Determinants of Expected Poverty Among Rural Households in Nigeria

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Abstract

Vulnerability measures are becoming tools for evolving proactive steps to alleviate poverty. Against this backdrop, this study examined the determinants of expected poverty (a measure of vulnerability) among rural households in Nigeria. The data for the study were obtained from the merged General Household Survey (GHS) and the National Consumer Survey (NCS) of 1996. The cross-sectional data were augmented with certain covariate factors. The data were analysed using three-stage feasible generalized least squares (3FGLS).

Both idiosyncratic and covariate factors affect the expected log per capita consumption of rural Nigerians. The overall expected poverty for the country at 0.535 is 1.02 times the observed poverty in 1996. Higher expected poverty is correlated with living in the North East, no formal education, farming, older head of household, large household size and male-headed household. The North East region has both lower mean per capita consumption and higher variance compared with other regions of the country. Consumption variance is highest for households whose heads have secondary education, while households whose heads have no formal education have the lowest mean expected consumption. Farming households have lower mean per capita consumption than non-farming households. Male-headed households have both lower mean consumption and higher consumption variance relative to their female-headed counterparts. Further, household heads below age 20 have the lowest mean consumption and the highest consumption variance. Households with more than ten members have very low mean consumption and very high consumption variance. Depending on whether there is low mean consumption or higher consumption variance or both, policy strategies suitable for the different groups will vary from increased mean per capita consumption to consumption smoothening or both.

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1. Problem statement

The issue of whether a household is poor is widely recognized as an important, though crude indicator of the household's wellbeing. This is reflected in the central role the concept of poverty plays in analysis of social protection policy. In recent years, however, the term vulnerability has come to be widely used alongside poverty in discussions of poverty alleviation and social protection strategies. The term has been given many meanings by researchers. Chaudhuri (2000) defined vulnerability as the ex-ante risk today that a household will, if currently poor, remain poor, or if currently non-poor will fall below the poverty line in the next period.

Building on recent literature on consumption smoothing and risk sharing, vulnerability to risk was defined by Skoufias (2002) as the degree to which the growth rate of household consumption varies with the growth rate of household income. The concept of vulnerability is closely related to terms such as "risk" and "shock". While risk refers to uncertain events that are not wellbeing-friendly, shocks are events like illness or macroeconomic crisis that propel a decline in wellbeing. The definition of vulnerability explicitly acknowledges that households may adopt a variety of risk management strategies such as savings and loans to protect themselves. A World Bank study on risk management in South Asia, however, defines vulnerability as the likelihood of being adversely affected by a shock that usually causes consumption levels, or other factors that affect well being, to drop (World Bank, 2001). Other studies have made use of various indicators in defining vulnerability. Quisumbing (2002) used both consumption smoothing definitions as well as the link between consumption smoothing and ex-post impact of shocks as measures of vulnerability.

Regardless of the different types of definitions put forward, it is clear that the term vulnerability deals proactively with the problems of households' poverty and risks. The term vulnerability is therefore different from poverty, since the concept of poverty is a measure of a household's actual wellbeing, while vulnerability is an analysis of the household's potential wellbeing. In this context, poverty is static, defined at a single point in time, while vulnerability is more dynamic. This does not mean that there is no connection between the two, however. The correlation between vulnerability and poverty can only be stressed when the vulnerability of different segments of the population is to be assessed at present and in the near future. In this connection, a household's vulnerability will be perceived as the probability that the household will experience poverty in the near future. It is also important to note that changes in vulnerability are broadly consistent with poverty trends (Bidani and Richter, 2001). This is why the term vulnerability is presently being used alongside poverty in discussing poverty alleviation and social protection policies.

Past studies (e.g., FOS, 1999; World Bank, 1996) have established that most of Nigeria's poor live in rural areas and that most rural households in Nigeria are poor. FOS (1999) and Omonona (2001) also took the step of identifying sources of poverty among rural farming households in Nigeria. A vulnerability assessment of Nigeria by Alayande (2003) found, again, that rural Nigerians are the most vulnerable to poverty, but did not provide information on the expected poverty profile of rural Nigerians using idiosyncratic and covariate variables or shocks. It therefore follows that it is necessary to probe into what makes rural households in Nigeria vulnerable to poverty. Granted that these households have different segments in terms of demographic and occupational compositions and the characteristics of the community in which the household resides, in this study we are interested in generating a vulnerability to poverty profile of the different segments of rural households of Nigeria. Vulnerability profiles of this type can be useful illustrative devices in the discussions of policy priorities among such segments of Nigerian rural population.

For the purpose of this study, vulnerability is defined as expected poverty (VEP). This is ex-ante information that measures vulnerability to poverty using cross sectional data. It is one of three approaches for measuring vulnerability to poverty. Others are vulnerability as low expected utility and vulnerability as uninsured exposure to risk (Hoddinott and Quisumbing, 2003b).[1] Nonetheless, the VEP adopted for this study is not without its own limitations, which are clearly underlined by the inconsistency between the uses of cross sectional data for analysis of dynamic concepts such as vulnerability. Hoddinott and Quisumbing (2003b) and Dercon (2001) highlight some of these drawbacks, which include the exclusive reliance of the approach on the strong assumption of the ability of cross sectional variability to capture temporal variability. Thus, any policy recommendation emanating from such results may be perverse. It is worth noting that one of the key advantages of VEP that allows for use of single cross sectional data in the analysis of vulnerability gives impetus to the use of VEP in this study. This is so since there exist no reliable panel data collected to date in Nigeria.

Meanwhile, Dercon (2001) has shown that the VEP can be improved through the incorporation of covariate risks - which will not necessarily be the same across regions and states. In this instance, this study extends the empirical application of VEP by Chaudhuri (2000) by including some covariate risks (regional specific variables) for which data are available in the country and in line with the suggestions by Dercon. Another key task of this study is its ability to discriminate between different sources of vulnerability as measured by expected poverty. Given that two groups in the population are estimated to be equally vulnerable, these two groups of population may have different household characteristics. The appropriate policies for mitigating the vulnerability of the two groups will differ, thus calling for discrimination between different sources of vulnerability. The dearth of knowledge on generating vulnerability to poverty profiles among different segments of rural populations and discriminating between different sources of vulnerability to poverty is a major policy challenge in Nigeria. Therefore, the study is interested in supplying the information lacking on these vulnerability to poverty issues.

2. Objectives, hypotheses and justification of the study

The main objective of this study is to assess rural Nigerian households' expected poverty. The specific objectives are to determine household characteristics and regional specific risks that affect consumption of rural Nigerians; to generate a vulnerability profile using expected poverty measure of different segments of rural population in Nigeria; to discriminate between the different sources of expected poverty among rural households in Nigeria; and to draw policy implications regarding the issue of vulnerability to poverty among rural households in Nigeria.

Hypotheses

The study tests two null and alternative hypotheses. One (H_O) is that observable characteristics of rural households and regional specific variables do not affect consumption and its variability among rural Nigerians. The other hypothesis (H_A:) is that observable characteristics of rural households and regional specific variables affect consumption and its variability among rural Nigerians.

Justification for the study

Without doubt the issue of vulnerability in social protection strategy is important, since its study adopts a forward looking approach that not only identifies the groups of households that are presently poor but also the households that are vulnerable to poverty. Vulnerability study has since become very relevant to our day-to-day living because poverty is presently perceived to connote dreading the future – that is, knowing that a crisis may erupt at any time, but without the knowledge of the extent of one's ability to cope with emerging crisis. It is in this view that this study intends to contribute to our knowledge on how vulnerable rural households in Nigeria are to poverty.

Despite the importance of vulnerability issues to social protection and poverty alleviation strategies, it is difficult to find in the literature studies that have an empirical account of a vulnerability to poverty (expected poverty) profile of the different segments of Nigeria's rural population. Neither is much literature available on how to discriminate among different sources of vulnerability to poverty among rural Nigerians. While there are numerous studies on vulnerability in other developing and developed countries such as Bangladesh, Russia and Thailand (e.g., Quisumbing, 2002; Bidani and Richter, 2001; Skoufias, 2002), welfare studies on Nigeria have often focused on poverty (FOS, 1999;

World Bank, 1996), despite the relevance of vulnerability to anticipating poverty problems beforehand and in future. There is especially a dearth of studies of this nature for rural Nigeria. Among the few available studies is that by Alayande (2003), which as noted did not consider time covariate risks (regional specific variables).

Arising from the relevance of the vulnerability issue to social protection and poverty alleviation policies, the justification for our study emanates from the fact that the overlap between poverty and vulnerability is not perfect, in part because of the general agreement that poverty is a static concept and vulnerability is a dynamic concept. Clarifying the distinction between poverty and vulnerability is important especially since social protection strategy is moving from ex-post poverty strategies to ex-ante vulnerability considerations. The imperfect overlap between the vulnerable and the poor therefore suggests that different types of policies may be needed for social insurance and for poverty reduction. Second, much of the recent interest in household vulnerability as the basis for social protection strategy arises from the growing recognition that poverty may be a transient state for many households (Chaudhuri, 2000). Third, vulnerability studies of this nature will give governments and other social protection strategists the evidence base they need to take proactive measures to protect vulnerable households.

This study expects to contribute to the scanty predicted poverty literature by determining household characteristics and region-specific risks that affect consumption by rural Nigerians. The study will generate vulnerability to poverty profiles of different segments of rural Nigeria. It will also discriminate among the different sources of vulnerability to poverty of rural households in Nigeria. Thus, this research can be expected to help in the design of appropriate policies for social protection strategies and actions.

3. Literature review

Recent studies on vulnerability place more emphasis on poverty and vulnerability classifications, sources of vulnerability, coping mechanisms, and vulnerability and poverty. Some also stress identifying household-specific vulnerability characteristics and analysing the differences in household vulnerability by observable characteristics and determinants of vulnerability to poverty. The methodology and results of such studies are discussed subsequently.

Bidani and Richter (2001), for example, classified households in Thailand using poverty and vulnerability classification schemes – as vulnerable and non-vulnerable, as well as poor and non-poor. On the basis of the ex-post status of these households, the study assessed how these two concepts – poverty and vulnerability – relate to each other. Results revealed that overall in 1999, about 15% of the population was poor compared with 9% in 1996. Using the predicted mean consumption levels from the feasible generalized least squares (FGLS) regression, poor households were categorized into chronic and transient poor. The changes in vulnerability were broadly consistent with the poverty trends. Mean vulnerability, as measured by the average probability to be poor the next year, rose from 9.5% in 1996 to around 15.6% in 1998 and declined to 15% in 1999. Results also revealed that the rise in poverty and vulnerability was triggered mostly by higher chronic poverty and more low-mean vulnerability. The geographic incidences of poverty and vulnerability were also very similar. Poverty and vulnerability are highest among rural northeast households, and almost no poor or vulnerable households live in Bangkok. The rankings of the regions in terms of poverty and vulnerability are the same, and a similar pattern is observed with socioeconomic characteristics such as education or gender of the household head.

Using a decomposition analysis to examine the sources of vulnerability, Bidani and Richter (2001) focused nationwide, by region-education segments and by selected population subgroups. The nationwide decomposition made use of predicted consumption mean and variance of households with median vulnerability level as a reference. Its results revealed that around three-quarters of the differences are due to differences in mean consumption. The region-education segments decomposition captured the important differences across subgroups that the nationwide decomposition exercise might not have captured. Results revealed that regional characteristics on the whole dominate educational attainment. Furthermore, within regional segments, the educational ranking showed that vulnerability declines as human capital increases. For the selected population subgroups, the decomposition identified the sources of vulnerability for specific group of the farming population. Farmers with large land holdings were substantially better off than those

with small holdings, while high asset public recipients were better off than low asset public recipients. This research work intends to provide expected poverty profiles of rural Nigerians and also carry out a future decomposition analysis of the sources of expected poverty. A study carried out on decomposition of sources of vulnerability in the context of expected poverty among rural households of Nigeria (the most populous country in Africa) will no doubt add to knowledge in the new found area of social protection strategy research.

Quisumbing (2002) examined the concept of coping mechanisms, vulnerability and poverty among rural households of Bangladesh. They assessed the responsiveness of private and public coping mechanisms and also attempted to link household-level vulnerability to the probability of being poor. Results showed that there is weak evidence that private coping mechanisms respond more to idiosyncratic changes in income than public transfers do. Poverty is strongly associated with many of the characteristics of groups that are more vulnerable to idiosyncratic shocks, but household level vulnerability is not highly correlated with poverty status, thus establishing an imperfect overlap between the vulnerable and the poor. The issues of private and public coping mechanisms are not being addressed by this research work. However, the fact that imperfect overlap has been established between the vulnerable and the poor gives additional support to our decision to study rural households of Nigeria. This further suggests that policies formulated for poverty reduction programmes may not be appropriate for the vulnerable groups to poverty. This is what this study sets out to do.

Skoufias (2002) studied two other issues of vulnerability in Russia. These are establishing the differences in household vulnerability by observable characteristics and identifying household specific vulnerability. Results revealed that there are statistically significant differences in household vulnerability by region. Specifically related to food consumption, households with younger children appear to be less vulnerable (probably as a consequence of the child allowance they receive), while female-headed households were more vulnerable. Household-specific vulnerability factors in Russia were identified using regression estimates as well as the construction of household-specific vulnerability measures reflecting the ability of households to insure their consumption from idiosyncratic income risk. Results revealed that irrespective of whether vulnerability is measured on the basis of insurance from idiosyncratic shocks to income or otherwise, the variables that are significantly correlated with the level of household vulnerability are mainly those identifying the region in which the household lives. Measures of vulnerability were negatively correlated with the total consumption per capita. Thus, other things being equal in a cross-section of households, wealthier (poorer) households are less (more) vulnerable, as one would expect in issues of vulnerability. The results of this study therefore suggest that the targeting of social safety net programmes need not be based solely on current poverty status of the household. Rather, social programme targeting can be effectively complemented with indicators of the ability of the household to protect its consumption from shocks. Taking a micro-level perspective, Dercon (2005) explored the links among risk, vulnerability and poverty and noted that risk is an important constraint to broad-based growth in living standards in the developing world. Likewise, we intend to explore the causal relationship between risk elements such as malaria, AIDS, rainfall and radiation (measuring the process by which rays of

light or heat are emitted) on the vulnerability status of rural Nigerians.

There are other vulnerability issues in the literature. Prichett et al. (2000) and Chauduri (2001) proposed methods by which vulnerability to poverty in Indonesia can be measured. Using a new conceptual framework for social protection, Holzman and Jorgensen (2000) discussed how social risk management could be achieved. Literature also abounds on theoretical tests of consumption behaviour using information on aggregate shocks (Jacoby and Skoufias, 1998) and smoothing consumption by smoothing income in India (Kochar, 1999). Morduch (1994) reviewed the link between poverty and vulnerability, while Rutkowski (1999) highlighted the Russian social protection malaise. Ligon and Schechter (2003) constructed a utilitarian measure of vulnerability that allows the quantification of the welfare loss associated with poverty as well as the loss associated with any of a variety of different sources of uncertainty. The duo apply the measure to a 1994 panel data set for Bulgaria and find that poverty and risk play almost equal roles in reducing poverty. According to them, aggregate shocks are more important than idiosyncratic sources of risks, but households headed by an employed, educated male are less vulnerable to aggregate shocks than are other households. The measure proposed by Ligon and Schechter (2003) has the advantage over other measures of vulnerability that work with the expected value of one of the Foster–Greer–Thorbecke measures (Foster et al., 1984) in that it can prevent the underestimation of the value of mechanisms for reducing risk such as credit, saving and insurance. Although Alayande (2002, 2003) attempts to determine factors that affect vulnerability to poverty in Nigeria and to assess vulnerability, his studies could not unmask the issues involved in vulnerability to poverty among rural households of Nigeria.

The various literature threads highlighted above have shown that the searchlight is presently being turned on vulnerability as means of solving social protection and poverty alleviation problems in the developed and developing countries' welfare studies. At the same time, the literature search revealed that there is a dearth of empirical evidence as regards vulnerability studies in the sub-Saharan African countries and most especially Nigeria. The gap in knowledge and literature on vulnerability issues is what this study set out to fill and supply.

4. Methodology

Vulnerability as defined is an exposure to a potentially adverse outcome. Its analysis thus provides the right avenue for social protection strategists to take proactive measures to protect vulnerable households. Hoddinott and Quisumbing (2003a/b) identified three approaches to assessing vulnerability; these are vulnerability as expected poverty (VEP), vulnerability as low expected utility (VEU) and vulnerability as uninsured exposure to risk (VER). According to the authors these three approaches share a common characteristic since each of them constructs a model that predicts a measure of welfare. Further, VEP and VEU share two characteristics: they make reference to a benchmark for the welfare indicator and enunciate a probability of falling below this benchmark.

Theoretical framework

Both the VEP and the VEU approaches employ the same measure in analysing vulnerability. The VEU approach, however, takes into consideration covariate shocks unlike VEP, while the VER assesses whether observed shocks generate welfare losses. In other words, it is an ex-post assessment of the extent to which a negative shock causes a household to deviate from expected welfare. Different authors have used the three approaches. Chaudhuri (2000, 2001) used VEP, Ligon and Schechter (2003) applied the VEU approach, and Skoufias (2002) and Quisumbing (2002) adopted VER.

Although our study intends to use VEP because of data limitations, there are shortcomings in using cross-sectional data as well as the Chaudhuri approach to infer vulnerability. This is so because such methodology captures only idiosyncratic risks and does not address covariate risks (community and national related risks). But these covariate risks matter in the context of vulnerability measures because we need to know how shocks evolve over time and across populations. Since the incorporation of covariate risks is crucial, we depart from the Chaudhuri approaches by extending VEP as suggested by Dercon (2001) with available data on covariate risks. This allows for inclusion of time varying covariates (such as regional specific variables) like rainfall, radiation, notable diseases, and price level and unemployment rates, among others. Advantages of the VEP approach include its capability to identify households “at risk” who are not poor and the fact that it can be estimated with single cross-sectional data. Thus our study adopts the VEP approach as its theoretical framework. This decision becomes imperative since only cross sectional data are presently available in Nigeria to carry out welfare studies.

Following the exposition by Dercon (2001), the starting point for VEP is to consider the vulnerability of particular household h at time t as the probability that the household will find itself consumption poor at time $t+1$:

$$V_{ht} = \Pr(c_{h,t+1} = z) \quad (1)$$

where $c_{h,t+1}$ is the household's consumption level at $t+1$ and z is the poverty line. In a situation where cross-section data are available, deriving a consumption prediction model is considered in general as:

$$c_{ht} = c(X_h, I_h, \Downarrow_h, \alpha_h \varepsilon_{ht}) \quad (2)$$

where X_h is a vector of observable household characteristics, I_h is a vector of risk management instruments, $\square$ is a vector of parameters describing the state of the economy at time t, $\square_h$ are unobserved but fixed household characteristics, and $\square$ are stochastic errors. To derive the vulnerability measure at the household level, substituting (2) in (1) gives:

$$V_{ht} = \Pr(c_{h,t+1} = c(X_{h_t} I_{h_t} \Downarrow_{t+1} \alpha_h \varepsilon_{h,t+1}) = z \,|\, X_{h_t} I_{h_t} \Downarrow_{t} \alpha_{h_t} \varepsilon_{ht}) \quad (3)$$

In other words, the estimated probability of being poor in period $t+1$ using the prediction model (1), based on information available in period t, but including (possibly predicted) information about $\square_t$ and ε_{ht+1}.

The crucial elements in this specification are $\square_{t+1}$ and ε_{ht+1}. Both variables are indexes and therefore include information about the evolving state of the aggregate economy (constant across households) and aggregate shocks. Typically, and in Chaudhuri (2001), there is no information on $\square_{t+1}$ within the data and so it is ignored, while similarly time dependence of errors and shocks ε_{ht+1} is allowed for. In short, the risk and the vulnerability to poverty considered are only idiosyncratic, i.e., no aggregate shocks are allowed for. In order to address this problem, Dercon (2001) suggests the use of additional independent variables to the ones suggested in the Chaudhuri approach. Such additional variables include vector of observable risk management instruments and vector of parameters describing the state of the economy at time t. The availability of data on certain regional variables such as rainfall, unemployment rate and price level (among others) can help capture information about the state of the economy in each region of the country, thereby addressing in part covariate risks. These data on national covariate risk were incorporated on regional basis, since Nigeria is presently informally demarcated into six geopolitical zones. Assigning variables by geopolitical zone becomes highly desirable since a single national figure for covariate risk will not allow for variations in the value of variables during analysis. This might result in the likelihood of reducing the explanatory powers of the covariate variables to nil with respect to consumption change.

Hence, the model is further linearized by X_h (dropping any distinction with I_h and □). Technically,

$$\ln C_k = X_k\alpha + \pi\delta h_t + e_k N(0,\sigma^2_{\varepsilon k}) \quad (4)$$

in which α, π and $\sigma^2_{\varepsilon,h}$ are coefficients to be estimated. This model is estimated using feasible generalized least squares (FGLS).

On the basis of the useful characteristics of this linear model and from the normality assumption of the errors, and defining ϕ as the standard normal distribution, household vulnerability is estimated as:

$$V_h = Pr(lnc_h < ln|zX_h) = \Phi lnz - X_h \Downarrow / X_h \Downarrow \quad (5)$$

Method of analysis

In this study we use the FGLS approach to assess the vulnerability of households to poverty. The step-by-step method of analysis is explained in the Appendix. We estimate the determinants of rural household consumption using Equation 6. For emphasis sake, this is represented below:

$$\frac{\ln C_k}{\hat{\sigma}_{\varepsilon k}} = \left[\frac{X_k}{\hat{\sigma}_{\varepsilon k}}\right]\beta + \frac{\Downarrow ht}{\hat{\sigma}_{\varepsilon k}}\lambda + \frac{e_k}{\hat{\sigma}_{\varepsilon k}} \quad (6)$$

where

c_h	=	consumption level of household h
X_h	=	vector of independent variables including household demographic composition and human capital
□h_t	=	vector of covariate shocks that are region specific
β	=	regression coefficients of idiosyncratic variables
λ	=	regression coefficients of covariate variables
$\hat{\sigma}_{\varepsilon k}$	=	variance of idiosyncratic and covariate variables
e_h	=	error term

Two types of explanatory variables were used for the expected poverty analysis. These are the idiosyncratic and the covariate variables. The covariates were used in this study in order to add value to the Chaudhuri approach and also because expected poverty must be predicted using as full a vector of covariates as possible given cross sectional data. This is so since covariate variables will include the evolving state of the aggregate economy and aggregate shocks and also because the Chaudhuri method, which includes

just own characteristics (demographic), effectively treats all shocks as measurement error – which in turn makes prediction of expected poverty very poor and unstable.

The use of idiosyncratic variables such as socioeconomic/demographic variables is justified by the Chaudhuri (2000) and Dercon (2001) studies. The idiosyncratic variables used are basically the demographic characteristics of the respondents, which include dependency ratio, household size, sex of household head, farming and non farming characteristics of respondents, and dwelling types. Other types of idiosyncratic variables used in the study are water sources, toilet type and educational characteristics of respondents.

High levels of dependency ratio, household size and farming characteristics of household head are expected to have a negative impact on expected per capita log consumption of households. Good dwelling types, water sources, toilet types and educational backgrounds are expected to positively affect respondents' expected per capita log consumption. The covariates used in explaining variation in consumption levels of respondents are the geopolitical zones in which respondents reside, regional price levels, regional unemployment rates, regional figures on volatility of government expenditure, regional rainfall pattern, regional sunshine hours and regional radiation figures.

Other covariate variables considered in the study include regional reported armed robbery cases, and regionally important diseases such as acquired immune deficiency syndrome (AIDS), malaria, measles and river blindness. High levels of regional price, unemployment rates, volatility of government expenditure, armed robbery and diseases are expected to have a negative impact on respondents' expected per capita log consumption. High levels of regional rainfall, sunshine hours and radiation hours are also expected to negatively affect respondents per capita log consumption.

Equation 6 will yield consistent, asymptotically efficient FGLS estimates of b and λ. The standard error of any of the estimated coefficients, $\hat{\beta}FGLS,i$ and $^{2}\overline{2}FGLS$ can be obtained by dividing the reported standard error by the standard error of the regression. The estimates of b, λ and q obtained through these FGLS methods are directly informative about how various household characteristics and regional specific risks affect the mean and variance of log consumption. They can also be used to assess how changes in a particular household's characteristics and region-specific risks affect the mean and variance of consumption. Most importantly, they can be used to estimate the vulnerability of household $h(v_h)$. This is presented in Equation 7 as:

$$\hat{V}_h = Pr\left(lnc_h < ln|zX_h\right) = \Phi\left(lnz - X_h \Downarrow / X_h \Downarrow\right) \tag{7}$$

The estimates generated from Equation 6 were used to generate the vulnerability status of households, hence the reason for its disappearance in Equation 7. One of the problems in the implementation of the model that we have specified lies in the probability of some errors in the measurement of consumption. This could lead to an overestimation of the variance of consumption, and thus vulnerability. The estimation procedure – FGLS – provides an advantage especially in the estimation of the variance of the idiosyncratic component of household consumption.

Generating a vulnerability to poverty profile of different segments of rural farming households in Nigeria

This objective is achieved by defining a vulnerability to poverty line in terms of some cutoff probability. In this study a threshold vulnerability level of 0.5 was chosen. After the vulnerability indexes were generated for each household, those with indexes equal to or above 0.5 were termed vulnerable, while those below 0.5 were termed non-vulnerable. This allows us to generate the proportion of households that is vulnerable both in the total population of rural households at large and within the various segments of rural households. The vulnerability profile was constructed in such a way that it highlighted the vulnerability to poverty profiles of respondents taking into consideration their various demographic characteristics. Vulnerability profiles of this type are useful illustrative devices in the discussions of policy priorities among the various respondents with peculiar demographic characteristics.

Decomposition of vulnerability sources

The objective of decomposing sources of vulnerability to poverty was achieved by adopting Equation 8. To implement decompositions, we first chose a reference household with an associated bundle of characteristics, X_r. The vulnerability of other households was then assessed relative to this reference household. The difference between the vulnerability level of a household with characteristics X_h and that of the reference household was then decomposed as follows:

$$\hat{v}_h - \hat{v}_r = v(\hat{\mu}_h^c, \hat{\sigma}_h^c) - v(\hat{\mu}_r^c, \hat{\sigma}_r^c)$$

$$= \left[v(\hat{\mu}_h^c \hat{\sigma}_h^c) - v(\hat{\mu}_h^c \hat{\sigma}_h^c)\right] + \left[v(\hat{\mu}_h^c) - v(\hat{\mu}_r^c \hat{\sigma}_r^c)\right] \quad (8)$$

The usefulness of the decomposition exercise can be explained as follows. Suppose two groups in the population are estimated to be equally vulnerable relative to the reference household, but in one case it is due to low levels of mean consumption and in the other to high consumption variance. The appropriate policies for mitigating the vulnerability of these two groups will in general differ and it will therefore be important, for policy purposes, to be able to discriminate between the different sources of vulnerability.

Data

Our study used merged data from the National Consumer Expenditure Survey of Households (NCESH) and the General Household Survey (GHS) conducted by the Federal Office of Statistics (FOS) in 1996/97 under the National Integrated Survey of Households (NISH). The consumer expenditure survey provides data that can be used to address some detailed issues of household and individual welfare. The details about the data are provided in Canagarajah et al. (1996) and FOS (1999).

Essentially, the National Consumer Surveys (NCS) are supplemental modules of NISH, which has been on the FOS schedule of duties since 1953. Both the NCS and the GHS cover all the states of the federation including the Federal Capital Territory (FCT). The sampling procedure is such that 120 enumeration areas (EAs) are selected and covered annually in each state. From these, ten EAs were randomly allocated to each month of the survey. In each selected EA, a sample of ten households was covered each month for the GHS, while five households were subsampled for the NCS. In the final analysis, the merged GHS and NCS data consist of 9,436 households spread across all the states of the federation. The data set is rich in providing the general information necessary for an assessment of vulnerability to poverty. Besides information on the structure and composition of households, it also provides information on the quality of housing facilities and the quality of economic infrastructure available to the household. Thus, it is possible to adequately capture the data necessary for the assessment of vulnerability in Nigeria. Of the 9,436 surveyed households, 7,425 were rural. However, owing to incomplete data set (missing key variables for vulnerability analysis) only 7,210 rural households were used for the analysis, representing 97.1% of all rural households covered in the survey.

The main objective of the consumer expenditure surveys (four surveys as at 1996: 1980, 1985, 1992, 1996) was to provide data to meet the following needs (FOS, 1999):

- Revision of weights needed for the construction or revision of the consumer price index (CPI),
- Provision of household income and expenditure data needed for preparing some aspects of national income,
- Measurement of welfare and poverty,
- Provision of data on expenditure patterns and other socioeconomic features of the average household, and
- Provision of data for market and private research groups.

The data on region-specific shocks or risks itemized in the variables used are usually collected by the Federal Office of Statistics (now National Bureau of Statistics, NBS) and published in *Annual Abstract of Statistics in Nigeria*. Specifically, we used data on the regional risks taken from the 1997 *Annual Abstract of Statistics* (FOS, 1997), which is the relevant year for the NCS and GHS data.

5. Results and discussion

Here we present the results of the analysis of expected poverty of rural households in Nigeria. We discuss the summary statistics of the idiosyncratic and covariate variables, the determinants of rural household consumption in Nigeria, the vulnerability to poverty profile in rural Nigeria, and the decomposition of expected poverty by sources in rural Nigeria.

Summary statistics

Table 1 presents the summary statistics of the variables used in this study. The per capita expenditure per month averaged ₦1,139.05, with lows from ₦15.48 to as high as ₦41,649.45. The standard deviation reveals a high level of dispersion. The modal PCE reveals that most households have per capita expenditure that is far below the mean at about ₦663.19, thus indicating that households may not be able to meet the basic needs of life. The dependency ratio is low at 0.875, showing that there is an average of one dependent per household. But this ranges as high as eight dependents. The existence of dependents in each household is bound to affect the consumption status of households negatively. The age range of the rural household heads is 83 years, with the minimum age of 16 and maximum of 99. Most of the heads of households are in their economically active period with the modal age standing at 40 years. This age structure may be an indication that they are also in their active reproductive stage, thereby having implications for future household size. Household size averaged about five members with standard deviation of three. This seems not to be large but there are households with as many as 24 members. Larger household sizes may be a precursor to low per capita consumption, other things being equal. The gender dimension shows that households are mainly headed by males, with only 12.6% headed by female.

Most households are into agriculture, which in Nigeria is weather dependent. Hence, most agricultural activities take place in the rainy season. The weather dependency of agriculture means there can be an abundance of food at one time and scarcity at another. Any unfavourable weather situation can lead to poor harvest, which may translate into food shortages in the next period. The dwelling structure of the rural households shows that a majority (about 72%) live in single rooms while a smaller proportion lives in a whole building. There is an average of three rooms per household, indicating that about two members of the household live in a room. This may have implications for the health status of household members.

Good drinking water, as typified by treated piped water, is available to very few households. Nearly nine in ten (87.2%) rural households rely on lower quality sources of water including tankers and stream water, which may predispose them to water-borne

diseases. Sanitation facilities are also not conducive to decent and healthy living. Toilets available to the rural households range from bush/dung hill to the most modern toilet facility (water closet). While close to 46% of the rural households have access to a covered pit, only about 6.5% have either a water closet or a VIP toilet (ventilated improved pit latrine). The rest, about 47.5%, use only open toilet facilities. Doubtless this also has implications for the health status of household members, rendering them vulnerable to certain covariate risks (health hazards).

The educational status of the heads of rural households shows that about 87 out of every 100 household heads have less than secondary education. A majority have no education at all and only 2.8% have tertiary education. The low level of education may affect the income earning capacity of the households as they may lack the requisite skill and training to secure a highly remunerative job. Even those in agriculture may not adopt improved and modern farming systems aimed at increasing their efficiency, thus making them vulnerable.

The estimated mean value of the unemployment rate in Nigeria (as at 1996) stood at about 3% with a minimum of 6%. The volatility of government expenditure is worth noting since the findings show an average estimated value of ₦742 million per year with maximum value of about ₦5 billion per annum. The high level of fiscal indiscipline in government expenditure as suggested by the volatility of government expenditure says a lot and shows that it could play an important role in explaining why more households in Nigeria are likely to be more vulnerable to poverty in future.

The last key variables to be discussed are reported diseases in the country. Apart from the likely noted negative effects that disease such as HIV/AIDS, measles and malaria can have on Nigerians, malaria stands out as one of the key diseases that could make non vulnerable Nigerians vulnerable to poverty in future. Statistics show that the mean reported malaria cases in government hospitals stood at 34,737, with a maximum of about 75,000. Most malaria cases are not reported in Nigeria, and the fact that malaria incidence tops the reported disease cases (Table 1) shows that it is likely to be an important variable explaining why non-vulnerable Nigerians become vulnerable to poverty in future.

Determinants of rural household consumption

Sources of expected poverty in rural Nigeria were determined using the three-stage feasible generalized least squares (3FGLS) estimates as indicated earlier. Following Dercon (2001) and in a departure from the basic use of only idiosyncratic variables in cross-sectional analysis of expected poverty, we used certain covariates to complement the cross-sectional data. The idea is to capture aggregate shocks hitherto unaccounted for in vulnerability studies (see Chaudhuri et al., 2001; Chaudhuri, 2000; Alayande, 2003).

In order to appreciate the outcome in the 3FGLS, we provide the descriptive statistics of the variables used in the study (Table 1). In all, 7,210 rural households were used for the analysis. The analyses were carried out using LIMDEP version 7.

Table 1: Descriptive statistics of selected variables

Variable	Mean	Standard deviation	Definitions
PCE	1,139.05	1,694.01	Deflated per capita consumption expenditure
DEP-RAT	0.8752	0.8272	Dependency ratio
NC	0.1741	0.3786	North Central
NE	0.1666	0.3726	North East
NW	0.2198	0.4146	North West
SE	0.1828	0.3865	South East
SS	0.1549	0.3619	South South
SW	0.1018	0.3024	South West
HH SIZE	4.521	2.6684	Household size
Sex of H	0.8737	0.3274	Sex of household head
Age-of-HH	44.76	13.010	Age of household head
Farming	0.8091	0.3930	Farming as proportion of all households
Non-farming	0.1909	0.1327	Non farming as proportion of all households
Dwelling types			
Single room	0.7216	0.4997	Single room
Flat	0.0198	0.1394	Flat
Duplex	0.0070	0.0846	Duplex
Whole building	0.2468	0.4312	Whole building
Others	0.00485	0.0695	Other building type
No-of-ro	3.124	2.2928	Number of rooms
Water sources			
PIPED-WA-	0.1005	0.3008	Piped water treated
PIPED-W1-	0.0279	0.1646	Piped water untreated
WELL-SPR	0.1032	0.3042	Well/spring protected
WELL-SP1	0.1881	0.3908	Well/spring unprotected
BOREHOLE	0.1398	0.3468	Borehole/hand pump
TANKER	0.1373	0.1164	Tanker/truck/vendor
STREAM 1	0.3032	0.4939	Stream
OTHERS 1	0.0061	0.0778	Pond/river/rain water/others
Toilets			
COVERE	0.4592	0.4984	Covered pit
UNCOVERE	0.1051	0.3067	Uncovered pit
PAIL	0.066	0.0813	Pail
WATER-CL	0.0399	0.1731	Water closet
TOILETO	0.0298	0.1701	Toilet on water
BUSH	0.2736	0.3732	Bush/dung hill
VIP	0.0264	0.1563	VIP latrine
Education			
No-educ	0.6711	0.7518	No education
PRI-EDUC	0.2079	0.4058	Primary education
SEC-EDUC	0.0917	0.2886	Secondary education
TER-EDUC	0.0283	0.1658	Tertiary education

Continued

Table 1, Continued

Variable	Mean	Standard	Definitions

		deviation	
Covariates			
PRICE-LEV	4033.64	6100.94	Price level
UEMPRATE (%)	2.98	2.984	Unemployment rate
VOLA GOV (₦ million)	742.79	4087.55	Volatility of government expenditure
RAINFALL (mm)	93.28	71.88	Rainfall
SUNSHINE (hour)	3.476	3.935	Sunshine hours
RADIATN (mm)	6.058	5.848	Radiation in mm
REPARMDR	70.10	71.89	Reported armed robbery cases in number
AIDS	4.296	13.091	HIV/AIDS (in number)
MALARIA	34,737	41,625.94	Reported malaria (number)
MEASLES	1,773.19	2654.66	Reported measles (number)
RIVER_BL	188.53	663.27	River blindness (number)

Source: Authors' computation.

In presenting the three-stage result of the 3FGLS, we proceed by providing a detailed explanation of its estimation. Following the assumption of a stochastic process generating the consumption of a household, we regressed both idiosyncratic and covariate characteristics against the log of per capita consumption expenditure of the different households using-OLS (stage 1). The error term of the OLS estimates was generated for each household, and its square was regressed against the idiosyncratic and covariate characteristics as done in the first regression. The estimated value from the second OLS regression was used to transform the variables for the second regression (stage 2). The essence of the transformation is to obtain an asymptotically efficient FGLS estimate to serve as a consistent estimate of variance of both idiosyncratic and covariate components of household consumption in Nigeria. The square root of the consistent estimate was used to transform the first regression, which was subject to OLS estimation. This yields consistent and asymptotically efficient estimates of the variables (stage 3). The results from both stage 2 and stage 3 were used to directly estimate the variance of the log of per capita consumption and the expected log of per capita consumption, respectively. The results of the first and second stages are in the Appendix while the third stage results are indicated in Table 2.

From Table 2, it is evident that both idiosyncratic and covariate factors affect the expected log per capita consumption of rural households in Nigeria. Among the covariate factors, the regional location of households, unemployment rate, AIDS and river blindness are the key determinants of expected per capita log consumption. It is worthwhile to note that some of the covariate variables did not have the expected signs. These are regional price levels, armed robbery, and regional diseases such as AIDS, malaria and measles. The fact that some of these variables do not have expected signs can be explained. For example, the well-organized and well-managed AIDS programme in Nigeria, which reduces the progression of HIV infection to AIDS, may explain the positive relationship between the two variables. Other variables such as unemployment and volatility in government spending have the expected signs. Similarly, idiosyncratic variables with significant influence on expected log per capita consumption include household size, sex of household head, age of household head, some housing types, pipe-borne water (treated and untreated) and borehole. Other idiosyncratic factors include use of covered

or uncovered pit, and tertiary education.

Table 2: Third stage of the 3FGLS estimates

Variable	Coefficient	Standard error	| P [| Z | >Z]
Constant	7.0001	.6657E-01	.0000
DEP___RAT	-.4870**	.3125E-01	.0000
NE1	-.1541**	.3590E-01	.0000
NW1	-.1581	.3319E-01	.6332
SE1	-.1497**	.3550E-01	.0000
SS1	-.1951**	.3729E-01	.0000
SW1	-.2075**	.4253E-01	.0000
HHSIZE	-.1807E-01**	.4119E-02	.0000
SEX_OF H	.1159**	.3301E-01	.0004
AGE_OF H	.4903E-02**	.7958E-03	.0000
FARMING__	.4391E-02	.2827E-01	.8766
FLATS1	.16296*	.7366E-01	.0269
DUPLEX1	-.3597**	.1332	.0069
WHOLEBUI	.1157**	.3140E-01	.0002
OTHERS	-.6023	.1566	.0001
NO_OF_RO	-.12778E-02	.4672E-02	.7845
PIPED_WA	-.10572*	.4519E-01	.0193
PIPED_W1	-.2645**	.7036E-01	0002
WELL_SPR	.2791E-01	.3792E-01	.4617
WELL_SP1	-.2075E-01	.3648E-01	.5694
BOREHOLE	-.1160*	.4368E-01	.0079
TANKER_T	.6283E-01	.9288E-01	.4987
OTHERS11	-.2571	.1453	.0768
COVERED	-.5390E-01	.3020E-01	.0743
UNCOVERE	.1217*	.4756E-01	.0105
PAIL1	.2753*	.1337	.0395
WATER_CL	-.7368E-02	.6903E-01	.9150
TOILET_O	.1319	.7067E-01	.0620
PRI_EDU	.4564E-01	.2863E-01	.1109
SEC_ EDUC	-.2910E-01	.4012E-01	.4682
TER_EDU	.2102**	.6730E-01	.0018
PRICELEV	.1820E-05	.2066E-05	.3784
UNEMPRATE	-.1119E-01*	.4526E-02	.0134
VOLAGOVE	-.1897E-05	.4370E-05	.6643
RAINFALL	-.2622E-03	.1731E-03	.1299
SUNSHINE	-.2465E-02	.3208E-02	.4422
RADIATN	-.1062E-02	.2246E-02	.6362
REPARMDR	.3396E-03	.2578E-03	.1878
AIDS	.3148E-02*	.8637E-03	.0003
MALARIA	.2412E-06	.2750E-06	.3804
MEASLES	.75016E-05	.4663E-05	.1077
RIVER_BL	.3553E-04*	.1669E-04	.0333

R^2 = 0.1880; adjusted R^2 = 0.1834; model test F(41,7168) = 40.48; prob. value = 0.000; diagnostic log – L = -9155.246

Note ** Significant at 1%

* Significant at 5%.

Vulnerability profile using expected poverty

Table 3 depicts the poverty status of rural households in Nigeria. The columns show both the predicted and observed poverty as well as the vulnerability to poverty ratios. The geopolitical distribution of the observed poverty profile shows that the South Eastern zone is the poorest while the North Central zone is the least poor. But the North East has the highest level of predicted poverty and the South South has the least predicted poverty level. The relativity of predicted poverty to the observed poverty level shows that for every hundred poor people in the North East, 27 more are expected to be poor in the future. The same trend is observed in the North West, South West and North Central zones. On the other hand, people are expected to move out of poverty in the South East and the South South in the future.

Table 3: Expected/observed poverty profile of rural households in Nigeria by demographic/socioeconomic characteristics

Demographic/socio-economic characteristics	Predicted poverty or expected poverty incidence	Observed poverty or poverty incidence	Predicted/ observed poverty ratio
Geopolitical zone			
North East	0.67777	0.53289	1.272
North West	0.55394	0.54826	1.010
South East	0.45599	0.55159	0.827
South South	0.36526	0.50224	0.727
South West	0.61444	0.52589	1.168
North Central	0.56335	0.47729	1.180
Educational level			
No formal education	0.67623	0.56533	1.196
Primary education	0.28219	0.43938	0.642
Secondary education	0.21785	0.43116	0.505
Tertiary education	0.07353	0.48039	0.153
Farming/Non farming			
Farming	0.54611	0.53925	1.013
Non farming	0.4891	0.46221	1.058
Gender			
Male	0.53587	0.5237	1.023
Female	0.53077	0.53068	1.0002
Age of household head			
21 or less	0.55172	0.52542	1.050
21 to 40	0.50081	0.52301	0.958
41 to 60	0.56237	0.523	1.075
61 and above	0.55473	0.48357	1.147
Household size			
1 person household	0.45185	0.47637	0.949
2 to 6	0.522	0.53045	0.984
7 to 10	0.60562	0.53345	1.135
above 10	0.78818	0.5122	1.539
All	0.53523	0.52469	1.020

Source: Authors' computation.

The poverty profile ratio by educational qualification shows that human capital is a

key factor in mitigating vulnerability to poverty. The observed poverty level shows that the incidence of poverty is highest in households without education. The expected poverty trend is similar to the observed poverty. More importantly, however, is that fewer people are expected to be poor relative to the observed (actual) poverty for households with primary, secondary and tertiary educations. Households whose heads are without education are prone to poverty. Indeed, an additional 20 households in this category are expected to be poor for every 100 currently poor households.

The incidence of poverty by occupational leaning indicates higher levels of poverty among farming households whether predicted or observed. Moreover, to every 100 currently poor households between 1 and 6 more farming and non-farming households, respectively, are expected to be poor. Both male- and female-headed households are vulnerable to poverty but male-headed households are more vulnerable.

The age categorization of vulnerability to poverty indicates that fewer households headed by persons aged 21–40 are expected to be poor in the future, but more households whose heads are in the other age groups will be poor in the future. Households with large family size are more prone to being poor in future. As household size increases, the vulnerability to poverty ratio will increase. Indeed, for households with more than six members, more members of these households will become poor in the future. Specifically, for every 100 poor households, 14 and 54 more households will become poor for households of sizes 7–10 and 10-plus, respectively, in the future.

Decomposition of expected poverty by sources

The decomposition of the expected poverty was arrived at by comparing the expected poverty of a household with that of a reference household, which is the one with the highest level of expected poverty in the population. The decomposition was based on the significant variables in the 3FGLS. This led to the selection of variables relating to geographical zones, educational status, occupation, gender, age of household head and household size. The decomposition also involved estimating the relativity of the expected per capita consumption by a given household to the household with the highest level of expected poverty, keeping the variance constant. Conversely, the difference in the variance of expected consumption was obtained using the relativity of the variance of a given household to the reference household, keeping the expected log of consumption constant. The results of the decomposition are indicated in Table 4.

From the table, the decomposition by geographical zones shows that the North East zone has the least expected consumption and the second highest variance of expected consumption. By contrast, the North Central zone has the highest expected consumption and the least consumption variance. Both the South West and the South East have almost equal expected poverty levels. However, a perusal of the sources of expected poverty indicates that the variance of consumption explains the predicted poverty more in the South West than in the South East. Following from this, the variance of consumption in the South West zone is 1.6 times more than that of the South East zone. The appropriate policy for alleviating expected poverty is thus more of consumption smoothening in the South West, while that of South East will involve more of raising per capita consumption. Also, the North East has a relatively high consumption variance as well as the lowest

mean consumption. This suggests that strategies for both consumption smoothening and increased per capita consumption should be the key policy focus to mitigate expected poverty.

Table 4: Decomposed different sources of expected poverty among rural households in Nigeria

Demographic/socio-economic characteristics	Expected poverty index	Mean consumption index	Consumption variance index
Geopolitical zone			
North East	0.60051	0.7498	0.03281
North West	0.58088	0.8089	0.01147
South East	0.59573	0.76771	0.02156
South South	0.60246	0.7501	0.01406
South West	0.59585	0.76838	0.03592
North Central	0.56701	0.84645	0.00945
Educational level			
No formal education	0.59765	0.7623	0.02281
Primary education	0.55226	0.88351	0.02125
Secondary education	0.56822	0.83903	0.02074
Tertiary education	0.55116	0.89367	0.01958
Farming/Non farming			
Farming	0.59484	0.76975	0.02156
Non farming	0.57508	0.82257	0.01903
Gender			
Male	0.59321	0.77371	0.02293
Female	0.57873	0.81569	0.0085
Age of household head			
21 or less	0.59814	0.76069	0.02495
21 to 40	0.59178	0.77792	0.0242
41 to 60	0.59168	0.7775	0.02052
61 and above	0.58843	0.78992	0.01269
Household size			
1 person household	0.58919	0.78266	0.01974
2 to 6	0.59008	0.78293	0.01974
7 to 10	0.59461	0.77066	0.02334
Above 10	0.60375	0.7424	0.03697
All	0.5914	0.77896	0.02112

Source: Authors' computation.

In terms of occupational dichotomy (farming/non-farming), farming households have lower mean consumption and higher variability in consumption compared with their non-farming counterparts. In this connection, increasing mean consumption and smoothening consumption strategies are necessary to mitigate against expected poverty among farming households.

Male-headed households have lower mean consumption and higher consumption variance compared with female-headed households. Logically, therefore, consumption smoothening strategies are key to mitigating against expected poverty of male-headed

households.

In terms of age, household heads below or about 20 years old have the lowest mean consumption and the highest consumption variance. Household heads above 60 years have the highest mean consumption and the lowest consumption variance. Households headed by people within the age ranges of 21–40 and 41–60 years have almost the same level of expected poverty relative to the reference household, but for the younger group this is more of high consumption variance compared with their older counterparts.

The result of the decomposition of expected poverty with respect to household size shows that households with 2–6 members have the highest mean consumption and one of the lowest consumption variances. Conversely, households with more than ten members have the lowest mean consumption and the highest variance of consumption. The key mitigating strategies against high levels of predicted poverty among households with more than ten members are raising per capita consumption and stabilizing consumption.

When expected poverty is decomposed with respect to the educational status of the head of the household, those whose heads have no formal education have the lowest mean consumption level while those whose heads have tertiary education have the highest mean consumption. In general, mean consumption increases with the level of education except among households headed by persons with secondary education. On the other hand, the consumption variance is highest for households headed by secondary school leavers, followed by those with primary education. Relative to the households headed by primary school leavers, those headed by tertiary education holders have almost the same expected poverty estimates.

On the other hand, the variance of consumption for primary school leavers is 2.3 times higher than that of households with heads educated to tertiary level. This suggests that the predicted poverty of heads of households with primary school is driven more by high consumption variance.

6. Conclusions and policy recommendations

Both idiosyncratic and covariate factors affect consumption by rural households in Nigeria. The key covariate factors are the regional location of households, unemployment rate, AIDS and river blindness. On the other hand, the household size, the sex, age and education status of household head, the housing types, and the water and toilet facilities are the key idiosyncratic factors. The rural South East zone constitutes the poorest region, while the rural North Central zone is the least poor. The rural North East zone has the highest level of predicted poverty, and the South South has the lowest. More rural households are expected to be poor in the North East, North West, South West and North Central parts of the country, while rural households are expected to move out of poverty in the South East and South South regions.

Households whose heads are without education recorded the highest incidence of poverty and more of them are expected to be poor in the future. Fewer rural households are expected to be poor relative to the observed (actual) poverty for households with primary, secondary and tertiary educations. There is evidence of higher levels of poverty among rural farming households (whether predicted or observed) compared with their rural non-farming counterparts. Fewer households with heads aged 21–40 years are expected to be poor in the future, but more households in the age groups 20 or less years, 41–60 years and 61-plus years are likely to be poor in the future. And as household size increases, so will the members of these households become poorer in the future.

It should also be noted that respondents with no formal education, household heads who are 61 years and above, along with households with 7–10 and 10-plus members, have higher expected poverty figures compared with their observed poverty figures. The reasons for this are not farfetched. Household heads with no education will have little or no basis for competing within the very competitive Nigerian economy and will therefore have access to fewer resources, which will make them poorer in the future. Similarly, the aged household head who is not within the active working age bracket will have access to fewer resources and will become poorer. Large households – family sizes of 7–10 and above – will obviously risk having to grapple with lower per capita income in future, given Nigerians' ever dwindling purchasing power, and are likely to become poorer in future.

Rural households in the South East and South West zones have almost equal expected poverty levels. However, the variance of consumption explains the source of expected poverty more for rural households in the South West than the South East. Further, rural households in the North East zone have relatively high consumption variance as well as the lowest mean consumption compared with other rural households in other regions of the country.

Rural households headed by primary school leavers have almost the same expected poverty estimates as those headed by tertiary education holders. Further decomposition analysis, however, suggests that the predicted poverty of households headed by primary school leavers is driven more by high consumption variance. Rural farming households in Nigeria have lower mean consumption and higher variability in their consumption profile compared with their rural non-farming counterparts. Male-headed households have lower mean consumption and higher consumption variance than those headed by females. Households headed by people within the age ranges of 21–40 and 41–60 have almost the same level of expected poverty relative to the reference household. The source of expected poverty of households headed by those within the age range 21–40 years is more of high consumption variance. Rural households with more than ten members have the lowest mean consumption and the highest variance of consumption in Nigeria.

The implications for policy arising from this study's conclusion are substantial. The appropriate region-specific policy for mitigating against expected poverty in the rural South West and North East zones would involve consumption smoothening strategies (e.g., meal subsidies, school feeding and food stamp programmes), while raising per capita consumption of rural households in the rural South East and North East zones is the key mitigating factors against expected poverty. Policy strategies to prevent expected poverty among farming households and households with more than ten members should aim to increase per capita consumption and smoothen consumption. An aggressive human capital development policy must be put in place to mitigate high levels of expected poverty among rural Nigerians. This is so since the findings have shown the lack of education of household heads predisposes households to poverty,. both observed and expected. And because the findings have shown that as household size increases, household members become more vulnerable to poverty, an aggressive family planning policy is another necessary component in the strategy for mitigating against high levels of expected poverty among rural Nigerians.

Notes

1 Full exposition on the three approaches is presented in the theoretical framework of this write-up.

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Appendix – Stages of the feasible generalized least square regression

This appendix derives from Chaudhuri (2000) and shows the stages of the feasible generalized least square regression. It does not contain covariate variables, but it has been appropriately documented in the final stage of the analytical tool used in the body of our study and following Dercon (2001).

We begin by assuming that the stochastic process generating the consumption of a household h is given by:

$$\text{Stage 1} \quad lnc_h = X_h\beta + e_h \tag{A1}$$

where c_h per capita consumption expenditure, X_h represents a bundle of observable household characteristics such as household size, location, educational attainment of the household head, etc., $\square$ is a vector of parameters, and e_h is a mean-zero disturbance term that captures idiosyncratic factors (shocks) that contribute to different per capita consumption levels for households that are otherwise observationally equivalent.

We assume that the variance of e_h is given by:

$$\sigma^2_{e,h} = X_h\theta \tag{A2}$$

We estimate β and θ using a three-step feasible generalized least squares (3FGLS) procedure.

First we estimate Equation A1 using an ordinary least squares (OLS) procedure. We use the estimated residuals from (A1) to estimate:

$$\hat{e}^2 OLS_{,}h = X_h\theta + \eta_h \tag{A3}$$

using OLS. The predictions from this equation are used to transform the equation as follows:

$$\text{Stage 2} \quad \frac{\hat{e}^2 OLS_{,}h}{X_h\hat{\theta}_{OLS}} = \left[\frac{X_h}{X_h\hat{\theta}_{OLS}}\right]\theta + \frac{\eta_h}{X_h\hat{\theta}_{OLS}} \tag{A4}$$

This transformed equation is estimated using OLS to obtain an asymptotically efficient

FGLS estimate, $\hat{\theta}_{FGLS}$. Note that $X_k\hat{\theta}_{FGLS}$ is a consistent estimate of $\sigma^2_{e,h}$ the variance of the idiosyncratic component of household consumption.

$$\sigma_{e,h} = \sqrt{X_h}\hat{\theta}_{FGLS} \tag{A5}$$

The estimates are then used to transform Equation A.1 as follows:

$$\text{Stage 3} \quad \frac{\ln_{ch}}{\hat{\sigma}_{e,h}} = \left[\frac{X_k}{\hat{\sigma}_{e,h}}\right]\beta + \frac{e_k}{\hat{\sigma}_{e,h}} \tag{A6}$$

OLS estimation of Equation A1 yields a consistent and asymptotically efficient estimate of $\square$. The standard error of the estimate coefficient, $\hat{\beta}_{FGLS}$, can be obtained by dividing the reported standard error by the standard error of the regression.

Using the estimates $\hat{\beta}$ and $\hat{\theta}$ that we obtain, we are able to directly estimate expected log consumption:

$$\hat{E}\left[\ln_{ch}/X_h\right] = X_h\hat{\beta} \tag{A7}$$

and the variance of log consumption:

$$\hat{V}\left[\ln_{ch}/X_h\right] = \hat{\sigma}^2_{e,h} = X_h\hat{\theta} \tag{A8}$$

for each household h. By assuming that consumption is log-normally distributed, we are then able to use these estimates to form an estimate of the probability that a household with the characteristics X_h will be poor, i.e., to estimate the household's vulnerability level. With $\Phi(.)$ denoting the cumulative density of the standard normal, this estimated probability will be given by:

$$\hat{v}_k = \hat{\Pr}\left(\ln_{ch} < \ln z/X_k\right) = \Phi\left[\frac{\ln z - X_k\hat{\beta}}{\sqrt{X_k\hat{\theta}}}\right] \tag{A9}$$

where
- c_h = consumption level of household h
- X_h = vector of independent variables including household demographic composition and human capital
- β = regression coefficients of idiosyncratic variables
- $\hat{o}_{e'h}$ = variance of idiosyncratic and covariate variables
- e_h = error term

Table A1: First stage of the 3FGLS estimates

Variable	Coefficient	Standard error	| P [| Z | >Z]
Constant	6.989093314	.66774840E-01	.0000
DEP___RAT	-.2648957568	.12393575E-01	.0000
NE	-.1226863212	.36047464E-01	.0007
NW	-.9282272599E-01	.33693736E-01	.0059
SE	-.1356796489	.35728735E-01	.0001
SS	-.5610284679E-02	36574801E-01	.8781
SW	-.8612350897E-01	.42144623E-01	.0410
HHSIZE	-.1235352081E-01	.41316142E-02	.0028
SEX_OF H	.2192382103E-01	.33245137E-01	.5096
AGE_OF H	.6167308921E-03	82297076E-03	.4536
FARMING__	.8943738791E-02	.28241293E-03	.7515
FLATS	-.1174826793	.75391673E-01	.1192
DUPLEX	.2267074607E-01	.12640612	.8577
WHOLEBUI	-.3170818125E-01	.31724351E-01	.3176
OTHERS	-.2816227132	.14932935	.0593
NO_OF_RO	.1391229865E-02	.46745582E-02	.7660
PIPED_WA	.5677658002E-01	.45134412E-01	.2084
PIPED_W1	.1352035576	.68874713E-01	.0496
WELL_SPR	-.4433689946E-01	.38269451E-01	.2466
WELL_SP1	-.1049967755	.36763160E-01	.0043
BOREHOLE	-.2656931449E-01	.43533001E-01	.5416
TANKER_T	.1561210034E-02	.93493959E-01	.9867
OTHERS1	.1728681562	.13892631	.2134
COVERED	.6341634103E-01	.30275533E-01	.0362
UNCOVERE	.1778266035E-01	.47891702E-01	.7104
PAIL	.1065928217E-01	.13687562	.9379
WATER_CL	.9901972774E-02	.69665311E-01	.8870
TOILET_O	.1189335923	.71343277E-01	.0955
PRI_EDU	.5306053069E-01	.28741643E	.0649
SEC_ EDUC	.3305942531E-01	.39926445E-01	.4077
TER_EDU	.2469313882	.67113537E-01	.0002
PRICELEV	.1398530594E-05	.20629426E-05	.4978
UNEMPRATE	-.1257945370E-01	.45365899E-02	.0056
VOLAGOVE	-.2739466697E-06	.43766715E-05	.9501
RAINFALL	-.3462360158E-03	.17388779E-03	.0465
SUNSHINE	.2388701862E-03	.32106303E-02	.9407
RADIATN	-.8813846958E-03	.22540413E-02	.6958
REPARMDR	.4480822517E-03	.25923581E-03	.0839
AIDS	1240062826E-02	.87228357E-03	.1551
MALARIA	.3999730524E-06	.27421548E-03	.1447
MEASLES	.7647361745E-05	.46837625E-05	.1025
RIVER_BL	.1030277373E-04	.16290723E-04	.5271

R^2 = 0.075678; adjusted R^2 = 0.07039; model test F(41,7168) = 14.3L; prob. value = 0.000; diagnostic log – L = -9155.299.

Table A2: Process leading to stage 2 of the 3FGLS

Variable	Coefficient	Standard error	| P [| Z | >Z]
Constant	.7173376836	.88345676E-01	.0000
DEP___RAT	-.6302643540E-01	.16397175E-01	.0001
NE	.1515186500	.47692179E-01	.0015
NW	.3223186514E-01	.44578105E-01	.4697
SE	-.4975760727E-01	.47270487E-01	.2925
SS	.5829521082E-01	.48389865E-01	.2283
SW	.1318031750	.55758954E-01	.0181
HHSIZE	.2479610204E-02	.54662842E-02	.6501
SEX_OF H	-.8606692694E-02	.43984593E-01	.8449
AGE_OF H	.6031064050E-03	.10888219E-02	.5796
FARMING__	-.4089950407E-01	.37364315E-01	.2737
FLATS	.1699841395	.99746076E-01	.0883
DUPLEX	-.7687721130E-01	.16724014	.6457
WHOLEBUI	.1147369243E-01	.41972533E-01	.7846
OTHERS	-.2266363308	.19756846	.2513
NO_OF_RO	.6072018237E-02	61846199E-02	.3262
PIPED_WA	.2231740289	.59714559E-01	.0002
PIPED_W1	.5676856318E-01	.91123888E-01	.5333
WELL_SPR	.5410538265E-01	.50631952E-01	.2852
WELL_SP1	.2171892145	.48639072E-01	.0000
BOREHOLE	.2370607095	.57595831E-01	.0000
TANKER_T	.1079873097	.12369610	.3827
OTHERS 1	.2642306392	.18380483	.1506
COVERED	-.7284818139E-01	.40055691E-01	.0690
UNCOVERE	-.1907158684	.63362559E-01	.0026
PAIL	-.2227178702	.18109170	.2187
WATER_CL	-.9463812915E-01	.92169880E-01	.3045
TOILET_O	-.2484613873	.94389893E-01	.0085
PRI_EDU	-8365958454E-02	.38026296E-01	.8259
SEC_ EDUC	.7421897251E-01	.52824219E-01	.1600
TER_EDU	-.8536682987E-01	.88793785E-01	.3363
PRICELEV	-.4925051419E-06	.27293523E-01	.8568
UNEMPRATE	-.2102653288E-02	.60020826E-02	.7261
VOLAGOVE	-.2340322433E-05	.57905043E-05	.6861
RAINFALL	.2780842217E-03	.23006021E-03	.2268
SUNSHINE	-.6290836920E-02	.42477872E-02	.1386
RADIATN	.1456928600E-02	.29821832E-02	.6252
REPARMDR	-.1803020991E-03	.34297893E-03	.5991
AIDS	.6960931684E-03	.11540646E-02	.5464
MALARIA	.1987354897E-07	.362797646E-02	.9563
MEASLES	-.1572375180E-07	.61967975E-05	.0112
RIVER_BL	-.2213298353E-05	.21553251E-04	.9182

R^2 = 0.013564; adjusted R^2 = 0.00792; model test F(41,7168) = 2.40; prob. value = 0.94610; diagnostic log – L = -11173.6003.

Table A3: Second stage of the 3FGLS estimates

Variable	Coefficient	Standard error	P [| Z | >Z]
Constant	1.000042318	.11712653	.0000
DEP___RAT	.3796452510E-01	.14465950E-01	.0087
NE1	.5539428445E-02	.54504334E-01	.9190
NW1	-.1466861341E-01	.41802178E-01	.7257
SE1	.1868629249E-02	.39895123E-01	.9626
SS1	.4051280333E-01	.48036477E-01	.3990
SW1	.2675537464E-01	.62245836E-01	.6673
HHSIZE	.9728137297E-03	.52332250E-02	.8525
SEX_OF H	-.1757670282E-03	.40467919E-01	.6640
AGE_OF H	-.8628222634E-03	.10674462E-02	.4189
FARMING__	.2433186527E-02	.35408369E-01	.9452
FLATS1	-.6870772683E-01	.12076280	.5694
DUPLEX1	.7567436557E-01	.14832033	.6099
WHOLEBUI	-.3251495251E-01	.42990860E-01	.4495
OTHERS	.3185112320E-01	.12854945	.8043
NO_OF_RO	.6102528809E-03	.65987563E-02	.9263
PIPED_WA	.1014429602E-01	.68878975E-01	.8829
PIPED_W1	.2046809050E-01	.84461957E-01	.8085
WELL_SPR	-.1457018281E-01	.48763666E-01	.7651
WELL_SP1	-.2148814150E-01	.58501117E-01	.7134
BOREHOLE	.1758764359E-01	.68010069E-01	.7959
TANKER_T	-.1747841817E-01	.12387196	.8878
OTHERS11	.1106605968	.22234612	.6187
COVERED	.2943243791E-01	.42098967E-01	.4845
UNCOVERE	-.1770911771E-01	.67094562E-01	.7918
PAIL1	-.4707340054E-01	.16509625	.7755
WATER_CL	.7854310563E-02	.96510466E-01	.9351
TOILET_O	.5034584056E-02	.94671473E-01	.9576
PRI_EDU	-.3391834525E-03	.36572137E-01	.9926
SEC_ EDUC	.1043118556E-01	.55447613E-01	.8508
TER_EDU	.6839661492E-02	.79426593E-01	.9314
PRICELEV	-.6531964906E-07	.27230882E-05	.9809
UNEMPRATE	-.3469620826E-03	.56005351E-02	.9514
VOLAGOVE	.4018537610E-06	.53742813E-05	.9404
RAINFALL	-.2091354174E-04	.22981389E-03	.9275
SUNSHINE	.4598663047E-03	.39170518E-02	.9065
RADIATN	.6706134991E-04	.27780151E-02	.9807
REPARMDR	.1756437287E-04	.29840906E-03	.9531
AIDS	-.4243971830E-03	.10777435E-02	.6937
MALARIA	.2332346546E-07	.34153530E-06	.9456
MEASLES	.4289326902E-06	.58096498E-05	.9411
RIVER_BL	.9456703543E-05	.19879584E-04	.6343

R^2 = 0.0019; R^2 squared = 0.0037; model test F(41,7168) = 0.35; prob. value = 1.000; diagnostic log – L = -13275.77.

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