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MODELLING THE DETERMINANTS OF INCOME VOLATILITY OF FARM HOUSEHOLDS IN AKWA IBOM STATE,

Udoh, E. J[1] and Akpan, O. D[1*]
[1]Department of Agricultural Economics & ExtensionUniversity of Uyo, Akwa Ibom State, Nigeria
*Corresponding author: sacrementum2020@yahoo.com, mobile: +2348032717955

Abstract
The determinant of income volatility of farm households in Akwa Ibom State is the aim of this study. Primary data were collected from farm households for a period of one year (April 2015 to March, 2016), using structured questionnaire. Income volatility indices were generated and measured from each farming household using Generalized Autoregressive Conditional Heteroskedacity (GARCH) and Coefficient of Variation (CV). The determinants of income volatility were estimated using Ordinary Least Square (OLS). The OLS regression result for both GARCH and CV reveals that; household size, educational status, and farm size, number of income activities, normalized farm and non-farm income, cost of inputs, household expenditure on food and non-food items significantly influences income volatility at varied probabilities level. (1%, 5% and 10%) and affects income of farm households. It was recommended among others that, yearly measurement and monitoring of income volatility of farming households should be carried out by government and other development agencies in Akwa Ibom State.
Keywords: Determinants, Income Volatility, GARCH, Coefficient of Variation and Farm Households

Introduction
Economic well-being of rural farmers is affected not only by the level of income but by fluctuations in price and output, (Poon and Weersink, 2011). In sub-Sahara Africa (SSA) especially Nigeria, volatility in households' income is widespread among the rural poor and remain persistently high, (Hackerand Solon, 2003). Worldwide, the rural sector harbors vast majority of the poor accounting for more than 70% of total population estimated at about 6,602,224,175 people, (World Bank, 2007). Between 1980 and 2012 Nigeria's rural poverty indices were higher than urban poverty and majority of the rural poor derived their livelihood from subsistence agriculture as rural income is equated with agricultural income, (NBS, 2004 and Fausat, 2012). However, the rural economy in sub-Saharan Africa (SSA) is strongly based on agriculture relative to other regions. In Nigeria about 70% of her over 180 million people depend directly on farm and farm related activities for survival or depend on these activities to complement other sources of livelihood, (Olawepo, 2010).

Globally, average income is about $2.5 or ₦390 per person (UNDP, 2012). In Nigeria and Akwa Ibom State in particular, more than 65% of the rural poor lives under $2.00 or ₦312.00 per day (threshold poverty) while two-third (2/3) lived under or around $1.25 or ₦195 a day (extreme poverty), UNDP (2012), Mankiw (2000) and Omoh (2012). Available statistics have shown that since independence, economic growth has by-passed the poor. Derek De Janvry and Elizabeth (2011) submitted that most countries in Asia and Latin America have experienced rapid reduction in rural poverty while a reverse is observed in sub-Saharan Africa where disparitybetween rural and urban incomes has tended to widen in Nigeria. Festus (2017) reported that, there is a grave gap in income inequalities and growing poverty in Nigeria are not moving in tandem with the nation's Gross Domestic Product. This has forced economists to conclude that the disparate trend typifies the imperfections in the country's macroeconomic structure. Review of the global welfare measures reveals that Nigeria is one of the most unequal nations in Africa in terms of income distribution and Akwa Ibom State is one

of the States with the highest income inequality and is prominent among the small scale holder farmers and other low income earners in the public service, (UNDP, 2012); CBN, (2011); IFAD, (2011); Livingstone, Sihonbeger and Deleway, (2011).

Currently, it is estimated that, Nigeria might have more poor people than India and China. Poverty profile in Nigeria shows that, Akwa Ibom State is the third state with the highest poverty rate of 27.1% in the south-south zone after Cross River State (31.2%) and Bayelsa state (32.5%), (UNDP, 2010). NBS (2004) report shows that, Akwa Ibom State has the second highest unemployment rate of over 25.8% after Delta state in the south-south zone, but leads other states in the zone in terms of income generating opportunities. Majority (69%) of the farm households in Akwa Ibom State are facing income uncertainties, both market related (price fluctuations) as well as non-market related (output variation). These uncertainties do not only induce substantial income risk, but are detrimental to the farming household's income and welfare (Ayakale, 2008). Olatona (2007) submitted that, in developing economies over 84.08% of income variation is caused by market and non-market related factors. Kareen (2010) in a study on rising income volatility and its implications in United States of America (USA) reported that, many households suffer devastating income uncertainties which have led to the introduction of market oriented economic reforms thereby exposing farming households to global market conditions. The fundamental question arising from the above discourse is what are the determinants of income volatility among farm households in Akwa Ibom State? The study aimed to examine the determinants of income volatility among farm households in Akwa Ibom State, Nigeria.

Review of empirical literature

Newman *et al.,* (2009) reported that program participation among households with volatile incomes may be affected by many factors. Umoh (1994) in a study on household expenditure pattern found that, an increase in income disparity among self-employed than wage earners and among households heads with or without secondary education concluded that there was disparity in income distribution among agrarian households in the study area while differences exists in consumption patterns of households which are linked to changes in disposable income between households. Orok (2005) reported that standard of living in rural households in Nigeria is linked to variation in income which is attributed to different individual capacity within the households and observed that an increase in level of education, age and socialization activities of an individual in the society influences the amount of disposable income of farm households. Lanjaour (1999) found that education was significant and positively correlated with off-farm income. Farm households with more education were involved in non-agricultural self-employment such as handicrafts, commerce and machinery repairs and agro-processing. Babatunde (2008), in a study on the role of off-farm income diversification found that, education and age coefficients were significant at 5% level, that households head with older heads benefits from agricultural employment, while education was particularly important for households with income from non-agricultural employment and self-employed activities. Dong (2005) found that, an increase in off-farm income increases the overall volatility of income among farm households in Vietnam. Weersick (2011) reported that, the coefficient of variation (CV) in farm income was significantly greater than that of off-farm income but both measures were inversely related to household's permanent income sources of the operation. Also, pensioners and livestock farmers were found to have a lower (CV) for both farm and off-farm income compared to business focused farmers.Hertz (2007) in a regression analysis of the determinants of income volatility at the state level revealed that, states with higher shares of employment in agriculture, wholesale and retail trade, and other services as compared to manufacturing and those with lower union coverage rates, experienced greater volatility (over 60%). Wicher *et al.,* (2004) found that off-farm income contributes about 22% to total farm household income and associates with a wide variation of farm household income with an appreciable incidence of negative income

because of the volatility in farm, business income from year-to-year. Awoyemi (2009) found that, seasonality is another price volatility factor and that may cause crops price to behave in a rather unpredictable manner. Ibekwe et al (2010)found that age was not statistically significant at 5% level but positively correlated with income. Similarly, the cause of household income volatility is subject to changes in family structure and joint decisions (household labour supply, joint job search, family formation and dissolution etc.) of household members. Ngwafon *et. al.,* (1997) reported that, over 83.8% and 77.7% of expenditures by the poor was spent on food. Austin *and* Zimmerman (2008) in a study on measuring trends in income variability in USA found that, the volatility of family income has increased overtime (a trend that is robust to a large variety of modeling choices) but the trend in individual income volatility is less clear. Moreover, a clear pattern in volatility of individual earnings or income, but family earnings and income exhibit a pattern of increasing volatility over time. Also, family income exhibits an upward trend in measured volatility of 1.5% per year (making the level of volatility roughly half again as high after 30 years), with substantial crucial deviations from trend.

Theoretical framework

The classical theory of income

This study leverages on the classical theory of income distribution and welfare. The classicalists emphasized on inherent ability of the economy to achieve and maintain full employment equilibrium. Proponents of the classical school upheld that, the economy is inherently stable, that deviations from full employment equilibrium are automatically corrected by adjustments in prices, wages (income), and interest rates. Therefore, the link between income volatility and farm household is found on the framework of Friedman Permanent Income Hypothesis. A Tubman type of model interprets the permanent income and absolute saving theories and defined normal income as a distributed lag income and used Koyck transformation to obtain an equation that yields separate estimates of the transitory and permanent (normal) marginal properties in a linear form. The original formulation of Friedman's theory is;

$$\boldsymbol{y_m = y^P + y^T} \quad - \quad - \quad - \quad -(1)$$

$$y_m = b_y{}^p + Cy^T \quad - \quad - \quad (2)$$

Where $\boldsymbol{y^p}$ = permanent income, Y^T = transitory income, $\boldsymbol{y_m}$ = measured income,b = marginal propensity to save. **C** = consumption being a function of income. Similarly, permanent income denoted by $\mathbf{y^p}$, regarded as the annuity value of wealth:

$$\boldsymbol{y^p = rw} \quad - \quad - \quad - \quad (3)$$

r = interest rate assumed to be fixed, w = annuity value of wealth.

Friedman (1953) and Palley (2005) decompose measured total disposable income **y**, into permanent component ($\mathbf{Y^p}$), and transitory component ($\mathbf{Y^T}$). The permanent income component is deemed systematic but unobservable, reflecting factors that determine the household's wealth, while the transitory component reflects "chance" income fluctuations.

$$\boldsymbol{Y_h = a_0 + a_1 X_h^p + a_2 X_h^T + \ \ldots \ + a_n X^T{}_h} \quad - \quad - \ (4)$$

Where; a_1, a_2 and a_n are coefficients of households permanent and transitory income, $Y_h$is household income, $X^P{}_h$ and $X^T{}_h$ are variables representing permanent and transitory incomes respectively.

Research methodology

The study area, population and data collection sources

The study was conducted in Akwa Ibom State, Nigeria. It is located in Nigeria's oil-rich south-south zone known as the Niger Delta region which occupies one of the largest wetland in West Africa. Geographically, it is located at latitude $4^o32^1$and 5^o33^1 north, longitude 7^o25^1 and 8^o24^1 square meters. It has thirty one (31) local government areas and Uyo as its state capital. The state is bordered on east by Cross River State, on the west by Rivers and Abia State and on the south by the Atlantic Ocean. The state has an estimated population of over 3.93 million people, (NPC, 2006). The population drawn for this study comprised of farm households who predominantly grows vegetables and other root crops in the study area.

Panel data were collected for both for both for both dry and wet season's started March to August and September to February, 2018 respectively. The instrument used for primary data collection was questionnaire whilesecondary data were sourced from official publications of National Bureau of Statistics (NBS), General household survey of 2016, Nigeria Statistical Factsheets on Economic and Social Development (various editions) and Central Bank of Nigeria Statistical Bulletin (various editions). Respondents were selected based on the Akwa Ibom State Agricultural Development Programme (AKADEP) structure.

Sampling Procedures and Techniques

The study used multi-stage sampling technique in the selection of respondents. Given the grouping of the State into six agricultural zones: Uyo, Etinan, Ikot Ekpene, Eket, Abak and Oron.The first stage involves purposive selection of three (3) out of six (6) agricultural zones; (Uyo, Abak and Oron). The reason for the purposive selections of these zones is to have a representative sample across the State (3) out of six (6) agricultural zones in the state: In each of the zones, nine (9) blocs were randomly selected. In the second stage, twenty seven (27) cells were randomly selected from nine (9) blocs. In each of the sub-cell, two (2) villages were randomly selected making up a total of fifty (54) four sub-cells (villages). The fourth stage involved simple random sampling (ballot) of ninety (90) respondents; ten (10) from each bloc and 30 from each zone). Out of ninety (90) sampled households, sixty (60) were selected from upland communities in Uyo and Abak zones while thirty (30) were selected from the wetland or riverine communities in Oron zone.

The determinants of income volatility and estimation technique

The determinants of income volatility were estimated using Ordinary Least Square method (OLS). The implicit form of the model is stated thus;

$$Gv = f(X_i U_t) \quad \ldots . \quad (5)$$

Where Gv- Income volatility indices generated from Generalized Autoregressive Conditional Heteroskadascity (GARCH), while $\mathbf{X_i}$ are explanatory variables as stated in equations 6, 7, 8 and 9 below. Income volatility indices generated through GARCH were used as dependent variable. The functional forms of the GARCH income equations are stated thus;

Linear Function

$$Gv = \delta_0 + \delta_1(HHS) + \delta_2(EDUSTAT) + \delta_3(AGE) + \delta_4(FMS) + \delta_5(INCACT) + \delta_6(NFMY) + \delta_7(NNFMY) + \delta_8(INPCO) + \delta_9(HEPF) + \delta_{10}(HEXPNF) + \varepsilon \ldots\ldots\ldots (6)$$

Exponential Function:

$$logGv = \delta_0 + \delta_1(HHS) + \delta_2(EDUSTAT) + \delta_3(AGE) + \delta_4(FMS) + \delta_5(INCACT) + \delta_6(NFMY) + \delta_7(NNFMY) + \delta_8(INPCO) + \delta_9(HEPF) + \delta_{10}(HEXPNF) + \varepsilon \ldots\ldots\ldots (7)$$

Double log Function:

$$logGv = \delta_0 + \delta_1 log(HHS) + \delta_2 log(EDUSTAT) + \delta_3 log(AGE) + \delta_4 log(FMS) + \delta_5 log(INCACT) + \delta_6 log(NFMY) + \delta_7 log(NNFMY) + \delta_8 log(INPCO) + \delta_9 log(HEPF) + \delta_{10} log(HEXPNF) + \varepsilon \ldots\ldots\ldots (8)$$

Semi-log Function:

$$Gv = \delta_0 + \delta_1 log(HHS) + \delta_2 log(EDUSTAT) + \delta_3 log(AGE) + \delta_4 log(FMS) + \delta_5 log(INCACT) + \delta_6 log(NFMY) + \delta_7 log(NNFMY) + \delta_8 log(INPCO) + \delta_9 log(HEPF) + \delta_{10} log(HEXPNF) + \varepsilon \ldots\ldots\ldots (9)$$

Where, $\hat{\partial}_0$ is constant, $\hat{\partial}_1 - \hat{\partial}_{10}$ are estimated parameters. $Gv = CV_v$ are income volatility indices generated from GARCH and CV respectively, *HHS*=household size, *EDUSTAT* =educational status, *AGE* = age of household heads, *FMS* = farm size, *INCACT* = number of income activity, *NFMY* = normalized farm income, *NNFMY* = normalized non-farm income, *INPCO* = input cost, *HEXPF* = household expenditure on food, *HEXPNF* = household expenditure on non-food, $\boldsymbol{\varepsilon}_t$ = error term. The study used four functional forms namely, Linear, Exponential, Double-log and Semi-log as stated in equations 6, 7, 8 and 9 were estimated to determine the factors that induced volatility on farm household's income in Akwa Ibom State. Equations 6, 7, 8 and 9 were estimated using Ordinary Least Squares (OLS). Income volatility indices generated through Generalized Auto-regressive Conditional Heteroskadasticity (GARCH) and the Coefficient of Variation (CV) were used for the study.

Results and discussion

Table 1: Descriptive Statistics of GARCH and CV Measure of Income Volatility Indices

Volatility Measure	Maximum	Minimum	Mean	STD	Skewness	Kurtosis
Gaech(On and Off season)	0.99	0.26	0.58	0.17	0.54	2.68
CV (On and Off season)	0.74	0.49	0.61	0.05	-0.25	2.51

Source: Author's analyzed data, 2018. GARCH=Generalized autoregressive conditional heteroskadasticity, CV= coefficient of variation

Table 1above presents descriptive statistics of the variables used in the study. It reveals that, the maximum GARCH and CV values are 0.99 and 0.74 respectively for both on and off season periods. Minimum values for GARCH and CV are 0.26 and 0.49 while mean values are 0.58 and 0.61. Standard deviation for GARCH and CV values is 0.17 and 0.05 respectively. The probability skew for GARCH is 0.54 showing positive but moderate skew while the probability for CV is -0.25 implying negative skewed of values. Similarly, result from table 1 further shows the kurtosis values (2.68 and 2.51) for both GARCH and CV of income volatility indices. The GARCH kurtosis value for is relatively higher than the CV kurtosis value.

Table 2: Regression Results of the Determinants of Income Volatility among Farming Households in Akwa Ibom State:GARCH and CV Approach

	GARCH - MULTIPLE REGRESSION RESULT				CV – MULTIPLE REGRESSION RESULT			
	LIN.(LE)	EXP.	D. LOG	SEMILOG	LINEAR	EXP.	D.LOG	SEMILOG
Constant	0.328	-0.989	-2.732	-0.589	0.675	-0.390	-0.421	0.662
	(1.670)*	(-2.902)***	(-1.166)	(0.436)	(10.91)***	(-3.779)	(0.618)	(1.625)
HHS	0.19	0.028	-2.34	-0.124	0.010	-0.001	-0.030	-0.022
	(1.916)**	(1.604)	(-0.860)	(-0.790)	(-3.33)***	(-0.208)	(-0.380)	(-0.458)
EDUSTAT	-0.004	-0.006	-0.023	-0.019	0.000	-0.001	-0.011	-0.008
	(-4.001)***	(-1.017)	(-0.293)	(-0.421)	(-0.661)	(-0.575)	(-0.483)	(-0.568)
AGE	-0.003	-0.006	-0.065	-0.036	0.000	-0.001	0.100	0.057
	(-1.037)	(-1.072)	(-0.276)	(-0.265)	(-0.870)	(-0.813)	(1.462)	(0.405)
FMS	-0.017	-0.073	-0.120	-0.058	0.120	0.003	0.013	0.008
	(-7.001)***	(-0.756)	(-1.408)	(-1.172)	(5.113)***	(0.110)	(0.506)	(0.517)
INCACT	0.024	0.048	0.330	0.171	0.003	0.004	0.022	0.015
	(1.681)*	(1.936)**	(2.09)**	(1.88)**	(3.007)***	(0.590)	(0.472)	(0.548)
NFMY	0.120	0.005	0.099	0.059	-0.00	0.001	0.008	0.004
	(3.009)***	(0.690)	(1.261)	(1.296)	(0.349)	(0.325)	(0.336)	(0.296)
NNFMY	0.014	0.006	0.074	0.042	0.025	-3.896E-5	-0.015	-0.009
	(4.607)***	(1.187)	(1.612)	(1.595)	(-.029)***	(-0.027)	(-1.115)	(-1.120)
INPCO	0.102	1.541E-5	0.071	0.039	-1.020E-5	-1.649E-5	-0.041	-0.025
	(11.34)***	(0.463)	(0.890)	(0.856)	(-1.686)*	(-1.636)	(1.772)*	(-1.84)*
HEXPF	-0.032	-3.170E-7	0.004	-0.011	3.514E-7	5.749E-7	0.029	0.019
	(-2.909)***	(-0.104)	(0.031)	(-0.138)	(0.633)	(0.621)	(0.761)	(0.825)
HEXPNF	7.059E.6	1.100E-5	0.183	0.113	-0.134	2.278E-8	-0.037	-0.021
	(2.327)***	(2.108**	(2.13)**	(2.28)***	(33.51)***	(-1.429)	(-1.477)	(-1.428)
Diagnostic Statistics								
R^2	*95.2*	*14.5*	*17.2*	*16.1*	*69.8*	*8.3*	*16.3*	*16.6*
Adj R^2	*90.0*	*3.7*	*6.1*	*4.7*	*59.1*	*3.3*	*5.01*	*5.3*
LOG Likehood	*35.67*	*-13.94*	*35.439*	*-1.364*	*139.607*	*93.62*	*93.72*	*93.62*
Fcal	*7.417***	*1.340*	*1.543*	*1.416*	*3.767***	*0.720*	*1.443*	*1.467*
Normality Test	*9.14***	*0.234*	*5.389*	*0.0263*	*5.822*	*9.464*	*5.747*	*9.464*
Reset Test	*8.545***	*1.206*	*0.537*	*0.0263*	*7.131*	*1.848*	*0.886*	*1.845*
AIC	***-49.35***	*49.87*	*-48.87*	*44.726*	*-257.2*	*-165.24*	*-65.4*	*-165.2*
Schwarz Criteria	-21.85	*77.36*	*-2.009*	*71.596*	*-229.7*	*-137.74*	*-38.6*	*-137.7*
Hannan Quin	-38.27	*60.96*	*-38.07*	*55.53*	*-246.13*	*-154.15*	*-54.6*	*-154.2*

Source: ***Extracted from Computer Print-out by the Researcher, 2018. ***, **,* represents10%, 5%and 1% probability levels.***

The determinants of income volatility among farming households in Akwa Ibom State were examine and presented in Table 2 above. Multiple regressions for both GARCH and CV were specified and the relationship between income volatility indices and its correlates were estimated. Four functional forms namely, linear, exponential, double log and semi-log for both GARCH and CV were specified and estimated using the variables stated in equation *(6).* The parameter estimates of the diagnostic tests as well as the respective coefficients of the variables in each of the functional forms are presented in Table 4. The linear equation of the GARCH result was selected as the led equation considering the number of variables and the

values of diagnostic test parameters that are significant. For the led equation (Linear-GARCH), the R^2 is 0.952 and the $\overline{R}^2$ adjusted $R^2\left(\overline{R}^2\right)$ is 0.90. The value of the R^2 (0.952) implies that, about 95.2% of variations in farm households income was captured and explained by the independent variables in the model. The F_{cal} of 7.41 was statistically significant at 1% level implying that, the estimated GARCH income volatility function was adequate for use in the analysis and it shows goodness of fit. The normality of 9.114 was significant at 1%.

RESET-test was 8.546 and significant at 1% probability level implying that the selected equation is appropriately correct, not mis-specified and the assumption of linearity among the variables is correct. The constant term of 1.670 was significant at 10% level. The coefficient of household size (HHS) was significant and positively related to income volatility of farming households in the study area, implying that an increase in number of household members by one person will lead to a 1.9% increase in volatility of household income. Income volatility among farming households had a significant positive relationship with educational status of the household head. The coefficient of this variable was significant at 1% level implying that an additional year of education reduces income volatility by 0.004%. Consistent with these results are Walker et al (2004) in Britain and Dong (2005) in Vietnam.The coefficient of farm size was significant at 1% and negatively correlated with income volatility of farming households. It reveals that, an additional cultivable land may lead to a 0.017% reduction in income volatility among farming households. The result further shows that, the coefficient of number of income generating activities (NIGA) was statistically significant at 10% level and positively correlates with income volatility of farming households in the study area. This implies that additional source of income will reduce volatility among farm households by 2.4% in the study area. The coefficient of normalized farm income (NFMY), was statistically significant at 1 percent level and positively correlates with income volatility. This result implies that, a naira increase in income leads to about 0.12% increase in income volatility. This could be linked to the fact that, farm income contributes higher (as compared to nonfarm income) to the total household income. The coefficient of non-farm income (NNFMY) is 0.014 and is statistically significant at 1%. This implies that a naira increase in income from non-farm activity leads to a 0.014% increase in income volatility. The coefficient of input cost (INPCO) was also statistically significant at 1 percent level and positively correlated with income volatility. The result shows that a naira increase in cost of inputs will lead to similar increase in production cost. The coefficient of household expenditure on food *(HHEXP)* was statistically significant at 1 percent level and negatively correlated with income volatility of farming households in the study area. The result reveals that a naira increase in household expenditure on food may likely reduce income volatility by 0.032%. Similarly, the coefficient of household expenditure on non-food items such as education, clothing, communication etc., shows a positive relationship with income volatility and significant at 1% level.

This relationship establishes the link between farm household expenditure on non-food items and income volatility in the study area. A naira increase in expenditure on non-food items increases income volatility by 0.007%. An increase in expenditure on non-food items may lead to a marginal increase in income volatility of farm households in the study area. This finding is consistent with Oscar *et al.,* (2004) and Mishra *et al.*, (1997).

Conclusion and recommendation

An empirical investigation of the determinants of income volatility of farming households was carried out. The result shows the relationship between the determinants of income volatility and its effects on farm households' wellbeing in Akwa Ibom State. Household size, educational status, number of income activities, household experience in farming significantly influences farm households income. The study recommended that relevant government institutions –Akwa Ibom Agricultural Development Programme (AKADEP),

International Institute for Tropical Agriculture (IITA) and the Integrated Farmers Scheme (IFS) among others, should support rural farmers in areas of creditand other relevant farming inputs including extension services to boost agricultural production which will in turn improves farmers income, rural savings and investment in Akwa Ibom State.

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