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Transaction costs and smallholder household access to maize markets in Zambia

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After liberalization of the Zambian economy, farmers were faced with the responsibility of finding the right buyers, negotiating prices and delivering produce leading to them incurring transaction costs. This study aimed at identifying and quantifying transaction costs factors and their impact on maize market participation for small holder farmers in Zambia. The study used primary data collected from a sample of 240 randomly selected households from Zambia's central Province. The Heckman's procedure was used to analyze factors affecting the likelihood and extent of participation in maize markets. The logit results (from the Heckman's two-stage process) show that ownership of assets such as radios and having access to alternative marketing channels increased the likelihood of market participation while the heckit results (OLS corrected for selectivity bias) shows that ownership of ox-carts, increased family size and experience in maize marketing were the factors that increased quantities of maize marketed. The study recommends provision of market information, improving accessibility to markets as well as increasing access to productive assets as means of alleviating impact of transaction costs.

Key words: Transaction costs, maize, market access, Zambia.

INTRODUCTION

Maize is one of the most important crops in Zambia. According to the Regional Agricultural Trade Expansion Support (2003), as a staple food, it comprises of up to 55% of the total dietary energy supply and affects food security and incomes of about 80% of the population. It also accounts for between 50 and 67% of the total area under cultivation (Central Statistical Office [CSO], 2002) and it is the single most important crop in the small scale sector in terms of gross value of production and crop sales. Although about 900,000 small-scale farmers account for over 65% of the total national production, they only contribute about 30% to the marketed surplus (Zulu et al., 2007). The smallholder maize market is also highly concentrated with more than 80% of the sales attributed to less than 30% of the sellers (Nijhoff et al., 2003). These low levels of market participation have been attributed to high transaction costs that make access to markets difficult (Kahkonen and Leathers, 1999). Due to differential access to assets, markets and information, transaction costs tend to be household specific and affects households differently leading to some being completely excluded from the markets.

The problems faced by smallholder farmers in marketing their produce have been linked to the liberalization of agricultural markets. For instance, Simatele (2006) argues that despite liberalization of the

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agricultural markets, the small-scale agricultural sector has been facing problems which are attributed to inadequacies in the marketing system for staples and agricultural inputs. Major among them, are the low prices of staples leading to problems of low real incomes for smallholder households and also food shortages (Nijhoff et al., 2003). Similarly, using historical trends in agricultural productivity, Yambayamba (2009) shows that since the market reforms of 1991, there has been a decline in absolute maize production, which they attribute to removal of fertilizer subsidies, the abolishment of pan-territorial pricing and the closure of maize collection depots in remote areas. These authors show that over the 12-year period between 1990/1991 and 2002/2003 seasons, the share of maize in total smallholder crop output declined from 76 to 55%. Similarly, Seshamani (1999) shows that the main adverse impact witnessed as a result of agricultural market liberalization were the negative supply response of the smallholder farmers due to the adverse impact on their incomes. This author shows that the index of maize production dropped from 145 in the 1989/90 growing season to 54 in the 1994/95 growing season. However, even though the area under maize cultivation fell by 4% in the 1996/1997 season compared to the previous (1995/1996) season, maize production fell by 32%, while maize sales fell by 53%. These declines in maize production and marketing are partly attributed to the fact that smallholder farmers experienced difficulties in accessing adequate and timely inputs, marketing of produce as well as in getting a fair price for their produce (Seshamani, 1999).

The above statistics show that low sales and non-participation in maize markets can be explained by both low production and reduced access to markets due to government withdrawal from providing support to smallholder farmers. For instance, whereas there have been several highly committed and well-funded efforts aimed at kick-starting a “green revolution” based on the understanding that agricultural productivity is a pre-condition for sustainable poverty reduction and improved living standards, they have been thwarted by their inability to anticipate and address downstream issues of marketing and governance (Jayne et al., 2007). Zambia's agricultural sector is also characterized by an inherent dichotomy in agricultural marketing, with smallholder traders facing an underdeveloped *informal* marketing system, and the more advanced large-scale traders and processers being part of a *formal* marketing system (Yambayamba, 2009).

Whereas the problem of low productivity has been extensively explored (Yambayamba, 2009; Zulu et al., 2007), the role that market access plays in leading to low maize productivity and sales has not received much attention, leading to misguided policies by government. For instance, government policies aimed at increasing the production of the national staple food (maize) have mostly revolved around increasing productivity through provision of subsidized inputs. To this effect, about 50% of the national agricultural budget has always been dedicated to provision of subsidized maize seed and fertilizer over the last eight years. This has been coupled with provision of extension services that are biased towards maize production. However, despite all these efforts aimed at increasing production, not much effort has been spent on assessing the role that access to markets play in stimulating production as well as market participation. This is despite some earlier studies (Kahkonen and Leathers, 1999) indicating that Zambian maize markets are riddled with high transaction costs leading certain potential participants being excluded from participating. As Seshamani (1999) points out, faced with a situation where government agents do not come to purchase his produce, the smallholder farmer has to go to the market centres to sell to them, which is not easy in view of the lack of transport to reach the markets. The author also shows that in the event that the farmer reaches the markets, he finds them to be buyers’ markets where the prices are not in his favor.

The fact that farmers do not only have to produce but also have to find the right buyers, they negotiate on prices and deliver their produce which leads them to incur transaction costs. According to Eggertson (1990), these are costs that arise when individuals exchange ownership rights for economic assets and enforce their exclusive rights[1]. They originate from activities such as searching for trading partners, screening partners, bargaining, monitoring, enforcement and transferring product (Key et al., 2000). These transaction costs may also include the costs associated with reorganizing of household labor and other resources in order to produce enough for the market (Makhura et al., 2001; Zaibet and Dunn, 1998). This paper attempts to explain the impact of transaction costs on maize market participation among the smallholder farmers in the Central Province of Zambia.

Transaction costs theory has been used to explain farmers’ behavior in both input and output markets. A study by de Janvry et al. (1991) showed that high transaction costs lead to missing markets for certain commodities. They concluded that in the absence of food markets households must be self-sufficient in terms of food, which confines their ability to reallocate land and labor to cash crops. These households tend to face wide margins between low selling price and high buying price. They also showed that the poorer the infrastructure, the less competitive the marketing systems, the less information is available, and the more risky the transactions which reduce the incentives.

In a study of household food marketing behavior in Senegal, Goetz (1992) used a range of factors to reflect the effect of transaction cost factors on the market participation in grain, both for buying and selling. For exogenous regressors, variables theoretically expected to

[1]Exclusive rights being defined as the power or in a wider sense, the right to perform an action or acquire a benefit and to permit or deny others the right to perform the same action or to acquire the same benefit.

affect quantities purchased and sold, as well as specific proxy variables for fixed transaction costs were used. These included ownership of carts for transportation to market, physical distance from market, number of persons in the household and a regional dummy variable separating study area into two regions with region being well integrated into the transport and communication infrastructure hence facing low information gathering costs while the other one was not. Other variables used included age of household head with older and more experienced heads expected to have greater contacts, which allow them to discover trading opportunities at low cost. An interaction term for information was also included. The study found that in the case of effects of fixed cost-type variables on market participation, better information plays an important role. For buyers, adding a person to the household raises the likelihood of market participation while ownership of assets was important in reflecting market access.

Key et al. (2000) extended Goetz's analysis by focusing on participation in maize markets in Mexico. Their study found that both fixed and variable transaction costs play a significant role in explaining household behavior. They also showed that ownership of assets such as transport equipment (pick-up) tends to reduce entry barriers into the market. Omamo (1998) used the transaction costs approach to determine households' decisions to rather devote resources to low-yielding food crops than to cash crops with higher market returns in Kenya. The analytical results show that transport costs are sufficient to explain the cropping choices. This implies that relatively more land is devoted to cash crops and less to food crops the closer the households are to markets. Matungul et al. (2001) used transaction costs theory to determine the determinants of crop marketing in South Africa. Using regression analysis, they found that the level of income generated from food crop sales by small-scale farmers is influenced by transaction costs and certain household and farm characteristics. Still in South Africa, a study to determine the role of transaction costs in participation of smallholder farmers in maize markets (Makhura et al., 2001) found out that transaction costs differ among households due to asymmetries in access to assets, market information, infrastructure and extension.

In Zambia, Kahkonen and Leathers (1999) analyzed changes in transactions costs for evidence of the private sector's ability to fill the vacancy left by government's withdrawal from agricultural marketing. Their assessment of the maize and cotton markets show that although there has been significant success in the private sector's response to liberalization, there are still many conditions that lead to inflated transactions costs especially at the farm level. They concluded that the limited competition among traders at the farm level in remote areas was the source of high transaction costs. Farmers are not well informed about prices in nearby markets, and find it difficult or impossible to search out alternative markets.

The factors contributing to these costs are the poor quality of roads, unavailability of transport, poor quality of communications infrastructure, and unavailability of credit. However, this study focused more on the impact of institutional arrangements (government interventions) on transaction costs, hence the need to study the farmer characteristics that influence the transaction costs they incur as they participate in the markets. This paper complements other studies by examining transaction costs at household level in Zambia. The objectives include identifying key transaction cost factors in the smallholder maize markets, examining their influence on the likelihood of market participation as well as their influence on quantities of maize marketed. In line with the Government's policy of increasing market access for smallholder farmers, this information would be useful to policy makers as an input in the design for interventions to enhance smallholder participation in maize markets.

METHODOLOGY

The study area, data sources and type

The study was carried out in Central province of Zambia. The dominant crops grown are maize, cassava, millet, groundnuts and beans. According to the 2010 population census (CSO, 2012) the population in the province was estimated at 1,307,111 which is about 10% of the national population. The population density is 10.7 persons per square kilometer. By stratifying the households into market participants and non-participants based on the 2005/06 agricultural season, 240 households were sampled using purposive quota sampling. Using a pre-tested structured questionnaire, data on socio-economic characteristics such as household, assets structure and factors like physical location and information access were collected. Household data included variables such as family size, age and education level of household head. Asset structure data comprised of ownership of assets such as bicycles, ox-carts, radios and televisions. These factors were used as proxies for transaction costs to test the main hypothesis that houses facing lower transaction costs had a high probability of market participation.

Theoretical framework

To incorporate transactions costs into an agricultural household model framework, it is convenient to specify market participation as a choice variable (Key et al., 2000). That is, in addition to deciding how much of each good i to consume c_i, produce q_i, and use as an input x_i, the household also decides how much of each good to "market" m_i (where m_i is positive when it is a sale and negative when it is a purchase). If there were no transactions costs, the household's objective would be to maximize the utility function:

$$u(c_a, c_m, c_l; z_u) \quad (1)$$

where: c_a = household staple food (maize in this case); c_m = purchased good; c_l = home time
subject to:

$$\sum_{i=1}^{N} p_i^m m_i + T = 0 \quad \text{(Cash constraint)} \quad (2)$$

$$q_i - x_i + A_i - m_i - c_i = 0, \qquad i = 1,\ldots\ldots,N$$ (Resource balance) (3)

$$G(q, x; z_q) = 0$$ (Production technology) (4)

$$c_i q_i, x_i \geq 0$$ (non-negativity constraint) (5)

where p_i^m is the market price of good *i*, A_i is an endowment in good *i*, *T* is exogenous transfers and other incomes, z_u and z_q are exogenous shifters in utility and production, respectively, and *G* represents the production technology.

Considering that in economic terms, transaction costs are costs paid by buyers but not received by sellers, and/or the costs paid by sellers but not received by buyers (Kissel, 2006), they effectively raise the price paid by a buyer and lower the price received by a seller (Minot, 1999). Although these costs are mostly unobservable and cannot be easily recorded (Key et al., 2000), factors that explain them can be observed (Heltberg and Tarp, 2001). Therefore, by introducing and expressing the transaction costs in monetary terms, the cash constraint becomes:

$$\sum_{i=1}^{N}\left[(p_i^m - t_{pi}^s(z_t^s)\delta_i^s + (p_i^m + t_{pi}^h(z_t^h))\delta_i^b\right] m_i + T = 0$$ (6)

where δ_i^s is equal to one if $m_i > 0$ and zero otherwise, and δ_i^b is equal to one if $m_i < 0$ and zero otherwise. Introduction of transaction costs imply that the price effectively received by the seller is lower than the market price p_i^m by the unobservable amount t_{pi}^s, and the price effectively paid by the buyer is greater than p_i^m by the unobservable amount t_{pi}^b. Transaction costs are expressed as a function of observable exogenous characteristics, z_t^s and z_t^b, that affect these costs when selling and buying. As such, under transaction costs, the household's objective can be expressed by Equations (1) and (3) to (6), while to derive the supply and demand equations, we define the Lagrangian:

$$L = u(c; z_u) + \sum_{i=1}^{N}\mu_i(q_i - x_i + A_i - m_i - c_i) + \phi G(q, x; z_q) + \lambda\left[\sum_{i=1}^{N}[(p_i^m - t_{pi}^s)\delta_i^s + (p_i^m + t_{pi}^b)\delta_i^b]m_i + T\right]$$ (7)

where μ_i, φ, and λ are the Lagrange multipliers associated with the resource balance, the technology constraint, and the cash constraint, respectively. Because the transaction costs create discontinuities in the Lagrangian, the optimal solution cannot be found by simply solving the first order conditions (Key et al., 2000; Minot, 1999). The solution is decomposed in two steps, solving first for the optimal solution conditional on the market participation regime, and then choosing the market participation regime that leads to the highest level of utility. Under the usual assumptions for utility and technology, the conditional optimal supply and demand are obtained by solving for the first order conditions are as follows:

$$\frac{\partial u}{\partial c_i} - \mu_i = 0, \; i = \{i | c_i > 0\}$$ (for consumption goods) (8)

$$-\mu_i + \phi\frac{\partial G}{\partial q_i} = 0, \; i = \{i | q_i > 0\}$$ (for outputs) (9)

$$-\mu_i + \phi\frac{\partial G}{\partial x_i} = 0, \; i = \{i | x_i > 0\}$$ (for inputs) (10)

$$-\mu_i + \lambda\left[(p_i^m - t_{pi}^s)\delta_t^s + (p_i^m + t_{pi}^b)\delta_i^b\right] = 0$$ (for traded goods) (11)

The decision price p_i is given as: $p_i = p_i^m - t_{pi}^s$, if $m_i > 0$, for sellers; $p_i = p_i^m + t_{pi}^b$, if $m_i < 0$, for buyers; $\tilde{p}_i = \mu_i/\lambda$, if $m_i = 0$, For self-sufficient where $\tilde{p}_i$ is the autarky shadow price (ASP). Using the decision prices p_i and the first order conditions, utility maximization subject to the technological constraint leads to a system of output supply equations $q(p, z_q)$ and input demand equations $x(p, z_q)$. Utility maximization subject to the income constraint leads to a system of demand equations for consumer goods $c(p, y, z_u)$.

$$\sum_{i=1}^{N} p_i c_i = y = \sum_{i=1}^{N}[p_i(q_i - x_i + A_i) - t_{fi}^s\delta_i^b] + T$$ (12)

To derive the household supply curves for home produced goods as a function of the market price under fixed transaction costs (FTCs) and proportional transaction costs (PTCs)[2] (Figure 1), let $q(p^m, z_q)$ be the supply curve without transaction costs. Then with transaction costs, the supply curve is:

$$q^s = q(p^m - t_p^s, z_q)$$ for sellers (13)

$$q^b = q(p^m + t_p^b, z_q)$$ for buyers (14)

$$q^a = q(\tilde{p}, z_q)$$ for autarky (15)

Showing transaction costs shift the supply curve upward for sellers and downward for buyers. The supply curve is discontinuous with three distinct regions:

q^b = buyers supply curve for market prices below $\tilde{p} - t_p^b$ (16)

q^s = sellers supply curve for market prices below $\tilde{p} + t_p^s$ (17)

q^a = autarky price between the two thresholds (18)

[2]FTCs do not vary with the level of sales, while PTCs are those that vary with the level of sales.

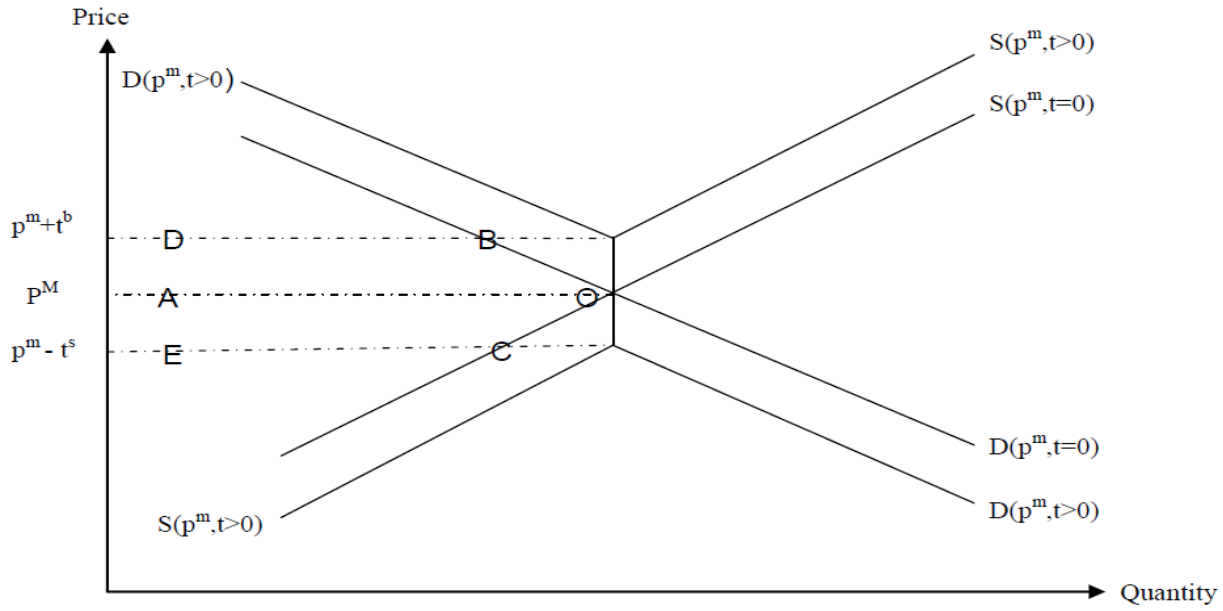

Figure 1. Household demand and supply under transaction costs. Source: Minot (1999).

This implies that fixed transaction costs delay entry into a market as a seller until market price reaches the higher level of $\tilde{p}+t_p^s$. Similarly, they delay entry into a market as a buyer until market price is as low as $\tilde{p}-t_p^b$. The household remains self-sufficient between these two thresholds. A household will switch from autarky to selling when the price that it receives is high enough to compensate for transaction costs.

Empirical model and estimation procedure

Assuming linear expressions:

$$q(p,z_q)=p\beta_m+z_q\beta_q \text{ (for supply functions)} \quad (20)$$

$$t_p^s=-z_t^s\beta_p^t \text{ (for PTCs for sellers)} \quad (21)$$

$$t_p^b=-z_t^b\beta_p^b \text{ (for PTCs for buyers)} \quad (22)$$

This leads to linear expressions for the supply by sellers (q^s):

$$q^s=p^m\beta_m+z_t^s\beta_t^s+z_q\beta_q \quad (23)$$

and by buyers (q^b):

$$q^b=p^m\beta_m+z_t^b\beta_t^b+z_q\beta_q \quad (24)$$

and for autarky households supply (q^a):

$$q^a=z_q\beta_q^a+z_c\beta_c^a \quad (25)$$

For production thresholds, linear expressions for $(\bar{q}^s)$ are used such that:

$$\bar{q}^s=z_t^s\alpha_t^s+z_q\alpha_q^s+z_c\alpha_c^s \quad (26)$$

and for $(\bar{q}^b)$ such that:

$$\bar{q}^b=z_t^b\alpha_t^s+z_q\alpha_q^b+z_c\alpha_c^b \quad (27)$$

The econometric specification is obtained by adding error terms to the supply equations:

$$q^s=p^m\beta_m+z_t^s\beta_t^s+z_q\beta_q+u_i \text{ (seller supply equation)} \quad (28)$$

$$\equiv x_i\beta_i+u_i$$

$$\bar{q}^s=z_i^s\ \alpha_i^s\ +z_q\alpha_q z_c\alpha_c+u_2$$

(seller threshold equation) (29)

$$\equiv x_2\alpha_2+u_2 \quad (30)$$

Where x_i is a vector of exogenous explanatory variables such as household characteristics and location characteristics that influence market participation. The market participation indicator variable (q^s) for the commodity is defined as:

$$q^s=1, \text{ if } p^m\geq\tilde{p}+t_f^s \text{ or } p^m\leq\tilde{p}-t_f^s \text{ (when a household sells)} \quad (31)$$

Table 1. Variables used and hypothesized relationships.

Variable description	Variable	Hypothesized relationship	
		Participation decision	Participation level
Ownership of bicycle	D2	+	+
Ownership of ox-cart	D3	+	+
Ownership of radio	D4	+	
Availability of alternative channels	D5	+	+
Listening to agricultural programs	D6	+	+
Ownership of television	D7	+	
Membership to farmer associations	D8	+	+
Size of harvest	QHST	+	
Age of household head	AGE	+	+
Distance to nearest maize markets	DIST	-	-
Education level of household head	EDU	+	
Household size (number of adults)	HHS	+	+
Frequency of listening to radio	FRR	+	+
Experience in maize marketing	EXP	+	+

$q^s = 0$, if $\tilde{p} - t_f^s \leq p^m < \tilde{p} + t_f^s$ (when a household does not sell) (32)

Data analysis

Under transaction costs, households face a two-stage decision problem (Winter-Nelson and Temu, 2003; Key et al., 2000; Makhura et al., 2001; Goetz, 1992). The first decision, is whether to trade or not and the second is how much to trade and is conditional on participation as a buyer or seller. Because some households participate in the market while others do not, if ordinary least squares regression (OLS) is estimated, the non-participants will be excluded introducing a sample selection bias in the model (Gujarati, 2004). Therefore, in order to analyze the factors affecting the probability and extent of participation in maize markets, a two-step Heckman's procedure (Heltberg and Tarp, 2001; Makhura et al., 2001; Nkonya et al., 1998; Goetz, 1992) was used. This involved two estimation steps. In step one, a logistic regression model was estimated to give the estimated probability that a house *i* purchased or sold maize. In step two, the intensity of participation was estimated by running a heckits that is OLS corrected for selectivity bias. This was run on observations for which sales were greater than zero.

$$P(SAI) = \alpha_1 + \alpha_2 D_{2i} + \alpha_3 D_{3i} + \alpha_4 D_{4i} + \alpha_5 D_{5i} + \alpha_6 D_{6i} + \alpha_7 D_{7i} + \alpha_8 D_{8i} + \beta_2 QHS + \beta_3 AGE + \beta_4 HHS + \beta_5 EDU + \beta_6 DIST + \beta_7 FRR + \beta_8 EXP + U_1 \quad (33)$$

The results from Equation (33) showed the influence of independent variables on the probability of maize marketing ($\delta Pr/\delta x$). The second model (step two) was used to identify the factors affecting the quantities of maize sold and was expressed as:

$$QTY = \alpha_1 + \alpha_2 D_{2i} + \alpha_3 D_{3i} + \alpha_5 D_{5i} + \alpha_9 D_{9i} + \beta_3 AGE + \beta_4 HHS + \beta_6 DIST + \beta_7 FLR + \beta_8 EXP + \sigma IMR + U_2 \quad (34)$$

Where *QTY* = Quantity of maize sold while all the other independent variables are the same as those used in step one except for dummies for radio and television as well as quantity harvested and education variables. This model was run using data from market participants only and included an inverse mills ratio (IMR) to correct for selectivity bias. It was used to estimate the impact of exogenous variables on quantities of maize sold. Table 1 shows the hypothesized relationships between the explanatory variables and probability of maize market participation as well as quantities of maize marketed.

RESULTS AND DISCUSSION

Quantitative factors affecting transaction costs

Comparisons show that the mean harvest size, mean asset value and mean land holding for market participants, were significantly higher ($P \leq 0.05$) than for non-participants (Table 2). The mean distance from commercial centres and main roads for participating households was also significantly lower ($P \leq 0.05$) than for non-participants. However, the average household age, mean household size and years of formal education attained by the household head were not significantly different between the two groups.

Effects of transaction cost on decision to participate in maize markets

Table 3 presents the results of the logit estimations of factors influencing the decision to sell maize. The model χ^2 (14) was 132.544 (and significant at the five percent level) implying that the model was predicting decision to sell better than if only the constant had been used. The R-Square of 0.708 indicates that 70.8% of the variation in the decision to sell maize can be explained by the independent variables in the model. The significant transaction costs factors influencing decisions to

Table 2. Comparison of quantitative transaction cost factors between market participants and non-market participants.

Variable	Non-participant (n = 105)	Participant (n = 135)	F-Statistic
Mean size of harvest (50 kg bags)	14.65	87.69	27.57**
Mean value of assets (million Kwacha)	3.15	8.89	15.34**
Mean age of household head (years)	46.60	45.72	0.13
Mean household size (number of adults)	6.45	6.78	0.04
Mean distances from commercial centres (km)	5.84	3.63	16.97**
Years of formal education completed by Household Head	8.05	9.00	0.09
Mean size of land holding (hectares)	5.17	19.07	6.99**

**Significant at 5%; *Significant at 10%.

Table 3. Factors determining households' decisions to participate in maize markets.

Variable	Coefficients	Standard error	*Exp(B)*
Constant	-1.859	1.664	0.264
Ownership of radio	2.191**	0.799	8.946
Ownership of television	2.479**	0.824	11.933
Own mobile phone	-2.436**	0.834	0.088
Listening frequency programs	-0.114	0.068	0.999
Distance to main markets	-0.372**	0.108	1.449
Ownership of bicycle	-0.185	0.831	0.539
Ownership of ox-cart	1.513*	0.853	4.540
Availability of multiple channels	1.818**	0.543	6.162
Education of household head	0.028	0.047	1.029
Age of household head	0.006	0.021	1.006
Household size (Number of adults)	-0.066	0.089	0.936
Size of maize harvest	0.093**	0.022	1.097
Membership to farmer groups	-0.114	0.575	0.892
Experience in maize marketing	-0.043	0.033	0.958
R^2=0.708 (Cox and Snell)			
$\chi^2(11) = 132.544^{**}$			

**p < 0.05, *p<0.10; Dependent variable: Sold maize in 2005/6 season; sample size: n= 220.

participate in maize markets were ownership of radio, ownership of television, availability of multiple maize marketing channels, distance to maize markets, ownership of ox-carts and the harvest size. Ownership of assets such as radio and television enables households to acquire market information at a lower cost thus reducing expenditure on search, negotiation and screening costs (Key et al., 2000; Goetz, 1992). This reduces the magnitude of the transaction costs thus increasing the probability of market participation for the household.

Presence of alternative marketing channels increases the efficiency of the marketing system through prevention of monopolistic tendencies (Minten, 1999; Kirsten and Vink, 2005) where short distance to markets reduces the magnitude of the transaction costs by reducing the amount of time and money spent in search for information. By reducing information asymmetry between buyers and sellers, these factors reduce the magnitude of transaction cost thus increasing the probability of maize market participation. Size of the harvest was found to significantly increase household's probability of maize marketing. This has been explained by the fact that those smallholder farmers who were faced with challenges in maize marketing responded by switching to other crops (Zulu et al., 2000; Seshamani, 1999). Similar results have been reported in South Africa (Matungul et al., 2001; Makhura et al., 2001) where households with larger maize harvests were likely to have surpluses for sale. Age and education level of the household head, maize marketing experience and membership to farmer organizations were not significant.

Effect of transaction cost factors on level of maize sales

Table 4 presents the results of the factors determining

Table 4. Factors influencing the quantities of maize sold by households.

Variable	Coefficient	Std. error	t-statistic
Constant	35.180	25.274	1.392
Experience in maize marketing	0.577*	0.323	1.777
Age of household head	-0.327	0.328	-0.995
Household size (Number of adults)	3.480**	1.515	2.298
Membership to farmer associations	-9.903	8.702	-1.046
Availability of alternative channels	-4.539	1.326	-0.440
Distance to commercial centers	-2.339	1.848	-1.265
Frequency of listening to radio	3.331**	1.139	2.925
Ownership of ox-carts	44.243**	10.272	4.304
Ownership of bicycles	1.398	9.264	-0.151
LAMBDA (IMR)	-26.145**	12.189	2.145
R^2	0.445		
Adjusted R^2	0.395		
S.E. of estimate	44.25		
F-Statistic	8.823		
Prob. (F-Statistic)	0.000		

** P < 0.05, *P<0.10. Dependent variable: Number of bags of maize sold; Sample size: n = 90.

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the quantities of maize sold by the households. The R^2 and adjusted R^2 were quite low (0.445 and 0.395 respectively) which is not unusual for cross sectional data, while the overall significant fit (F) was 8.823 indicating that the data correctly fits the model. The coefficient on the inverse mills ratio (lambda) was significant at five percent level indicating that correlation between the error terms of the decision to sell (u_1) and level of market participation (u_2) was different from zero, $\sigma_{u1} \neq 0$. This implies that sample selection bias would have resulted if the level of maize sales had been estimated without taking into account the participation decision.

The significant transaction costs factors influencing the quantities of maize marketed were household size, experience in maize marketing, frequency of listening to agricultural programs on the radio and ownership of ox-carts. As the household size increased by one adult, the quantity of maize sold by the household would increase. Although family size has two opposing effects with large family size implying large food demand thus reducing marketable surplus, large family size also implies increased labor supply (Makhura et al., 2001). Considering that the sampled households depended on family members for labor supply, the larger the number of adults in the household, the more labor they had and the more maize they were likely to produce. An increase in maize marketing experience also increased the quantities of maize sold. Experience in maize marketing makes certain information and search costs low (Goetz, 1992; Makhura et al., 2001) due to prevalence of social networks. Experienced households may also have greater contacts and increased trust gained through repeated exchange with the same parties (Kirsten and Vink, 2005) allowing them to discover trading opportunities at lower costs.

By reducing the unit cost of production and delivering produce to the market, assets such as oxen reduces variable transaction costs faced by households leading to higher levels of market participation (Key et al., 2000). The regression results show that households that owned ox-carts marketed 2,200 kg more than those that did not own ox-carts. This observation may be explained by the fact that most transactions were being conducted either at the market centers or trader's premises with farmers bearing the cost of delivering the produce. Similar results have been reported in Mozambique (Heltberg and Tarp, 2001), Mexico (Key et al., 2000) and South Africa (Makhura et al., 2001).

CONCLUSION AND RECOMMENDATIONS

The results show that high transaction costs negatively influence the decision to participate in maize markets as well as the quantities marketed in Zambia. Based on these findings, it is recommended that information be provided for farmers, through existing government agencies such as the National Agricultural Information Services (NAIS) on who is buying maize, at what prices they are buying and the location of these buyers using mass media such as radio and television. To increase the likelihood of market participation, action should be taken to increase farmers' access to marketing channels through increased access to transport which also minimises the impact of distance on those farmers located far away from major maize trading centres. This can be achieved by improving on the quality of rural

roads by rehabilitating feeder roads connecting villages to major trading centres and highways so as to encourage private transporters to venture into these rural areas. Furthermore, public investments that raise smallholders' productivity, such as improved seeds availability and innovative extension programs should be intensified while actions aimed at increasing household's productive asset base such as ox-carts should also be intensified through provision of affordable loans as well as work-for-asset programmes which are already being implemented in some areas.

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