	**0.791**	**0.769**	**0.849**
Years of schooling	40.6	0.378	0.270	38.6
Child school attendance	36.7	0.450	0.554	40.8
Health	**0.866**	**0.778**	**0.769**	**0.848**
Health care	79.5	0.711	0.724	78.1
Food security	32.3	0.235	0.135	29.3
Consumption expenditure	**24.1**	**0.155**	**0.127**	**22.1**
Living condition	**0.990**	**0.730**	**0.416**	**0.900**
Electricity	70.9	0.210	0.052	59.5
Telephone	47.6	0.119	0.041	39.9
Water	49.5	0.109	0.133	42.6
Flooring	96.2	0.719	0.425	87.8
Cooking fuel	99.3	0.957	0.692	95.1
Severe poverty incidence	**82.4**	**0.322**	**0.155**	**66.2**
Multidimensional deprivation (H0)	**95.1**	**0.569**	**0.344**	**81.0**

Source: Author's computation (2019).

Years of schooling: If there is a household member who has not completed six years of schooling, the household is considered poor. This measure indicates that 38.6% of the population were under grade six education. As expected, deprivation in years of schooling decreases with increasing urbanization from 40.6% in rural areas to 27% in urban areas.

Child school attendance: The second indicator of education poverty is school attendance, whereby any school-aged child is considered deprived if s/he is not currently attending school up to class eight. About 40.8% of school-aged children were not attending school. Deprivation in school attendance surprisingly increases with increasing urbanization from 36.7% in rural areas to 55.4% in urban centres.

Health care: If individuals in a household did not consult any medial practitioner in the last 12 months, they are considered deprived. About 78.1% of the population did not consult any medical practitioner within the last year, indicating that they were deprived of health care. This may be attributable to various factors, including the absence and scarcity of health centres and practitioners, and/or inability to access health services due to financial and other constraints.

Food security: Food insecurity is also a proxy for undernourishment as an indicator of health poverty. Households are considered deprived or food insecure if they faced difficulty in satisfying food needs in the last 12 months. Shortage of food for an extended period is an indicator of food insecurity in terms of both quantity (energy requirement) and quality (nutrition), which can adversely affect human health. About 29.3% of the population had faced difficulty in satisfying their food needs, suggesting that their health was adversely affected by food shortage and poor nutrition. Food insecurity significantly decreases with increasing urbanization from rural (32.3%) to urban centres (13.5%).

Consumption expenditure: Real consumption expenditure per capita is an indicator of income poverty used in this study. If individuals were living below the absolute poverty line ($1.90 or ETB40.43 per day at an exchange rate of 21.28 in December 2015), they were considered consumption poor. Accordingly, the absolute poverty determined by using the annual real consumption expenditure per capita was ETB14758. Individuals falling below this absolute poverty line were 22.1% (considered income poor). Income poverty was greater than twofold in rural areas (24.1%) compared to urban centres (12.7%).

Electricity: Individuals who had no access to electric source of lighting from standard sources (electricity from electric meter, electric meter from generator, solar energy, biogas, electric battery, lantern, dry cell) were considered poor in electricity. About 59.5% of the population were deprived of electric light from standard sources, whereby the greatest majority were rural residents (70.9%). Access to improved lighting significantly decreases with increasing urbanization: from 70.9% in rural areas to 5.2% in urban centres.

Telephone: The second indicator of living condition or service poverty is ownership of private telephone services, whereby individuals were considered poor if they had no private access to any type of telephone services. About 39.9% of the population were deprived of telephone services; of which 47.6% was the deprivation rate among rural residents.

Water: Access to sources of safe drinking water is the other important indicator of poverty due to living condition. About 42.6% of the entire population and half of the rural population (49.5%) were deprived of safe drinking water. Deprivation in safe drinking water in urban areas increases with increasing urbanization (from 10.9% in small towns to 13.3% in urban centres).

Flooring: Individuals were considered deprived if a household was living in a house with a dirt floor or a floor made of sand or dung. The proportion of the population living in a house with a dirt floor was very high (87.8%). Most Ethiopians were house poor, living in houses with unclean floors. About 96.2% of the rural population were living in such unclean houses. Deprivation in the quality of flooring significantly decreases with increasing urbanization.

Cooking fuel: Individuals in households were considered deprived if a household's source of cooking fuel was dung, wood, or charcoal. About 95.1% of the population were poor in terms of their sources of cooking fuel. Almost all rural residents (99.3%) and 76.9% of urban population used poor sources of coking fuel like dung, wood and/or charcoal. Though deprivation in cooking fuel decreases with increasing urbanization, the proportion of deprived urban population was very high (95.7% in small towns and 69.2% in large towns).

Incidence of severe poverty: If the intensity of deprivation is above 50%, individuals are said to be in severe poverty. Accordingly, 66.2% of the poor in Ethiopia were in severe poverty. Severe poverty was extremely high (82.4%) and four-times higher in rural areas compared to urban areas in Ethiopia (15.5%); significantly decreasing with increasing urbanization.

Incidence of multidimensional deprivation (H0): The study estimated the mean index of the incidence of multidimensional deprivation across areas of residence based on deprivation with respect to the 10 indicators discussed above. Accordingly, the results indicated that 81% of the population was multidimensionally poor or deprived in the 10 indicators of wellbeing. The rural population was relatively more deprived (95.1%). Multidimensional deprivation decreases from 95.1% in rural areas to 34.4% in large towns. The highest deprivation was attributable to living condition (90%), followed by education (84.9%), and health (84.8%.

Intensity of deprivation: The density curves of the intensity of multidimensional deprivation in the 10 indicators between rural, small towns, and large towns is plotted in Figure 3. The density curves indicate the proportion of poor and nonpoor population by areas of residence. Greater proportion of the rural population was relatively more multidimensionally deprived, falling above the dimensional poverty cut-off point (k = 0.333), indicating that the intensity of multidimensional deprivation decreases with increasing urbanization.

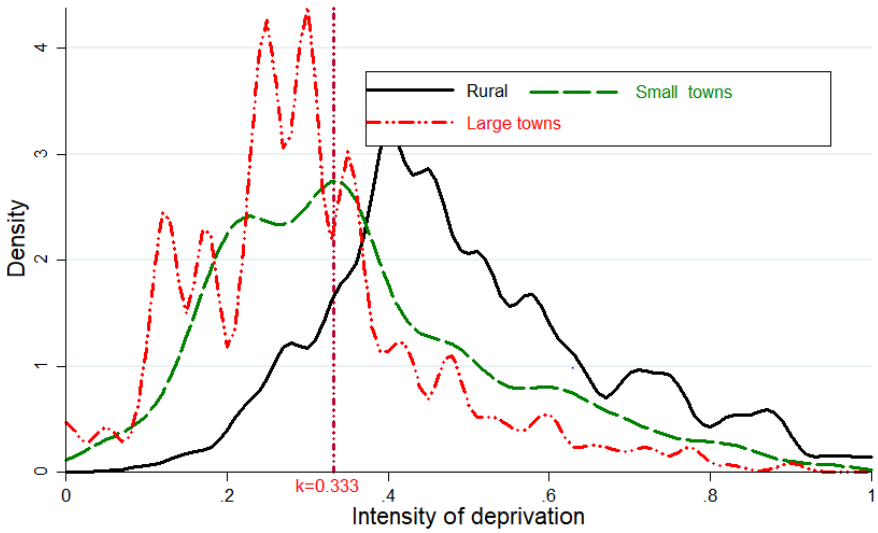

Figure 3: ***Density Curves of Intensity of Multidimensional Deprivation by Place of Residence***

Source: Author's computation (2019).

3.3 MPI for Ethiopia

The MPI as a measure of welfare reflects both the incidence and the intensity of poverty (the percentage of deprivations suffered by each person or household on average). It reflects the proportion of weighted deprivations that the poor experience in a society out of all the total potential deprivations that the society could experience. In other words, it is the percentage of deprivations poor people experience, as a share of the possible deprivations that would be experienced if all people were deprived in all dimensions. It represents the share of the population that is multidimensionally poor adjusted by the intensity of the deprivation suffered.

The Alkire-Foster (AF) (2011) methodology of multidimensional poverty analysis was employed to estimate the measures.[4] Table 6 reports the spatial distribution of these measures. The results indicate that 81.3% of the population in Ethiopia were multidimensionally deprived of the 10 weighted indicators. Regardless of the different indicators and dimensions used in this study, the incidence of multidimensional poverty is nearly similar to the one reported by the Oxford Poverty and Human Development Initiative (OPHI) in the same year (83.1%) (OPHI, 2016). But the prevalence of multidimensional poverty was increasing with increasing urban growth. Rural areas relatively contributed 78.4% to the incidence of multidimensional poverty in Ethiopia. Ethiopia was the second MPI poor in the world in 2015, and the fifth MPI poor in 2018 (OPHI, 2015, 2018; Alkire et al., 2015).

Table 6: Spatial Distribution of Poverty in Ethiopia

Multidimensional poverty measures	Rural	Semi-urban	Urban	National
MPI				
Population share	0.813	0.055	0.133	1.000
Headcount ratio (H0)	0.784	0.912	0.948	0.813
Adjusted headcount (MPI=M0)	0.427	0.584	0.655	0.466
Relative contribution to incidence (H0)	0.784	0.061	0.155	1.000
Relative contribution to adjusted headcount (M0)	0.745	0.068	0.186	1.000
Nonmonetary MPI				
Headcount ratio (H0)	0.657	0.848	0.940	0.705
Adjusted headcount (MPI=M0)	0.305	0.489	0.584	0.352
Relative contribution to incidence (H0)	0.758	0.066	0.177	1.000
Relative contribution to adjusted headcount (M0)	0.704	0.076	0.220	1.000
Monetary poverty				
Incidence of poverty (α=0)	0.241	0.155	0.127	0.221
Poverty gap index (α=1)	0.064	0.052	0.034	0.060
Squared poverty gap index (α=2)	0.026	0.022	0.014	0.024

Source: Auhtor's computation (2019).

[4] Because the data on the 10 dimensions is ordinal (0/weight), the Alkire-Foster (AF) (2011) methodology does not compute adjusted poverty gap (M1) and adjusted squared poverty gap (M2) indices (see, Alkire & Apablaza, 2008).

The MPI (46.6%), also denoted by M0, is the product of two factors: headcount ratio (H), and intensity. Because they were on average deprived in 81.3% of the weighted indicators, Ethiopians were deprived in 46.6% of the total potential deprivations they could experience overall. Like the incidence of multidimensional deprivation, the MPI increases with increasing level of urban growth: from 42.7% in rural areas to 65.5% in urban areas.

The incidence of nonmonetary poverty estimated with three nonmonetary dimensions of wellbeing (education, health, and living condition) is 70.5%, which is 11 percentage points lower than the overall MPI (81.3%). Similarly, the nonmonetary MPI was 35.2%, which is 11.4% lower than the overall MPI. Nonmonetary MP was almost twofold: higher in urban Ethiopia compared to rural areas, indicating that nonmonetary poverty is increasing with urban growth. Incidence of monetary poverty (measured by real consumption expenditure per capita), estimated by using the FGT method, was 22.1%; which is by far lower than the other two multidimensional measures. The results generally suggest that income poverty in Ethiopia was significantly reduced, and relatively lower than the other forms of poverty.

The major departure in the findings of this study from the global MPI estimated from the DHS data is that multidimensional poverty estimated from LSMS data using the four dimensions is relatively more prevalent and deeper in urban Ethiopia compared to the estimates for rural Ethiopia. However, monetary poverty is relatively lower in urban Ethiopia. The rural population are relatively better off in nonmonetary poverty, but worse off in overall MPI and monetary poverty.

High incidence of multidimensional poverty above the national mean was observed in many of the regions (Table 7). Only three regions (Amhara, SNNP, and Benshangul-Gumuz) had incidence rate below the national average. The results also show that the incidence of multidimensional poverty is surprisingly high in urban centres of Ethiopia, including Addis Ababa (97%), Dire Dawa (92.5%), and Harari (93.9%).

Table 7: Regional Distribution of the AF MPIs

Region	Population Share	Headcount Ratio (H0)	MPI (=M0)
Tigray	0.056	0.865	0.530
Afar	0.009	0.957	0.554
Amhara	0.209	0.771	0.441
Oromia	0.422	0.845	0.475
Somali	0.034	0.890	0.494
Benshagul-Gumuz	0.012	0.766	0.456
SNNP	0.207	0.723	0.399
Gambella	0.006	0.914	0.564
Harari	0.003	0.939	0.604
Addis Ababa	0.037	0.970	0.702
Dire Dawa	0.005	0.925	0.592
National	**1.000**	**0.813**	**0.466**

Source: Auhtor's computation (2019).

3.4 Decomposition of the MPIs

To estimate the relative and absolute contributions of the 10 indicators and the four (aggregated) dimensions of multidimensional poverty, the AF (2011) total MPIs (H0 and M0) were decomposed to their constituent parts (Table 8). The contribution of the four dimensions to the total MPI, in order of importance, are income, health, education, and living condition; with significant and comparable contributions.

Table 8: Decomposition Results of the AF MPIs by Indicators/ Dimensions Using the Shapley Approach

Dimensions/Indicators	Contribution to H0		Contribution to MPI	
	Absolute	Relative	Absolute	Relative
Education	**0.144**	**0.177**	**0.089**	**0.190**
Years of schooling	0.090	0.111	0.055	0.118
Child school attendance	0.054	0.066	0.034	0.072
Health	**0.160**	**0.197**	**0.100**	**0.214**
Health care	0.036	0.045	0.024	0.051
Food security	0.124	0.152	0.076	0.163
Income	**0.400**	**0.492**	**0.205**	**0.440**
Consumption expenditure	0.400	0.492	0.205	0.440
Living condition	**0.109**	**0.134**	**0.073**	**0.157**
Electricity	0.026	0.033	0.018	0.038
Telephone	0.038	0.047	0.025	0.054
Water	0.035	0.043	0.023	0.049
Flooring	0.007	0.008	0.005	0.011
Cooking fuel	0.003	0.003	0.002	0.005
National	**0.813**	**1.000**	**0.466**	**1.000**

Source: Auhtor's computation (2019).

*Education***:** Education contributed 0.144 and 17.7% to total MPI in absolute and relative terms, respectively. This is the third largest contribution (next to health) to the incidence of the total MP. Similarly, the relative contribution of education to the total MPI (M0) was 19%. Compared to child school attendance, years of schooling contributes more to education poverty.

*Health***:** Health ranks second in its contribution to the total MPI in both absolute and relative terms. It relatively contributes 19.7% to the total MP incidence (H0). Similarly, the relative contribution of health to the total MPI (M0) was 21.4%. Compared to health care, food security contributed more to health poverty.

*Income***:** The inclusion of income dimension in the MPI analysis has suggested a different insight towards MPI measurement in Ethiopia. Without income, the MPI analysis seems to be a partial view of the entire welfare situation in a society. As expected, nearly half of the total multidimensional poverty in Ethiopia is attributable to consumption/income poverty. It has 49.2% and 40% relative contributions to the incidence and the MPI, respectively.

Living condition: Unlike the global MPI measure, indictors related to income (e.g., assets) were eliminated and the contributions of other income-related indicators were captured by real consumption expenditure included as a separate dimension of the MPI analysis. The results indicate that the living condition of the population, as captured by access to major utilities and facilities, has comparable contribution to the other dimensions of wellbeing in Ethiopia. It contributes 13.4% to the incidence of MPI, and 15.7% to MPI. Access to telephone and safe drinking water have relatively larger contributions to the total MPI. However, cooking fuel and flooring have relatively lower contributions to poverty.

3.5 Multidimensional Inequality

The multidimensional inequality index (MII) was computed by using the Araar MII (Araar, 2009) with uniform dimensional weights of 20% each (Table 9). To apply this method of analysis, the 10 weighted indicators were aggregated to the four dimensions. The results indicate that the relative MII in Ethiopia was 0.229, which is lower than the inequality level reported by the OPHI for the same year (0.267) (OPHI, 2016). MII in Ethiopia increases with urban growth. The nonmonetary MII estimated by excluding the income dimension of wellbeing was 0.169, which is significantly lower than the overall MII (0.229). On the other hand, monetary inequality was 0.344, with little variation by place of residence. The major source of inequality in Ethiopia is income or monetary inequality. Compared to the Gini index of unidimensional inequality reported by OPHI for the same year using the DHS dataset (0.336%), the MII in this study shows almost similar level of inequality in Ethiopia.

Table 9: Spatial Distribution of Inequality among the Poor and Relative Contribution of Dimensions (%)

Inequality measures	Inequality index	Education	Health	Income	Living condition
MII (λ=0.5)	**0.229**	**23.80**	**17.43**	**46.92**	**11.85**
Rural	0.212	23.89	18.13	49.06	8.92
Small towns	0.302	21.90	16.37	49.73	12.01
Large towns	0.328	19.39	15.83	44.99	19.79
Nonmonetary MII (λ=0.5)	**0.169**	**46.29**	**32.17**	**-**	**21.55**
Rural	0.151	49.14	34.55	-	16.31
Small towns	0.210	44.54	32.20	-	23.26
Large towns	0.247	36.12	28.72		35.15
Monetary inequality (Gini)	**0.344**	**-**	**-**	**-**	**-**
Rural	0.331	-	-	-	-
Small towns	0.316	-	-	-	-
Large towns	0.355				

Source: Auhtor's computation (2019).

The total MII decomposed to the welfare dimensions indicates that the primary sources of inequality in Ethiopia are income (or real consumption expenditure), with 46.9% contribution to the national MII. The other three dimensions have nearly differentiated contributions to the total MII, respectively with 23.8%, 17.4% and 11.9% relative contribution. As expected, the greatest proportion of MII is attributable to income inequality. Ethiopians are more likely to face equity problems mainly arising from the difference in their income/consumption expenditure. Inequality related to education, health, and income generally decrease with the level of urbanization; but MII due to living condition increases with the level of urbanization in Ethiopia.

The contributions of welfare dimensions to total nonmonetary MII has also significant difference across place of residence.[5] The highest source of nonmonetary inequality in Ethiopia was education (46.3%), followed by health (32.2%), and living condition (21.6%). Nonmonetary inequality due to education and health generally decreases with increasing level of urbanization. However, the contribution of living condition to nonmonetary MII rather increases with increasing urbanization, suggesting that urbanization in Ethiopia is not accompanied by improved urban facilities and services.

4. Conclusion

The global MPI is the basic framework of poverty analysis based on DHS dataset collected in100 countries of the world. However, because poverty has multiple dimensions and indicators in different countries of the world, countries are expected to adapt the global MPI to their country contexts, suggesting the need to look for alternative data sources suitable for the analysis of multidimensional poverty and inequality. Accordingly, this study has utilized the LSMS dataset of 22,296 individuals to design a national MPI for Ethiopia.

The study employed the Alkire-Foster methodology of multidimensional poverty analysis using the LSMS data, and identified four dimensions with 10 indicators of multidimensional poverty and inequality. The findings indicate that 81.3% of the Ethiopian population was multidimensionally poor; and are deprived in 46.6% of the weighted indicators of multidimensional poverty. Overall, multidimensional poverty and nonmonetary poverty is more prevalent in urban areas compared to rural areas. Multidimensional poverty is more attributable to income, followed by health, education, and living condition. Multidimensional inequality in Ethiopia with four dimensions was estimated to be 0.229, with significant variation by place of residence; where it is relatively more in urban areas. The decomposition results show that the major sources of multidimensional inequality are income, followed by education, heath, and living condition.

[5]The total absolute MII is not reported here for it was similar to the relative MII (0.260). The unidimensional income inequality estimated from the same dataset was 34.4%, which is higher than the MII estimated in this paper. To estimate the contribution of dimension to total MII, the 10 indicators are aggregated to the four dimensions since Araar (2009) MII doesn't' allow more than six dimensions/indicators.

The national multidimensional poverty and inequality measures adapted to the Ethiopian context imply the need to contextualize the dimensions and indicators of welfare related to national policy interventions with the availability of alternative data sources like the LSMS. This is an opportunity for global comparison of MPIs covered by the LSMS survey.

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