An Economic Analysis of Ugandan Agricultural Constraints

by

Adam. M. Komarek and Fredoun Ahmadi-Esfahani
Agricultural and Resource Economics
The University of Sydney, NSW, 2006

Contributed paper presented to the
50th Annual Conference of the
Australian Agricultural and Resource Economics Society
Manly Pacific, Sydney
8-10th February 2006

An Economic Analysis of Ugandan Agricultural Constraints

Adam M. Komarek and Fredoun Z. Ahmadi-Esfahani
Agricultural and Resource Economics
University of Sydney, NSW, 2006

Abstract

Transaction costs and poor asset endowments appear to be major impediments to small scale agricultural development in Uganda. Reasons for the lack of commercialisation of agriculture, and the barriers to increasing the value of banana crop sales and banana production are the focus of this paper. Using agricultural household economics theory, an empirical analysis based on the Heckman model is undertaken. Data collected through a primary farm survey in three different regions of Uganda form the crux of the analysis. Preliminary findings indicate that transaction costs and production constraints are hindering development, thereby hampering poverty alleviation efforts.

Keywords; Agricultural development, Household economics, Ugandan survey, Market access

1. Introduction

The majority of the world's poor are engaged in small scale agriculture (Ellis 1993), with Uganda being no exception. Development of the small scale agricultural sector has the greatest potential to make deep inroads into poverty rates. In recent years increasing attention has been focused on the impact of imperfect markets on agricultural livelihoods, in part, stemming from the existence of transaction costs. Transaction costs are defined the full cost of carrying out exchange (Coase 1960). They include marketing costs and the non- price costs of exchange.

Uganda is a tropical landlocked country in East Africa, it is well endowed in natural resources relative to other sub-Saharan Africa countries. Ugandan social indicators reveal its underdevelopment on a global scale. Agriculture accounts for 85 per cent of export earnings and over 80 per cent of national employment (Government of Uganda 2000). The sector's contribution to GDP has declined from over 50 per cent in the 1980s to 36 per cent in 2002 (World Bank 2004).

In Uganda, the three most common causes of poverty are poor health, limited access to land and a lack of market access (MFPED 2002). The main causes of poverty outlined by NAADS (2000) are poor access to agricultural markets due to inadequate infrastructure, the generally low level of education which impairs rapid technological change, and the prevalent small size of land holdings which itself is aggravated by inadequate access to extension services, finance and tools. As pointed out by Deininger and Okidi (2001), three stylised facts characterise rural areas in Uganda. First, informational imperfections give rise to high levels of credit rationing. Second, transaction costs drive a wedge between buying and selling prices for different commodities, generating a wide margin within which it is economically rational for producers to remain self-sufficient. Third, households' endowments of human and physical capital are important not only from an efficiency point of view, but also for their ability to access markets. Restricted access to markets means a lack of income to purchase production inputs, consumer goods, and asset accumulation.

Statistics from UBOS (2002) show this lack of market orientation, with over 75 percent of households sell less than 25 percent of their output. Rural poverty, whilst on the

decline, still accounts for 40 percent of the population (UBOS 2003). Low input agriculture is common in Uganda. Statistical information is not readily available at the district level, so a study on specific areas could shed light on these issues

Given the importance of agriculture to national development, the Ugandan government has included agriculture as a major pillar in the quest for poverty eradication. The Plan for Modernisation of Agriculture is a holistic framework developed to help eradicate poverty, and constitutes part of the Ugandan Governments broader Poverty Eradication Plan. The aim of the plan is "eradicating poverty by transforming subsistence agriculture to commercial agriculture" (MFPED 2000).

An economic analysis of how transaction costs, production shifters and household characteristics are influencing Ugandan farm households has the potential to provide an enhanced understanding into the complex web of agricultural development. It appears that market access and production constraints are causing great variations in income. For policy analysis, it is of interest to focus attention on strategies that promote the commercialisation of agriculture, as well as focusing on increasing the value of crop sales. To date, studies in Uganda have not fully addressed how transaction costs, namely different marketing strategies, are impacting on the value of crop sales.

Uganda makes an excellent case study, as it has enjoyed stable governance and steady economic development progress in the past 20 years (World Bank 2004). Policy advice for Uganda may be beneficial, as it could be implemented easily, relative to less stable countries in sub-Saharan Africa. Econometric modelling based on survey results is a most suitable approach to policy analysis. Policies can be devised based on what variables have the most explanatory power, in explaining variation in the value of banana sales. Improving the value of sales will help reduce poverty, as extra income can be used to purchase goods and services.

The purpose of this paper is to provide a framework for analysing households facing transaction costs, to examine a farm household survey conducted in Uganda, overview the data collected, and report on some preliminary results. The preliminary results are aimed at providing some insight into farm household marketing and production. After a brief literature review, the paper provides an overview of agricultural household behaviour, and the empirical model that is used to estimate the impacts of transaction

costs on the value of banana sales per acre. Next, the household data set is examined, including survey design and some descriptive statistics. Finally, preliminary results are presented followed by concluding comments.

2. Literature review

Several authors have shown that high transaction costs reduce output market access and significantly lower selling prices (Goetz 1992; Jayne 1994; Omamo 1998; Key *et al.* 2000; Heltberg and Tarp 2002). These analyses generally have relied upon household economics and econometric techniques to show transaction costs produce a range of market participation regimes, or a buyer, and have a significant impact on volumes and value of sales. The econometric techniques are all based on household economics using either a probit model, Heckman model or ordinary least squares.

Taking a different approach Omamo (1998) built a linear program that incorporated transaction costs and a number of central features of African farming. Results showed that under transaction costs specialisation might not be viable.

Makhura (2001) used a probit model to determine what influences the probability of selling and then ordinary least squares to determine what factors influence the value of sales. Following Key *et al.* (2000), Heltberg and Tarp (2002) estimated agricultural supply response in Mozambique. Marketing behaviour was analysed in two steps, using the Heckman procedure. Reduced form equations were estimated for market participation and the value of quantities sold. This method allowed distinguishing between factors that determine whether or not to sell any output to the market, and the factors that influence the value of sales. Vakis *et al.* (2002) moved beyond measurable transaction costs such as transport costs and looked at bargaining and information. It was found that access to price information was equivalent to a 23 percent reduction in transportation costs.

In Uganda, the seminal studies on agricultural development have been related to natural resource management and the usage of physical and human capital (Pender *et al.* 2004a; Nkonya *et al.* 2005). Using the Ugandan National Household Survey from 1999/2000, Pender *et al.* (2004a) link rural poverty and agriculture, especially natural resource degradation. The value of crop production, crop choice, labour usage, land management

and household income was estimated. Land management decisions, measured by the amount of non labour inputs applied per hectare, were modelled using the Heckman sample selection model. For each input, the probability of usage and amount used was estimated. It was found that access to roads, markets and infrastructure had mixed impacts on non-labour input usage. Access to information and services had an impact, but was statistically insignificant.

The impact of access to sealed roads was estimated by Pender *et al.* (2004b), and was surprisingly small and actually reduced the value of crop production. This finding was surprising, as in high access areas it would be expected that more perishable crops are grown.

The decision to sell coffee at the farm gate was analysed by Fafchamps and Vargas Hill (2005), through using a Probit model. A non-linear relationship existed between wealth and market sales, smaller and larger coffee farmers sold at the farm gate, while medium sized growers traveled to the market. The interaction between wealth and quantity sold revealed that wealthier farmers are less likely to sell at the market. Perhaps the shadow value of their time is higher.

The welfare effects of exogenous changes in transactions costs differ fundamentally between households already participating in markets and those that are not (Renkow and Hallstrom 2000). For the former, the benefits of diminished transactions costs are continuous, for the latter, there will be no welfare gains until price bands reach a threshold level at which exchange begins to take place. This threshold level was estimated by (Key *et al.* 2000).

Previous studies have not analysed crop market access in Uganda at the household level. An approach that takes into consideration transaction costs and production factors could provide evidence as to what is more significant in explaining banana sales.

3. Analytical framework

As proposed by Goetz (1992) and Sadoulet and de Janvry (1995), the effect of transaction costs is to drive a wedge between selling and buying prices. This price difference influences both quantity traded, and the decision of whether to participate in the market.

A graphical analysis on how transaction costs influence three different households is provided for a food crop in Figure 1.

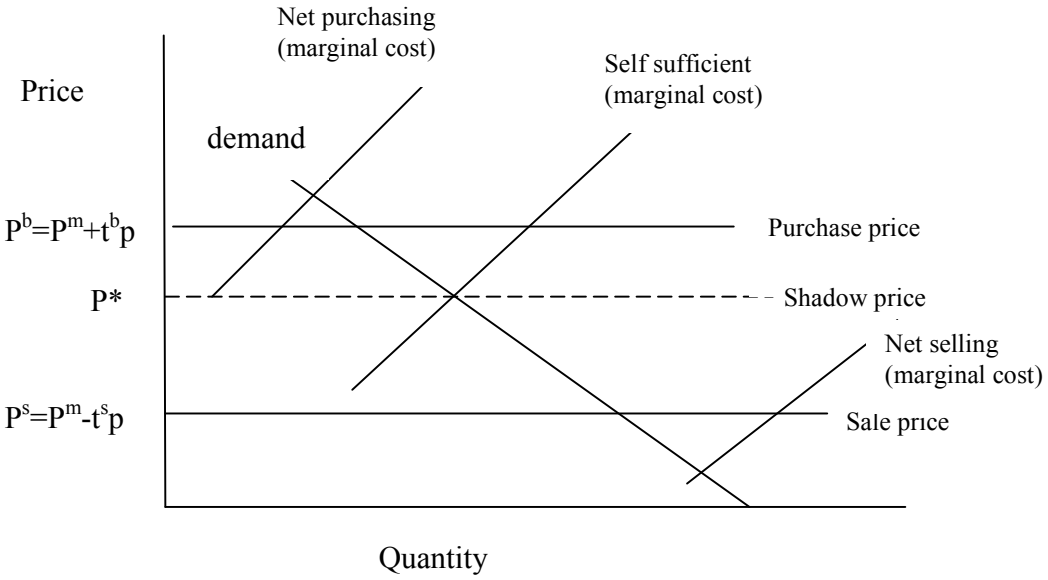

Figure 1 Price bands and market participation
Source: de Janvry and Sadoulet (2004)

The effective sales price for the food crop is P^s (the market price P^m net of transaction costs associated with selling, t^sp), and the effective purchase price is P^b (the market price P^m plus any transaction costs associated with buying the crop, t^sp). If the households supply curve intersects the demand curve (for simplicity, the same across each household) below the sale price the household will be a net seller, at this intersection is the households shadow price of the crop. Transaction costs are creating a region of self sufficient households where:

$$P^s \leq P^* \leq P^b \tag{1}$$

A reduction in transaction costs would have a two-fold consequence. Firstly, the number of market participants would increase, thus re-orientating producers for the market. This would occur when equation (1) does not hold. The second impact is the potential to increase the value of crop sales through increasing the effective price received.

Based on this graphical analysis, reduced form production and consumption equations can be estimated. This theoretical approach has been relied upon by Goetz (1992) and Heltberg and Tarp (2002), and was developed by Strauss (1984). The production and consumption of agricultural crops, as shown in Heltberg and Tarp (2002), can be expressed as follows:

$$\begin{aligned} Q_i^s &= Q_i^s(p_i, z_i^s) \\ Q_i^c &= Q_i^c(p_i, (\alpha + \pi(p_i, z_i^s), z_i^c) \end{aligned} \tag{2}$$

where Q_i^s is the quantity produced of crop i by the household, and Q_i^c is the consumption of crop i by the household, p_i is the price of crop, z_i^s are factors of production that influence production and z_i^c are household characteristics that relate to consumption, α is exogenous income sources and $\pi(.)$ are farm profits not including family labour. The marketable surplus is the difference between consumption and production defined as:

$$Q_i^{MS} = Q_i^{MS}(p_i, \alpha, z_i^s, z_i^c) \tag{3}$$

Furthermore, the price of agricultural goods needs to account for transaction costs. Proportional transaction costs impact on the endogenous price the household receives for their marketable surplus. Proportional transaction costs are broken up into different categories, relating to transport costs, costs related to the exogenous output price, costs relating to time spent on marketing, and other transaction costs. These costs are represented in equation (4), where d is the distance to market, τ is the time required to travel to the market, ϖ is the implicit wage rate, and $Q_i^{\sigma tp}$ is the quantity transported per trip. The transportation costs identity was derived by (Fafchamps and Vargas Hill 2005), and otc are other transaction costs. Many transaction costs are a function of the crops exogenous price, these are like ad valorem taxes:

$$\sum_{i=1}^{I} ptc_i == \frac{d\tau\varpi}{Q_i^{\sigma tp}} + tc(p_i) + tc(T_m) + otc_i \tag{4}$$

Thus, marketable surplus is a function of prices, proportional transaction costs, exogenous income, production and consumption characteristics, and can be defined as:

$$Q_i^{MS} = Q_i^{MS}(p_i, ptc_i, \alpha, z_i^s, z_i^c) = Q_i^{MS}(X_i) \quad (5)$$

Having a larger marketable surplus leads to higher incomes, thus finding ways to increase the level of marketable surplus, or in fact having a marketable surplus will be beneficial. There are reasons why households may not participate in crop markets and remain self-sufficient. Households may keep food from home production, thus avoiding the wide price margin between selling and buying prices. Reliance on own production for subsistence farming is also a risk management strategy. The probability of participating in the market is defined as:

$$\Pr(\text{market participation})_i = g(X_i, \Phi_i) \quad (6)$$

where Φ are fixed transaction costs.

Based on this framework, collecting data on variables that impact marketable surpluses appears important, as it will be possible to estimate what impacts on participation in markets and the value of crop sales.

4. Empirical model

To estimate the probability of participating in a crop market the Heckman procedure can be employed. This estimation technique is based on Heckman (1979), and is outlined in Greene (2003). Using this switching regression model, the choice of marketing regime between being a seller and being self sufficient can be jointly estimated with the value of crop sales. The estimation is a two-step procedure. In the first step the probability of being a seller is estimated in a probit equation. In the second step the value of crop sales conditional on market participation is estimated, where:

$z_i^* = \mathbf{w}_i'\alpha + e_i$ market participation is a function of a vector of variables (w), (7)

$z_i = 0$ if $z_i^* \leq 0$ if there is no market participation,

$z_i = 1$ if $z_i^* > 0$ if some of the farm output is sold,

$y_i^* = \mathbf{x}_i'\beta + u_i$ y_i is the value of sales and is a function of a vector of variables (x), (8)

$y_i = y_i^*$ if $z_i = 1$ the value of sales is observed only if the household participates in the market, and y_i is not observed if $z_i = 0$.

A probit model is used to calculate the probability of $z_i = 1$,

done using the method of maximum likelihood

$pr(z_i = 1) = \phi(\mathbf{w}_i'\alpha)$ where ϕ is the standard normal cdf. (9)

The second step is to estimate the expected value of y_i, conditional on z_i=1

$E(y_i \mid z=1, \mathbf{x}_i) = \mathbf{x}_i'\beta + E(u_i \mid z_i = 1) = \mathbf{x}_i'\beta + E(u_i \mid e_i > \mathbf{w}_i'\alpha)$. (10)

Using the statistical proof that

$$E(u_i \mid e_i > \mathbf{w}_i'\alpha) = \rho\sigma_e\sigma_u \frac{\vartheta(\mathbf{w}_i'\alpha)}{\phi(\mathbf{w}_i'\alpha)} \quad (11)$$

where $\vartheta =$ the standard normal pdf

inserting (11) into (10) yields

$$E(y_i \mid z=1, \mathbf{x}_i) = \mathbf{x}_i'\beta + \rho\sigma_e\sigma_u \frac{\vartheta(\mathbf{w}_i'\alpha)}{\phi(\mathbf{w}_i'\alpha)}. \quad (12)$$

A maximum likelihood estimator can be used to estimate the model, or the two steps can be estimated with a probit model and ordinary least squares. The maximum likelihood estimator doesn't use the term $\frac{\vartheta(\mathbf{w}_i'\alpha)}{\phi(\mathbf{w}_i'\alpha)}$, which is the inverse mills ratio.

The full Heckman model was not estimated, rather the second step was estimated in Masaka and Ntungamo, which was the value of banana sales per acre. This was done through using equation (5). The price variable was excluded, as it was expected the household's effective sales price had strong colinearity with transaction costs. If both price and transaction costs were included it might have been difficult to unravel their effects separately. The value of banana sales per acre was estimated using the ordinary least squares, and is represented by equation (14), the units are Ugandan Schillings. There is sound evidence that using the yield variable could lead to endogeneity problems (Dutilly-Diane *et al.* 2003; Nkonya *et al.* 2004). To overcome this, an additional model

was estimated, in which yield was a function of production related variables. This model is outlined in equation (13):

$$yield_i = \delta_0 + \delta_1 as_i + \delta_2 ex_i + \delta_3 labour_i + \delta_4 kgman_i + e_i \quad (13)$$

where:
as= access to extension services,
ex= years of farm experience,
labour= hours of labour used/acre,
kgman=kilograms of manure applied/acre, and
e= error term.

$$vs = \beta_0 + \beta_1 hhm_i + \beta_2 yield_i + \beta_3 dtm_i + \beta_4 gm_i + \beta_5 bf_i + \beta_6 p\inf_i + \beta_7 wst_i + \beta_8 \text{int}_i + \beta_9 nt_i + \varepsilon_i \quad (14)$$

where:
vs= the value of banana sales per acre,
hhm= number of people in the household,
yield= banana yield in kg/acre,
dtm= distance to town in kilometres,
gm= 1 if sell crops at the farm gate = 0 if travel to the market,
bf= 1 if bargain prices with buyers =0 if receive a fixed price,
pinf=1 if recieve information on banana prices =0 if don't,
wst=1 if sell to a trader form outside the local village =0 otherwise,
int= pinfo×bf,
nt= 1 if household is in Ntungamo =0 if in Masaka, and
ε = error term.

To estimate the empirical model, data on the dependant and explanatory variables were required.

5. Ugandan farm households: the survey

5.1 Survey design

The data for this analysis come from a stratified sample of 206 farm households in three different regions of Uganda, surveyed in September and October 2005. The data were collected by a team from the Ugandan Bureau of Statistics in collaboration with the University of Sydney. Households were questioned concerning farm operations, marketing behaviour, crop market access, usage of inputs, consumption and family characteristics. The questionnaire was designed to capture the households past 12 months, specifically for the cropping seasons July 2004 to June 2005. The choice of questions was based on evidence from Ugandan government and research organisation reports that a lack of capital and poor access to markets are major constraints to agricultural development.

The households were stratified into the different regions based on the major crop grown, and its importance to Ugandan agriculture, which included bananas, maize and coffee. The banana sub-sample was in Ntungamo in south western Uganda, the maize sub-sample was in Iganga in eastern Uganda, and the coffee sub-sample was in Masaka in central Uganda. Ntungamo is a peri-urban district that serves as an excellent case study of a district that is isolated but still modernising agriculture. The stratification was aimed at providing a survey sample that was representative of the Ugandan agriculture sector, and was a means to increase the precision of the sample. Selective descriptive statistics of the data for the three different regions are presented in Tables 1 and 2, allowing comparisons among regions and among national statistics.

5.2 Summary of survey trends

Table 1 Descriptive statistics of household crop production

District	Value of total crop sales (Ush)	Per cent of food crop sold.	Cropped area (acres)	Per cent self sufficient in food crop	Banana yield Kg/acre
Masaka	405334	8	3.97	52	3580
Iganga	144533	13	2.75	19	N/A
Ntungamo	3306690	58	6.63	1	3895

Mean values

Source: Survey results

Masaka and Iganga had much smaller cropped areas, these regions are located in more developed parts of Uganda closer to the capital, Kampala. By a large proportion, Ntungamo had the highest value of crop sales, and the greatest per cent of food crop sold. Being a cash cropping region Masaka had the most food self-sufficient households. Banana yields are similar across both Masaka and Ntungamo. Similar yields indicate similar factors of production.

Statistics in table two highlight aspects of household marketing and production. The growers who sold more produce at the market were in Ntungamo. Being further away from Kampala, fewer traders come around to farms to collect goods. Maize and coffee traders travel from Kampala to Iganga and Masaka to collect produce (Collinson *et al.* 2002). The majority of households sold crops at the farm gate, as they could not afford to carry the crop to the market. This could be related to labour shortages, an inability to pay for truck services, or not having any method of reaching the market, or that the only way to sell is through a trader.

The method of selling crops was evenly divided, with 53 per cent bargaining with buyers and 47 per cent receiving a fixed price. More bargaining occurred in Ntungamo, with the least, 19 per cent, occurring in Iganga. Personally knowing the buyer was common, with 55 per cent of the households having this knowledge. More households who knew the

buyer were in Iganga and Masaka, indicating a regular pattern of traders coming to collect crops.

Table 2 Descriptive statistics

Variable	Total sample	Masaka	Iganga	Ntungamo
Number of people in household	6.3	6.9	6.2	5.7
	(2.1)	(1.9)	(2.2)	(2.1)
Education higher than primary (1/0)	0.34	0.48	0.22	0.3
	(0.5)	(0.5)	(0.4)	(0.5)
Per cent of income generated from farm	64.6	54.8	80.4	58
	(21.7)	(21.1)	(21)	(12.1)
Transport crops to market (1/0)	0.3	0.15	0.04	0.71
	(0.46)	(0.36)	(0.2)	(0.45)
Distance from household to town (km)	14.6	7.8	10.8	24
	(9.7)	(5.7)	(3)	(9.4)
Bargain prices (1/0)	0.53	0.58	0.19	0.77
Receive information through word of mouth (1/0)	0.88	0.65	0.98	0.98
Member of a producer group (1/0)	0.31	0.35	0.1	0.52
Receive extension services (1/0)	0.55	0.59	0.14	0.94
Input expenditure (Ush)	37895	54159	26400	33128
		(115959)		(37511)
Use chemical inputs (1/0)	0.138	0.4	0	0.014
Use non chemical inputs (1/0)	0.52	0.53	0.07	0.96

Mean values, with standard deviation in brackets.

Source: Survey results

Information on crop prices was available to 89 per cent of households. The majority of this information, 88 per cent, was by word of mouth. In Masaka, 35 per cent of

households received prices on the radio. In Iganga, households only had price information at the time of maize harvest.

Access to extension services has long been viewed as a source of improved crop productivity, 55 per cent of households received on average 2.17 visits per year. Services were mainly related to crop production and land conservation. These extension services were provided by the government, namely the National Agricultural Advisor Department.

The descriptive statistics underscore the low-external input usage agriculture practised in Uganda. Only about 10 per cent of households use improved seed varieties. The use of organic fertilisers such as mulch and manure are common with 40 per cent of households using both. The use of non-organic inputs, for example, chemical fertiliser was on average 5 per cent. Pesticide usage was highest in Masaka with 31 per cent of households using them, compared to 10 per cent for all districts. Overall Iganga had the lowest application of inputs. Iganga had 22 per cent of households using machinery, mainly for the purposes of digging. Other districts used no machinery. Overall, during 2004/2005 the average amount of money spent on non labour inputs was 37660Ush.

Thirty seven per cent of households hired labour to assist with farm operations, indicating that an active labour market does exist.

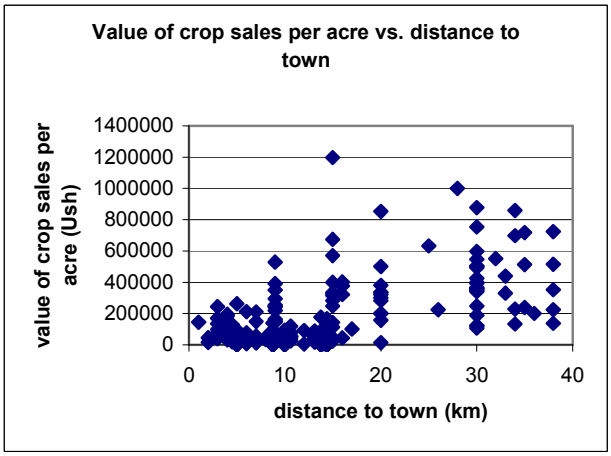

Figure 2 Value of crop sales per acre vs. distance to market

Source: survey results

The finding in figure two is counter-intuitive, one would expect that being closer to town would result in higher value of sales per acre as there would be lower transaction costs and better access to inputs. The correlation between the value of crops sales per acre and distance to town is 0.55. Possibly households further from town are on more productive land, or are larger thus benefit from economies of scale in production.

Table 3 Correlation between where sell crop and value of sales

Region	Masaka	Iganga	Ntungamo	Total
Correlation	-0.42	-0.35	0.54	-0.15

Source: Survey results

Households who sell their crops at the farm gate in Masaka and Iganga have a lower value of sales compared to those who travel to the market, the opposite is true in Ntungamo. The correlation between bargaining and receiving a fixed price to the value of crop sales per acre is 0.26. Households who bargain are positively correlated to value of crop sales per acre.It is apparent from the survey that there is a wide variety of households, using different marketing and production methods. To estimate how different market access and production factors are impacting the value of banana sales per acre the empirical model in section four was estimated.

6. Preliminary estimation results

The preliminary results presented in table 4 are for the banana growing Masaka and Ntungamo sub-samples. Equation (13) uses yield as an explanatory variable for sales value, this could lead to inconsistent estimates if yield is endogenous. To test whether or not yield was endogenous the Hausman test, equation (15), was conducted.

$$\begin{aligned} H_0 &: \operatorname{cov}(yield_i, \varepsilon_i) = 0 \\ H_1 &: \operatorname{cov}(yield_i, \varepsilon_i) \neq 0 \end{aligned} \tag{15}$$

To test the hypothesis in equation (15) it was necessary to estimate equation (14), with the estimated values of e_i from equation (13) included. The coefficient of e_i was not significantly different from zero, t-Statistic of -0.48. Consequently the null hypothesis, which states there is no endogeneity, was not rejected at a 5 per cent level of significance. Therefore the initial model seemed theoretically sound. The estimation results of equations (13) and (14) are presented in Table 4.

Table 4 Factors affecting the value of banana sales per acre and the kilograms of bananas produced per acre.

Independent variable	Ordinary least squares	
	Bananas produced Kg/acre	Value of banana sales/acre In Ugandan Schillings
Number of household members		4742 (12458)
Distance to town		105 (2624)
Sell at farm gate		108521* (58999)
Bargain prices		272468** (140996)
Sell to trader from out local district		-130978** (58872)
Know exogenous price		58162 (66218)
Household in Ntungamo		582508*** (109534)
Yield		95*** (19)
Interaction		-179845* (107508)
Access to extension services	895*** (372)	
Years of farm experience	-17 (17)	
Hours of labour used/acre	0.23 (0.26)	
Kg manure/acre	-0.03 (0.06)	
Number of observations	86	86
F	1.98	19.66
R^2	0.10	0.69

Coefficients values reported with standard errors in brackets.

*, **, *** means the associated coefficient is significant at 10, 5, and 1 per cent respectively

Yields were exogenous to the household, highlighting the low input usage nature of agriculture in the sample. Households have relatively similar means of production, and possibly within a certain area exogenous factors determine yield like rainfall, soil type, if government extension officers visit farms, or if an input supplier is located nearby. The only variable to have explanatory power in determining banana yields was access to extension services. Having this service increased yields by, on average, 895kg/acre. There is a need for extension services to target the poorest households, and not just the households which will give the best official results. Nkonya *et al.* (2005) also found access to extension services significantly increased the value of sales per acre. Labour, years of experience and amount of manure applied all had negligible affects. With an R^2 of 0.1, there appear to be other variables that explain the variation in crop yields.

Larger households had higher banana sales per acre, which appears counter-intuitive. It would be expected that larger families have to provide more food for household consumption and less can be marketed. Larger families might have more labour which can be used to improve crop yields and help market crops. This could increase sales per acre. However, the variable is statistically insignificant. Goetz (1992) found the amount sold declined when family sizes increased, the finding wasn't statistically significant.

Compared to households that received a fixed price for their bananas, households who bargain when selling had statistically significant higher per acre sales. Those who bargained received, on average, an extra 208667Ush per acre compared to those who did not bargain. Results suggest those who are offered a fixed price do not have many options to sell their bananas, and the price is dictated by the buyer.

Selling crops at the farm gate is positively associated with banana sales per acre, compared to those who travelled to the market. One would sell at the farm gate if prices were better, other reasons for selling at the farm gate include not being able to reach the market due to poor infrastructure, poor information about when the market is on, and the opportunity cost of time spent accessing markets. Farm gate sales may be prevalent also because quantities sold are small thus the cost of accessing the market is high per kg/banana. The average quantity sold was four banana bunches at a time. Owning bicycles and carts may make access to markets easier. To minimise transaction costs,

when larger quantities are sold at the farm gate, buyers might be willing to pay more if larger volumes can be purchased at once.

Households further from the market often had higher value of sales per acre, possibly as one travels into more isolated areas the land is of better quality thus yields are higher. However, one would expect that in isolated areas the cost of accessing markets would be higher. Although highly statistically insignificant, the finding is somewhat surprising. In Uganda, (Nkonya *et al.* 2005) has a similar result, as the distance to an all weather road increased so did the value of sales per acre, again the variable was insignificant. In Mozambique, (Heltberg and Tarp 2002) found as distances to the province capital increased so did the quantity of crops sold. The variable was not statistically significant, but it was significant in determining market participation. Distance to market was also positively and insignificantly associated with the quantity sold to the market Key *et al.* (2000). The insignificance of distance is important. Within the district distance to town is not important.

Having information available on the exogenous price of bananas positively affected banana sales per acre, although the variable wasn't significant. An interaction term was included in equation (7). This variable captured the effect of receiving price information for those households who bargained the price they received. The variable had a negative sign, indicating that sellers who bargain and have prior information on prices, received a lower value of sales per acre, compared to bargainers without price information. This finding is also unusual, it would be expected that people with price information could command a better price as there is less chance of being underpriced as the seller has more information about market prices.

Banana farmers sold their crops to a variety of sources, including local market places and to traders. Those who sold to traders from places out of the local area received, on average, 130978Ush less per acre than those who sold to other sources. Often households sold to traders from Kampala, these traders have their own transaction costs to account for, like searching for a buyer, and transporting bananas back to Kampala. Providing more selling options appears to be a good policy to improve sales. Thus, facilitating trade through improved infrastructure and marketing channels appear potentially important. The variable also shows that there is significant demand for bananas within the district, as

households selling to buyers within the district have higher sales than those who sell to outside traders.

Intuitively one would expect higher yields to significantly raise banana sales, this was indeed true. For every extra kilogram of bananas produced per acre the household generated, on average, an extra 95Ush. While this variable is highly significant, compared to other transaction cost variables it has a smaller impact on banana sales. The yield variable had a small range (Table 1) implying that production is exogenous.

The most significant variable was household location. Households in Ntungamo earn, on average, 582504Ush per acre more than those located in Masaka. Ntungamo may have more fertile soils or better rainfall. Alternatively because Ntungamo farmers are larger they could benefit from economies of scale when marketing bananas. Also in Masaka coffee production is more prevalent, and bananas may be seen as only a food crop not a cash crop.

7. Concluding comments and further work

In this paper, it has been shown that transaction costs and yields influence the value of banana sales per acre. The paper has introduced explanatory variables that haven't been used before in the literature to test what impacts the value of banana sales per acre. While the survey is a small size, and results are only preliminary, policy options that focus on improving farm yields and lowering transaction costs appear the best development strategy. Transaction costs have a larger influence on value of sales than production, as the magnitude of their coefficients was much larger. Some households may produce better quality produce this will lead to higher sales values, if proper grading of bananas is done. Results in this study and in most previous studies show that distance to market is not important in determining the amount of a crop sold, although it can be a barrier to crop market entry. Before any detailed policy recommendations can be given full results and a field trip have to be completed, this will ensure policy advice is well informed. Preliminary results show much of the marketing of bananas may be out of the hands of households. Creating more marketing options appears beneficial. Providing an environment that is conducive for trade should be a priority. This could be done through

improving infrastructure such as roads and market facilities, by providing households with information about market times and locations. Collective action by households to sell bananas could also boost incomes by lowering transport costs. This option has barriers in itself as farmers are often untrusting of others handling their goods.

It appears that there could be monopsony power for banana buyers, and if households have very limited options to sell bananas, the buyers may be gaining rent from this lack of competition. Large marketing margins are evident. At the time of the survey bananas in Kampala sold for 300Ush/kg while surveyed households received 153Ush/kg, a 50 percent margin appears to be going to middlemen. Bananas do not undergo any processing, this margin must account for transport costs and profits to middlemen. Reducing this apparent market power on purchases will assist in enhancing competition.

Given bananas are the world's most important traded fruit, further developing the export trade of the apple banana could provide farmers with a worthy diversification opportunity. The apple banana is gaining price premiums in United Kingdom supermarkets. Reducing the cost of air freight and improving the packaging of apple bananas would be beneficial.

While a lot of bananas are sold to traders from Kampala to meet urban demand, households receive lower prices when selling to these traders. This suggests that local and regional demand for bananas is also strong, and that collective action by producers to market larger quantities may lower the cost of exchange. Formation of producer groups to sell bananas and buy trucks appears a worthwhile investment strategy.

Such questions as, why households who bargain have higher sales? Why households who sell to traders from outside the local district have lower sales? and why so many households sell at the farm gate? require further attention. Further work includes, collecting more data on crop production and marketing channels, and implementing the Heckman model for market participation. Work in progress also includes an adapted household model which incorporates transaction costs and missing markets, from this a non-linear model will be built using survey data.

References

Coase, R.H. (1960). The problem of social cost, *Journal of Law and Economics* 3, 1-44.

Collinson, C.D., Kleith, U., Burnett, D.G., Ferris, R.S.B., Jagwe, J.N. and Muganga, A.K. (2002) *Transaction cost analysis*, IITA, Kampala.

de Janvry, A. and Sadoulet, E. (2004), Progress in the modeling of rural households' behaviour under market failures, in Alain de Janvry and Ravi Kanbur (Ed), *Essays in Honor of Erik Thorbecke*, Kluwer publishing.

Deininger, K. and Okidi, J. (2001), Rural Households: Incomes, Productivity, and Non-farm Enterprise', in Reinikka, R. and Collier, P. (ed), *Uganda's Recovery The role of Farms, Firms, and Government*, World Bank, Washington.

Dutilly-Diane, C., Sadoulet, E. and de Janvry, A. (2003), Household Behaviour under Market Failures: How Natural Resource Management in Agriculture Promotes Livestock Production in the Sahel, *Journal of African Economies* 12, 343-370.

Ellis, F. (1993), *Peasant economics: farm households and agrarian development*, 2nd edn. Cambridge University Press, New York.

Fafchamps, M. and Vargas Hill, R. (2005), Selling at the Farmgate or Traveling to Market, *American Journal of Agricultural Economics* 87, 717-734.

Goetz, S.J. (1992), A Selectivity Model of Household Food Marketing Behavior in Sub-Saharan Africa, *American Journal of Agricultural Economics* 74, 444-452.

Government of Uganda 2000, *United Nations Conference on the Least Developed Countries, Brussels, 14-20 May 2001: country presentation*, United Nations, Geneva.

Greene, W.H. (2003), *Econometric analysis*, 5th edn, Prentice Hall, Upper Saddle River, New .Jersey.

Heckman, J.J. (1979), Sample Selection Bias as a Specification Error, *Econometrica* 47, 153-161.

Heltberg, R. and Tarp, F. (2002), Agricultural Supply Response and Poverty in Mozambique, *Food Policy* 27, 103-124.

Jayne, T.S. (1994), Do High Food Marketing Costs Constrain Cash Crop Production? Evidence from Zimbabwe, *Economic Development and Cultural Change* 42, 387-402.

Key, N., Sadoulet, E. and de Janvry, A. (2000), Transactions Costs and Agricultural Household Supply Response, *American Journal of Agricultural Economics* 82, 245-259.

MFPED (2000), Plan for modernisation of agriculture: eradicating poverty in Uganda, Ministry of finance planning and economic development, Kampala.

MFPED (2002), Uganda participatory poverty assessment process Second Participatory Poverty Assessment Report Deepening the understanding of poverty, Ministry of finance planning and economic development, Kampala.

NAADS (2000), Master document of the NAADS taskforce and joint donor group, National agricultural advisor services, Entebbe.

Nkonya, E., Pender, J., Kaizzi, C., Edward, K. and Mugarura, S. (2005), Policy options for increasing crop productivity and reducing soil nutrient depletion and poverty in Uganda, International Food Policy Research Institute, Washington.

Nkonya, E., Pender, J., Jagger, P., Sserunkuuma, D., Kaizzi, C. and Ssali, H. (2004), Strategies for Sustainable Land Management and Poverty Reduction in Uganda Research Report 133, International Food Policy Research Institute, Washington.

Omamo, S.W. (1998), Farm-to-Market Transaction Costs and Specialisation in Small-Scale Agriculture: Explorations with a Non-separable Household Model, *Journal of Development Studies*. 35, 152-163.

Pender, J., Ssewanyana, S., Edward, K. and Nkonya, E. (2004a), Linkages between poverty and land management in rural Uganda: evidence from the Ugandan national household survey, 1999/00, International Food Policy Research Institute, Washington.

Pender, J., Nkonya, E., Jagger, P., Sserunkuma, D. and Ssali, H. (2004b), Strategies to Increase Agricultural Productivity and Reduce Land Degradation: Evidence from Uganda, *Agricultural Economics* 31, 181-195.

Renkow, M. and Hallstrom, D.G. (2000), *Infrastructure Investment, Transactions Costs, and Rural Poverty Alleviation*, Proceedings of the 24th International Association of Agricultural Economists meeting; 13-18 Aug 2000, Berlin, Germany.

Sadoulet, E. and de Janvry, A. (1995), *Quantitative development policy analysis*, John Hopkins University Press, Baltimore.

Strauss, J. (1984), Marketed Surpluses of Agricultural Households in Sierra Leone, *American Journal of Agricultural Economics* 66, 321-331.

UBOS (2002), Uganda National Household Survey 1999/2000 Report on the Crop Survey Module, Ugandan Bureau of Statistics, Entebbe.

UBOS (2003), Uganda National Household Survey 2002-03; Report on the Socio-economic survey, Ugandan Bureau of Statistics, Entebbe.

Vakis, R., Sadoulet, E. and De Janvry, A. (2002), Transaction costs and the role of bargaining and information: evidence from Peru, University of California, Berkeley.

WorldBank (2004), *World development indicators CD-ROM*, IBRD World Bank, Washington.