BRILL

THE AFRICAN REVIEW 48 (2021) 1–21

TARE
THE AFRICAN REVIEW

brill.com/tare

Towards Dynamic Assessment of Determinants of Household Vulnerability to Poverty in Tanzania

Innocent M. Pantaleo | ORCID 0000-0001-9407-8543
Senior Lecturer; School of Economics, University of Dar es Salaam, Dar es Salaam, Tanzania
innopanta@gmail.com

Wilhelm M. Ngasamiaku | ORCID 0000-0003-3717-3469
Lecturer; School of Economics, University of Dar es Salaam, Dar Es Salaam, Tanzania
ngasamike@yahoo.com

Abstract

The paper examines the determinants of vulnerability to expected poverty in Tanzania. Following Landau et al. (2012), Chaudhuri (2000) and Chaudhuri et al. (2003) on estimating Vulnerability to Expected Poverty (VEP), the paper uses a three waves of Tanzania National Panel Survey Data for Tanzania collected between 2008/2009, 2010/2011 and 2012/2013 to find that being employed in agriculture, residing in rural area and household size turns out to be significantly more likely to be poor in the future, at a given consumption level and in all cross-section combination. It also appeared that most of the variables were statistically insignificant at influencing the conditional variance of future consumption across household characteristics. Lastly, nearly 39.42% and 59.49% of households who were poor in 2008 turned out to be less vulnerable in 2010 and 2012 respectively and the rest turned out to be high vulnerable. Thus, consumption stabilization strategies are likely to be influential if they target families whose household head is aging.

Keywords

vulnerability – poverty – Tanzania – variance – expenditure

 | DOI:10.1163/1821889X-12340042

1 Introduction

Studying the mechanisms through which poor individual households can escape poverty is a central issue of the development economics discourse. Households are faced with a multitude of non-idiosyncratic shocks, which are difficult to insure against in the private market, thereby prompting the government to act as an insurer of last resort (Deryugina, 2013). Suffice also to note that over 80 percent of the poor and the extreme poor in Tanzania live in the rural areas with more than half of the rural poor depending on subsistence agriculture for their livelihoods (World Bank, 2015). In view of this, households live in a very risky environment associated with a number of unforeseen shocks. Farmers for instance increasingly face the prospect of long and repeated spells of drought, crop or livestock diseases abound, and businesses seem to fail quite regularly across the country. In particular, climate volatility is likely to have severe implications for poverty (Ahmed et al., 2011). This risky environment is likely to make Tanzanians very vulnerable to poverty if not properly understood and covered. Arguably, considerations of risky and vulnerability are key to understanding the dynamics of poverty (World Bank, 2004). The World Bank Study further noted that worldwide consultations with the poor have revealed that they are preoccupied with dealing with risks and uncertainty, and their inability to effectively deal with shocks often lies at the core of their poverty.

Poverty is multi-dimensional; its measurement is frequently operationalized by analyzing a monetary welfare indicator such as income or consumption, setting a poverty line and aggregating the poverty data. In either case, poverty has been measured *ex post* meaning that poverty studies focus on households that are currently in poverty or were poor in the past. With this assessment one is able to show only the effect of past interventions and leaving out the future outlook of the poverty problem. The use of methods such as vulnerability assessment would help to take into account the dynamics of poverty condition and hence formulate an effective policy to address poverty problem. Vulnerability assessment is important because it enables us to formulate an efficient social policy that seeks to go beyond poverty alleviation in the present, and examine poverty prevention in the future. With the vulnerability assessment, we are able to identify and develop poverty solving strategies that are able to take into account the transient nature of poverty so as to include households that have a high probability of being poor and therefore directly devote necessary resources to households that are vulnerable to poverty. It is important to help households that are at risk of becoming poor and households already poor who are likely to stay poor. These households need to be provided with social safety nets and other interventions that minimize the

likelihood that they will be poor in the future. By estimating the vulnerability of households to poverty, we are able to take into account important variables that represent both external shocks and household specific shocks. External shocks such as long and repeated spells of drought, crop or livestock diseases that affect the welfare of households are well considered when vulnerability assessment is employed. In addition, the household specific shocks such as unemployment, illness, change in household structure etc are also considered and thus making comprehensive inclusion of the relevant variables.

It should be noted that an effective policy package to address on poverty need to be more on prevention than alleviation. For prevention to happen, we need to know who are likely to be poor in future so that we start taking corrective measures now. Various studies have used cross sectional data to assess the households/individual vulnerability to poverty (Chaudhuri, 2003; Suryahadi and Sumatro, 2003; Christiansen and Subbarao, 2005; Günther and Harttgen, 2009; Jha and Daug, 2010). However, there is a problem with methods using cross sectional data. According to Landau et al. (2012) vulnerability estimates based on cross-sectional data are much less accurate than those based on panel data. It is well known that these methods are based on stringent assumption that vulnerability remains constant over time, that neither the household's covariates nor the expected income will change over time. Only the residual (shocks) change and that shocks are serially uncorrelated. Thus, the assessment of the household vulnerability to poverty by using only the cross-sectional data does not accurately estimate and identify households who are vulnerable to poverty.

The assessment of vulnerability to poverty requires panel data that usually takes into account records of the same households over several years that can be used to capture the dynamics of specific households' information regarding the risks that they face (World Bank, 2001). Methods that use panel data are far superior in assessing vulnerability to poverty (Landau et al., 2012). With panel data, it is possible to capture some of the dynamic structure of vulnerability. Despite the importance of understanding the extent of vulnerability and its correlates on identifying and developing poverty solving strategies, in Tanzania, studies on the same are scanty. To the best of our knowledge only Pantaleo (2020), Mutabazi et al. (2015), Ahmed et al. (2011) and Sarris and Karfakis (2006) have attempted to study the extent of vulnerability. Yet these studies mainly focus on few specific areas of the country hence they may not adequately provide the evidence for poverty assessment at national level and thus failing to understand how some key shocks such as unemployment, illness, change in household structure and so forth, affect Tanzanian household welfare. In addition, not all considers the dynamic nature of poverty. Pantaleo (2020) on Kagera Region look at the risks (as a measure of vulnerability) to

poverty posed by variability and unstable household's income and consumption to find out that the risks of households falling into poverty increases over time, regardless of whether is purely rural or have some urban characteristics. Mutabazi et al. (2015) analyses the determinants of poverty and vulnerability of smallholder farmers in the rural areas of Morogoro region in the face of climate change to establish that the pattern of future vulnerability tended to overlap with poverty rates. They also found out that ageing of the household head and large-sized households tended to increase the level of vulnerability. Lastly, Ahmed et al. (2011) through investigating the role of climate variability and its productivity effects to poverty status of household found that as precipitation volatility decreases so is the poverty vulnerability. Sarris and Karfakis (2006) estimated idiosyncratic shocks as a measure of vulnerability of rural households in two regions of Tanzania (Ruvuma and Kilimanjaro) found that vulnerability is quite high in the rural areas of Tanzania, and considerably higher in the region which is regarded as generally poorer, namely Ruvuma.

This paper will contribute on the existing knowledge on poverty and vulnerability responding to the reasons as to why a country may experience prolonged growth rate without significant poverty reduction. Is it that most of the households are vulnerable to poverty for a long spell of time hence not benefiting to the growth strategies? What are the determinants of the observed vulnerability to poverty? This gap is filled by making full use of the existing panel data collected in 2008/09, 2010/11 and in 2012/2013 to assess households' vulnerability to poverty. In this study, we identify households who are expected to be poor ex ante and consider these to be vulnerable to poverty. Using panel data, we are able to estimate proportion of households who are likely to be poor and also pinpoint exactly which household will be poor and their determinants. From this we are able to identify the characteristics of the vulnerable households and the location. Specifically, we extend Dercon (2001) approach and follow Landau et al. (2012), Chaudhuri (2000) and Chaudhuri et al. (2003) and consider Vulnerability to Expected Poverty (VEP).

2 Methodology and Approach

2.1 *Measuring Vulnerability to Poverty: A Theoretical and Analytical Framework*

The assessment of household vulnerability to poverty is done by extending the Dercon (2001) framework and investigates vulnerability to poverty using the approach of Chaudhuri (2000) based on consumption per capita obtained from the National panel survey (NPS). While taking into account the

dynamic dimension of poverty, the measure of vulnerability as expected poverty (VEP), an ex ante measure proposed by Chaudhuri et al. (2003) will be adopted because of the advantage of the VEP approach especially in terms of its ability to identify households exposed to risks but who are not poor. This method estimates the probability that a given shock or set of shocks will move a household below a given minimum level (e.g., poverty line) or result into household level to stay below the minimum if it is already below this level. In this approach, vulnerability is defined as the probability of being poor in the future and this can take two forms. It is either the *ex ante* risk that a household that is not poor will fall below the poverty line or the risk that a household that is currently poor will remain poor. This can formally be expressed as:

$$V_{h,t-1} = Pr\left(Y_{h,t} \leq Z_h\right) \tag{1}$$

where $Y_{h,t}$ is the household's per capita income/consumption level at time t and Z_h is the appropriate poverty line.

We know that the vulnerability level is not directly observable, since it represents the expectation of the household's income/consumption per capita in the next time period. Therefore, to arrive at the estimation of the vulnerability to poverty, we need to forecast the expected household income/consumption in future. Thus, as per Chaudhuri (2003), the estimates of household consumption for the year t is:

$$Y_{h,t} = X_{h,t}\beta + e_{h,t} \tag{2}$$

where X_{ht} represent the covariates of household h at time t; e_{ht} represent the residual for household h at time, interpreted as positive or negative "shocks" or deviations from the expected consumption.

However, predictions of household consumption based only on cross sectional data are much less accurate than those based on panel data (Landau et al., 2012). For the given panel data, the estimates of household consumption in future is obtained from equation 3 adopted from Landau et al. (2012):

$$Y_{h,t} = X_{h,t-1}\beta + Y_{h,t-1}\gamma + e_{h,t} \tag{3}$$

In both equation (2) and (3), we assume that the error term is conditionally mean independent of

$$Y_{h,t}, X_{h,t} \text{ and } X_{h,t-1}$$

Similar to Chaudhuri et al. (2003) and by assuming the conditional variance is linear in the log of current per capita expenditures and household characteristics, the conditional variance of future per capita expenditures is modeled as follows:

$$(e_{h,t})^2 = X_{h,t-1}\beta + Y_{h,t-1}\gamma + u_{h,t} \tag{4}$$

$$(e_{h,t})^2 = X_{h,t}\beta + u_{h,t} \tag{5}$$

Estimating Equation (2) and Equation (5) sequentially or Equation (3) and Equation (4) sequentially using OLS and using the resulting parameters to establish the predicted estimation values of the equations will provide the estimate of future per capita expenditure (from predicted estimated values of Equations (2) and (3)) and conditional variance of household future per capita expenditure (from predicted estimated value of Equations (4) and (5)).

The estimated (predicted) household per capita expenditure above and the national poverty line is used to finally establish the vulnerability as expected poverty (VEP). Household's vulnerability to poverty is derived as the conditional probability of the household falling into poverty in the next period (Chaudhuri et al., 2002) using equation (6):

$$\hat{V}_{h,t-1} = Pr\left(\hat{Y}_{h,t} \leq Z_h \mid X_{h,t-1}\right) = Pr\left(\hat{Y}_{h,t} \leq Z_h \mid X_{h,t-1}, Y_{h,t-1}\right) = Pr\left(poor_t = 1 \mid X_{h,t-1}, Y_{h,t-1}\right) \tag{6}$$

To determine the vulnerable, the obtained probability is compared with a prior set threshold which in most cases is 0.50, which we term the high vulnerability threshold. Thus, a household whose vulnerability level exceeds 0.50 is more likely than not to end up poor and can be considered, therefore, to be highly vulnerable.

The other approach to estimate Equation 6 and achieve the same is to directly estimate the probability of being poor in t using a probit model, thereby making the assumption that the conditional variance of future per capita expenditures is constant across households.

3 Empirical Strategy and Estimation Approaches

To operationalize the model above, data for two waves (across the three waves) are used separately to determine the parameters that are important for forecasting well the household consumption in future period as opposed to the

case when cross section data is used.[1] Results are provided basing on the following thirteen models:

Model 1 $\ln y_{h,2010} = x_{h,2008}\beta + \ln y_{h,2008}\gamma + e_{h,2010}$
Model 2 $(e_{h,2010})^2 = x_{h,2008}\beta + \ln y_{h,2008}\gamma + u_{h,2010}$
Model 3 $Pr\,(poor_{2010} = 1 \mid X_{h,2008}, Y_{h,2008}) = \varphi\,(x_{h,2008}\beta + \ln y_{h,2008}\gamma + e_{h,2010})$
Model 4 $\ln y_{h,2008} = x_{h,2008}\beta + \ln y_{h,2008}\gamma + e_{h,2008}$
Model 5 $(e_{h,2008})^2 = x_{h,2008}\beta + \ln y_{h,2008}\gamma + u_{h,2008}$
Model 6 $\ln y_{h,2012} = x_{h,2008}\beta + \ln y_{h,2008}\gamma + e_{h,2012}$
Model 7 $(e_{h,2012})^2 = x_{h,2008}\beta + \ln y_{h,2008}\gamma + u_{h,2012}$
Model 8 $Pr\,(poor_{2012} = 1 \mid X_{h,2008}, Y_{h,2008}) = \varphi\,(x_{h,2008}\beta + \ln y_{h,2008}\gamma + e_{h,2012})$
Model 9 $\ln y_{h,2012} = x_{h,2010}\beta + \ln y_{h,2010}\gamma + e_{h,2012}$
Model 10 $(e_{h,2012})^2 = x_{h,2010}\beta + \ln y_{h,2010}\gamma + u_{h,2012}$
Model 11 $Pr\,(poor_{2012} = 1 \mid X_{h,2010}, Y_{h,2010}) = \varphi\,(x_{h,2010}\beta + \ln y_{h,2010}\gamma + e_{h,2012})$
Model 12 $\ln y_{h,2010} = x_{h,2010}\beta + \ln y_{h,2010}\gamma + e_{h,2010}$
Model 13 $(e_{h,2010})^2 = x_{h,2010}\beta + \ln y_{h,2010}\gamma + u_{h,2010}$

In this work, the probit model (Model 3, Model 8 and Model 11) since it is simpler to implement, it is therefore used to provide an interesting comparison by allowing the assessment of the inter-temporal variance in per capita expenditure to depend on household current expenditure and characteristics.

The estimation of the models above is also used to examine the determinants of vulnerability. The value of the vulnerability as estimated in Equation (6) is expected to vary from 0 to 1. Thus, the estimated vulnerability denotes the vulnerability of households with the characteristics X_h. In this paper, each household is assigned an estimated degree of vulnerability – the probability that a given household will fall into poverty in future. The following thresholds/ categories are used to assess vulnerability:

1. The highly vulnerable, for whom $\hat{v}_t \geq 0.5$;
2. The relatively vulnerable, for whom $h.d.p_t \leq \hat{v}_t < 0.5$, where $h.d.p_t$ is headcount poverty index at time t; and,
3. Those who are "not vulnerable."

For establishing poverty levels, we used the Poverty line of per capita expenditure below 50% of median household per capita expenditure as a measure of disposable income. The poor and vulnerable groups were further split into subcategories based on the grouping above and were cross-tabulated with the variable categorizing poverty as a household declared poor if the estimated per

1 Landau et al. (2012) points out that predictions based only on cross sectional data are much less accurate than those based on panel data.

capita expenditure is below a predetermined cutoff, which is a poverty line Z_h at a particular time t.

To apply these models, one needs first to determine which of the available covariates are best suited for predicting consumption. In this study, we include a bundle of observable household characteristics such as sex, age, household size, education of the household head, occupations of household heads, access to potable water, access to electricity, access to health centers, marital status, location and roofing materials.

4 Data

The actual implementation of the estimation procedure uses the information from the Tanzania National Panel Survey (TNPS) of 2008/09, 2010/11 and 2012/13. This data is collected by the National Bureau of Statistics (NBS). This is longitudinal data which is collected under the auspices of the National Strategy for Growth and Poverty Reduction (NSGRP). The overarching objective of developing TNPS data set is to provide a solid mechanism for tracking NSGRP progress, enhancing understanding of poverty dynamics and establish the impact of the various policies that are being implemented in the rural and urban areas. The TNPS provides the first national panel datasets which can be usefully applied to study the dynamics related to household livelihoods. TNPS data collection instruments or questionnaires were comprehensively designed to capture all important information about households in both rural and urban settings. The effects in paper are gauged through a comparative analysis of the three TNPS data waves (2008/9, 2010/11 and 2012/13). We also use the constructed consumption aggregates as proxy for household per capita expenditures.

5 Results and Discussions

5.1 *Descriptive Statistics*

Table 1 provides the definition of variables used in this chapter, their scale and the descriptive statistics. Based on the descriptive analysis of our sample, it appeared that the household size (mean) increased from 4.9 in wave 1 (2008/09) to 5.3 in year 2012/13. However, the level of standard deviation for the second wave (2010/11) was much higher than that of the first and third waves, signifying that there was a wider variation in household size among the households in the second survey than in the other ones. Household size

reflected the labour resources available within a household, which may be used for various economic activities, hence contributing to more household income. The mean age of the household head shows an increasing trend over time with the highest observed in wave three at 47.61 years, with a standard deviation of 15.71. This was a reflection that there was no wide variation within the data set in respect to the variable. Age reflects the level of experience that one may have accumulated to manage the household, which may be reflected by the level of per capita expenditure.

On the other side, the sample were characterized by many household heads working in agriculture as their main occupation and with education completed mainly being standard seven. Metal materials dominate the roofing materials and most of the households live in rural areas.

5.2 *Vulnerability Estimates*

The analytical results of the Vulnerability Estimates are based for the three waves (2008/9, 2010/11 and 2012/13) and are provided in Tables 2, 3, 4, 5, A1 and A2. In this case, we use data from a single cross-section paired from a two year panel from the available panel data.

In all regressions, a set of characteristics representing household such as sex, age, household size, education of the household head, occupations of household head, access to potable water, access to electricity, access to health centers, marital status, location and roofing materials are used. For each cross-section paired from respective panel data are presented as per the thirteen models. These models provide results of estimation of the expected mean and variance of the future per capita expenditure distribution, and dummy-based probit regression results for comparison. The models provide also the estimations using Chaudhuri (2002) methods.

In Tables 2, A1 and A2, the lagged per capita expenditure levels are found to be significantly associated with future per capita expenditure and poverty. However, the parameters in a model estimating the expected mean and the probit models have opposite signs, since being poor implies having a lower expected per capita expenditure.

Aging, household size, being employed in agriculture, residing in rural areas and surprisingly being married in all cross-sectional combinations appear more likely to have a lower future expenditure and be poor at a given level of current consumption. The results are surprising especially when it comes to influence the household size, since we expected in a situation where more households are in rural areas that more people in the household will contribute more to household's income hence possibility of increased welfare. Mutabazi et al. (2015) posits that the implications of household demographic

TABLE 1 Descriptive statistics, 2008–2012

	2008		2010		2012	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
Log of consumption	10.48	0.75	10.56	0.73	10.81	0.74
Age of household head (years)	45.53	15.6	46.08	15.6	47.61	15.71
Household size (units)	4.90	2.72	5.38	2.91	5.37	2.86
Sex of the household head (1 = Male)	0.76	0.43	0.75	0.43	0.74	0.44
Head employed in agriculture (1 = Agriculture)	0.64	0.48	0.63	0.48	0.62	0.49
Head employed by the government(1 = Government)	0.04	0.2	0.43	0.2	0.04	0.19
Head employed by private company (1 = Private)	0.09	0.28	0.09	0.29	0.09	0.29
Head is self employed (1 = Self)	0.15	0.35	0.12	0.33	0.14	0.34
Head completed standard seven (1 = HH Std7)	0.45	0.5	0.44	0.5	0.44	0.49
Head completed ordinary level secondary (1 = HH Secondary)	0.04	0.21	0.03	0.18	0.04	0.19
Head has fallen sick and visited facility (1 = HH Sick)	0.14	0.35	0.16	0.36	0.21	0.41
House roofed with grass material (1 = Grass Roof)	0.39	0.49	0.35	0.48	0.3	0.5
House is roofed with metal material (1 = Metal Roof)	0.58	0.49	0.63	0.48	0.68	0.47
Water for drinking is from piped source (1 = Piped Water)	0.36	0.48	0.54	0.49	0.84	0.37
House uses electricity for lighting (1 = Electricity)	0.16	0.36	0.17	0.37	0.05	0.21
Head resides in rural area (1 = Rural)	0.66	0.47	0.64	0.48	0.65	0.48
Household head is married (1 = Married)	0.83	0.38	0.83	0.37	0.83	0.38

SOURCE: AUTHORS' COMPUTATIONS

TABLE 2 Determinants of vulnerability in Tanzania, 2008–2010

	Future consumption		Probit approach	Chaudhuri approach	
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Log of consumption lagged	0.4382	0.0287	−0.5834		
	(0.0202)***	(0.0161)	(0.0705)***		
Age of household head (years)	−0.0003	0.0000	−0.0039	−0.0010	−0.0015
	(0.0008)	(0.0006)	(0.0025)	(0.0009)	(0.0007)*
Household size (units)	−0.0186	−0.0091	0.0441	−0.0810	0.0015
	(0.0046)***	(0.0037)*	(0.0140)**	(0.0047)***	(0.0040)
Sex of the household head (1 = Male)	0.0698	0.0080	−0.1077	0.1691	−0.0270
	(0.0310)*	(0.0246)	(0.0948)	(0.0334)***	(0.0283)
Head employed in agriculture (1 = Agriculture)	−0.1041	−0.0956	0.1610	−0.2409	−0.1134
	(0.0457)*	(0.0364)**	(0.1412)	(0.0492)***	(0.0417)**
Head employed by the government (1 = Government)	0.1686	−0.1024	−0.7864	0.2905	−0.1549
	(0.0688)*	(0.0547)	(0.4366)	(0.0742)***	(0.0629)*
Head employed by private company (1 = Private)	0.0600	−0.0762	−0.3182	0.0472	−0.0807
	(0.0570)	(0.0454)	(0.2268)	(0.0617)	(0.0523)
Head is self employed (1 = Self)	0.0587	−0.0871	−0.3117	0.0388	−0.0393
	(0.0511)	(0.0407)*	(0.1865)	(0.0553)	(0.0469)
Head completed standard Seven (1 = HH Std7)	0.0146	−0.0379	−0.1384	−0.0505	−0.0505
	(0.0258)	(0.0205)	(0.0770)	(0.0280)	(0.0237)*
Head completed ordinary level secondary (1 = HH Secondary)	0.1006	−0.0557	−0.5152	0.1828	0.0091
	(0.0578)	(0.0460)	(0.3954)	(0.0625)**	(0.0530)
Head has fallen sick and visited facility (1 = HH Sick)	0.0372	−0.0296	−0.0687	0.1994	0.0512
	(0.0320)	(0.0254)	(0.1010)	(0.0344)***	(0.0291)
House roofed with grass material (1 = Grass Roof)	−0.1147	−0.0876	−0.1689	−0.4364	−0.1627
	(0.0796)	(0.0634)	(0.2436)	(0.0858)***	(0.0727)*

TABLE 2 Determinants of vulnerability in Tanzania, 2008–2010 (*cont.*)

	Future consumption		Probit approach	Chaudhuri approach	
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
House is roofed with metal material (1 = Metal Roof)	0.0497 (0.0771)	−0.1247 (0.0613)*	−0.5999 (0.2435)*	−0.2064 (0.0834)*	−0.1729 (0.0707)*
Water for drinking is from piped source (1 = Piped Water)	0.0484 (0.0253)	−0.0159 (0.0201)	−0.1521 (0.0797)	0.0604 (0.0273)*	0.0072 (0.0232)
House uses electricity for lighting (1 = Electricity)	0.2126 (0.0395)***	−0.0041 (0.0315)	−0.4350 (0.2177)*	0.5161 (0.0413)***	−0.0407 (0.0350)
Head resides in rural area (1 = Rural)	−0.0863 (0.0348)*	0.0504 (0.0277)	0.2371 (0.1125)*	−0.0926 (0.0377)*	−0.0175 (0.0320)
Household head is married (1 = Married)	−0.0634 (0.0354)	−0.0196 (0.0282)	−0.1976 (0.1148)	−0.1254 (0.0383)**	−0.0218 (0.0324)
_cons	6.1210 (0.2496)***	0.1940 (0.1987)	5.8743 (0.8071)***	11.2674 (0.1106)***	0.6834 (0.0937)***
N	2097	2097	2098	2098	2098
ar2					
pr2					

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
SOURCE: AUTHORS' COMPUTATIONS

TABLE 3 Relationship between poverty and vulnerability within years, 2008–2012

	2008		2010		2012	
	Non-poor	**Poor**	**Non-poor**	**Poor**	**Non-poor**	**Poor**
Relative vulnerable	93.42	75.34	60.57	34.16	87.86	55.25
High vulnerable	6.58	24.66	39.43	65.84	12.14	44.75

SOURCE: AUTHORS COMPUTATIONS

structure on livelihood processes and outcomes are complex, non-linear and arguable. As with other similar studies, old age tends to correlate with vulnerability and social insecurity (Abunuwasi and Mwam, 2001; Barrientos, 2007, Mutabazi et al., 2015). Therefore, poverty and vulnerability reduction policy geared towards reducing vulnerability among the elderly people should be an important agenda.

Being employed in agriculture, people living in rural areas and household size turns out to be significantly more likely to become poor in the future, at a given consumption level and in all cross-sectional combination. The results on the implication of being employed in agriculture to vulnerability and poverty does not differ much with what is observed in Mutabazi et al. (2015) in which they found that the relationship is nonlinear as an exponential increase in years in farming increased the vulnerability – meaning that increased farming experience does not constantly reduce vulnerability. Sickness as shock has not turned out to have a significant contribution on making a household poor or on having less future expenditure in most of the cross-sectional combination.

TABLE 4 Relationship between poverty and vulnerability across years, 2008–2012

	2008–2012*		2008–2010*		2010–2012*	
	Non-poor	**Poor**	**Non-poor**	**Poor**	**Non-poor**	**Poor**
Relative vulnerable	83.74	59.49	57.85	39.92	85.23	57.70
High vulnerable	16.26	40.51	42.15	60.08	14.77	42.30

Note: *The first year represent the period a household were observed poor or non-poor and the second year represents the period a households were observed vulnerable or high vulnerable
SOURCE: AUTHORS' COMPUTATIONS

In addition, it appears that most of the variables are statistically insignificant at influencing the conditional variance of future consumption across household characteristics. Most of the results do not differ much with the Chaudhuri approach. The main difference lies in the fact that the Chaudhuri approach results into more statistically significant variables especially with regard to the factors influencing the conditional variance of future consumption across household characteristics.

Tables 3, 4 and 5 provides the relationship between being Vulnerable and poor basing on the Vulnerability threshold provided above, for 2008, 2010 and 2012. In Table 4, nearly 39.42% and 59.49% of households who were poor in

TABLE 5 Relationship between poverty across years, 2008–2012

	2008–2012*		2008–2010*		2010–2012*	
	Non-poor	**Poor**	**Non-poor**	**Poor**	**Non-poor**	**Poor**
non-poor	86.64	51.54	84.33	52.74	85.07	46.76
poor	13.36	48.46	15.67	47.26	14.93	53.24

Note: *The first year represents the period a household were observed poor or non-poor and the second year represent the period a household were observed poor or non-poor
SOURCE: AUTHORS COMPUTATIONS

2008 turned out to be less vulnerable in 2010 and 2012 respectively and the rest turned out to be highly vulnerable. The trend shows that most households were persistent to poverty in 2010 as compared to 2012 and that the longer the time the more likely a household finds a way to move out of poverty since people may enhance their productive capacity – hence improving farm returns on investment and ultimately income.

Table 5 shows that households were not stable in a particular welfare state and mostly households that were non-poor in 2008 turned out to be poor in 2010 and 2012 respectively. This is partly explained by presence of high level of uncertainty about future and risks among the households and provides evidence on the transient nature of poverty in Tanzania as described in Hulme et al. (2001). The results relates to the findings of Pantaleo (2020) on Kagera region. In other words, the expenditure level of a large number of households is close to the poverty line and these household will change places with households below poverty line overtime.

6 Conclusion

The paper has examined the determinants of vulnerability to expected poverty in Tanzania. The paper uses three waves of National Panel Survey Data for Tanzania collected between 2008/2009, 2010/2011 and 2012/2013. Using panel data we estimated the proportion of households who are likely to be poor and also pinpoint exactly which household will be poor and their determinants. Specifically, we extended Dercon (2001) approach and followed Landau et al. (2012), Chaudhuri (2000) and Chaudhuri et al. (2003) and considered Vulnerability to Expected Poverty (VEP). Results for Chaudhuri (2000) were reported separately.

For all combinations of the cross-sections of the panel data we found that being employed in agriculture, residing in rural areas and household size turns out to be significantly more likely to be poor in the future, at a given consumption level and in all cross-sectional combination. Also, aging, household size, being employed in agriculture, residing in rural areas and surprisingly being married in all cross-sectional combinations appear more likely to have a lower future expenditure and be poor at a given level of current consumption. However, it appeared that most of the variables were statistically insignificant at influencing the conditional variance of future consumption across household characteristics. Lastly, nearly 39.42% and 59.49% of households who were poor in 2008 turned out to be less vulnerable in 2010 and 2012 respectively and the rest turned out to be highly vulnerable. The results could be rationalized by other studies including Mutabazi et al. (2015; 2009) and Barrientos (2007).

The emerging policy implication from the study findings entails that vulnerability assessment is important because it enables us to formulate an efficient social policy that seeks to go beyond poverty alleviation in the present, and examine poverty prevention in the future. Further to it, we are able to identify and develop poverty solving strategies that are able to take into account the transient nature of poverty so as to include households that have a high probability of being poor and therefore directly devote necessary resources to households that are vulnerable to poverty including, consumption stabilization strategies are likely to be influential if they target families whose household head is aging.

Appendices

TABLE A1 Determinants of vulnerability in Tanzania, 2008–2012

	Future consumption		**Probit approach**	**Chaudhuri approach**	
	Model 6	**Model 7**	**Model 8**	**Model 4**	**Model 5**
Log of consumption lagged	0.4296 (0.0217)***	0.0291 (0.0196)	−0.7648 (0.0700)***		
Age of household head (years)	0.0018 (0.0009)*	−0.0003 (0.0008)	−0.0063 (0.0024)**	−0.0010 (0.0009)	−0.0015 (0.0007)*

TABLE A1 Determinants of vulnerability in Tanzania, 2008–2012 (*cont.*)

	Future consumption		Probit approach	Chaudhuri approach	
	Model 6	**Model 7**	**Model 8**	**Model 4**	**Model 5**
Household size (units)	−0.0047 (0.0049)	−0.0082 (0.0045)	0.0074 (0.0137)	−0.0810 (0.0047)***	0.0015 (0.0040)
Sex of the household head (1 = Male)	0.0090 (0.0333)	0.0542 (0.0300)	−0.0011 (0.0930)	0.1691 (0.0334)***	−0.0270 (0.0283)
Head employed in agriculture (1 = Agriculture)	−0.1137 (0.0492)*	0.0296 (0.0444)	0.1291 (0.1383)	−0.2409 (0.0492)***	−0.1134 (0.0417)**
Head employed by the government (1 = Government)	0.0352 (0.0738)	0.0434 (0.0667)	−0.4237 (0.3239)	0.2905 (0.0742)***	−0.1549 (0.0629)*
Head employed by private company (1 = Private)	0.0144 (0.0612)	−0.0762 (0.0553)	−0.5630 (0.2401)*	0.0472 (0.0617)	−0.0807 (0.0523)
Head is self employed (1 = Self)	0.0205 (0.0548)	0.0273 (0.0495)	−0.1261 (0.1768)	0.0388 (0.0553)	−0.0393 (0.0469)
Head completed standard seven (1 = HH Std7)	0.0191 (0.0277)	−0.0439 (0.0251)	−0.0920 (0.0754)	−0.0505 (0.0280)	−0.0505 (0.0237)*
Head completed ordinary level secondary (1 = HH Secondary)	0.1081 (0.0620)	−0.0587 (0.0560)	−0.3020 (0.3081)	0.1828 (0.0625)**	0.0091 (0.0530)
Head has fallen sick and visited facility (1 = HH Sick)	−0.0201 (0.0344)	−0.0641 (0.0310)*	0.1009 (0.0953)	0.1994 (0.0344)***	0.0512 (0.0291)

TABLE A1 Determinants of vulnerability in Tanzania, 2008–2012 (*cont.*)

	Future consumption		Probit approach	Chaudhuri approach	
	Model 6	**Model 7**	**Model 8**	**Model 4**	**Model 5**
House roofed with grass material (1 = Grass Roof)	0.0170 (0.0855)	−0.2277 (0.0772)**	−0.1952 (0.2726)	−0.4364 (0.0858)***	−0.1627 (0.0727)*
House is roofed with metal material (1 = Metal Roof)	0.1675 (0.0828)*	−0.2271 (0.0748)**	−0.5151 (0.2734)	−0.2064 (0.0834)*	−0.1729 (0.0707)*
Water for drinking is from piped source (1 = Piped Water)	0.0408 (0.0271)	−0.0070 (0.0245)	−0.1080 (0.0781)	0.0604 (0.0273)*	0.0072 (0.0232)
House uses electricity for lighting (1 = Electricity)	0.2300 (0.0424)***	−0.0776 (0.0383)*	−0.3562 (0.1866)	0.5161 (0.0413)***	−0.0407 (0.0350)
Head resides in rural area (1 = Rural)	−0.1471 (0.0374)***	−0.0036 (0.0338)	0.2672 (0.1046)*	−0.0926 (0.0377)*	−0.0175 (0.0320)
Household head is married (1 = Married)	−0.0876 (0.0380)*	−0.0648 (0.0343)	0.0271 (0.1158)	−0.1254 (0.0383)**	−0.0218 (0.0324)
_cons	6.3195 (0.2681)***	0.3015 (0.2421)	7.8188 (0.8009)***	11.2674 (0.1106)***	0.6834 (0.0937)***
N	2097	2097	2098	2098	2098
adj. R^2	0.472	0.013		0.479	0.010
pseudo R^2			0.234		

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
SOURCE: AUTHORS' COMPUTATIONS

TABLE A2 Determinants of vulnerability in Tanzania, 2008–2012

	Future consumption		Probit approach	Chaudhuri approach	
	Model 9	**Model 10**	**Model 11**	**Model 12**	**Model 13**
Log of consumption lagged	0.5345 (0.0271)***	−0.0084 (0.0228)	−0.9139 (0.0976)***		
Age of household head (years)	0.0019 (0.0011)	−0.0002 (0.0009)	−0.0099 (0.0034)**	−0.0003 (0.0011)	−0.0017 (0.0008)*
Household size (units)	−0.0078 (0.0055)	−0.0104 (0.0046)*	0.0233 (0.0175)	−0.0641 (0.0054)***	−0.0133 (0.0039)***
Sex of the household head (1 = Male)	−0.0085 (0.0420)	0.0834 (0.0353)*	0.0978 (0.1299)	0.1349 (0.0436)**	0.0563 (0.0309)
Head employed in agriculture (1 = Agriculture)	−0.0799 (0.0533)	0.0508 (0.0448)	0.2218 (0.1800)	−0.1716 (0.0552)**	−0.0467 (0.0394)
Head employed by the government (1 = Government)	0.0867 (0.0803)	0.0300 (0.0675)	−0.6210 (0.6086)	0.2218 (0.0835)**	−0.1371 (0.0594)*
Head employed by private company (1 = Private)	−0.0396 (0.0600)	0.0031 (0.0505)	−0.2731 (0.2678)	0.0717 (0.0626)	−0.0622 (0.0446)
Head is self employed (1 = Self)	−0.0294 (0.0563)	0.0660 (0.0474)	0.1304 (0.1998)	0.0236 (0.0587)	−0.0413 (0.0416)
Head completed standard seven (1 = HH Std7)	0.0247 (0.0327)	0.0000 (0.0275)	−0.1166 (0.1005)	−0.0169 (0.0342)	−0.0393 (0.0243)

TABLE A2 Determinants of vulnerability in Tanzania, 2008–2012 (*cont.*)

	Future consumption		Probit approach	Chaudhuri approach	
	Model 9	**Model 10**	**Model 11**	**Model 12**	**Model 13**
Head completed ordinary level secondary (1 = HH Secondary)	0.1341 (0.0738)	−0.0581 (0.0620)		0.3754 (0.0763)***	−0.0624 (0.0539)
Head has fallen sick and visited facility (1 = HH Sick)	−0.0202 (0.0384)	−0.0129 (0.0323)	−0.0395 (0.1243)	0.1155 (0.0399)**	0.0127 (0.0283)
House roofed with grass material (1 = Grass Roof)	−0.1422 (0.1167)	−0.0927 (0.0981)	0.4191 (0.5790)	−0.4585 (0.1211)***	−0.0756 (0.0856)
House is roofed with metal material (1 = Metal Roof)	0.0359 (0.1104)	−0.0880 (0.0928)	0.0924 (0.5731)	−0.2087 (0.1151)	−0.1161 (0.0813)
Water for drinking is from piped source (1 = Piped Water)	0.0040 (0.0321)	−0.0179 (0.0270)	−0.1563 (0.0980)	0.0675 (0.0335)*	−0.0073 (0.0237)
House uses electricity for lighting (1 = Electricity)	0.1994 (0.0447)***	−0.0572 (0.0375)	−0.5536 (0.2211)*	0.5325 (0.0441)***	0.0260 (0.0314)
Head resides in rural area (1 = Rural)	−0.1501 (0.0427)***	0.0481 (0.0359)	0.3135 (0.1282)*	−0.1002 (0.0444)*	0.0734 (0.0316)*

TABLE A2 Determinants of vulnerability in Tanzania, 2008–2012 (*cont.*)

	Future consumption		Probit approach	Chaudhuri approach	
	Model 9	**Model 10**	**Model 11**	**Model 12**	**Model 13**
Household head is married (1 = Married)	−0.0386 (0.0478)	−0.1001 (0.0402)*	−0.2458 (0.1578)	−0.0512 (0.0499)	−0.1024 (0.0353)**
_cons	5.3024 (0.3331)***	0.4848 (0.2800)	9.0387 (1.2075)***	11.1662 (0.1460)***	0.5578 (0.1035)***
N	1269	1269	1212	1270	1257
adj. R^2	0.554	0.013		0.487	0.026
pseudo R^2			0.305		

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
SOURCE: AUTHORS' COMPUTATIONS

References

Abunuwasi, J., & Mwami, L. (2001). Social insecurity of the elderly people in Tanzania today: a theoretical framework. *UTAFITI* (*New Series*), *4*, 179–206.

Ahmed, S. A., Diffenbaugh, N. S., Hertel, T. W., Lobell, D. B., Ramankutty, N., Rios, A. & Rowhani, R. (2011). Climate volatility and poverty vulnerability in Tanzania. *Global Environmental Change*, *21*, 46–55.

Barrientos, A. (2007). New strategies for old-age income security in low income countries. International Social Security Association (ISSA) Technical Report 12. Retrieved from http://193.134.194.37/content/download/40640/790535/file/TR-12-2.pdf.

Chaudhuri, S. (2000). Empirical methods for assessing household vulnerability to poverty. Draft version, Columbia University.

Chaudhuri, S. (2003). Assessing vulnerability to poverty: Concepts, empirical methods and illustrative examples. Columbia University.

Christiaensen, L. & Subbarao, K. (2005). Towards an understanding of household vulnerability in rural Kenya. *Journal of African Economies*, *14*(4), 520–558.

Dercon, S. (2001). Assessing vulnerability to poverty: an application to rural Ethiopia. Mimeo, Oxford University.

Gunther, I. & Harttgen, K. (2009). Estimating households vulnerability to idiosyncratic and covariate shocks: A novel method applied in Madagascar. *World Development*, *37*(7), 1222–1234.

Hulme, D., Moore, K. & and Shepherd, A. (2001). Chronic poverty: meanings and analytical frameworks. CPRC Working Paper 2.

Jha, R. & Dang, T. (2010). Vulnerability to poverty in Papua New Guinea in 1996. *Asian Economic Journal*, *24*(3), 235–251.

Landau, K., Klasen, S. & Zucchini, W. (2012). Measuring vulnerability to poverty using long-term panel data. Courant Research Centre PEG, 118.

Mutabazi, D. K., Sieber, S., Maeda, C. & Tscherning, K. (2015). Assessing the determinants of poverty and vulnerability. *Regional Environmental Change*, *15*(7), 1243–1258.

Pantaleo, I. (2020). Are households in Tanzania vulnerable to poverty. *Business Management Review*, *23*(1), 19–30.

Sarris, A. & Karfakis, P. (2006). Household vulnerability in rural Tanzania. FAO Commodity and Trade Policy Research Working Paper No. 17, June 2006.

Suryahadi, A. & Sumatro, S. (2003). Poverty and vulnerability in Indonesia before and after the economic crisis. *Asian Journal*, *17*(1), 45–64.

World Bank (2001). Dynamic risk management and the poor: Developing a social protection strategy for Africa. Africa Region Human Development Department, World Bank, Washington, DC.

World Bank (2001). World-development report 2000/01 – Attacking poverty. Oxford University Press.

World Bank (2015). Tanzania Mainland poverty assessment. World Bank, Washington, DC.