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An Ordered Probit Model Analysis of Transaction costs and Market Participation by Sweet Potato Farmers in South Eastern Nigeria.

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Abstract

This study determined the factors (related to fixed and variable transaction costs) influencing the decision to participate in sweet potato markets by a random sample of 320 small holder farmers in south eastern Nigeria. Data were collected with structured and validated questionnaire, and analyzed using the ordered probit analysis procedure. Participation decisions revealed that marketing experience, farm size, membership of cooperatives/social organizations, extension contact, farming experience and road conditions to the nearest town had positive relationship with decision to be autarkic other than buyer and to be seller other than autarkic, and were significant at 1% level of probability. The coefficient of age, household size, and output were also positive and significantly related to decision to be autarkic other than buyer and to be seller other than autarkic at 5% level of probability. The coefficients for access to credit, and access to communication facilities were positive and significantly relate to decision to remain autarkic other than buyer and to be seller other than autarkic. The coefficients for level of education, distance to the nearest town, distance from the farm to the market and cost of transportation were negative and significantly related with the decision to remain autarkic other than a seller and to be buyer other autarkic at 1% level of probability. The coefficient for sex was positive and significantly related to decision by female farmers to be autarkic other than buyer and to be seller other than autarkic. These decisions to participate as a buyer, seller or

remain autarkic were as a result of fixed and proportional transaction costs associated with participating in the market.

Keywords: Ordered probit, Transaction costs, Market participation, potato, autarkic.

INTRODUCTION:

The rural poor in South Eastern Nigeria obtain their daily food energy from root and tubers which sweet potato is one of such crops (Alexandratos, 1995; Scott et.al 2000).

Chandara (2003) described root and tubers as crops that deserve particular attention because the world poorest and most food insecure households look up to these crops as a contributing, if not, the principal sources of food, nutrition and cash income. Sweet potato (Ipomoea batatas) is a creeper of the convolvilaceae family. It originated from central America and is widely grown as important staple food in most parts of the world.

Presently, Nigeria is the number one producer of sweet potato in Africa with annual output of 3.46 million metric tons (FAO, 2006), and globally the second largest producer after China. The crop is grown for both human and animal consumption. It is the only crop among the root and tuber crops that has a positive per capita annual rate of increase in production in sub-Saharan Africa (Twewe et.al, 2003). Sweet potato is efficient in the production of carbohydrate, minerals, vitamins and cash per unit area and per unit time (Getahurn and Terete, 2002). The crop plays major role in poverty reduction, and improves health situation especially for diabetics (Kapinga et al, 2001). The exploitation of this potential has been limited because of limited ways in which the crop is utilized. Its post harvest use is remarkably narrowed and limited to human consumption in the boiled and fried forms (Hagerimana and Owori, 1997).

In Southeastern Nigeria, sweet potato farmers find it difficult to participate in markets because of a ange of constraints and barriers reducing the incentives for participation, which may be reflected in hidden costs that make access to markets and productive assets difficult (Makhura, 2001). Transaction costs, that is, observable (Variable) and non-observable (fixed) costs associated with exchange, are the embodiment of access barriers to market participation by resource poor farmers (Holloway, et al, 2000).

Households commonly incur fixed costs in making the decision to trade in a market. Such costs are known to exist irrespective of transactions volume and surely affect the decision about how much quantity to supply to the market noted by (Cogan, 1981) in a neo-classical model of labour supply. Yet the standard estimation of market supply equations fails to account for these fixed costs (Holoway et al, 2005). Hobbs (1997) classified fixed transaction costs into information, negotiation, and monitoring or enforcement costs. Fixed and variable transaction costs impact on market participation whereas

supply decisions (amount sold), conditional on market participation, only depend on variable transaction costs. If transaction costs are large, they need to be measured and explained. De Janvry and Sadoulet (2005) have argued that attempting to observe them directly will always underestimate their importance, quite likely by large amounts. The study showed, however, that they can be derived from observed behavior. Transaction costs reflect the character of the market, but are mainly embedded in household characteristics and their economic environment (Holoway et al, 2000; Makhura, 2001).

The objective of this paper is to determine the factors that influence the decision of sweet potato farmers to participate in sweet potato markets.

METHODOLOGY

(a) **The Theoretical Model**: The ordered probit model is a widely used approach to estimating models of ordered type which almost employs the probit link function. There is a latent continuous metric underlying the ordinal responses observed by the analyst. The latent continuous variable Y is a linear combination of some predictors, x, plus a disturbance term that has a standard normal distribution:

$Y = X_i B + e$ ……. (1)

The latent variable, Y_i exhibits itself in ordinal categories, which could be coded as 0,1,2 ……k. The response of category k is thus observed when the underlying continuous response falls in the k-th interval as;

$Y^* = 0$ if $Y^* \leq \delta_o$

$Y^* = 1$ if $\delta_o \leq Y^* \delta_1$

$Y^* = 2$ if $\delta_1 \leq Y^* \delta_2$ …… (2)

Where Y^* (i = 0, 1, 2) are the unobservable threshold parameters that will be estimated together with other parameters in the model. When an intercept coefficient is included in the model, Y^*_{iB} is normalized to a zero value (Green, 2000) and hence only k-1 additional parameters are estimated with X_s. Like the models for binary data, the probabilities for each of the observed ordinal response which in this study had 3 responses (0,1,2) will be given as;

Prob (Y = 0) = P ($Y^* = 0$) = $P(B_iX_i+e_i =0) = Ø(B_ix_i)$

Prob (Y = 1) = $Ø(\delta_i – B_iX_i)$ - Ø (B_iX_i)

Prob (Y = 2) = 1 – Ø $(\delta_i – B_iX)$……(3)

Where, $0 < Y^*_i < Y^*_i < Y^*_i = 1,2$……..n is the cumulative normal distribution function such that the sum total of the above probabilities is equal to one. The specification of the ordered probit model is as follows;

Let Y_i denote the category net buyer ($0 = Y_i$), autarkic ($1 = Y_i$), or net seller ($2 = Y_i$) to which household belongs.

(b) The empirical model: In this study, the market participation decision for sweet potato farmers is specified as follows;

$$I_i^{\text{sell or not}} = b_o + b_1^{op} X_1^{op} + b_2^{op} X_2^{op} + b_3^{op} X_3^{op} + b_4^{op} X_4^{op} + b_5^{op} X_5^{op} + b_6^{op} X_6^{op} + b_7^{op} X_7^{op} + b_8^{op} X_8^{op} + b_9^{op} X_9^{op} + b_{10}^{op} X_{10}^{op} + b_{11}^{op} X_{11}^{op} + b_{12}^{op} X_{12}^{op} + b_{13}^{op} X_{13}^{op} + b_{14}^{op} X_{14}^{op} + b_{15}^{op} X_{15}^{op} + b_{16}^{op} X_{16}^{op} + b_{17}^{op} X_{17}^{op} + b_{18}^{op} X_{18}^{op} + b_{19}^{op} X_{19}^{op} + b_{20}^{op} X_{20}^{op} + b_{21}^{op} X_{21}^{op} + b_{22}^{op} X_{22}^{op} + \mu^{op} \quad \ldots\ldots(4)$$

Where,

$I_i^{\text{sell or not}}$ = Buyer = 0, Autarky = 1 and Seller = 2

X_1 = Marketing experience (years)

X_2 = Farm size (Ha)

X_3 = Extension contact (No. of visits)

X_4 = Membership of cooperatives (dummy Variable, 1 = member, 0 = non-member)

X_5 = Volume of credit (₦)

X_6 = Cost of transportation (₦)

X_7 = Dependency ratio (the number of dependents below 18 years and above 60 years per household of working age)

X_8 = age (years)

X_9 = Distance to the nearest town (km)

X_{10} = Distance from the farm to the market (km)

X_{11} = Distance from the house to the market (km)

X_{12} = Distance from the house to the farm (km)

X_{13} = Output (kg/ha)

X_{14} = Farm income (₦)

X_{15} = Non-farm income (₦)

X_{16} = Road conditions to nearest town (dummy variable; 1 = good, 0 = bad)

X_{17} = Sex (dummy variable; 1 = male, 0 = female)

X_{18} = Household size (No. of persons)

X_{19} = Access to credit (dummy variable, 1 = access, 0 = no access)

X_{20} = Access to communication facilities (dummy variable, 1 = access, 0 = no access)

X_{21} = Level of education (No. of years spent in school)

X_{22} = Farming experience (years)

μ = error term

It is expected a priori that the coefficients of X_1, X_2, X_3, X_4, X_5, X_7, X_8, X_{13}, X_{14}, X_{15}, X_{16}, X_{17}, X_{18}, X_{19}, X_{20}, X_{21}, $X_{22} > 0$; X_6, X_9, X_{10}, X_{11}, X_{12}, < 0.

b_1 - b_{22} are coefficients to be estimated, and bo is intercept or constant.

(c) The Data

The study was conducted in South Eastern Nigeria. It lies between latitude 6^0 and 9^0 North and longitude 4^0 and 7^0 East, and has land mass of 10,952, 400 ha. The population of the area is over 16 million people (NPC), 2006).

South Eastern Nigeria is made up of five states namely; Abia, Anambra, Ebonyi, Enugu and Imo. Majority (65%) of the inhabitants are engaged in agriculture, mainly crop farming and animal rearing. Three out of the five states in the South Eastern Nigeria were randomly selected for the study. They were Imo, Abia and Enugu States. A multi-stage random sampling technique was used to select sample. At the second stage, two agricultural zones per state were randomly selected; namely; Orlu and Okigwe for Imo State, Umuahia and Ohafia for Abia State, and Enugu North and Enugu East for Enugu State, giving a total of six agricultural zones. At the third stage, two local Government Areas (LGAs) were randomly selected from each agricultural zone, giving a total of 12 LGAs. In the forth stage, four communities were randomly selected from each LGA, giving a total of 48 communities.
In the fifth stage, the list of sweet potato farmers in the selected communities was compiled with the assistance of the resident extension agents and this formed the sampling frame totaling 598 farmers. Due to unequal sampling frame in the selected communities, proportionate and random sampling techniques were employed to selected 320 small holder sweet potato farmers.

Data were collected by means of structured and validated questionnaire between February and July 2009, on variables such as age, level of education, household size, sex, farm income non-farm income, farm size, marketing experience, extension contact, membership of cooperative, volume of credit, cost of transportation, dependency ratio, distance to the nearest town, distance from the farm to the market, distance from the house to the farm, output, road conditions to nearest farm, access to credit, access to communication facilities etc. Data were analyzed using the ordered probit model.

RESULTS AND DISCUSSION

Decision on market participation:

The results of ordered probit model regression for market participation are shown in Table 1. The non-zero censoring points were of negative signs, with the lower censoring thresh hold at -1. 76 sweet potato net purchases and the upper threshold at -0.95 sweet potato net sales, each statistically significantly different from zero. These estimates imply that purchases or sales of less than 1kg are generally uneconomical. Farmers were more willing to enter the market for smaller volume sales than purchases, likely reflecting the fact that sales of sweet potato are essentially means by which households meet immediate cash needs related to payment of children school fees, food purchases and ceremonial or emergency health expenses (Bellmare and Barret, 2006). The goodness of fit measured by the high Chi-square value of 73.096 showed that the choice of explanatory variables included in the ordered probit model explained the variation in decisions to participate in the market. Results of market participation decisions show that marketing experience (X_1), farm size (X_2), extension contact (X_3), membership of cooperatives/socials organization (X_4), road conditions to the nearest town (X_{16}) and farming experience (x_{22}) had positive relationship with decision to be autarkic other than buyer and to be seller other than autarkic, and were significant at 1% level of probability. The coefficients for age (x_8), household size (x_{18}), and output (x_{13}) were also positive and significantly related to decision to be autarkic other than buyer and to be seller other than autarkic at 5% level of probability. The coefficients for access to credit (x_{19}) and access to communication facilities (x_{20}) were positives and significantly related to decision to remain autarkic other than buyer and to be seller other than autarkic.

The coefficients for sex (x_{17}) was positive and significantly related to decision by female farmers to be autarkic other than buyer and to be seller other than autarkic. The coefficients for level of education (x_{21}), distance to the nearest town (x_9), distance from the farm to the market (x_{10}) and cost of transportation (x_6) were negative and significantly related with the decision to remain autarkic other than a seller and to be buyer other than autarkic at 1% level of probability.

These results imply that farmers who have access to communication facilities, membership of cooperative societies with more frequency of extension contacts were

more likely to be autarkic than buyers and were more likely to the sellers than to be autarkic, ceteris paribus. Farmers who were more educated were more likely to be autarkic than sellers and were more likely to be buyers than autarkic. Contact with extension agents tends to improve farmers' access to information (Lapar et al, 2003). Access to information through extension, membership of cooperative societies, access to communication facilities and education tends to remove the fixed transaction costs facing the sweet potato farmers in entering the sweet potato markets.

The negative coefficient of education was contrary to the a priori expectation.

This suggests the strong competing effect of diverting skills to other off-farm employment opportunities as the level of education increases within the household. This finding agrees with those of Okoye, et al (2010) and Arega et al (2007).

The coefficient of sex was positive, implying that female headed households were more likely to be autarkic than buyers and were more likely to be sellers than autarkic, ceteris paribus. Female headed households have a greater likelihood of participation in sweet potato markets than male headed households. This result agrees with those of Okoye, et al (2010) on transaction costs and markets participation by small holder cassava farmers in South Eastern Nigeria; Arega et al (2007) on maize markets in Kenya, and Makhura (2001) on livestock markets in South Africa.

This could be because better sales bargain are made by women. The sex of the head of the household reflects the fact that female farmers will face lower transaction costs since they tend to have more credibility.

Farmers who were older were more likely to be autarkic than to be buyers and were more likely to be sellers than to be autarkic, ceteris paribus. This suggests that fixed costs such as language barriers or discrimination may constrain the ability of non-indigenous or migrant farmers to integrate in some markets (Vakis et al, 2003). Also, these farmers will have stronger social network and will have established credibility within the network (Makhura et al, 2001) if they are older.

Farmers with long distance to the nearest town and from the farm to the market as well as high cost of crop transportation were likely to be autarkic other than sellers and buyers other than buyers and sellers other than autarkic. If road condition to the

nearest town were good and output of sweet potato high, farmers were likely to remain autarkic other than buyers and sellers other than autarkic. Poor state of infrastructure also leads to a hike in crop transportation costs per Km. Transaction costs will be reduced if the market would be located close to the farmers with good road networks.

The coefficient for volume of credit (x_5), dependency ratio (x_7), distance from the house to the market (x_{11}), distance from the house to the farm (x_{12}) and farm income (x_{14}) were positive but not significant at 5% level of probability, while the coefficient for non-farm income (x_{15}) was negative but not significant at 5% level of probability.

Table 1. Results of ordered probit regression for market participation.

Explanatory Variable	**Parameter**	**Coefficient**	**T-value**
Intercept -	b_0	17.067	4928
Marketing experience (X_1)	b_1	0.092	3.173
Farm size (X_2) -	b_2	0.187	2.981
Extension contact (X_3)-	b_3	0.063	2.772
Membership of social org	b_4	0.077	2.694
Volume of credit (X_5)	b_5	0.089	1.903
Cost of transportation (X_6)	b_6	-0.091	-4.552
Dependency ratio (X_7)	b_7	0.066	1.529
Age of household head (X_8)	b_8	0.128	2.413
Distance to the nearest town(x_9)	b_9	-0.043	-3.009
Distance from the farm to the market (x_{10})	b_{10}	-0.059	-3.161
Distance from the house to the Market (x_{11})	b_{11}	0.083	1.391
Distance from the to house to the farm (x_{12})	b_{12}	0.097	1.408

Output of sweet potato (x_{13})	b_{13}	0.049	2.337
Farm income (x_{14})	b_{14}	5.018	1.668
Non-farm income (x_{15})	b_{15}	-3.739	-1.723
Road conditions to nearest town (x_{16})	b_{16}	0.088	3.683
Sex of household head (X_{17})	b_{17}	0.053	2.446
Household size (x_{18})	b_{18}	0.167	2.502
Access to credit (x_{19})	b_{19}	0.071	2.291
Access to communication facilities (x_{20})	b_{20}	0.083	2.306
Level of education (x_{21})	b_{21}	-0.094	-4.103
Farming experience (x_{22})	b_{22}	0.078	3.608
Ancillary parameters			
C_1		-1.764	-5.067
C_2		-0.952	-3.826
Log likely hood		-267.394	
Chi-square		73.096	

*Significant at 5%

**Significant at 1%

Source Survey results, 2009

CONCLUSION

The findings of this study support previous studies (Okoye et al, 2010; Arega et al, 2007; Makhura, 2001) that existence of transaction costs constrains farmers from selling their produce. In all, these results highlight the importance of allowing for non-negligible fixed costs in markets participation studies. Policies that reduce transaction costs through improved transportation and encouragement of marketing cooperatives would increase market participation by farmers.

Also, provision of access roads would facilitate faster delivery of farm produced to urban consumers.

The transaction costs of participation could thus be reduced through improved information, transportation facilities, infrastructural facilities and encouragement of production and marketing cooperations.

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