UC Berkeley
Agriculture for Development

Title

Transaction Costs and Smallholder Farmers' Participation in Banana Markets in the Great Lakes Region

Permalink

https://escholarship.org/uc/item/4mz3b26f

Authors

Jagwe, John
Ouma, Emily
Machethe, Charles

Publication Date

2009-07-01

Transaction Costs and Smallholder Farmers' Participation in Banana Markets in the Great Lakes Region

John Jagwe
Emily Ouma
Charles Machethe

University of Pretoria
International Institute of Tropical Agriculture

Transaction Costs and Smallholder Farmers' Participation in Banana Markets in the Great Lakes Region

John Jagwe[1, 2], Emily Ouma[2], Charles Machethe[1]

[1]Department of Agricultural Economics, Extension and Rural Development, University of Pretoria (LEVLO, 002, Pretoria, South Africa); [2]International Institute of Tropical Agriculture, Burundi, c/o IRAZ, B.P. 91 Gitega

Abstract. This article analyses the determinants of the discrete decision of a household on whether to participate in banana markets using the FIML bivariate probit method. The continuous decision on how much to sell or buy is analyzed by establishing the supply and demand functions while accounting for the selectivity bias.

Results indicate that buying and selling decisions are not statistically independent and the random disturbances in the buying and selling decisions are affected in opposite directions by random shocks. Transaction cost related factors such as geographical location of households, market information sources and travel time to the nearest urban centre do influence participation. Other factors such as labour availability, farming experience, gender of household head, off-farm income and the asset base of the household also affect the likelihood and intensity of participation.

Policies guiding central and local governments towards increased investment in rural infrastructure (i.e. feeder roads networks, trunk roads, telecommunication services and establishment of market places) can help reduce transaction costs and thereby improve participation of smallholder farmers in markets. Policies supporting group formation may lead to improving economies of scale and flow of information amongst farmers which may increase market participation.

1

Introduction

Markets and improved market access are of critical and immediate importance to rural poor households as a prerequisite for enhancing agriculture-based economic growth by improving the competitiveness of farming enterprises and improving rural incomes. Despite this, participation of smallholder farmers in domestic markets in most developing countries remains low due to a range of constraints. One of the limiting constraints faced by smallholder farmers is linked to poor market access (Makhura et al., 2001). National and international policy initiatives that aim at addressing this constraint have to address issues associated with reduction of transaction costs, which are often the embodiment of access barriers to market participation of smallholder farmers and market risks. In addition, there is need to put structures in place to support producer organizations. A number of studies such as Goetz (1992), Key et al (2000) as well as Makhura et al (2001) have isolated high transaction costs to be one of the key reasons for smallholder farmers' failure to participate in markets. Majority of the smallholder farmers are located in remote areas with poor transport and market infrastructures, contributing to the high transaction costs faced. In addition, they lack reliable market information as well as information on potential exchange partners. In some instances, these transaction costs tend to be so high that markets can be said to be "missing" (Omamo, 1998; Key et al, 2000).

Very few studies have empirically investigated the factors that influence smallholder farmers' food market participation in developing countries, yet the rural farming populations form the bulk of the poor (Alene et al., 2008; Goetz, 1992; Makhura et al., 2001). This is in contrast to the huge amounts of empirical work on the effects of transactions costs on labor market participation. This paper investigates smallholder farmers' decision to participate in banana

markets in Burundi and Rwanda by estimating jointly, the non-independent determinants of selling and buying decisions. The determinants of households' level of participation in buying and selling of bananas have been estimated, controlling for sample selection bias.

Bananas play a key role in Rwanda and Burundi, contributing to rural populations' household food security and revenue. The two countries are among the twenty leading banana producers in the world with annual production estimated at 1.5 million metric tonnes in Burundi and 2.6 million metric tonnes in Rwanda (FAOSTAT, 2008). The two main banana types grown in the region include the cooking types, which is largely produced for home consumption with surplus sold to the market and beer banana types which is a main source of household income as it is transformed into banana beer and sold to consumers (Spilsbury et.al. 2004). The importance of bananas to the livelihoods of the rural populations in the two countries accentuates its role as a crop whose production and marketing could be a potential pathway of improving rural livelihoods. A better understanding of the determinants of banana market access barriers, which is directly linked to transaction costs, is therefore critical in understanding why some farmers opt not to participate in markets, while others opt to participate as sellers or buyers. This would enable identification and generation of appropriate intervention measures that would enable the rural populations to benefit from banana markets.

The overall objective of this study is to examine the effects of transaction costs and other factors on the participation of smallholder farmers in banana markets. The specific objective of this study is to examine the effects of transaction costs on the discrete decision of a household on whether to participate in banana markets and to what extent.

The hypothesis to be tested in this study is; "the decision of a household on whether to participate in a market and the intensity of participation are inseparable and are similarly affected by transaction costs."

The rest of the paper is divided as follows; a brief section on transaction costs theory is given followed by the economic model description then the econometric estimation and data to be used are described. The empirical results from the analysis are presented and the paper concludes outlining the policy implications.

Transaction Cost Theory

Transaction cost theory derives from the "New Institutional Economics" approach and focuses on institutions of governance[1]. It is based on the premise that institutions are transaction cost minimizing arrangements which may change and evolve with changes in the nature and sources of transaction costs (Williamson, 1985). Transaction costs, occasionally referred to as "hidden costs" are the observable and non-observable costs associated with exchange of goods and services. These costs arise due to the frictions involved in the exchange process as it entails transfer and enforcement of property rights. Past studies such as Key et al. (2000) have categorized these costs into fixed and variable transaction costs. Fixed transaction costs are invariant to the volume of output traded and affect market participation decisions of smallholder farmers. They include the costs of: (a) searching for a trading partner with whom to exchange or searching for a market (b) negotiation and bargaining particularly when there is imperfect information regarding prices (c) screening, enforcement of contracts and supervision particularly

---

[1] Institutions of governance refer to modes of managing transactions and include market, quasi-market and hierarchical modes of contracting.

when credit sales are involved as the sellers have to screen the buyers for reliability and lower the likelihood of defaults (Kirsten and Vink, 2005). Variable transaction costs on the other hand are per unit costs of accessing markets that vary with the volumes traded and may affect the decision of market participation as well as quantity traded. These include costs associated with transferring the output being traded such as transportation costs and time spent to deliver the product to the market. These costs are largely unobservable or cannot be easily recorded in a survey. In essence, the variable transactions costs raise the real price of commodity purchased and lower the real price received for commodity sold.

Economic Model

The market participation model presented in this article is inspired by the economic theory of agricultural households' behavior presented in Strauss (1986) and later extended by Key et al. (2000), to incorporate both fixed and variable transaction costs. A simplified household utility is assumed to be a function of goods and services consumed specified as:

$$U = (C; \Delta^c) \tag{1}$$

Where U is the household utility function, which is assumed to be monotone increasing in its arguments, strictly concave, and to possess continuous second partial derivatives; C is the set of consumption goods and services; and the vector Δ^c parameterizes the utility function and summarizes individual and household characteristics as well as asset structure.

The household faces a cash constraint that states that expenditures on all purchases cannot exceed revenues from all sales and transfers. The cash constraint can be expressed to include both variable and fixed transaction costs following Key et al. (2000), as:

$$\sum_{i=1}^{N} \left[\left(p_i^m - t_{vi}^s(\Delta_t^s) \right) \xi_i^s + \left(p_i^m + t_{vi}^b(\Delta_t^b) \right) \xi_i^b \right] m_i - t_{fi}^s(\Delta_t^s) \zeta_i^s - t_{fi}^b(\Delta_t^b) \zeta_i^b + T = 0 \qquad (2)$$

where p_i^m is the market price of good i; m represents the amount of each good "marketed" and is positive if there is a sale of good i and negative if there is a purchase; ζ_i^s is equal to one if $m_i > 0$ and zero otherwise, and ζ_i^b is equal to one if $m_i < 0$ and zero otherwise; Δ_t^s and Δ_t^b are exogenous characteristics that affect the variable transactions costs when selling (t_{vi}^s) and buying (t_{vi}^b) respectively. The variable transactions costs raise the price effectively paid by a buyer and lower the price effectively received by a seller. The price effectively received by the seller is lower than the market price p_i^m, by the unobservable amount, t_{vi}^s, and the price effectively paid by the buyer is greater than p_i^m by the unobservable amount t_{vi}^b; t_{fi}^s and t_{fi}^b are the unobservable fixed transactions costs when selling and buying good i respectively and are a function of the observable exogenous factors Δ_t^s and Δ_t^b that can explain these costs; and T is exogenous transfers and other incomes.

The technology of farm production is represented by a twice differentiable concave production function;

$$G(Y, X_i; \Delta^z, M, \Omega) \qquad (3)$$

where Y is the output produced from the farm, X_i represents both purchased and non-purchased inputs. Vector Δ^z represents household characteristics affecting production decisions, M is a vector of fixed factors such as land, and Ω is a vector of fixed effects of location, such as population density and market access.

The household also faces a resource balance constraint presented as:

$$Y_i - X_i + A_i - m_i - C_i = 0, \qquad i = 1, \text{K}, N \tag{4}$$

The resource balance states that for each of the N goods, the amount consumed, C_i, used as input, X_i and sold, m_i is equal to what is produced, Y_i and bought plus the endowment, A of the good. Since output (Y_i), inputs (X_i) or consumption (C_i) of a good i may be zero in a given production cycle but not less than zero, a non-negativity constraint is imposed;

$$C_i, Y_i, X_i \geq 0 \tag{5}$$

The decision problem is to choose whether or not to participate in the product market and the quantity of products in order to maximize household welfare given the fixed and variable transactions costs faced by the household. This can be restated formally as;

$$L = U(C; \Delta^c) + \sum_{i=1}^{N} \eta_i (Y_i - X_i + A_i - m_i - c_i) + \psi(G(Y, X_i; \Delta^z, M, \Omega))$$

$$+ \lambda \left[\sum_{i=1}^{N} \left[\left(p_i^m - t_{vi}^s \right) \zeta_i^s + \left(p_i^m + t_{vi}^b \right) \zeta_i^b \right] m_i - t_{fi}^s \zeta_i^s - t_{fi}^b \zeta_i^b + T \right] \tag{6}$$

where η_i, ψ and λ are the Lagrangian multipliers associated with the resource balance, technology constraint on farm production and cash constraint respectively. Maximization of this Lagrange with respect to the marketed goods would result in discontinuities due to the fixed transactions costs. The optimal solution for the Lagrange function is therefore decomposed into two steps; first solving for the optimal solution conditional on the market participation regime, secondly choosing the market participation regime that yields the highest level of utility. The first step involves maximization of the Lagrangian function with respect to consumption goods C_i, outputs Y, inputs X_i and the marketed goods m_i, yielding the following first order conditions;

$$\partial U / \partial C_i - \eta_i = 0 \tag{7}$$

$$\eta_i + \psi\, \partial G/\partial Y = 0 \tag{8}$$

$$-\eta_i + \psi\, \partial G/\partial X_i = 0 \tag{9}$$

$$-\eta_i + \lambda\left[\left(p_i^m - t_{vi}^s\right)\xi_i^s + \left(p_i^m + t_{vi}^b\right)\xi_i^b\right] = 0 \qquad i \in \{i \mid m_i \neq 0\} \tag{10}$$

Based on equation 10, the market participation decision price can then be defined thus;

$$p_i = \begin{cases} p_i^m - t_{vi}^m & \text{if } m_i > 0, \quad seller \\ p_i^m + t_{vi}^m & \text{if } m_i < 0, \quad buyer \\ \hat{p}_i = \eta_i/\lambda & \text{if } self - sufficient / autarkic. \end{cases} \tag{11}$$

When the good i is marketed, the decision price includes the variable transactions costs. However, when the good is not marketed, the decision price becomes an unobservable internal shadow price, η_i/λ. The household's market participation decision under conditions of variable and fixed transactions costs is taken as a choice decision, where the household is assumed to weigh up its expected utility under the three regimes presented in equation 11 and choose the one associated with the highest utility. The utility levels to be compared under the three different regimes can be presented in the form of indirect utility functions;

$$\begin{aligned}
V^s &= V_i(p_i^m - t_{vi}^s, y_0(p_i^m - t_{vi}^s) - t_{fi}^s, \Delta^c) && \text{if } seller \\
V^b &= V_i(p_i^m + t_{vi}^b, y_0(p_i^m + t_{vi}^b) - t_{fi}^b, \Delta^c) && \text{if } buyer \\
V^a &= V_i(\hat{p}_i, y_0(\hat{p}_i), \Delta^c) && \text{if } autarkic
\end{aligned} \tag{12}$$

Where y_0 is the household income at the decision price p of good i before incurring the fixed transactions cost, t_{fi}. The optimal market participation for a household is to buy when the market prices are below $p_i^m - t_{vi}^b$, be autarkic when $p_i^m - t_{vi}^b < p_i^m < p_i^s + t_{vi}^s$ and sell when market prices

are above $p_i^m + t_{vi}^s$. An increase in the fixed transactions costs directly lowers household income and utility.

The corresponding supply function for good i with transactions costs can be presented as;

$$q_i^s = q(p_i^m + t_{vi}^s, \Delta^z, M, \Omega) \qquad \textit{for sellers}$$
$$q_i^b = q(p_i^m - t_{vi}^s, \Delta^z, M, \Omega) \qquad \textit{for buyers} \qquad (13)$$
$$q^a = q(\hat{p}_i, \Delta^z, M, \Omega) \qquad \textit{autarkic households}$$

The fixed transactions costs do not affect the supply curve but affects the market participation decision. It is assumed that once the household makes the decision to participate in the markets either as a buyer or seller, then only the marginal return to production affects supply decisions. With fixed transactions costs, entry into the market as a seller is delayed until the decision price is sufficiently high to compensate for the fixed transactions costs. On the other hand, entry into the market as a buyer is delayed until the market price is sufficiently low.

Econometric Estimation

The econometric specification of the preceding model consists of market participation decision equations and banana supply equations estimated separately for buyers ($i = 1$) and sellers ($i = 2$). It is assumed that the market participation decision in a given season is mutually exclusive from the households' perspective. The mutual exclusivity assumption renders the participation decision as a set of discrete choices. For instance, a seller satisfies the condition to be a seller but does not satisfy the condition to be a buyer or autarkic and vice-versa in a given season. This also conforms to the data used as there is no single household that is both selling and purchasing bananas in a given season. Equations 12 and 13 show that market participation depends on both fixed and variable transactions costs while the supply or demand decision, conditional on market

participation only depends on the variable transactions costs. Using q_i^s to denote quantity sold by households and from equation 12, a set of structural equations can be envisioned to assess the market participation theoretical model and an empirical probability model. It follows that;

$$q_i^s > 0 \Leftrightarrow E[V^s(p_i^m - t_{vi}^s, y_0(p_i^m - t_{vi}^s) - t_{fi}^s, \Delta^c)] - E[V^n(p_n, y_0(p_n), \Delta^c)] > 0$$
$$q_i^s = 0 \; otherwise$$

(14a)

That is, the household banana market supply quantity is greater than 0 if the expected utility associated with market participation as a seller is greater than the expected utility associated with the n alternatives, that is, being a buyer or autarkic after the evaluation of each of the alternatives.

Similarly for buyers,

$$q_i^b > 0 \Leftrightarrow E[V^b(p_i^m + t_{vi}^b, y_0(p_i^m + t_{vi}^b) - t_{fi}^s, \Delta^c)] - E[V^n(p_n, y_0(p_n), \Delta^c)] > 0$$
$$q_i^b = 0 \; otherwise$$

(14b)

For the reduced form estimation of the probability model, a linear expression of utility is assumed;

$$V_i^m = \beta_1 X_{i1} + \mu_{i1}$$
$$V_i^n = \beta_n X_{in} + \mu_{in}$$

(15)

Where the X_{in} are the exogenous explanatory variables in equation 14, V_i^m is the utility associated with market participation either as a seller or buyer and μ_{in} are random disturbance terms for the population of buyer, seller and autarkic households. A market participation indicator variable (Z_i^*) for individual i can be defined as:

$$Z_i^* = 1 \; if \; V_i^m > V_i^n$$

(16a)

and

$$Z_i^* = 0 \ \ if \ V_i^m \leq V_i^n \tag{16b}$$

Since μ_{i1} and μ_{in} are random variables, the probability of market participation can then be specified as;

$$
\begin{aligned}
pr(Z_i^* = 1) &= pr(V_i^m > V_i^n) \\
&= pr(\beta_1 X_{i1} - \beta_n X_{in}) < pr(\mu_{in} - \mu_{i1}) \\
&= F_v(\beta X_i)
\end{aligned} \tag{17}
$$

Where $v = \mu_{in} - \mu_{i1}$, $\beta X_i = \beta_1 X_{i1} - \beta_n X_{in}$, and $F(.)$ is a cumulative distribution function for the random variable v.

The reduced-form household banana market supply or demand functions can be specified as;

$$q_i^m = \gamma X_i + \varepsilon_i \qquad i = 1, 2 \tag{18}$$

The vector X represents the independent variables specified on the right-hand side of equation (13); β, and γ are vectors of parameters to be estimated. The error terms, μ_i, and ε_i are assumed to be joint-normally distributed with zero means and finite variances.

Application of OLS to the household banana market supply or demand function to estimate the γ coefficients would yield biased parameter estimates since they do not take into account the process generating the observed market quantities of households. A Lee-Heckman type two-step process has therefore been applied to correct for the possibility of bias due to sample selection (Lee, 2003; Maddala, 1983). The model is estimated using an extension of the Heckman two-step procedure. The first step involves the estimation of the relationships in equation (17) using a bivariate probit model. This provides estimates of joint probabilities of

market participation for buyers and sellers and provides estimates of β and ρ, which is the correlation between errors. These estimates are then used to calculate the inverse Mills ratios (λ), which is then added to the market supply and demand functions in equation (18). This process yields the following equation which can be estimated by OLS free of selection bias. The structural household banana market supply and demand functions take the form;

$$q_i^m = \gamma X_i + \sigma_i \lambda_i + \varepsilon_i^* \qquad i = 1,2 \tag{19}$$

Where $\lambda_i = \phi(\beta X)/\Phi(\beta X)$ if $Z_i = 1$, and $\lambda_i = -\phi(\beta X)/(1 - \Phi(\beta X))$ if $Z_i = 0$, and ϕ and Φ are the probability density and cumulative distribution functions of the normal distribution respectively. The coefficients on the variable λ_i in the household banana market supply equation provide estimates of the covariance between the errors in the selectivity equation (17) and the market supply equation, that is, $\sigma_i = \text{cov}(\varepsilon_i^* \mu)$.

The banana market participation decision given in equations (16a) and (16b) are assumed to be non-separable, within a utility maximization framework. The probability of a household participating in the market as a buyer is affected by the characteristics of participation as a seller particularly in terms of the transactions costs involved and vice-versa. Participation decisions are affected by random shocks to household banana market supply and demand; the correlation between the shocks (ρ) is positive if the sellers and buyers are similarly affected by the shocks (Goetz, 1992). The t-statistic on the parameter $\hat{\rho}$ is a Wald test of the hypothesis that ρ equals zero. Statistical significance of the correlation between the error terms in the equation would imply that a full information maximum likelihood bivariate probit should be used, as opposed to univariate probit estimation.

Data Description

The data used in the present analysis were collected between June and November 2006 in Rwanda and Burundi. Five communes of Gitega, Kirundo and Cibitoke provinces were covered in Burundi while in Rwanda, seven districts of East, West and South provinces were covered. A random sample of fifty to one hundred farm households was selected from each of the communes and districts yielding a total sample size of one thousand, four hundred and six households. Information from these households was gathered through questionnaire interviews. The questionnaire covered a range of topics including household systems and socio-economic structures, farming system agronomics, access to markets and marketing patterns of the focus crops, post harvest handling and processing of the focus crops, social structure of the households and households' embedding in social structures within the sites, status and determinants of food security, and health and nutritional status of the household. The questionnaire design and development was carried out by lead scientists of the Consortium for Improving Agriculture-based Livelihoods in Central Africa (CIALCA) project while data collection was done by fully trained enumerators speaking the local language. Additional data used was obtained from GIS – derived measures of location and distance to markets in order to better understand the market access effects particularly as it relates to variable transaction costs. All the surveyed households were geo-referenced, making it possible to derive the GIS measures. Table 1 presents the definitions and sample statistics for the variables used in the bivariate probit and OLS estimations.

Table 1: Data definitions and descriptive statistics

Variable	Variable Description	Sample Mean	S.D.
	Independent Variables		
BICYCLE_CAR	1 if the household owns a bicycle or a car	0.38	0.48
ACCESS	Time taken to reach the nearest urban market (in hours)	3.08	2.76
CHILD5	Number of children household members 5 years old and below	1.18	1.08
CHILD17	Number of children household members aged 6-17 years old	2.18	1.86
ONFARM_M	Number of active male household members aged 18-59 years full time on-farm.	0.74	0.67
ONFARM_W	Number of active female household members b/w 18-59 years full time on-farm.	0.86	0.79
OLDMEM	Number of adult members more than 59 years old	0.16	0.46
FSIZE	Average total land size in ha	2.72	8.30
CREDIT	1 if the household has obtained credit in 2005-06		
OFF_FARM	1 if household has access to off farm income		
FEMH_WID	1 if the household is female headed		
FARMGATE	1 if market outlet is farm gate		
URBANMKT	1 if market outlet is big urban or regional market		
INF_TRADER	1 if source of price information is traders		
INF_MEDIA	1 if source of price information is media		
INF_NEIGH	1 if source of price information is neighbor		
INF_MARKET	1 if source of price information is market		
MEMFARM	1 if household is a member of a farmer group		
RADIO	1 if the household owns a radio		
CIBITOKE	1 if household resides in Cibitoke province		
GITEGA	1 if household resides in Gitega province		
KIRUNDO	1 if household resides in Kirundo province		
EST	1 if household resides in East province		
OUEST	1 if household resides in West province		
SUD	1 if household resides in South province		
BEERBANPRI	Price per Kg of beer banana (US$)[a]	0.20	0.18
COOKBANPRI	Price per Kg of cooking banana (US$)[a]	0.23	0.47
YRSEXP	Number of years of farming experience	17.8	12.6
SOILWAT	1 if household carries out soil and water conservation measures		
PUR_HIR	1 if the land tenure system is freehold or rental		
TLU_TOT	Tropical Livestock Units (TLU)	0.07	0.47
	Dependent variables		
S_1	1 if household participates in the market as a seller		
S_2	1 if household participates in the market as a buyer		
Q_1	Total amount in Kg sold in the market by banana selling households[b] in the reference period	184.4	445.8
Q_2	Total amount in Kg bought from the market by banana buying households[b] in the reference period	3.8	11.7

[a] Average annual 2006 dollar rates used – 1 US$ = 1059.1 FBU and 549.9RWF.
[b] Calculated for only those who participated in the banana markets.

The model specifications were estimated using LIMDEP econometric software package, version 8. The independent variables include the set of standard variables theoretically expected to influence market participation decision and quantities traded. A number of variables have been included to proxy fixed and variable transactions costs. Dummy variables for car, motorcycle or bicycle ownership have been included to assess households' transportation ease to the market. Access to transportation equipment reduces the costs associated with transportation and is therefore expected to positively influence market participation. The variable for time taken to reach the nearest urban centre has been used to proxy the state of the road infrastructure and market access[2]. Areas closer to urban areas form large demand centers offering lucrative prices while declines in the cost of market information and transport flows due to good road infrastructure reduce transaction costs. The age variables, CHILD5, CHILD17 and OLDMEM are hypothesized to influence the fixed costs of market participation. The older and more experienced members have greater and repeated contacts, which may enhance mutual trust and allow trading opportunities to be undertaken at lower costs (Goetz, 1992). The number of children less than six years of age and those above six has been included to indicate the number of dependants, a factor that may influence household market participation direction as seller or buyer since the number of dependants is expected to influence the household marketed surplus.

Dummy variables for market outlets mainly used by households for their agricultural produce has been used to proxy both variable and fixed transactions costs. Selling to a local or large urban market compared to farm gate is expected to be associated with better market prices and consequently is assumed to stimulate marketed production and by implication, decrease the variable transactions costs associated with sales. However, the fixed cost factors such as distance

---

[2] For each survey site, the nearest urban markets were chosen for calculating the accessibility indicators.

to these market outlets would influence market participation. The distance to the local markets is proxied by the travel time variable to the nearest large urban centre.

Price information source dummy variables have been included to also represent fixed cost type transactions costs. Access to price information is hypothesized to play a significant positive role in influencing market participation. The summary statistics show that the main source of price information is the market. Forty three percent of the households indicate obtaining price information from the market compared to 21 and 7 percent who indicate that their price information source to be neighbors and the media respectively. The variables for ownership of a radio and membership to farmer groups have also been included to proxy market information sources.

Other variables such as total land size, access to formal credit and number of male and female household members between 18-59 years of age indicate access to production enhancing assets which would influence the production of a marketable surplus. The average household total land size is 2.7ha though the variation is quite large across households as is evident in the large standard deviation of 8.3. The variable for number of male and female household members between 18-59 years of age indicates the household labor self sufficiency which has a positive influence on both banana production and participation in banana markets. Access to off farm income is a wealth indicator which can be viewed on one hand as positively influencing production, and on the other as influencing the direction of market participation as a buyer since it increases a households' purchasing power. Its expected sign in the model is therefore ambiguous. The variable for gender of the household head influences market participation and market volume as it is linked to financial and labor resources access. An individual household's province of residence may also be a determining factor in market participation decisions and

market volumes, as it reflects among other things, the agro-climatic conditions as well as the local market pricing conditions.

The banana prices, both cooking and beer banana influence the supply or demand quantities by households. A positive relationship is expected for the selling households and a negative one for the buying households following the theory of consumer behavior. Other production enhancing variables that have been included in the model are land tenure security of the household, tropical livestock units and presence of soil and water conservation structures. The security of land tenure is a wealth indicator and also influences the production objective function and types of initiatives that a household would undertake. It is hypothesized to have a positive relationship with production of a marketable surplus. A similar relationship is hypothesized for the tropical livestock unit variable[3]. This indicates the total number of livestock units owned by a household. The average number of livestock units owned per sample household is only 0.07, representing about one livestock unit per household. It is assumed that households with livestock use livestock manure to fertilize agricultural plots, thereby increasing production.

Empirical Results

Market participation decision

Table 2 presents the results of the full information maximum likelihood (FIML) bivariate probit estimates of the equations explaining the probability of households to participate in banana marketing. The estimate of ρ (correlation between the errors) that maximized the bivariate probit function is -0.224 and is significantly different greater than zero at the 1% level. This suggests that the random disturbances in the banana market participation decisions of sellers and

---

[3] 1 Tropical Livestock Unit is refers to a 250 Kg live weight animal. The following conversions have been used: 1 cattle (cow/bull) is equivalent to 1 TLU while 1 small ruminant is equivalent to 0.12.

buyers are affected in opposite directions by random shocks and that their participation decisions are not statistically independent. Consequently, inefficient parameter estimates may be obtained if the equations are estimated separately.

The sample value of the likelihood ratio is 324.4 with a critical value of $\chi^2_{21,0.01} = 4.02$ is statistically significant at the 1% level suggesting that the independent variables taken together influence market participation decisions. The results suggest that ownership of a bicycle or a car by a household reduces the probability of market participation as a seller, which seems counter-intuitive. A plausible explanation is that ownership of a bicycle or a car is considered an asset for the wealthier households who could be participating less in the banana markets. An increase in time taken to reach the nearest urban centre decreases the probability of market participation for sellers and buyers, a result consistent with findings based on Senegal data (Goetz, 1992). This reinforces the argument that poor market access for households located in remote areas raises costs associated with marketing and information access. The coefficient for a household member between the ages of 6 and 17 had a negative sign and significantly different from zero in the equation for buyers but was not statistically significant in the sellers equation. This age group category contributes to on-farm family labor supply particularly during non-school going periods, thereby influencing the marketable surplus production.

Table 2: Bivariate Probit Estimates of Market Participation Equations of Banana Sellers and Buyers

Variable	Sellers			Buyers		
	Coefficient	Standard Error	Marginal Probability	Coefficient	Standard Error	Marginal Probability
INTERCEPT	0.056	0.140	-	-0.087	0.129	-
BICYCLE_CAR	-0.159**	0.083	-0.063	-0.074	0.080	-0.005
ACCESS	-0.002***	0.000	-0.001	-0.00012***	0.00008	-0.000006
CHILD5	-0.054	0.037	-0.021	0.005	0.034	0.000
CHILD17	0.007	0.020	0.003	-0.057***	0.022	-0.004
ONFARM_M	0.057	0.059	0.023	-0.047	0.056	-0.003
ONFARM_W	-0.018	0.050	-0.007	0.043	0.048	0.003
OLDMEM	-0.010	0.081	-0.004	0.062	0.075	0.004
FSIZE	0.009*	0.005	0.004	0.000012	0.000008	0.000006
CREDIT	-0.029	0.091	-0.011	0.130	0.088	0.008
OFF_FARM	0.008	0.077	0.003	0.150**	0.074	0.009
FEMH_WID	-0.215**	0.109	-0.084	0.000013	0.001	-0.00006
FARMGATE	0.092	0.068	0.036	0.066	0.065	0.004
URBANMKT	-0.092	0.068	-0.036	-0.066	0.065	-0.004
INF_NEIGH	-0.060	0.074	-0.024	-0.246***	0.075	-0.015
INF_MARKET	0.136**	0.063	0.053	0.055	0.061	0.003
MEMFARM	0.053	0.083	0.021	-0.040	0.078	-0.003
RADIO	0.078	0.086	0.031	-0.038	0.082	-0.002
CIBITOKE	0.407***	0.158	0.160	-0.359**	0.163	-0.022
KIRUNDO	-0.265*	0.151	-0.104	-0.093	0.137	-0.006
EST	-0.126	0.096	0.049	-0.136	0.095	-0.008
OUEST	0.607***	0.130	0.239	-0.275**	0.127	-0.017
Log-likelihood function	-1732.07					
RHO(1,2)	-0.224***					
	(0.045)^{b}					
Log-likelihood ratio	324.4					

Note: *, ** and *** denote significance at the 10, 5 and 1% levels respectively. The Log-likelihood ratio test is given by $2(L_u - L_w)$ and is asymptotically distributed as a χ^2 with 21 degrees of freedom.

^{b} Standard error in parenthesis

The results also show that larger land sizes raise the probability of market participation for sellers. This is expected since land is a critical production asset having a direct bearing on production of a marketable surplus, *ceteris paribus*. Access to off farm income increases the likelihood of banana market participation for buyers. This finding is consistent with those found in agricultural product market participation studies of other countries (Alene et al., 2008). Off farm income raises a household's purchasing power, and particularly when labor is a constraining factor, households are forced to weigh between on-farm production and off farm income. The gender of the head of the household has a significant impact in the market participation decision. There is a lower likelihood of market participation as sellers for female headed households but is not statistically significant for the buyers' equation. A plausible explanation for this is that female headed households are resource constrained, thereby affecting production of a marketable surplus[4]. To assess the link between labor resource and gender of the head of the household, a multiplicative interaction term between gender of the household head and number of adult members in the household was introduced in the model. However, this did not yield statistically significant results and was eventually dropped.

The coefficients for market outlet variables in the equations for both buyers and sellers were not significantly different from zero. Market price information variables produced varying results for both buyers and sellers. Market as a source of price information increases the likelihood of market participation for sellers while neighbors as a source of price information reduce the probability of market participation for buyers. Ownership of radios turned out to be statistically insignificant in influencing market participation for both sellers and buyers. This is possibly because communication assets are less useful in accessing market information and in facilitating

---

[4] Most female headed households lack access to productive assets (land, labor, capital) thereby limiting their production capabilities.

transactions in the region. In Burundi and Rwanda, agricultural production price information is not commonly published in newspapers or announced in the electronic media. In the rare cases when this is done, the focus is only for major markets which may not be accessible to farmers. Alene et al (2008) find similar results in their study of maize market participation in Kenya.

The fixed effects location variables are significant in explaining banana market participation. For Burundi and Rwanda, Gitega and South provinces, respectively were left out of the model to avoid the dummy variable trap. The results indicate that households in Cibitoke province are more likely to participate in the banana market as sellers than buyers relative to those in Gitega province. The marginal effect for Cibitoke household participation for sellers is 0.16 compared to -0.02 for buyers. Cibitoke is a high banana production area in Burundi, particularly for beer bananas which are transformed into banana wine mainly used as a source of household revenue. Conversely, households in Kirundo province are less likely to participate in the market as sellers compared to those in Gitega province, possibly because of differential market access across the two provinces (Andy et al., 2006). For Rwanda, households in the West province are more likely to participate in the markets as sellers and less likely to participate as buyers relative to those in South province. Location of a household in the West province raises the probability of market participation as a seller by 24%. The coefficient for East province is negative but statistically insignificant. In Rwanda, high banana production areas are in the East province, followed by West and South provinces.

Banana Supply and Demand Functions

Table 3 presents the results of the banana supply and demand functions by sellers and buyers. White's formula has been used in the calculation of the standard errors since the two step

Table 3: Banana supply and demand functions by sellers and buyers

	Sellers (Kgs sold)		Buyers (Kgs bought)	
	Coefficient	Standard Error	Coefficient	Standard Error
INTERCEPT	-121.189***	39.593	1.038	0.777
ADULTS	0.266***	0.042	-0.037***	0.010
CHILD5	-10.810	9.408	-0.517	0.333
CHILD17	9.584*	5.752	0.156	0.142
BEERBANPRI	0.476***	0.022	0.001	0.001
COOKBANPRI	0.241***	0.023	0.001	0.001
OFF_FARM	0.024	0.039	-0.001	0.001
ACCESS	-0.165***	0.039	-0.045***	0.010
FSIZE	0.020	0.054	0.021**	0.009
FEMH_WID	-0.560***	0.185	0.003**	0.001
CREDIT	-8.916	25.955	1.303	2.295
YRSEXP	0.278***	0.071	0.003**	0.001
SOILWAT	-29.947	36.258	2.001***	0.359
PURC_HIR	0.061**	0.028	0.001***	0.00008
TLU_TOT	-0.192***	0.035	0.002*	0.001
_	0.166***	0.029	-0.001*	0.001
R-Squared adjusted	0.382		0.238	

Note: *, ** and *** denote significance at the 10, 5 and 1% levels respectively

procedure employed in the analysis results in heteroskedastic residuals. The inverse Mills ratio, λ is significant in both the sellers and buyers banana market supply and demand equations, indicating that sample selection bias would have resulted if the banana supply and demand equations would have been estimated without consideration of the market participation decision.

There exists a positive relationship between the number of adults in a household and the intensity of participation of a household as sellers and the coefficient is significant at the 1% level. This could be attributed to the fact that the more adults a household has the more productive labour it can devote to the production of a marketable surplus. Conversely, the more the number of adults, the greater the intensity of purchases of bananas by the households.

Results indicate that the intensity of banana sales is inversely related to the number of children who are 5 years of less in a given household. Though the coefficient for this variable is not significant, it indicates that households with greater numbers of infants have greater food requirements yet less labour available for production hence lessening the marketable surplus.

The greater the number of children aged 6 – 17 years a households contains the greater the intensity of banana sales of that household. With a positive coefficient significant at 1%, the results can be attributed to the fact that these children engage in productive activities which result into an increase in the capacity of a household to produce a marketable surplus of bananas.

Results indicate that for every unit increment in the price (in US dollars) of beer bananas, the intensity of banana sales from the selling household increases by about 48%. Likewise a unit

increment in the price results into a 24% increment in sales of cooking bananas. This result suggests that beer bananas are more responsive to prices and this is attributed to the fact that the beer bananas are mostly produced for commercial purposes.

The coefficient for off-farm income variable is positive but not significant. This offers a slight indication that the more off-farm income a household accesses, the greater the increment in the capacity to produce a marketable surplus hence the greater the intensity of banana sales.

The coefficient for the family size variable was not significant for the supply function but was positive and significant for the demand function implying that the bigger the family size the greater the demand for bananas by that household. This result implies that though bananas are a very crucial diet for the population in the study area, not every member of the household may contribute towards increasing the households' capacity to produce a marketable surplus of bananas.

The coefficient for the variable capturing households which carry out soil and water conservation measures was positive and significant for the demand function of bananas and was negative but not significant for the supply function in the analysis. The plausible explanation for this could be that households able to carry out such measures could be engaged in other activities that are more remunerative and thus find it more logical to purchase bananas to meet their food requirements rather than engage in producing them.

Results indicate that there is a significant positive relationship between households which are under the freehold tenure system or which rent land and the intensity of banana sales. The explanation for this could be that these types of tenure systems offer confidence to households to invest in production systems that can yield a marketable surplus of bananas.

A significant negative relationship is observed between number of tropical livestock units possessed by households and the amounts of bananas sold. This could be explained by the fact that as household concentrates more on livestock production they become less involved in bananas production and hence produce less marketable surpluses.

Considering the variables linked to transaction costs, the shorter the time taken to reach the nearest urban market, the greater the intensity of participation in banana markets for both the selling and buying households. The coefficients for this variable are negative and significant at the 1% level for both categories (i.e. buyers and sellers). This variable captures the transaction costs incurred in accessing the market facilities. The distance could be short yet the condition of the road could be terrible and vice versa hence the time taken to travel to the urban market is a more acceptable means of capturing the transaction costs involved.

Linked to transaction costs is the number of years of farming experience. This variable does not only reflect the accumulation of expertise in farming but is also linked to the network and connections that a household develops overtime which facilitate their access to markets (Gabre-Madhin, 2001; Putnam, 1995). Results show that intensity of banana sales increases by 28% for every extra year of farming experience a household gains.

With regards to gender, results show that a significant negative relationship exists between households headed by females and the intensity of banana sales yet a significant positive relation ship exists between such female headed households and intensity of banana purchases. The plausible explanation for this observation is that female household heads are more negatively affected by the transaction costs of searching for buyers, contracting and enforcing a sales transaction as opposed to the male headed households. Likewise, female headed households are more likely to be resource constrained hence resort to markets to meet their deficits (Woods, 2003; Guiterrez, 2003)

Conclusions and Policy Implications

The analyses done reveal that market participation is not only a function of the factors of production a household is endowed with but it is also affected by the transaction costs involved in accessing markets for both inputs and outputs. Transactions costs include costs of searching for a trading partner, costs of making a contract and costs of enforcing one. Factors such as distance, access to information, gender of the household head and social capital of the household influence the level of participation of a household in markets.

For gender in particular, households headed by women are likely to have lower banana supplies to the market by a substantial 56% relative to their male headed counterparts. This suggests that increased targeting of women for market participation may increase the impact of policy interventions that aim at improved market access.

The decision by a household on whether to participate in a market or not is mostly influenced by the fixed transaction costs. The proximity of the market place, the ease of access to the market place, means of transport, source of information and the geographical location of the household in terms of provinces have direct effect on the fixed transaction costs.

Policies geared towards improving physical access to market places and availability and access to market information could yield positive results towards improving participation of smallholder farmers in markets. Such policies may include those related to improvement of rural infrastructure (i.e. construction and maintenance of feeder roads and trunk roads networks that ramify these areas of production, investment and improvement of telecommunication services to make them affordable to smallholder farmers so that information flow can improve…).

Other interventions may include the promotion of collective action amongst the smallholder farmers for purposes of improving their economies of scale in input and output markets and for the improvement of information flow amongst the members. This impacts directly on their bargaining power and hence enhances their participation in markets. Such roles can be able enhanced by NGOs and service providers who support the farmers therefore policies which favor their operations are likely to achieve some desired results as well.

Since market places play a central role in the exchange of goods especially in the developing economies, investments aimed at making such places more available and accessible by a greater portion of the smallholder producers would result in increased market participation. Policies

guiding local governments towards investing in rural market infrastructure ought to be instituted

as was the case in China's rural market development in the reform era (Chung, 2004).

References

Alene, A.D.; Manyong, V.M.; Omanya, G.; Mignouna, H.D.; Bokanga, M.; Odhiambo, G. 2008. Smallholder market participation under transactions costs: maize   supply and fertilizer demand in Kenya. *Food Policy* 33(4):pp318-328.

BAA 2008. Bureau of African Affairs: Background note; Burundi. February, 2008

Brorsen B.W. Dicks M.R. Just W.B. 1996. Regional and farm structure effects of planting flexibility. *Review of Agriculture Economics* 18(3) 467 – 475

Chowdhury S. K., 2002. Access to information, Transaction costs and Marketing choice of Rural Households between Middlemen and Direct Buyers in Bangladesh"; *ZEF University of Bonn,* Germany

Chung Him 2004. China's Rural Market Development in the Reform Era" *Ashgate Publishing, Ltd.,* 187 pages

Chvosta R.J., Rucker R.R. and Watts M.J. 2001. Transaction Costs and Cattle Marketing: The Information Content of Seller-provided Pre Sale Data at Bull Auctions *American Journal of Agricultural Economics*, Vol.83(2) May 2001, pp 286-301

Jagwe J.N. and Ouma E.A. 2008. Banana Marketing in Rwanda, Burundi and South Kivu *CIALCA project Survey Report*, July (2008) Consortium for Improving Agriculture-based Livelihoods in Central Africa (CIALCA), International Institute of Tropical Agriculture (IITA).

Coase R.H. 1960. The problem of Social Cost" *Journal of Law and Economics* 3 (October):1-44

de Janvry, A., M. Fafchamps, and E. Sadoulet. 1991. Peasant Household Behavior with Missing Markets: Some Paradoxes Explained. *Economic Journal* 101(1991):1400–17.

Delgado C. 1999. Sources of growth in Smallholder Agriculture in Sub Saharan Africa: The Role of Vertical Integration of Smallholders with Processors and Marketers of High Value-Added Items. *Agrekon* Vol.38 Special Issue: May 165-189.

Eswaran M. and Kotwal A. 1986. Access to Capital and Agrarian Production Organization. *Economics Journal* 96(June): 482- 498

Fafchamps, M., E. Gabre-Madhin, and B. Minten. 2005. Increasing Returns and Market Efficiency in Agricultural Trade. *Journal of Development Economics*

Fafchamps M., and Hill R.V., 2005. Selling at Farmgate or Traveling to Market. *American Journal of Agricultural Economics*, Vol. 87(3) August 2005: 717 - 734

FAO. 2002. Land Tenure and Rural Development" FAO Land Tenure Studies 3. Rome: FAO.

FAOSTAT 2008. Food and Agriculture Organization, *online statistical database*

Farm Africa. 2004. Reaching the poor a call to action. Investment in Smallholder agriculture in Sub-Saharan Africa. Prepared jointly by *FARM-Africa, Harvest Help and Imperial College, London* (the Center for Development and Poverty Reduction, Department of Agricultural Sciences)

Ferris R.S.B., S. Gaidashova, J.Tuyisenge, M. Rucibigango, E. Mukabazirake, B. Kagiraneza, J. Ndirigwe, C. Gatarayiha, K. Wanda, 2002 Market survey of the Banana sub-sector in

Rwanda. Consultancy report commissioned by ATDT-CIAT, IITA-FOODNET, CRS and ISAR, September 2002.

Finkelshtain, I., and Chalfant, J.A. 1991. Marketed Surplus Under Risk: Do Peasants Agree with Sandmo? *American Journal of Agricultural Economics* Vol.73 (August):557-67.

Gabre-Madhin 2001. Market Institutions, Transaction Costs and Social Capital in the Ethiopian Grain Market. *IFPRI research report 124,* International Food Policy Research Institute, Washington D.C

Goetz, S.J. 1992. A Selectivity Model of Household Food Marketing Behavior in Sub-Saharan Africa. *American Journal of Agricultural Economics*, 74(1992):444–52.

Guiterrez Martha 2003. *Macro Economics: Making Gender Matter-Concepts,Policies and Institutional Change in Developing Countries.* Zed books, (June)

Heckman, J.J. 1979. Sample Selection Bias as a Specification Error. *Econometrica* 47:931–59

Holloway G., Nicholson C., Delgado C., Staal S. and Ehui S. 2000. Agro-Industrialization through Institutional Innovation, Transaction costs, Cooperatives and Milk Market Development in the East African Highlands. *Agricultural Economics* Vol.23: 279-288.

IFAD 2003. Promoting Market Access for the Poor in order to achieve the Millennium Development Goals. *International Fund for Agricultural Development* Roundtable discussion paper for the 25th Anniversary Session of IFAD's governing council. (February)

Key, N., E. Sadoulet, and A. de Janvry 2000. Transactions Costs and Agricultural Household Supply Response. *American Journal of Agricultural Economics* 82(2000):245–59.

Kirsten J. and N. Vink 2005. The Economics of Institutions: Theory and Applications to African Agriculture. University of Pretoria Dept of Agricultural Economics Extension and Rural Development. Course study material

Lee E.T. and Wang J.W. 2003. Statistical Methods for Survival Data Analysis. *Technometrics,* Vol.45 No.4., November, pp372-373

Maddala, G.S. 1983. Limited-Dependent and Qualitative Variable in Econometrics Cambridge: *Cambridge University Press.*

Makhura M., Kirsten J. and Delgado C. 2001. Transaction costs and smallholder participation in the maize market in the Northern Province of South Africa. *Seventh Eastern and Southern Africa regional Conference*, February, pp 463 – 467

Minten B. and Kyle S., 1999. The Effect of Distance and Road Quality on Food Collection, Marketing Margins and Traders' Wage: Evidence from Former Zaire. *Journal of Development Economics* Vol.60, pp 467 – 495

Nkamleu G.B. and Adesina A.A. 2000. Determinants of Chemical Input Use in Peri-Urban Lowland Systems: Bi-variate Probit Analysis in Cameroon. *Agricultural Systems* 63(2000) 111-121.

Omamo S.W. 1998. Transport costs and Small holder Cropping Choices: An Application to Siaya District, Kenya. *American Journal of Agricultural Economics* Vol.80 February: 116-123.

Omamo, S. W. 2003. Policy Research on African Agriculture: Trends, Gaps, and Challenges. *International Service for National Agricultural Research (ISNAR),* The Hague.

Pingali, P., M. Meijer, and Y. Khwaja. 2005. Commercializing small farms: reducing transaction costs. Rome: FAO. <www.ifpri.org/events/seminars//SmallFarms/>

Putnam, R. D. 1995. Bowling Alone: America's Declining Social Capital', *Journal of Democracy* 6:1, January, 65-78.

Reardon T., P.Matlon and C.L. Delgado 1988. Coping with Food Insecurity at Household Level in Drought Affected Areas of Burkina Faso. *World Development*, 16(1988): 1065-1074

Reardon T. C. P. Timmer C. B. Barrett and J. A. Berdegue, 2003. The Rise of Supermarkets in Africa, Asia and Latin America. *American Journal of Agricultural Economics* 85(5):17

Sadoulet E., A. de Janvry and C. Benjamin 1998. Household Behaviour with Imperfect Labour Market. *Industrial Relations* 37(January) 85-108

Skoufias E., 1994. Using Shadow wages to estimate Labour Supply of Agricultural Households. *American Journal of Agricultural Economics* 76(May): 215-227

Spilsbury, J.D., Jagwe, J.N., Wanda, K., Nkuba, J., and Ferris᾽ R.S. B. 2004, Evaluating the Marketing Opportunities for Banana and its Products in the Principle Banana Growing Countries of ASARECA, Kenya, Rwanda, Tanzania and Uganda. *ASARECA / IITA Monograph 8*, IITA Ibadan, Nigeria,

Stiglitz J.E., 1988 *Economic Organisation, Information and Development* in H.Chenery and T.N. Srinivasan (eds) Handbook of Development Economics, Volume 1:92-160 Elsevier Science publishers.

Watanabe M., 2006. Middlemen: The Visible Market Makers. Working Paper 06-10 *Economics Series* 02, January 2006

WDR 2008. World Development Report: Agriculture for Development *The World Bank,* Washington D.C.

Woods Pamela, S.A. 2003. The Importance of Gender, Proximity and Transport   Availability as Transaction Costs in the Utilization of Veterinary Services in Zimbabwe. In *Africa's Changing Markets for Health and Veterinary Services: The New Institutional Issues*, edited by David K. Leonard. University of California Press/University of California International and Area Studies Digital Collection, Edited Volume #5,