

Chapter 4

Vulnerability to Poverty in Ethiopia



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1 Introduction

Ethiopia is one of the least developed countries in the world. Poverty in Ethiopia is deep-rooted and pervasive. Like in many other developing countries, poverty reduction is the top policy priority in Ethiopia. Poverty reduction policies in most developing countries, including in Ethiopia, focus on people or households' that are currently poor and ignore those who are likely to be poor in the future. For more than two decades now, poverty assessments or analyses have been done to inform policymakers about alleviating poverty in developing economies. These poverty assessments have shown detailed profiles of the poor to understand the incidence or depth of poverty in various segments of the population. But poverty is a stochastic phenomenon; poor households today may or may not be poor tomorrow. Households that are non-poor today may face some adverse shocks and become poor in the near future. Among the currently poor households there may be some who will continue to be poor in the future. In general, a poverty analysis (households' current poverty levels) is an ex-post measure of a household's well-being and may not be a good guide to the household's vulnerability to poverty in the future. Inadequate research in the area of vulnerability to poverty has contributed to this focus on current poverty. For policy purposes, what really matters is the likelihood of households or individuals falling into poverty in the near future or vulnerability to poverty. The most effective way of ensuring households' economic well-being is by preventing them from falling into poverty rather than concentrating on poverty after it has occurred.

Although Ethiopia has achieved economic growth, it is unclear whether vulnerability to poverty has also declined in the country. Households' vulnerability to poverty is essential for any poverty reduction effort and for bringing about

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sustainable growth and development in the country. Risk is inherent in human life and households in Ethiopia are exposed to different risks (for example, droughts, crop and animal diseases and floods). Households' exposure to different risks, whether idiosyncratic or covariate, is the main reason for examining vulnerability to poverty. Vulnerability is seen as the probability of a non-poor person or household becoming poor in the future or the prospect of a poor person or household continuing to be poor in the future (Christiansen and Subbarao 2004).

Policies designed for reducing poverty should take into consideration the current non-poor but vulnerable to poverty households with the poor households. As pointed out by Raghbendra et al. (2009) the part of the population that faces vulnerability to poverty is considerably different from the part that is observed to be poor. In Ethiopia, around 48 percent of the households are highly vulnerable to poverty and about 18 percent of the non-poor households are highly vulnerable to poverty (Fekadu 2013). Moreover, the distribution of vulnerability to poverty across different regions differs significantly from the distribution of poverty. Hence, poverty reduction strategies need to consider not just poverty alleviation but also poverty prevention (vulnerability to poverty).

Poverty and vulnerability to poverty are closely related concepts. According to Hoddinott and Quisumbing (2003) vulnerability is uninsured exposure to different risks or it can be defined as the risk of non-poor individuals or households falling below the poverty line or those already below the poverty line remaining in poverty. This means that vulnerability is measured as the probability of a household falling into poverty in the near future. The poor are typically the most exposed to different risks and they also have the fewest instruments to deal with these risks. Hence, poverty and vulnerability are two sides of the same coin (Chaudhuri et al. 2002; Tu Dang 2009).

Vulnerability is high in developing nations but data which can help understand the risks that households may face in the future is not readily available. In developing countries, financial markets are not well established and they are also less efficient so households have limited market-based instruments like insurance. Social insurance programs related to unemployment, sickness and injury are also not well established in developing nations.

It has now been widely recognized that policies aimed at combating poverty ought to focus not only on those who are currently poor but also on those who face the risk of moving into poverty and those already trapped in it. This is why an analysis of households' vulnerability to poverty is becoming the main focus of development economics literature.

There is widespread poverty in Ethiopia, and many households suffer spells of chronic and transient poverty. Research indicates that expected poverty (vulnerability) is much higher in Ethiopia than the point in time estimates of poverty (Fekadu 2013; Negassa et al. 2014). Various interventions have been made to reduce the incidence of poverty. However, it is difficult to solve this problem due to the depth and complexity of poverty and vulnerability to poverty. Hence, vulnerability to poverty has to be a point of concern in Ethiopia and this needs a rigorous analysis. However, little empirical work has been done to examine the extent of vulnerability

to poverty in the country. The available studies on vulnerability to poverty focus only on one-dimensional vulnerability to poverty by using income or consumption expenditure (Dercon and Krishnan 2000; Negassa et al. 2014) and ignore vulnerability to multidimensional poverty. Some studies on unidimensional vulnerability to poverty are also region specific. For example, Fekadu (2013) studied vulnerability to poverty in the Oromia regional state which does not show vulnerability to poverty among households in the country. Others are gender based, for example Negassa et al.'s (2014) study on vulnerability of female headed households to poverty. It does not give a comprehensive picture of households' vulnerability to poverty in the country.

This research, however, studies vulnerability to poverty both from one-dimensional and multidimensional perspectives and provides a detailed account of vulnerability in Ethiopia. This paper uses rigorous modeling techniques to estimate households' vulnerability to both unidimensional and multidimensional poverty and makes a contribution to literature on vulnerability to poverty.

The rest of the paper is structured as follows: Sect. 2 discusses the conceptual framework of the research, Sect. 3 reviews related literature and Sect. 4 discusses the data and methodology. Section 5 presents the results and discusses its findings. Section 6 gives a conclusion and provides some recommendations.

2 Conceptual Framework

Vulnerability to poverty can be conceptualized as having two components: exposure to a shock and the ability to manage the shock. Shocks include natural shocks such as droughts, floods and crop failures or economic shocks such as economic crises. Households can use different mechanisms to protect themselves from such risks or vulnerabilities – by drawing on their savings, diversifying their livelihoods or by building social networks that provide informal social assistance. People become vulnerable when all these risk coping mechanisms fail. An assessment of vulnerability also includes household welfare incorporating both average expenditure and the risks that households face.

One of the greatest developmental challenges facing the world today is the elimination of poverty by reducing people's vulnerability to poverty because societies that are characterized by high levels of poverty and vulnerability to poverty are seen as lacking the potential needed to move out of underdevelopment. Poverty and vulnerability to poverty are complex and multifaceted concepts that are interlinked in such a way that each causes the other. While poverty makes people vulnerable to various shocks such as droughts, diseases and other natural disasters because the poor have less resources to deal with these shocks. This vulnerability to shocks exacerbates their poverty and hence their vulnerability to future shocks.

Hence, a poverty assessment that includes an analysis of vulnerability to poverty is both desirable and necessary for various reasons. First, for thinking about appropriate forward-looking anti-poverty interventions it is clearly necessary to go

beyond cataloging who is currently poor and how poor they are to an assessment of households' vulnerability to poverty – who is likely to be poor, how likely are they to be poor and why are they likely to be poor. Second, focusing on vulnerability to poverty helps in highlighting the distinction between poverty prevention interventions and poverty alleviation interventions. Third, vulnerability is an inherent aspect of human well-being and exposure to risks and uncertainties about the future affect current well-being (Tu Dang 2009).

For instance, if there are two households (A and B) on the same iso-poverty surface and if household A is relatively healthy and well educated but deprived income-wise, it may be less vulnerable and better able to withstand a shock than household B that possesses a higher income but is more deprived in terms of health and education. In other words, when present measures of multidimensional poverty compare individuals they ignore the differential risks and vulnerability conditions of alternative attributes yielding the same level of poverty today (Thorbecke 2008). Dependence exists between the form that poverty takes today and possible poverty outcomes in the future.

3 Literature Review

Poverty affects the lives of millions of people worldwide. Governments and international organizations widely use poverty measures to design poverty alleviation policies. These policies are future focused. However, the most commonly used poverty measures indicate the current poverty or poverty history of a country and do not say anything about future poverty or households' vulnerability to poverty and hence do not provide forward looking information. If policymakers design poverty alleviation policies on the basis of the poverty status in the current year, the poor may have escaped from poverty and the non-poor may have slipped into poverty in the future due to various reasons. The question is who is likely to suffer the most poverty in the future and an important way of measuring this is by considering vulnerability to poverty. Therefore, any poverty analysis should consider households' vulnerability to poverty for designing appropriate poverty reduction policies. It is also suggested that ex-ante measures for preventing households from becoming poor as well as ex-post measures to alleviate those already in poverty should be combined in evaluating poverty.

There is no consensus on a definition of vulnerability to poverty. However, research is increasingly defining vulnerability to poverty as the probability of falling into poverty (Chaudhuri et al. 2002). Vulnerability to poverty can also be defined as the probability that an individual or a household may be poor in the near future regardless of whether he or the household is currently poor or not. Vulnerability can be defined as a probability or a risk that a household will fall into poverty at least once in the near future. Vulnerability, unlike poverty, is a more future oriented concept that considers households' possible welfare changes in the future. Therefore, vulnerability has the nature of a probability forecast and is seen

as expected poverty (Gowon et al. 2013; Tu Dang 2009). Poverty is an ex-post realization of variables such as well-being or income with respect to a socially determined minimum threshold (poverty line), while vulnerability is the ex-ante expectation of that variable relative to this threshold (Dercon 2005). The World Development Report (2000–2001) defines vulnerability as a risk that a household or an individual will experience an episode of income or health poverty over time. Vulnerability is also defined as the probability or risk today of being in poverty or falling into deeper poverty in the future.

There are three widely used approaches for measuring vulnerability to poverty (Hoddinott and Quisumbing 2003): vulnerability as expected poverty (VEP), vulnerability as low expected utility (VEU) and vulnerability as uninsured exposure to risk (VER). All share a common characteristic, namely they construct a model that predicts a measure of welfare. VEP and VEU share two more commonalities; they refer to a benchmark for this welfare indicator, z , and enumerate a probability of falling below this benchmark. Vulnerability is the likelihood that realized consumption will fall below the poverty line. The VEP and VEU approaches measure vulnerability at the individual level. However, aggregation over all the individuals or households considered gives a measure of aggregate vulnerability. Because expected poverty is more easily measurable than utility-based measures (Ligon and Schechter 2003), conceptualizing vulnerability in terms of expected poverty seems reasonable in assessing ex-ante household welfare.

VER assesses whether observed shocks generate welfare losses but does not measure vulnerability as it does not construct probabilities. They are ex-post assessments of the degree to which a negative shock causes a household to deviate from the expected welfare. In terms of policy implications, the VEP approach can help distinguish between those who are currently poor and those who are permanently poor and hence could help design preventive measures before an adverse event occurs. Vulnerability as expected poverty has been widely used in literature (Gunther and Harttgen 2009; Imai et al. 2010; Jha et al. 2010; McCulloch and Calandrino 2003; Sricharoen 2011). This approach has also been used for estimating vulnerability to poverty in different contexts in different developing countries like Vietnam (Imai et al. 2011a), rural China (Zhang and Wan 2006) and Guatemala (Tesliuc and Lindert 2004).

Different ideas have been expressed on the relationship between poverty and vulnerability and the poverty line. According to one idea, in vulnerability to poverty the poverty line is adjusted in such a way that the utility of a person at the current poverty line and that at the adjusted poverty line become equal. The adjusted poverty line is a simple relative augmentation of the current poverty line under a multiplicative model of vulnerability with constant Arrow-Pratt relative risk aversion. Therefore, a household or a person who is non-poor (poor) currently may not be treated as non-poor (poor) in a vulnerable situation. We studied the implications of vulnerability to the poverty line and the issue of adjusting the poverty threshold under vulnerability so that the corrected poverty line also represents the standard of living in an environment of vulnerability.

According to Dang and Lanjouw (2014) two thresholds are important for identifying the poor and vulnerable groups. These are the poverty line and vulnerability line, below which non-poor households can face high risks of falling back into poverty. The first approach is identifying a population that is not vulnerable and seeing the lower bound income level for this population group as the vulnerability line. The second approach considers the population that is clearly not poor but faces a real risk of falling into poverty and the upper bound income level for this population can be set as the vulnerability line. This approach avoids the arbitrariness and indirectness of scaling up the poverty line by a certain factor to get the vulnerability line.

Vulnerability as an area of economic research using panel data has been widely explored. However, due to the limitations imposed by the lack of reliable and up to date panel data in developing countries, vulnerability analyses using cross-sectional data that uses the variance of consumption to estimate households' expected poverty is now widely used (Chaudhuri et al. 2002; Fekadu 2013; Gowon et al. 2013; Imai et al. 2010; Jha et al. 2010; McCulloch and Calandrino 2003; Raghbendra et al. 2009; Sricharoen 2011). Besides the lack of long panel data for an analysis of vulnerability to poverty, most current surveys often do not contain sufficient information about the shocks that households face when estimating the impact of these shocks on vulnerability. Important shocks that households face which make them likely to be vulnerable to poverty are illnesses, flooding, droughts and cyclones. There may be other shocks such as asset losses, labor market disturbances, harvest failures and civil unrest. Economists have also recognized that households' well-being depends not just on their average income or expenditure, but also on the risks that they face, hence vulnerability is a more satisfactory measure of welfare (Dercon and Krishnan 2000; Raghbendra et al. 2009; Tu Dang 2009). Hence, collecting data on some of these and other relevant indicators may prove valuable for an analysis of vulnerability to poverty.

Literature indicates that there are demographic, socioeconomic and community characteristics that affect households' vulnerability to poverty. Poverty and vulnerability to poverty vary across regions and seasons. Household head's education and ownership of agricultural land have a positive effect on consumption and hence reduce variability in consumption or vulnerability to poverty. Vulnerability studies have also shown that location is an important determinant of vulnerability to poverty. This is not surprising because infrastructure is not evenly distributed across regions in most developing countries as a result of which economic conditions are different across different locations. Location matters for access to markets and credit and other public services, hence understanding the underlying causes of vulnerability at each location is the first step in determining appropriate location-specific policies to cope with vulnerability. Research, however, underscores that currently there is little knowledge about how location-specific characteristics affect vulnerability.

Chaudhuri et al. (2002) used cross-sectional data in Indonesia and a three-stage feasible generalized least squares procedure to estimate the variance of the log of consumption on household characteristics. Their results indicate that at the national level, 23 percent of the Indonesians were poor and 45 percent were vulnerable to

poverty. A study in Bangladesh using data from the Household Income and Expenditure Survey (HIES) for 2005 showed that poverty was not the same as vulnerability as a substantial share of those currently above the poverty line was highly vulnerable to poverty in the future. The study stated that those without education were likely to be the most vulnerable. The geographical diversity of vulnerability is considerable, for example, vulnerability in the coastal division, that is, the Chittagong division is almost double that in Dhaka and almost four times higher than Khulna division. In investigating the factors that affect vulnerability, McCulloch and Calandrino (2003) found that demographic characteristics, education, household location and assets were important factors in vulnerability to poverty.

Using a large repeated cross-sectional survey dataset collected under the Chinese Household Income Project, Imai et al. (2010) found that poverty and vulnerability to poverty significantly decreased in China during the study period (1988–2002). They also indicate that household head's education and access to electric power were negatively associated with both poverty and vulnerability to poverty. On the other hand, agricultural land size and irrigated land were associated with vulnerability to poverty but not poverty. Their study also indicated that education and location were among the factors that consistently emerged as significant covariates of vulnerability to poverty.

Using the expected poverty measures approach, Imai et al. (2011b) estimated the vulnerability of various ethnic groups in Vietnam. They found that households in ethnic minority groups were poor and more vulnerable than those in ethnic majority groups. Their study highlighted the importance of ethnic considerations in studies on vulnerability to poverty. An analysis of poverty and vulnerability in Tajikistan, using a panel dataset and an expected poverty approach revealed that rural households were poorer and more vulnerable than urban households (Jha et al. 2010).

Using a panel dataset of villages in rural Ethiopia, Dercon and Krishnan (2000) showed that on average, year-to-year poverty in Ethiopia was very similar. However, they found high vulnerability in consumption and poverty over the seasons and year-by-year. They computed poverty under different scenarios: whether there was a safety net program, whether the rainfall in the area where the household was located was normal or bad and whether there were seasonal price fluctuations. A comparison of these scenarios indicated that poverty can change substantially within a relatively short period of time and a large number of households were vulnerable to shocks than what was implied by standard poverty statistics. The number of households falling below the poverty line when serious shocks hit the household and community in rural Ethiopia was about 50–75 percent more than the poverty estimates obtained using the current cross-section estimates in each period (Dercon and Krishnan 2000). Based on the Ethiopian Rural Household Survey for 1999–2000, Negassa et al. (2014) showed that on average 38 percent of the sampled households were highly vulnerable to poverty and 16.38 percent of the non-poor were highly vulnerable to poverty. However, based on recent data used for their study, only 35.26 percent of the households in rural Ethiopia were poor. This indicates that expected poverty or vulnerability to poverty were greater than the point in time estimates of poverty, which connotes the importance of a forward-looking poverty analysis (vulnerability to poverty).

Literature on vulnerability to poverty in Ethiopia using the same Ethiopian Rural Household Survey data shows some differences in results. For example, using Ethiopian Rural Household Survey data, vulnerability to poverty in Ethiopia was estimated to be 51 percent. Villages in the northern (Tigray) and southern regions (SNN) were found to have the highest average vulnerability of approximately 52 percent which is a bit higher than the national average (51 percent). Vulnerability to poverty in the Amhara and Oromia regions was 50 percent and 49 percent respectively which is less than SNN (52 percent) and even the national average (51 percent). This implies that vulnerability to poverty among rural households in Ethiopia is not the same; farmers in different regions have different levels of vulnerability to poverty. Research also indicates that this could be linked to variations in rainfall in different parts of the country.

Most studies on vulnerability to poverty are unidimensional and are based primarily on monetary outcome measures such as consumption per capita. However, vulnerability can be analyzed by other observable multidimensional outcomes. Vulnerability to multidimensional poverty is the threat of facing multidimensional poverty in the future related to both predicted shortfalls in any particular well-being dimension and also to the effect of any uncertainty or risk on well-being. A vulnerability analysis involves identifying threats and responses in exploiting opportunities and resisting or recovering from the negative effects of a changing environment. Therefore, the assets and entitlements available to individuals and households are critically related to vulnerability. Our study underscores the importance of building productive assets for increasing incomes and decreasing income variances to escape from the threat of poverty. Some literature redefines poverty and draws attention away from shortfalls in income or consumption expenditure to other forms of deprivation (Calvo 2008). Existing research also discusses vulnerability to multidimensional poverty using data from Peru (1998–2002) and discusses bidimensional vulnerability to poverty and sheds some light on the importance of vulnerability to multidimensional poverty. However, this research limits itself only to two dimensions (consumption and leisure). Therefore, studies on vulnerability to multidimensional poverty using health, education and other important well-being indicators are important to bridge this gap.

4 Data and Methodology

4.1 Data

This research used the 2011 Household Consumption and Expenditure Survey's (HCES) data for unidimensional vulnerability to poverty in the analysis. Household Consumption and Expenditure Surveys (HCES) are complex surveys conducted on a nationally representative sample to characterize important aspects of household socioeconomic conditions. These surveys are done by the Central Statistical Agency (CSA) of Ethiopia since 1995–96 at four- or five-year intervals. The 2010–11 HCES

is the fourth survey in the series. The survey covered all rural and urban areas except the non-sedentary population in Afar and Somali and households in the selected sample except homeless persons and foreigners. The primary purpose of the survey is providing information on poverty monitoring, calculating national accounts and as an input for consumer price indices. The food data collected in HCES can be used for producing a variety of food security and nutrition indicators.

The survey provides income, expenditure and other socioeconomic data at the household level, which is useful in an analysis of poverty and vulnerability to poverty. The household-based questionnaire provides information on the population's basic characteristics such as sex, age, household size, marital status, education and employment. It also includes households' consumption (food and non-food) and also the quantities consumed and their values. Non-food consumption includes cigarettes, alcohol, clothes, household goods, transport, health and education. We consider land ownership as a proxy for physical capital ownership and household head's education as proxy for the human capital ownership of a household as shown in most poverty research.

For an analysis of vulnerability to multidimensional poverty, we use Ethiopian Demographic and Health Survey (EDHS) data for 2011. EDHS surveys are done by Ethiopia's Central Statistical Agency (CSA) with support from the worldwide Demographic and Health Survey (DHS) project. It is a comprehensive dataset that consists of samples from all regions in the country and represents the national population of Ethiopia. The sample was selected using a stratified, two-stage cluster design while enumeration areas (EAs) were the sampling units for the first stage and households comprised the second stage of the sampling.

DHS is cross-sectional data collected in Ethiopia almost every 5 years. The data collected contains information on household characteristics, households' dwelling units such as the sources of water, types of sanitation facilities, access to electricity, types of cooking fuel, materials used for the floor and ownership of various assets like TV, radio, telephone, land, car, bicycle, cattle, sheep, goat and others. The data also contains household members' level of education, children's school attendance, child health, child mortality, maternal mortality and nutrition status (Central Statistical Agency of Ethiopia and ICF International 2012).

4.2 Unidimensional Poverty

The unidimensional measure of poverty has been widely used in poverty analyses, but this measure has been criticized as it considers only income or consumption expenditure. Hence, literature also focuses on analyses of multidimensional poverty as these include many dimensions of well-being. Despite its limitations, the unidimensional measure of poverty provides good information for assessing public policies and evaluating the impact of the interventions. Therefore, before we analyze vulnerability to poverty using consumption expenditure, it is essential to assess unidimensional poverty as poverty and vulnerability to poverty are related concepts.

We used the family of Foster, Greer and Thorbecke (FGT) poverty measure (P_α), that is widely used because it is consistent and additive decomposable (Foster et al. 1984). The FGT index is given by:

$$P_\alpha = \frac{1}{N} \sum_{i=1}^q \left(\frac{Z - CE_i}{Z} \right)^\alpha \quad (4.1)$$

where Z is the poverty line, CE_i is the per capita consumption expenditure in increasing order of $CE_1 \leq CE_2 \leq \dots \dots \leq CE_q \leq Z < CE_{q+1} \leq \dots \dots \leq CE_N$ for all households N , q is the number of poor people in the pupation of size N and α measures policymakers' degree of aversion to inequality among the poor, that takes the values 0, 1 and 2. The higher the value of α , the higher is the weight attached to the poorest of the poor. Three indices of poverty can be measured using different values of α ($\alpha = 0, \alpha = 1, \alpha = 2$). For $\alpha = 0$, the poverty index is the head count poverty index (P_0), which measures the proportion of the population whose consumption expenditure per capita is less than the poverty line or it measures the incidence of poverty. Poverty rate is simple to compute and easy to understand. But the index ignores differences in well-being between poor households, it does not take the intensity of poverty into account and is not sensitive to changes in consumption or income as long as they remain below the poverty line. For $\alpha = 1$, the poverty measure is the poverty gap index (P_1), which measures how far the poor households are from the poverty line. It gives a better understanding of the depth of poverty and shows how much would have to be transferred to the poor to bring their expenditure up to the poverty line. Finally, for $\alpha = 2$ we get the squared poverty gap index (P_2) which measures the severity of poverty. It measures the inequalities among the poor on top of measuring the distance from the poverty line.

4.3 Vulnerability to Unidimensional Poverty

The key to estimating a household's vulnerability to poverty is obtaining an estimate of the household's variance of consumption expenditure (Suryahadi and Sumarto 2003). A reliable estimate of consumption expenditure variance can be obtained from panel data with a sufficiently long period of observations (Ligon and Schechter 2003). But most household survey data available to date in most developing nations are cross-sectional. Hence, there is clearly a need of developing a method for estimating the variance in a household's consumption expenditure using cross-sectional data. Such a method has been developed by Chaudhuri et al. (2002).

In principle, measuring vulnerability to poverty needs to know the resources that the households can draw on in the next period including assets such as land and education, skills and experience and the risks that each household faces such as droughts, family illnesses and higher prices for food and the probability of handling each set of risks, for example, family support and borrowing money. However, it is

clearly impossible to collect all the information needed for such an analysis and hard to model all the possible behavioral responses of the households. The solution, as in all models, is simplifying it enough to make the problem tractable. In the simplest case, three pieces of information and one additional assumption are enough to allow us to measure households' vulnerability to poverty. The required information is: the household's expected consumption per capita in the next period $E(c_{t+1})$, variance in the household's expected level of consumption per capita in the next period δ^2 and the poverty line Z . The assumption required is that the expected level of consumption follows a known distribution such as the normal distribution.

Although we do not know exactly what a household's level of consumption will be next year, it is possible to arrive at reasonable estimates by building a model of the determinants of consumption and then using the model to predict next year's consumption. A household's probability of being poor in the future depends both on its mean consumption expenditure and the variation in consumption expenditure. Therefore, an estimation of vulnerability to poverty requires an estimation of future mean consumption as well as its variability or volatility.

As done by Chaudhuri et al. (2002) we begin by assuming that the stochastic process generating the consumption of household h is given by:

$$\ln C_h = X_h \beta + e_h \quad (4.2)$$

where C_h is per capita consumption expenditure, X_h represents a bundle of observable household characteristics such as household size, location and the educational attainments of the household head, β is a vector of parameters to be estimated and e_h is a disturbance term that captures idiosyncratic factors.

Household future consumption is further assumed to be dependent on uncertainties in some idiosyncratic and community characteristics. To have a consistent estimator of the parameter it is necessary to allow heteroskedasticity. We do, however, allow the variance of e_h (and hence of $\ln C_h$) to depend on observable household characteristics in some parametric way. There are a number of ways in which this can be done. The estimates we report are generated assuming the following simple functional form:

$$\delta_{e,h}^2 = X_h \theta \quad (4.3)$$

We estimate β of Eq. (4.2) and θ using a three-step feasible generalized least squares (FGLS) procedure suggested by Amemiya (1977). Equation (4.2) is first estimated using an ordinary least squares (OLS) procedure, then the estimated residuals from Eq. (4.2) are used for estimating the following equation, again by using OLS:

$$\hat{e}_{ols,h}^2 = Z_h \theta + \eta_h \quad (4.4)$$

The estimation from is then used to transform Eq. (4.4) to:

$$\frac{\hat{e}_{ols,h}^2}{Z_h \hat{\theta}_{ols}} = \left(\frac{Z_h}{Z_h \hat{\theta}_{ols}} \right) \theta + \frac{\eta_h}{Z_h \hat{\theta}_{ols}} \quad (4.5)$$

This transformed equation is estimated using OLS to obtain an asymptotically efficient FGLS estimator $\hat{\theta}_{FGLS}$. $Z_h \hat{\theta}_{FGLS}$ is a consistent estimate of δ_{eh}^2 , which is the variance of the idiosyncratic component of household consumption. This is then used to transform Eq. (4.2) to:

$$\frac{\ln C_h}{\sqrt{Z_h \hat{\theta}_{FGLS}}} = \left(\frac{X_h}{\sqrt{Z_h \hat{\theta}_{FGLS}}} \right) \beta + \frac{e_h}{\sqrt{Z_h \hat{\theta}_{FGLS}}} \quad (4.6)$$

Using the estimates $\hat{\beta}$ and $\hat{\theta}$ we can directly estimate the expected log consumption:

$$E[\ln C_h | X_h] = X_h \hat{\beta} \quad (4.7)$$

The variance of log consumption given the characteristics of household X_h is:

$$\hat{V}[\ln C_h | X_h] = \delta_{e,h}^2 = X_h \hat{\theta} \quad (4.8)$$

For each household h , by assuming that consumption is log-normally distributed (that is, $\ln C_h$ is normally distributed), we form an estimate of the probability that a household with characteristics, X_h will be poor, that is, the household's vulnerability level. Letting $\Phi(\cdot)$ denote the cumulative density of the standard normal, the estimated probability is given by:

$$\hat{V}_h = \hat{P}_r(\ln C_h < \ln Z | X_h) = \Phi \left(\frac{\ln Z - X_h \hat{\beta}}{\sqrt{X_h \hat{\theta}}} \right) \quad (4.9)$$

Equation (4.9) gives us vulnerability to poverty \hat{V}_h or the probability that the per capita consumption level (C_h) will be less than the poverty line (Z), conditioned on the household characteristics (X_h) and $\Phi(\cdot)$ denotes the cumulative density of the standard normal distribution. Our measure of vulnerability as a probability of poverty captures the likelihood that incomes will fall below the poverty line at some point in the future. The advantage of this vulnerability measure is that it can be measured with cross-sectional data but this measure requires a large sample in which some households experience a good time and others suffer from negative shocks and it is also likely to reflect unexpected large negative shocks.

The most important identifying assumption is that cross-sectional variance can be used for estimating the inter-temporal variance (Sricharoen 2011). Due to the

idiosyncratic components of the model, cross-sectional variance can most likely explain a part of the inter-temporal variance. An advantage of a FGLS approach for estimating the variance of household consumption is that it yields a consistent estimate even when consumption is measured with an error (Tesliuc and Lindert 2004). In such models, a low R square value is very common due to the measurement error (from unobserved and omitted variables) associated with the use of cross-sectional data in consumption studies (Sricharoen 2011).

Identifying whether a given household is vulnerable or not is an important exercise that can have important implications for targeting development assistance. Generally speaking, we require a threshold probability level of poverty above which a household is qualified as being vulnerable. There are two vulnerability thresholds (Chaudhuri et al. 2002): the observed current poverty rate in the population and the alternative threshold which is 0.5. The most commonly used threshold in existing literature is the poverty probability of 0.5. This threshold indicates that a household whose poverty probability level is greater than 50 percent is more likely to be poor and thus can be considered to be vulnerable (Chaudhuri et al. 2002). The use of this line has been justified based on several features. First, this threshold defines the point in Eq. (4.9) where expected income exactly equals the poverty line. Second, a 50 percent or more chance of a household falling into poverty makes intuitive sense and seems a reasonable threshold to demarcate the vulnerable from those who are not vulnerable. We use this vulnerability threshold.

According to MOFED (2013), in Ethiopia the poverty line per adult person per year for 2011 was determined as birr 3781.

The covariates that we use in our analysis are: linear and quadratic terms in the age of household head, variables of household characteristics including number of children and the dependency ratio, characteristics of household head such as sex, marital status, educational attainment (can read and write, has formal education and highest grade completed), occupational characteristics and religion. Variable descriptions and summary statistics of the variables used in the unidimensional vulnerability analysis are shown in Table 4.4. The FGLS estimation results for expected consumption and variance for the whole sample (rural and urban) is given in Table 4.1.

4.4 The Multidimensional Poverty Measure

Vulnerability is complex and is a multidimensional concept that must be understood in relation to the outcomes of interest (poverty). Communities, households and individuals are responsive or have different coping strategies to deal with vulnerability to poverty. Policy interventions too can address vulnerability in many ways. Vulnerability to poverty is based on the multidimensional poverty index (MPI). We now discuss the multidimensional measures of poverty. MPI is the most prominent household poverty assessment measure which goes beyond the monetary (income

Table 4.1 Description of variables used in the determinants of vulnerability to unidimensional poverty

Variables	Description
Age	Age of the household head
Age2	Age square of the household head
Fsize	Number of household members
nchildren	Number of children in the household
depratio	Dependency ratio of the household
HGC	Highest grade completed by the household head
Sex	Sex of the household head
RAW	The household head can read and write (1 = yes, 2 = no)
AFE	The household head has formal education (1 = yes, 2 = no)
Residence	Residence of the household
Mstatus	Marital status of the household head
Religion	Religion of the household head
Occupation	Occupation of the household head

or consumption expenditure) measure and accounts for the multidimensionality of poverty. MPI measures a range of deprivations such as living standard, health, education, empowerment and threat of violence and is currently used in more than 100 countries. In academic literature, interest in measuring multidimensional poverty is growing (for example, Adetola 2014; Bourguignon and Chakravarty 2003; Dhongda et al. 2015; Maasoumi and Xu 2015). This paper uses the Demographic and Health Survey (DHS) data for Ethiopia and examines the extent of multidimensional poverty using the MPI measure by adapting the method on which MPI is based to better address local realities, needs and the available data.

MPI has the deprivation cut-off and the poverty cut-off. A deprivation cut-off vector is used for determining whether a household is deprived in that indicator. If a household's achievement level in a given dimension is less than the respective deprivation cut-off, the household is said to be deprived in that indicator and will have a value of 1. If a household's level of achievement is greater than or equal to the deprivation cut-off, the household is not deprived in that indicator and will have a value of 0 in that indicator. Finally, we have a deprivation score matrix with values of 0 and 1.

After identifying the dimensions and indicators, the crucial problem is assigning suitable weights to the indicators (Berenger and Chouchane 2007). In a multidimensional poverty analysis, there is no general consensus on the relative weights of the indicators (Decancq and Lugo 2013; Maasoumi and Xu 2015; Ravallion 2011). Various authors (Atkinson 2003) have used the equal weight approach. However, this approach has been criticized because most multidimensional poverty indicators are assumed to be correlated and this approach fail to consider these correlations (Ravallion 2011). Following this criticism, another weighting approach has also been used. One of the weighting systems proposed and used is a factor analysis. The

factor analysis (FA) model makes no prior assumptions regarding the pattern of the relationships among the observed indicators and can be used for cardinal and categorical data. Further, a factor analysis is also useful for placing variables into meaningful categories as doing so reduces the number of variables. Therefore, we use the factor analysis model to determine the weight of the indicators. Each component or factor (F_i) is a linear weighted combination of the initial variables. Suppose we have variables denoted by X_1, X_2, \dots, X_m , then we have:

$$\begin{aligned}
 F_1 &= \lambda_{11}X_1 + \lambda_{12}X_2 + \lambda_{13}X_3 + \dots + \lambda_{1m}X_m \\
 F_2 &= \lambda_{21}X_1 + \lambda_{22}X_2 + \lambda_{23}X_3 + \dots + \lambda_{2m}X_m \\
 &\cdot \\
 &\cdot \\
 F_n &= \lambda_{n1}X_1 + \lambda_{n2}X_2 + \lambda_{n3}X_3 + \dots + \lambda_{nm}X_m
 \end{aligned}
 \tag{4.10}$$

In Eq. (4.10), λ_{nm} is the weight which is the eigenvector of the correlation matrix. In this MPI computation, each household is assigned a deprivation score according to its deprivations in the component indicators. The deprivation score of each household (dc_h) is calculated by taking a weighted sum of the deprivations experienced, and the score increases as the number of deprivations increase:

$$dc_h = W_1I_1 + W_2I_2 + \dots + W_nI_n \tag{4.11}$$

where $I_i = 1$ if the household is deprived in indicator i and 0 otherwise, and W_i is the weight attached to indicator i with $\sum_{i=1}^d W_i = 1$.

Once the deprivation score is obtained, the households are categorized based on the poverty cut-off. In the applied method of the MPI measure, a household is categorized as being multidimensionally poor if its deprivation score is greater than or equal to one-third (33 percent) and non-poor otherwise.

MPI combines two key pieces of information – the proportion or incidence of households whose share of weighted deprivations is k or more (H). This measure is the head count ratio and is given by:

$$H = \frac{q}{n} \tag{4.12}$$

Here q is the number of households who are multidimensionally poor and n is the total population. However, the head count ratio (H) violates dimensional monotonicity. To solve the dimensional monotonicity of the head count ratio, the second component in MPI is the intensity (or breadth) of poverty (A). It is the average deprivation score of multidimensionally poor households and can be expressed as:

$$A = \frac{\sum_{h=1}^q dc_h}{q} \quad (4.13)$$

where dc_h is the censored deprivation score of household h and q is the number of households who are multidimensionally poor. MPI is the product of both incidence (H) and severity or depth (A) components:

$$\text{MPI} = H \times A \quad (4.14)$$

where H is the head count ratio or the percentage of people who are multidimensionally poor and A is the average intensity of poverty among the poor.

4.5 Vulnerability to Multidimensional Poverty

Literature has so far focused on vulnerability to poverty defined in terms of a single measure of consumption expenditure (Chaudhuri et al. 2002; Hoddinott and Quisumbing 2003). However, this approach has a limitation as poverty reflects deprivation in multiple dimensions and hence vulnerability to poverty should also be multidimensional. Hoddinott and Quisumbing (2003) state that there is no reason why vulnerability cannot be measured without consumption expenditure that is often used for measuring vulnerability. Feeny and McDonald (2015) also acknowledge that vulnerability can, and should, be expressed with other well-being indicators including health and education rather than only with consumption expenditure. Other authors too underscore the importance of other dimensions such as body mass indices (Decron and Krishnan 2000) or access to social services (Coudouel and Hentschel 2000) in multidimensional vulnerability studies. In vulnerability to multidimensional poverty, the multidimensional deprivation score can be used as a welfare indicator and can be a solution for the inherent limitation of relying on only consumption expenditure in measuring vulnerability to poverty (Feeny and McDonald 2015). Moreover, in a country like Ethiopia where more than 85 percent of the population lives in rural areas and has limited access to formal markets, consumption expenditure does not fully reflect household welfare for measuring vulnerability. Therefore, vulnerability to multidimensional poverty should include other well-being indicators in the analysis to address the inherent limitations of relying on consumption-based measures of vulnerability to poverty.

Besides analyzing vulnerability to unidimensional poverty, this paper also addresses vulnerability as a multidimensional concept. Equation (4.15) provides a reduced form equation for the household deprivation score (dc_h), which is used as the well-being indicator in an analysis of vulnerability to multidimensional poverty:

$$dc_h = X_h\beta + e_h \quad (4.15)$$

Household deprivation score dc_h , in this case is the weighted deprivation score of households according to Alkire and Foster's (2011) method of calculating the multidimensional poverty index (MPI). The deprivation score can be used as a well-being indicator in an analysis of multidimensional poverty. An increase in dc_h represents an increasing level of destitution in one or more of the three dimensions of the deprivations: health, education and living standards. X_h is household characteristics including family size, number of children under 5 years, household head's age, land for agriculture, wealth index, bank account and marital status of the household head. Further, a dummy variable is used for assessing the differences in vulnerability to multidimensional poverty between regions. β is the parameter to be estimated and e_h is the disturbance term. According to Srivicharoen (2011) the error term in this equation is inter-temporal variance. The usual OLS assumption of constant variance across households is somewhat restrictive. However, this also presumes that the model is fully specified, given that a household's experience of shocks and its responses to these shocks are not excluded, which is a somewhat strong assumption.

Therefore, multidimensional vulnerability to a household's poverty i at time t ($V_{i,t}$) is given as the probability that the weighted deprivation score one period ahead ($dc_{i,t+1}$) will be greater than the multidimensional poverty cut-off (k):

$$V_{i,t} = \Pr(dc_{i,t+1} > k) \quad (4.16)$$

Households face different risks and have different risk management strategies and hence the variance of the disturbance term is interpreted as the inter-temporal variance of well-being (Chaudhuri et al. 2002). They, therefore, allow for heteroskedasticity in the model by regressing the variance of the disturbance term on the observed characteristics of household X_i as:

$$\delta_{e,h}^2 = X_i\theta + u_i \quad (4.17)$$

The level of variance of a household's deprivation ($\delta_{e,h}^2$) is considered to be a function of its demographic and local characteristics (X) as well as the stochastic nature of the shock. Presence of heteroskedasticity makes OLS estimates inefficient. Therefore, the estimation of β and θ requires a three-stage feasible generalized least square (FGLS) procedure as indicated by Amemiya (1977). FGLS' main advantage is that the mean and the variance of household well-being are unbiased predictors of future well-being, even when there is a measurement error (unless there is a systematic variation in the measurement error).

To overcome any systematic measurement error in well-being, given the differences in employment sources and domestic food production, a number of authors stratify household samples in developing countries according to rural and urban

regions (for example, Chaudhuri et al. 2002). Accordingly, we too estimate vulnerability to poverty by separating the sample into rural and urban areas.

First, we estimate Eq. (4.15) using OLS, then from this estimation we get the residual. We use the squared residual as the dependent variable in Eq. (4.17) and X as the independent variable in the estimation. Equation (4.17) is transformed to produce asymptotically efficient FGLS estimates of the variance of future well-being as:

$$\frac{\hat{\delta}_{e,h}^2}{X_i\theta} = \left(\frac{X_i}{X_i\theta} \right) \theta + \frac{u_i}{X_i\theta} \quad (4.18)$$

The variance of well-being in Eq. (4.18) is used to transform Eq. (4.15) to produce an asymptotically efficient estimator of $\hat{\beta}_{FGLS}$

$$\frac{dC_h}{\sqrt{X_i\hat{\theta}_{FGLS}}} = \left(\frac{X_i}{\sqrt{X_i\hat{\theta}_{FGLS}}} \right) \beta + \frac{u_i}{\sqrt{X_i\hat{\theta}_{FGLS}}} \quad (4.19)$$

Given this, households' vulnerability to multidimensional poverty ($V_{i,t}$) is estimated using:

$$\hat{V}_{i,t} = \hat{P}_r(dC_{i,t+1} > K|X_i) = \Phi \left(\frac{X_i\hat{\beta}_{FGLS} - K}{\sqrt{X_i\hat{\theta}_{FGLS}}} \right) \quad (4.20)$$

where $dc_{i,t+1}$ is the estimated household weighted multidimensional poverty deprivation score in the next period, K is the conventional multidimensional poverty cut-off and is equal to 33 percent. The probability density function which is denoted by (Φ) is the cumulative density function of the standard normal distribution.

5 Results and Discussion

5.1 Unidimensional Vulnerability to Poverty

We did an analysis of unidimensional vulnerability to poverty using the FGLS method. It is well understood that one of the basic assumptions of the ordinary least squares (OLS) is that the error term has a mean zero and constant variance. If this assumption is violated, there is heteroscedasticity, and this requires using FGLS. The results of the model for the log consumption expenditure and variance of the log consumption expenditure are given in Table 4.1. We use vulnerability as expected poverty in this research. Log per capita household consumption expenditure is used as the dependent variable and different demographic and

socioeconomics variables are used as independent variables. The description variables (Table 4.1) and summary statistics of the explanatory variables used in the regression are given in Table 4.2. Variables family size, highest grade completed, number of children, dependency ratio and age of the household head and its square are included in the model because of the possible non-linear relationship between them (Tables 4.3 and 4.4).

A unidimensional poverty analysis using household income and consumption expenditure data for 2011 shows that in Ethiopia 35 percent of the population was below the poverty line (62 percent rural population and 19 percent urban population). Our results also show that 38 percent of the households in Ethiopia were vulnerable to poverty; this is similar to vulnerability estimates in other studies. These estimates appear to support the claim that the observed incidence of poverty underestimates the percentage of the population that is vulnerable to poverty (Dercon and Krishnan 2000; Raghbendra et al. 2009). Among the rural people, 89 percent were vulnerable to poverty while only 22 percent of the urban people were vulnerable to poverty (Table 4.5). Controlling for all other determinants of vulnerability, a large family size tended to reduce the future consumption of the household, thereby increasing household vulnerability; this is almost similar to other findings (Edoumiekumo et al. 2013; Tu Dang 2009). We also found that the larger the dependency ratio, the larger a household's vulnerability to poverty. It is well-known that households with many children and other non-productive family members are on average poorer than households with fewer children and fewer dependent family members.

Households with older heads tend to have lower consumption per capita with a non-linear effect as the household head's age coefficient is negative and significant (and its square is positive and significant). A dummy variable is used if there are regional variations in consumption expenditure. Taking Tigray as the reference region, our analysis showed that there were regional variations in per capita consumption. Consumption per capita in all other regions (except Somali) was significantly less than that in Tigray. If all other factors affecting vulnerability remain constant, vulnerability to poverty will be higher in other regions as compared to Tigray.

Female headed households are associated with significantly lower mean future consumption expenditures as compared to their male counterparts.

We also compared people living in rural areas, towns and big cities and our results show that households in big cities and towns tended to have higher expectations of per capita future consumption as compared to rural households as infrastructure will provide access to markets, health and education. However, transportation facilities, production support services and social infrastructure is less developed in rural areas leading to a reduction in opportunities for earning in these areas. Further, there is significant evidence that households in urban areas have lower variance or volatility in consumption expenditure. We also considered marital status in our analysis. Never married households (the reference) had higher per capita consumption as compared to others (married, divorced, separated and widowed) in Ethiopia and were more vulnerable to poverty. This finding is similar to the find-

Table 4.2 Summary statistics of variables used in unidimensional vulnerability analysis (n = 17,487)

Variables	Description	Mean	Std Dev	Minimum	Maximum
Age	Age of the household head	40.1	15.473	12	96
Age2	Square age of the household head	1846.82	1452.21	144	9216
Fsize	Number of family members	3.8	2.319	1	28
nchildren	Number of children in the household	1.29	1.479	0	13
depratio	Dependency ratio of the household	0.303	0.266	0	1
HGC	Highest grade completed by the household head	9.4	4.860	0	20
Sex	Sex of the household head (1 = male, 2 = female)	1.368	0.482	1	2
RAW	The household head can read and write (1 = yes, 2 = no)	1.286	0.452	1	2
AFE	The household head attended formal education (1 = yes, 2 = no)	1.293	0.455	1	2

Table 4.3 Summary statistics of variables used in an analysis of multidimensional vulnerability (n = 2683)

Variables	Description	Mean	Std Dev	Minimum	Maximum
Fsize	Household family size	4.7	2.501	1	22
Childrenunder5	Number of children under 5 years	0.86	0.980	0	10
HHheadage	Household head's age	43.6	16.431	15	95
Educ	Household head's education	3.4	2.762	0	8
depratio	Dependency ratio	1.408	1.254	0	10
TLU	Tropical livestock unit	3.125	7.619	0	166.7
Landforagri	Land for agriculture	0.642	0.297	0	1
Bankaccout	Bank account	0.098	0.297	0	1
HHheadsex	Household head's sex	1.293	7.619	1	2
Mstatus	Marital status	1.496	1.243	0	9
wealthindex	Wealth index	2.987	1.566	1	5

ings of other studies. This difference was also observed in urban Ethiopia, but it was not significant in rural areas. Our analysis also indicated that religion mattered in consumption expenditure. Per capita log consumption expenditure of Catholic, Protestant and Muslim households was significantly less than that of Orthodox (the reference) households. This implies that if we keep all other factors that affect vulnerability constant, Catholic, Protestant, Waq feta and followers of traditional religions are more vulnerable to poverty than Orthodox followers.

An increase in schooling or the highest grade completed (HGC) by the household head had an impact on productivity and hence on a household's earnings and could also influence the productivity of other family members. Therefore, educational attainment is a variable that needs to be considered. An increase in the highest grade completed by the household head had a significant positive

Table 4.4 Head count ratio (H), intensity (A) the and Multidimensional poverty index (MPI) for Ethiopia and its regions

Region or residence	H	A	MPI
Ethiopia	0.908	0.789	0.717
Urban	0.634	0.522	0.330
Rural	0.993	0.836	0.831
Regions:			
Tigray	0.941	0.810	0.762
Afar	0.932	0.822	0.766
Amhara	0.984	0.805	0.792
Oromia	0.969	0.821	0.796
Somali	0.994	0.857	0.852
Benishangul	1.00	0.845	0.845
SNNP	0.991	0.819	0.812
Gambela	0.929	0.791	0.735
Harari	0.873	0.692	0.604
Addis Ababa	0.546	0.461	0.251
Diredawa	0.730	0.795	0.580

impact on per capita consumption expenditure. This conforms with other studies that concluded that literacy and education attainment decreased poverty and vulnerability to poverty (Fekadu 2013). But there is no statistical evidence that a household head's ability to read and write and formal education significantly affected vulnerability to poverty.

It is assumed that as the skills of the household head increase productivity and thereby earnings will also increase. Our results indicate that the more skilled and professional the household head, the higher the per capita consumption; this is more pronounced in urban than in the rural areas. Keeping all other things that affect vulnerability constant, as the skills and profession of the household head improve the household's vulnerability to poverty tends to decrease.

5.2 *Multidimensional Vulnerability to Poverty*

This research also studied multidimensional vulnerability to poverty. The results indicate that 90 percent of the population was multidimensionally poor while 89 percent was vulnerable to multidimensional poverty. This shows that multidimensional poverty and vulnerability to multidimensional poverty are very high in Ethiopia. Further, multidimensional poverty is by far greater than unidimensional poverty in the country. This difference is attributed to the use of health and education indicators in an analysis of multidimensional poverty in addition to income or living standard indicators used in an analysis of unidimensional poverty. This can also be mentioned as one of the reasons for shifting from a traditional

Table 4.5 Results of estimation of vulnerability to unidimensional poverty

Variables	Total sample		Rural		Urban	
	Consumption	Variance	Consumption	Variance	Consumption	Variance
Age	-0.0089***	0.0006	-0.0036	-0.0022	-0.0090***	0.0019
Age2	0.0001***	0.0000	0.0001	0.0000	.0001***	-0.0000
Fsize	-0.1709***	0.0132***	-0.1154***	0.0201***	-0.1747***	0.0127***
nchildren	0.1418***	-0.0162***	0.0775***	-0.0101	.1368***	-0.0244***
depratio	-1.0339***	-0.0137	-0.8373***	-0.0685	-1.0100***	0.0251
HGC	0.0255***	0.0002	0.0169***	-0.0038	.0257***	0.0008
Sex_2(1 = M, 2 = F)	-0.0777***	-0.0333***	-0.0175	-0.0074	-0.0879***	-0.0393***
RAW_2(1 = yes, 2 = no)	0.0130	-0.0006	-0.0176	-0.0121	0.0049	-0.0067
AFE_2(1 = yes, 2 = no)	0.0294	0.0125	-0.0065	-0.0036	0.0411	0.0502
Residence (rural is base):						
Big city	0.4198***	-0.0032	-0.0368	0.0342	0.0091	-0.2869***
Other town	0.2985***	-0.0014	0.1699	-0.1093	-0.1252	-0.2868***
Mistatus (never married):						
Married	-0.1357***	-0.0307**	-0.0264	-0.0212	-0.1308***	-0.0355**
Divorced	-0.0490**	-0.0090	-0.00015	-0.0064	-0.0402*	-0.0124
Separated	-0.1358***	-0.0036	-0.1046	-0.0255	-0.1258***	-0.0072
Widowed	-0.1248***	0.0129	-0.0509	-0.0649	-0.1134***	0.0179
Living together	-0.0944*	-0.0213	-0.2655	0.0764	-0.0900*	-0.0246
Religion (Orthodox is base):						
Catholic	-0.0856*	-0.0589*	-0.1685***	-0.0473	-0.0479	-0.0507
Protestant	-0.0669***	-0.0138	-0.0956***	-0.0086	-0.0612***	-0.0176
Muslim	-0.0210*	-0.0277***	-0.0413*	-0.0427**	-0.0259**	-0.0246**
Waq feta	-0.0425	0.0604	0.0179	-0.0389	-0.1995	0.2347
Traditional	-0.5350***	0.1094	-0.4304***	0.1174	-	-
Others	-0.0212	-0.0205	-0.1258	0.0981	0.0077	-0.1089

Occupation (senior officials):														
Professional	-0.0916***	-0.0292	0.4377***	-0.0999	-0.1070***	-0.0253								
Associate professional	-0.1131***	-0.0264	0.4677***	-0.0657	-0.1315***	-0.0220								
Clerk	-0.1440***	0.0146	0.3015**	0.1834*	-0.1548***	0.0127								
Service/market worker	-0.0387	0.0910***	0.3408***	0.0348	-0.0488*	.0978***								
Skilled agriculture	-0.1979***	-0.0047	0.0857	-0.0789	-0.1507***	0.0344								
Craft worker	-0.2153***	0.0254	0.2223*	-0.0005	-0.2303***	0.0284								
Machine operator	-0.0987***	0.0115	0.4764**	-0.0789	-0.1135***	0.0165								
Elementary Occup.	-0.3361***	0.0145	0.0271	-0.0399	-0.3460***	0.0222								
Defense force	-0.2020***	-0.0274	0.2615	-0.1560	-0.2136***	-0.0150								
Region (Tigray as base):														
Afar	-0.1117***	-0.0743***	-0.0677	-0.0962**	-0.1445***	-0.0850***								
Amhara	-0.1825***	-0.0228	-0.0655**	-0.0386	-0.2227***	-0.0231								
Oromia	-0.1671***	-0.0235	0.0121	0.0039	-0.2188***	-0.0381*								
Somali	0.0286	-0.0562**	-0.0097	0.0137	0.0189	-0.0727**								
Benishangul	-0.1065***	-0.0240	-0.0169	0.0495	-0.1422***	-0.0588**								
SNNP	-0.1875***	-0.0273	-0.1445***	-0.0060	-0.1936***	-0.0414*								
Gambela	-0.1480***	-0.0611***	0.0178	-0.0891**	-0.1928***	-0.0458*								
Harari	-0.0655**	-0.0581**	0.2774***	-0.0350	-0.1460***	-0.0690**								
Addis Ababa	-0.1590***	-0.0388**	-	-	-0.1989***	-0.0506**								
Diredawa	-0.2085***	-0.0489*	0.0858	-0.0257	-0.2831***	-0.0604*								
_Cons	9.8904***	0.2143***	9.0933***	3.284***	10.3716**	0.4738***								
N	13,978	13,978	3266	3266	10,712	10,712								
R2	0.5943	0.0156	0.4012	0.0313	0.5321	0.0183								
R2_a	0.5931	0.0127	0.3937	0.0193	0.5304	0.0146								

Note: * $P < 0.1$; ** $P < 0.05$; *** $P < 0.01$

one-dimensional poverty analyses to an analysis of multidimensional poverty and vulnerability to poverty.

Our study of multidimensional vulnerability to poverty, showed that family size had a vulnerability increasing impact in Ethiopia in general and in rural Ethiopia in particular as the coefficient is positive and statistically significant, which is consistent with other studies (for example, Fekadu 2013). Increase in the household head's level of education and age decreased multidimensional poverty because as people get older they have more life and work experience and have better capacities to get out of multidimensional poverty. Similarly, as the household head's education increases multidimensional poverty decreases. The dummy variable wealth index revealed that when a household head gets richer, multidimensional poverty decreases; however, vulnerability to multidimensional poverty increases, especially in rural areas. Land for agriculture increases variance or vulnerability to multidimensional poverty in rural areas as agricultural land is the most important resource for the rural people engaged in agriculture.

Marital status also matters in vulnerability to multidimensional poverty. As compared to the never married households (the reference), the deprivation score is higher for others (married, divorced, separated, widowed). If we keep other factors affecting vulnerability to multidimensional poverty constant, vulnerability is higher for other marital situations as compared to the never married household heads. Regional comparisons are important in poverty and vulnerability studies because regional differences in poverty and vulnerability to poverty are common in many developing economies (Chaudhuri et al. 2002). The deprivation scores of Amhara, Oromai, Somali and SNNP were significantly greater than that of Tigray but deprivation scores of Harari, Addis Ababa and Diredawa were less than that of Tigray. Vulnerability to poverty in the Diredawa region was higher than that in Tigray but vulnerability to poverty was less in Afar and Harari regions as compared to Tigray (the reference) (Table 4.6).

6 Conclusion

Like other developing countries, Ethiopia is still challenged by poverty and vulnerability to poverty. Our study considered vulnerability because the current poverty level may not necessarily be a good guide for determining expected poverty in the future. We used the expected poverty approach to assess vulnerability to poverty. Studies on vulnerability to poverty require panel data. However, in developing countries panel data is rarely available. So, estimating vulnerability with cross-sectional data is the second best alternative but this requires the strong assumption that the environment is stationary so that the cross-sectional variance can be used for estimating inter-temporal variance.

We implemented the methods we proposed using household income and consumption expenditure data and demographic and health survey data for Ethiopia. Much of the variation can be attributed to the differences in the households' observ-

Table 4.6 Estimation results of vulnerability to multidimensional poverty

Variables	Total sample		Rural		Urban	
	Deprivation score	Variance	Deprivation score	Variance	Deprivation score	Variance
Fsize	0.0001	0.0008***	0.0014	0.0004**	-0.0167***	0.0002
Childrenunder5	-0.0028	-0.0006	-0.0091***	-0.0005	-0.0231**	0.0033
HHhead age	-0.0006***	-0.0000	-0.0001	-0.0000	-0.0009*	0.0001
Educ	-0.0161***	-0.0002	-0.0169***	0.0001	-0.0059**	-0.0004
depratio	0.0146***	-0.0005	0.0120**	-0.0001	.0275***	0.0004
TLU	-0.0000	-0.0000	-0.0003	0.0000	-0.0095**	-0.0008
Land for Agri.	-0.0047	0.0027**	-0.0320***	0.0031**	-0.0185	-0.0008
Bank account	-0.0764***	0.0025	0.0100	0.0009	-0.0912***	-0.0016
HHhead sex	0.0005	-0.0008	0.0056	-0.0007	-0.0005	0.0015
Mstatus (never married):						
Married	0.0243**	0.0023	0.0226*	0.0024	0.0244	-0.0010
Divorced	0.0516***	0.0033	0.0282	0.0044	0.0745***	-0.0008
Separated	0.0233*	0.0032	0.0258*	0.0033	0.0157	-0.0078
Widowed	.0413***	0.0064**	0.0109	0.0074***	0.0812***	-0.0005
Living together	0.0444	-0.0010	0.0185	-0.0003	0.0257	-0.0237
Wealth index (the poorest):						
Poorer	-0.0375***	0.0044***	-0.0409***	0.0037***	-0.1088	0.0042
Middle	-0.0432***	0.0043***	-0.0463***	0.0037***	-0.1091	-0.0035
Richer	-0.1263***	0.0096***	-0.1240***	0.0070***	-0.1235**	-0.0012
Richest	-0.3813***	0.0242***	-0.2889***	0.0182***	-0.2975***	0.0072
Region (Tigray as base):						
Afar	-0.0156	0.0008	-0.0284**	0.0018	0.0988***	0.0102
Amhara	0.0362***	-0.0010	0.0050	0.0003	0.1723***	0.0006
Oromia	0.0255**	-0.0026	0.0074	-0.0019	0.1304***	0.0174**
Somali	0.0314**	0.0046*	-0.0174	0.0037**	0.3362***	-0.0004
Benishangul	0.0117	-0.0008	-0.0083	0.0001	-	-
SNNP	0.0351***	-0.0008	0.0093	-0.0002	-	-
Gambela	-0.0054	0.0008	-0.0218	0.0030	0.1121***	0.0057
Harari	-0.0551***	0.0002	-0.0849***	0.0040**	0.0390	0.0064
Addis Ababa	-0.0979***	-0.0027	-	-	0.0366	0.0094
Diredawa	-0.0265*	0.0055**	0.0641***	-0.0045**	-0.0009	0.0083
_Cons	0.9161***	-0.0010	0.9447***	-0.0012	0.7057**	0.0031
N	2585	2585	1963	1963	622	622
R2	0.7646	0.1513	0.5332	0.1300	0.5133	0.0401
R2_a	0.7620	0.1420	0.5267	0.1178	0.4926	0.0018

Note: * $P < 0.1$; ** $P < 0.5$; *** $P < 0.01$

able characteristics; all the variables included in the analysis had some influence on household well-being. For instance, the number of children, family size and dependency ratio had a negative influence on a household's consumption expenditure. Three main conclusions emerge from this analysis. First, the percentage of the population that faces a non-negligible risk of poverty is more than the percentage that is observed to be poor. While 35 percent of the population is poor, over 38 percent of the population is vulnerable to poverty. In an analysis of multidimensional poverty, the proportion of the population under multidimensional poverty (90 percent) and the proportion vulnerable to multidimensional poverty (89 percent) are quite high. This highlights the importance of shifting from a one-dimensional analysis to an analysis of multidimensional poverty and vulnerability to poverty. Second, the distribution of vulnerability across different segments of the population can differ markedly from the distribution of poverty. We argue that this highlights the need for a distinction between poverty prevention programs, that is, those aimed at reducing vulnerability and poverty alleviation programs.

Third, we find differences in the sources of vulnerability for different segments of the population. For rural households, the main sources of vulnerability are prospects of low mean consumption and high consumption volatility. This has important implications for poverty prevention programs that are needed to address different groups' vulnerability. In general, poverty reduction strategies in Ethiopia need to incorporate not just alleviation efforts but also prevention efforts. Further, the distribution of vulnerability across different regions can differ significantly from the distribution of poverty; therefore, programs that aim to reduce vulnerability need to be targeted differently from programs that are aimed at poverty reduction even at the regional level.

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