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Analysis of the Determinants of Small-Scale Farmers' Grain Market Participations in Ethiopia: The Contribution of Transaction Costs

Rehima Mussema[1], Belay Kassa[2], Dawit Alemu[1] and Rashid, S. [4]

[1] *Ethiopian Institute of Agricultural Research, P. O. Box. 2003, Addis Ababa, Ethiopia*

[2] *Corresponding Author and professor of Agricultural Economics, Haramaya University, P. O. Box. 138, Dire Dawa, Ethiopia, e-mail: belayk@gmail.com*

[4] *Senior Research Fellow, International Food Policy Research Institute, Markets, Trade and Institutions Division, 2033 K Street, NW, Washington, DC 20006-1002, USA, e-mail: s.rashid@cgiar.org*

Abstract

The paper is based on data collected in 2007/08 by IFPRI on smallholder market participation in Ethiopia from a random cross-section sample of 1577 households, with a focus on staple food grains and the effects of transaction and non-transaction costs on output market participations as a buyer and a seller. The multivariate Probit and multivariate Tobit models were used to identify the determinants of market participation regimes. The results indicated that demographic characteristics of the households (age and dependency ratio), production assets (own and rented-in land and oxen), land characteristics, volume of production, and households income diversification (livestock and non-farm income) affected both sellers and buyers. Transaction costs associated with ownership of donkey and access to road and market explained the variation of market participations. Regional characteristics (distances, agro-climatic conditions, etc.) also highly affected the market participation of the households.

Keywords: Ethiopia; market participation; multivariate Tobit; multivariate Probit; transaction costs

Introduction

Promotion of small-scale commercialization is one of the major key pillars of the agricultural transformation and development, the country is pressuring in the new Growth and Transformation Plan - GTP (MoFED, 2010). Farmers benefit from commercialization, through participation in the markets. Generally, commercialization has assumed a dichotomy between "food" crops and "cash" crops, however farmers may also supply to market the amount left out after meet household consumption (Pender and Dawit, 2007). Market participation doesn't mean supply surplus product to the market, but households may also participate in the market as a buyers. In some cases, farmers may sell at low price when they face financial constraints, especially during harvest time and may be obliged to buy back the same product at a letter date at a high price. Farmers may sell cash crop and buy relatively cheap crop for household consumption. In this case, households may become a net seller or net buyer. In whatever case of market participation, transaction costs and non transaction costs may affect entry of small farmers into the markets. These

opportunities or constraints may affect the demand and supply condition of the grain markets.

Stimulating participation of subsistence farmers into surplus market will help farmers to meet market demands, transform from subsistence to commercial farms and benefit from these economic opportunities and it is relevant to achieve food security and income diversity. Transaction costs and other socio-economic factors are barriers to participate in agricultural markets, and understanding in more depth the decisions involved is important for policy. Coase (1937) argues that market exchange is not costless. Transactions costs are the embodiment of barriers to market participation by resource-poor smallholders and are factors responsible for market failures in developing countries (de Janvry *et al.*, 1991; Sadoulet and de Janvry, 1995). Quantitative measurement of market transaction costs still remains as major problem hence their measure can only be indirectly revealed from the behaviour of potential agents in markets. Distance from the market, poor infrastructure, and poor access to assets and information are sources of high transaction costs. High transaction costs create a price range in which an agricultural household will decide neither to buy nor to sell goods, causing households (or regions) not to be integrated in trade (Key *et al.*, 2000).

A number of studies indicated that high transaction costs to be one of the key reasons for smallholder farmers' failure to participate in markets (Goetz, 1992; Key *et al.,* 2000; Makhura *et al.,* 2001; Pender and Dawit, 2007). The high potential areas of Ethiopia can produce relatively enough food to feed the people in the food deficit areas. However the surplus grain producing areas are unable to reach the food deficit areas. People living in deficit areas face high price due to high transportation cost while producers in surplus regions earn low producer prices. As a result, localized shortage of food supply exists due to poor marketing and distribution networks, high transport cost, and related infrastructural problems that isolate surplus production areas. Due to high transaction costs, which are significant in output markets tend to reduce potential suppliers of market in the Ethiopian grain market (Eleni, 2001).

Different methodologies have been applied to address the determinants of market participation. By using logit model, transaction costs and non transaction costs affected the likelihood of sellers' market participation in Western Uganda and Nigeria (Agbola *et al.*, 2009; Komarek, 2010). Getachew and Nuppenanu (2009) applied two limits Tobit model and observed that transaction costs affected Banana markets in Ethiopia. Some studies applied the Heckman Two Stage model on small holders' participation in maize market in South Africa and cereal market in sub-Saharan Africa, and observed that transaction costs affected sellers' market participation decision and level of market participation (Makhura *et al.* 2001; Siziba *et al.*, 2011). Omiti *et al.* (2009) applied truncated regression model and found that transaction costs and non-transaction costs affected the intensity of market participation of vegetable, maize and milk in Kenya.

The above studies did not take in to account the market participation of buyers. However, several studies have been done on producers' market participation as sellers or buyers. Studying smallholder grain market behaviour in south-eastern Senegal, Goetz (1992) applied the two-tiered (Probit and an endogenous switching regression) models and identified information, ownership of carts, market distance and regional dummy significantly affected market participation of buyers and sellers. Key *et al*. (2000) find both fixed and variable transaction costs play a significant role in explaining the behaviour of maize sellers and buyers in Mexico, the used the Household Model for their analysis.

Renkowa *et al.* (2004) extended the agricultural household model with missing markets and found that fixed transactions costs significantly affected supply and demand for maize in Kenya. Bellemare and Barrett (2006) applied Ordered Tobit model and found out that fixed and variable costs matter in the participation and level of participation for livestock buyers and sellers in Kenya and Ethiopia. Alene *et al.* (2008) used selection model on maize supply and fertilizer demand in Kenya and found that market distance and other cost affected buyers and sellers. By applying Tobit model, cost and non transaction costs factors were the significant determinants of cassava sellers and buyers behaviour in sub-Saharan Africa (Enete and Igbokwe, 2009). Ouma *et al.* (2010) also used bivariate Probit model in Central Africa and observed that fixed and variable transaction costs influenced banana seller and buyer. The paper presents the determinants of market participation for both buyers and sellers with due emphasis to the role transaction costs.

Material and Methods

The study covered four regions of Ethiopia: Amhara, Tigray, Oromiya and SPNNPR. By using a stratified random sampling technique, from 31 zones and 63 woreda as 1706 farm households were selected and interviewed by International Food Policy Research Institute (IFPRI). Of these 1577 households produced at least one cereal crop in 2007/08 and they were taken as the study subject.

Coverage: The study covered four regions of Ethiopia: Amhara, Tigray, Oromiya and SPNNPR. By using a stratified random sampling technique, from 31 zones and 63 woreda as 1706 farm households were selected and interviewed by International Food Policy Research Institute (IFPRI). Of theses 1577 households produced at least one cereal crop in 2007/08 and they were taken as the study subject.

Market positions and models used: The study identified five different types of market participation positions: net sellers (NS) 15%), net buyers (NB), sellers only (SO), buyer only (BO) and autarky market position. Households are faced with at least two types of participations, one is a discrete decision on whether or not to participate in a given market options and the other is a continuous decision as on how much to buy or sell. There are some categories such as supplying of a crop by households that may

encourage other households to buy. Hence the study expected selling positively correlated to buying. Therefore, multivariate Probit (MVP) and multivariate Tobit (MVT) models are appropriate frameworks for modelling.

The study expanded transaction cost studies (Goetz 1992; Key *et al.*, 2000) used multivariate Tobit, which is the extension of Tobit model (Tobin, 1958), adapted the interdependence of the dependent variables to be a function of the data (Lee, 1993; Cornick *et al.*, 1994; Park and Widdows, 2001; Chavas and Kim, 2004). Since the probability is not readily available from MVT model, the study used MVP model in the first stage and in the second stage the MVT model for the intensity of participation was applied following Demmer, *et al.*, 2002; Battersby, 2005; Ito and Kurosaki, 2007; Osili and Xie, 2009; Algesheimer, 2010; and GARIE, 2010. The study follows, Ouma *et al* (2010), who applied bivariate Probit model to jointly estimate buyers and sellers market participations.

Model specification of market participation: In the first stage of the model, the dependent variables are binary: take value 1 if household receive money from grain sale or spent money on grain (Y^*_{im} is positive), and 0 otherwise. The MVP model assumes that each subject has T distinct binary responses and a matrix of covariates that can be any mixture of discrete and continuous variables. The study defined the unobserved latent variables for NS, NB, SO, and BO, $Y^*_{i1,}$ $Y^*_{i2,}$ Y^*_{i3} and Y^*_{i4}, respectively. The general formulation of the MVP model is:

$$Y^*_{im} = \beta'_m X_{im} + \mu_{im}, \quad (1)$$

Where Y^*_{im} is a latent participation variable for a household i, β' is the unknown regression parameter vector, m=1,...,4 is participation options, $\mu_{i,}$ is a T × 1 vector of residual error. Assume error terms μ_{i1}, $\mu_{i2,}$ μ_{i3} and μ_{i4} are independent. The study then assumes that these error terms are jointly normally distributed with a mean zero and covariance matrix Σ, μ_{im}~ MVN (0, Σ) with the four variances assumed equal to 1 (see equation 2).

$$\begin{pmatrix}\mu_1\\ \mu_2\\ \mu_3\\ \mu_4\end{pmatrix} \sim N_M\left[\begin{pmatrix}0\\0\\0\\0\end{pmatrix}, \begin{pmatrix}1 & \rho_{12} & \rho_{13} & \rho_{14}\\ \rho_{12} & 1 & \rho_{23} & \rho_{24}\\ \rho_{13} & \rho_{23} & 1 & \rho_{34}\\ \rho_{14} & \rho_{24} & \rho_{34} & 1\end{pmatrix}\right] \quad (2)$$

The relationship between Y^*_{im} and Y_{im} in the MVP model is given by

$$\begin{cases} \mathbf{Y_{im} = \quad 1 \quad if \quad Y^*_{im} > 0} \\ \qquad\qquad\quad 0 \quad \text{Otherwise} \end{cases} \quad \mathbf{(3)}$$

Assume that Y^*_i is distributed per a Normal distribution: $Y^*_i \sim N(\rho_i, 1)$. This leads to a "Probit " model of choice where the probability of participation, P, is specified as:

$$P(Y_i = 1/\beta, \sum) = \Phi(Y^*_i) \qquad (4)$$
$$Y^*_i \sim N(X_i\beta, \sum)$$

where Φ is the Probit link which denotes the cumulative distribution function (CDF) of the normal distribution, $\beta = (\beta'_1 \ldots\ldots \beta'_T)$ is a p×T matrix of unknown regression coefficients, where $\sum$ is the T×T correlation matrix of Y^*_i . The basic specification is a Probit model (3) which captures the likelihood that a household has market participation to sale or purchase grain in markets.

In the second stage, to identify intensity of market participation, the study used MVT model. In this stage, the income from grain (for SO and NS) and the expenditure on grain (for BO and NB) were used as the dependent variables. Income from sale or expenditure on grain were observed only when an indicator variable for a household i's decision on participation option m, Y^*_{im} takes the value of 1. The observational equation for the amount of participation option, Y^*_{im}, is equation (5). The four latent continuous variables (Y^*_{i1}, Y^*_{i2}) and, (Y^*_{i3}, Y^*_{i4}) represent uncensored average income and expenditure, respectively. Indexing household by i, i = 1,…,N, the MVT model for the logarithm of the latent variable in equation (5) income or expenditure, Y^*_{im}, is:

$$\ln Y^*_{im} = \tau X_{im} + \beta X_{im} + \varepsilon_{im} \qquad m = 1,\ldots, 4 \qquad (5)$$

The vector of household residuals from the log income or expenditure models, is assumed to follow a multivariate normal: ε_{im} is a T × 1 vector of residual error distributed as $N_T(0; \sum)$, i.e. $\varepsilon_{im} \sim MVN(0, \sum)$, as the same as assumed in participation decision, "Probit " model. Because equations (1) and (5) use the same predictors, it must be assume that μ_{im} and ε_{im} are interdependent in order to identify the model. In this model, $\ln Y^*_{im} \sim N(X_t \beta, \sum)$ and $\ln Y^*_{im}$ is a J × 1 continues latent variables that determine the choice probabilities of an optimizing household. The multivariate error distributions allow information from one regime to influence the conditional predictions of another. Assuming the censoring occurs at zero, the model is generally written as:

$$Y_{im} = Y^*_{im} \text{ if } \begin{cases} Y^*_{im} > 0 \\ 0 \text{ Otherwise} \end{cases} \qquad t = 1, 2, \ldots.n, \quad j = 1, 2\ldots J \qquad (6)$$

The participation options' X_{im} used in equations (1) and (5) are the same. However, these participants influenced a household's participation decision differently from his or her participation option decision, so the study allowed for different coefficients in these four equations. Given n observations, this leads to the following negative log likelihood function:

$$LL = \frac{n}{2}\ln/\sum_i/ + \frac{1}{2}\sum_{i=1}^{n}(\boldsymbol{Y}_i - \boldsymbol{X}_i\boldsymbol{\beta})'\sum_i^{-1}(\boldsymbol{Y}_i - \boldsymbol{X}_i\boldsymbol{\beta}) \quad (7)$$

where β can be broken into two components containing the parameter estimates for the censored variable (SO), β^1, and the parameter estimates for the uncensored variables (BO, NB, and NS), β^2.

Result and Discussion

Demographic and Socio-economic characteristics of the households

Summary statistics of the variables used in the MVP and MVT are presented in Table 1. Approximately 92% of the households were headed by males and the average age of the households head was 45. Education is believed to be an important feature that determines the readiness to accept new ideas and innovations. The household's head spent an average of 1.66 years on formal education; the variable indicated statistical difference among market participation options that NS households were most educated. The average dependency ratio in the households was 119.78 which indicated a significant difference among market options; the highest ratio was found in BO households, while the lowest was in NB's. Only 6% of the households had agricultural trade experience and nearly 26% of them had credit access. Access to extension service is significant and it is one of the country's strategies for increasing production and productivity; however only 21% of the households had agricultural input access on credit. Both NS and SO were the best users from extension service.

Oxen are the most common significant and important factors of production, the households had an average of 1.55 oxen to perform farming activity and SO households had the largest number of oxen, while NB's and BO's had the smallest number. The total average land size of the households was 1.22 hectare and significant difference was indicated among the market options; the largest holding was in SO households, and BO's were the least holder. Addition of land increases production capacity of the households; hence an average of 29 of the proportion plot was leased-in which is statistically significant among market participation options, the BO households had smaller rented in proportion to grow food crops. Fertility condition of the land may affect the productivity and production of crops; in turn it may affect market positions of the households. Nearly 39% of fragmented plot of land were under fertile group which was significant; both NS and SO households had the highest proportion, while the least proportion was found in BO households. On average 35% of the plots in the household was irrigated which is statistically significant; self-sufficient household were the most users of irrigation.

Table 1. Independent variables used in MVP and MVT models

Variables	NS N = 239	NB N = 159	SO N = 376	BO N = 557	Autarky N = 246	Total N = 1577	χ^2 /t-value	Expected sign
Gender (% male)	94	88	93	92	91	92	5.19	±
Age (years)	43.54 (12.26)	43.40 (12.64)	45.24 (12.81)	45.09 (13.20)	45.24 (13.03)	44.74 (12.89)	137.85***	-,+
Education (years)	2.00 (2.82)	1.99 (2.99)	1.52 (2.50)	1.69 (2.83)	1.25 (2.33)	1.66 (2.70)	11.76***	±
Depend ratio (ratio)	113.91 (74.58)	104.57 (74.36)	118.02 (85.12)	128.16 (90.12)	119.01 (86.79)	119.78 (84.90)	56.02***	-, +
Trade exp. (%)	5	9	4	6	6	6	4.54	+
Credit ace. (%)	30	27	24	26	24	26	3.17	-, +
Extension (%)	26	15	26	16	24	21	23.47***	+, -
Oxen (number)	1.74 (1.56)	1.23 (1.40)	2.06 (1.29)	1.23 (1.11)	1.54 (1.13)	1.55 (1.30)	47.24***	+, -
Land size (hectare)	1.43 (1.45)	1.17 (1.55)	1.60 (1.18)	0.91 (1.32)	1.17 (1.02)	1.22 (1.32)	36.33***	+, -
Rent in plot (proportion)	29.24 (18.56)	29.56 (12.27)	28.15 (17.16)	31.43 (20.26)	27.27 (10.62)	29.07 (16.92)	18.10***	+, -
Fertile plot (proportion)	45.18 (37.45)	38.47 (40.02)	44.88 (38.81)	30.80 (38.52)	35.90 (37.64)	37.90 (38.89)	38.70***	+, -
Irrigated plot (proportion)	36.98 (22.37)	37.56 (20.64)	29.05 (18.02)	36.06 (21.28)	38.90 (26.71)	35.38 (22.17)	19.68***	+, -
Diversification (%)	75	57	88	57	72	69	121.22***	+, -
Pro (kg)	1705 (1978)	663 (745)	1839 (1326)	661 (1578)	1243 (6359)	1191 (2915)	19.95***	+, -
Other income (Birr)	4682 (14544)	3466 (12830)	1710 (3295)	2572 (5408)	2686 (6289)	2841 (8305)	10.39***	-, +
Livestock income (Birr)	1108 (1911)	1261 (2727)	1461 (3943)	1677 (4117)	1140 (2071)	1413 (3420)	16.41***	-, +

Coop. (%)	45	26	42	30	36	35	29.88***	+
Equb (%)	14	13	9	8	10	10	8.50*	+
Donkey (%)	45	32	46	43	46	43	10.55**	±
Mkt info (%)	54	43	53	43	43	47	15.83***	+
All-weather-road (minute)	67.17 (77.25)	65.23 (68.88)	79.84 (98.27)	60.96 (79.76)	76.74 (92.64)	69.29 (85.53)	32.17***	-
Market dist. (minute)	66.86 (86.49)	60.17 (53.07)	63.10 (58.93)	79.03 (71.75)	73.52 (84.98)	70.63 (72.32)	38.78***	-
Region (%)	15	10	24	35	16	100	169.24***	
Tigray (%)	16	17	20	29	33	24		
Amhara (%)	32	14	40	17	29	27		
Oromiya (%)	24	16	22	32	15	24		
SNNPR (%)	28	53	18	21	22	25		

Source: Own computation from IFPRI's 2008 data

Diversification of crop is common in Ethiopia and the variable is significant; about 69% of the households practiced in crop diversification to expand their income and to protect production risk. The most diversifiers were SO households, while the least were NB and BO households. The households produced an average of 1191 kg of grain in 2007/08 which was significant; SO households were the best producers, followed by NS. The households obtained an average of Birr 2841 from non farming activities; the variable is highly significant. The SO households were under the lowest non farming income earners, while NB obtaining the highest non farming income. Moreover household earned an average of Birr 1413 from sale of their livestock. Membership social organizations indicated significant difference among market options. About 35% of the households were members of the cooperatives, as 10% of the households were under Equb (traditional credit and saving association); most members under these groups found in SO market option.

The ownership of pack animal and communication equipment, and time taken to reach the all weather road and nearest market centre has been used to proxy the state of transaction costs; and all are statistically significant. About 43% of the households had own donkey to transport their grain; SO and self-sufficient households had most access to this animal followed by BO's. Nearly 47% of the households own radio and/or TV to obtain market information; NS had most access to follow market information. The average distances to the all-weather road and to the nearest market were approximately 1:09 and 1:11 hours, respectively. The longest time taken to reach the road was for SO, but it was the shortest for BO households. Conversely, the time taken to reach the nearest market was longest for BO, while it was the shortest for NB households. Regional disparities may affect market participation positions of the households, the variable was highly significant.

Empirical findings

The econometric results of the study are summarized in Table 2. The study used the log of income of sellers and log of expenditure of and buyers were used as dependent variables. The estimate of the four equation error correlation, ρ, that maximized the MVP with the lower censoring threshold at -0.4207 and the upper threshold -0.0829, while the ρ that maximized the MVT varies from -0.4503 to -0.0577, each statistically significantly different from zero at the 1% level; except correlation between ρNS*NB significant at 10% level in MVT. This suggests that the random disturbances in the NS, NB, SO and BO participation decisions are influenced in opposite direction by random shocks. This implies that one cannot defensibly estimate the four separate Probit or Tobit models. The statistically significant covariance estimates also signal added efficiency in estimation using the multivariate approach. The overall fit of the equations indicated that in the MVP model that the Log Likelihood Ratio (LR) is 455.663 and Wald statistics is 717.39, while in MVT model the LR is 699.273 and Wald statistics is 1135.19, with significant at 1% level each, suggesting that the explanatory variables taken together influence market participation decisions and level of market participations. Hence the models are concluded as having a good fit. The important point here is that variables influencing the probability of a non-zero value need also

increase or decrease the conditional mean of the values in the same way except the variables, age in NS households and market distance in BO households that significant only in MVP.

The probability of market participation of NS statistically significant and declined with the household head's age, while the probability and the level of market participation of SO households declined with the household head's age and increased with BO's, as expected. The marginal effect indicated that a one year increase in age of the household head reduced the probability of NS and SO market participation by 3.59% and 5.88%, respectively, while the probability of the households in BO market participation increased by 13.46%. A one year increase in the age of the household head also leads to decrease the income of SO households by 45.81%, while it increased the expenditure of BO participants by 58.06%. This result suggested that the production capacity and willingness of technology adoption of elders were less than that of younger; which, may the causes of low surplus production. This finding similar that of Bellemare and Barrett (2006); age of the household head negatively and positively affected livestock sellers and buyers, respectively. Some findings reported that household head's age declined with maize supply in Kenya and vegetable sales in Ethiopia (Alene *et al*., 2008; Adugna, 2009)

As expected, dependency ratio statistical significant and positively affected the probability and the intensity of BO participants. A one unit increase in dependency ratio leads to increase the probability and expense of BO households by 0.52% and 2.68%, respectively. This justified that may fewer people were working and every worker has nearly two or more mouths to feed. Hence dependants in the households could not been satisfied from own production, hence households may compel to purchase food from market. However, dependency ratio significantly and negatively affected the probability and the level of participation of NB. The partial effect indicated that a unit increase in dependency ratio declined the probability of NB households by 0.28% and declined the expense by 2.07%. The explanation is that aged farmers may accustom saving and use their grain wisely. Similarly, household with more children may go to produce on others farm (share cropping in) to safe their children from hunger and they might used grain wisely which led to minimize NB's position. Similarly, Bellmemare and Barreett (2006) found that dependency ratio negatively affected livestock buying. However, dependency ratio positively affected wheat supply in Ada'a, Alaba and Fogera woredas (Berhanu and Hoekstra, 2007).

As expected, the ownership of draft power significantly positively affected the probability and the level of SO participants, while draft power negatively affected BO's market participation decision and level of participation. An increase in number of oxen by one unit leads to increase the probability and income of SO participants by 8.11% and 55.85%, respectively, while reduced the probability and expenditure of BO participants by 7.58% and 32.02%, respectively. This implies that oxen are the main source of farm power of the households which might enabled to produce surplus for the market and alleviate food shortage in the family. This result is consistent with the

findings of other studies that the probability of vegetable sales market participation was positively affected by the ownership of oxen (Abay, 2007; Adugna, 2010).

Land size had a positive significant effect on the probabilities and the level of SO participants, while a negative significant effects on BO's probability and intensity of participations, which were expected. Addition of one hectare leads to increase the probability and income of SO participants by 4.27% and 31.69%, respectively, while it reduced the probability by 14.42% and expenditure by 75.01% for BO participants. A larger area of land provides a greater opportunity for surplus production which may increased market supply and have sufficient food in the households. Some literatures highlighted about the positive contribution of land on cereal and banana sales market participation (Makhura *et al*., 2001; Renkow *et al*., 2004; Alene *et al*., 2008; Getachew and Nuppenau, 2009; Jagwe *et al*., 2010; Omiti *et al*., 2009; Komarek, 2010; Siziba *et al*., 2011).

However, the probability and the intensity of NB market participation were significantly increased with land holding. An increment of land size by one hectare leads to a 2.4% and a 22.72% increase in the probability and expense of NB households, respectively. This implied that the positive effect of land on market participation is a reduced-form effect, since land increases farm output on one hand that is produce relatively high valued grain (like *teff* or wheat) and non grain; this leads to a higher household income, which may increase the demand for relatively cheap food grain on the other hand for the households consumption. Renkow *et al.* (2004) found that land size positively associated with supply and demand of maize in Kenya.

As expected, rent in land significantly and negatively affected the probability and the level of BO households. A one unit increase in proportion of rent in plots reduced the probability and food expense of BO participants by 0.38% and 1.81%, respectively. This implies that rent in land increases the production capacity of the households which may enable to produce additional cereal crops to minimize food insecurity in the family.

The likelihood and the level of NS and SO market participations were significantly increased with fertile plot, as expected. An addition of proportion of fertile plot by one unit enhanced the probabilities of market participation of NS by 0.04% and SO's by 0.06%, while increased income of NS by 0.37% and SO's by 0.41%. Conversely, the probability and the intensity of BO market participation were significantly and negatively affected by the fertile plot. A one unit increase in the proportion of fertile plot leads to decrease the probability and expense of BO households by 0.09% and 0.47%, respectively. This implied that fertile land is promising to increase productivity and production of agricultural products which may enable to supply to market and minimize food shortage in the households.

Table 2. MVP and MVP estimates of market participation of grain sellers and buyers

Variables	Marginal effect of NS		Marginal effect of NB		Marginal effect of SO		Marginal effect of BO	
	MVP	MVT	MVP	MVT	MVP	MVT	MVP	MVT
GENDER	0.0327	0.1669	-0.0164	-0.1470	-0.0258	-0.1629	0.0618	0.2738
	(0.0326)	(0.2637)	(0.0327)	(0.2858)	(0.0292)	(0.1949)	(0.0265)	(0.1391)
AGE	-0.0359*	-0.2289	-0.0141	-0.0688	-0.0588*	-0.4581**	0.1349***	0.5806**
	(0.0289)	(0.2241)	(0.0340)	(0.3000)	(0.0290)	(0.1961)	(0.0282)	(0.1376)
EDUCON	0.0007	0.0119	0.0024	0.0174	-0.0050	-0.0292	0.0040	0.0188
	(0.0032)	(0.0242)	(0.0039)	(0.0344)	(0.0031)	(0.0203)	(0.0030)	(0.0153)
DR	-0.0021	-0.0144	-0.0028***	-0.0207**	-0.0008	-0.0094	0.0052*	0.0268*
	(0.0018)	(0.0144)	(0.0020)	(0.0177)	(0.0018)	(0.0116)	(0.0016)	(0.0089)
TRADEEXP	-0.0292	-0.1455	0.0177	0.1867	0.0203	0.0971	-0.0549	-0.1177
	(0.0347)	(0.2681)	(0.0388)	(0.3411)	(0.0343)	(0.2072)	(0.0294)	(0.1535)
CRACRACC	0.0214	0.1691	0.0070	0.0659	0.0024	0.0276	-0.0208	-0.1717
	(0.0180)	(0.1394)	(0.0217)	(0.1960)	(0.0177)	(0.1167)	(0.0185)	(0.0900)
EXTEN	0.0076	0.0641	-0.0124	-0.1049	0.0056	0.0635	-0.0150	-0.2291
	(0.0198)	(0.1567)	(0.0248)	(0.2288)	(0.0184)	(0.1199)	(0.0194)	(0.1120)
OXEN	-0.0013	0.0462	-0.0086	-0.0816	0.0811***	0.5585***	-0.0758***	-0.3202**
	(0.0163)	(0.1299)	(0.0176)	(0.1591)	(0.0151)	(0.1039)	(0.0137)	(0.0718)
FARMSIZE	0.0114	0.0594	0.024**	0.2272**	0.0427*	0.3169**	-0.1442***	-0.7501***
	(0.0202)	(0.1514)	(0.0240)	(0.2145)	(0.0198)	(0.1312)	(0.0235)	(0.1195)
RENTIN	0.0006	0.0053	0.0001	0.0013	0.0008	0.0060	-0.0038**	-0.0181**
	(0.0009)	(0.0063)	(0.0010)	(0.0098)	(0.0009)	(0.0050)	(0.0009)	(0.0044)
FRTILE	0.0004***	0.0037***	0.0000	-0.0001	0.0006**	0.0041***	-0.0009**	-0.0047**
	(0.0002)	(0.0016)	(0.0002)	(0.0022)	(0.0002)	(0.0013)	(0.0002)	(0.0010)
IRRG	-0.0013	-0.0088	-0.0001	-0.0018	-0.0024	-0.0133	0.0001	0.0011
	(0.0011)	(0.0085)	(0.0007)	(0.0075)	(0.0012)	(0.0096)	(0.0006)	(0.0040)
DIVERS	0.0111	0.1173	-0.0018	-0.0344	0.1230***	0.8252***	-0.1120***	-0.5503***
	(0.0211)	(0.1653)	(0.0230)	(0.2007)	(0.0229)	(0.1658)	(0.0180)	(0.0915)
PROKG	0.0023***	0.0171***	-0.0005*	-0.0047*	0.0041***	0.0295***	-0.0091***	-0.0499***
	(0.0009)	(0.0063)	(0.0006)	(0.0055)	(0.0010)	(0.0055)	(0.0015)	(0.0062)
OTHERINC	0.0005	0.0019	0.0003	0.0049	-0.0132***	-0.0790***	0.0189***	0.1138***
	(0.0024)	(0.0183)	(0.0029)	(0.0256)	(0.0022)	(0.0143)	(0.0022)	(0.0106)
LSINCO	-0.0004*	-0.0031*	0.0001	0.0013	-0.0004	-0.0014	0.0015***	0.0048**
	(0.0003)	(0.0024)	(0.0004)	(0.0032)	(0.0003)	(0.0018)	(0.0003)	(0.0013)

Variables	Marginal effect of NS		Marginal effect of NB		Marginal effect of SO		Marginal effect of BO	
	MVP	MVT	MVP	MVT	MVP	MVT	MVP	MVT
COOP	0.0207	0.1327	-0.0105	-0.0553	-0.0308	-0.1578	-0.0159	0.1982
	(0.0181)	(0.1455)	(0.0225)	(0.2089)	(0.0181)	(0.1156)	(0.0167)	(0.0971)
EQUB	0.0269	0.1766	0.0014	-0.0070	-0.0193	-0.1763	-0.0147	-0.1868
	(0.0249)	(0.1960)	(0.0296)	(0.2675)	(0.0258)	(0.1583)	(0.0253)	(0.1399)
DONKEY	-0.0065	-0.0550	-0.0020	-0.0022	-0.0563***	-0.3732***	0.0720**	0.4513***
	(0.0179)	(0.1425)	(0.0220)	(0.2028)	(0.0169)	(0.1104)	(0.0157)	(0.0894)
MKTINFO	0.0057	0.0743	-0.0041	-0.0503	0.0076	-0.0132	0.0190	0.1408
	(0.0174)	(0.1370)	(0.0207)	(0.1862)	(0.0162)	(0.1040)	(0.0156)	(0.0808)
WEZRDIST	-0.0012	-0.0101	0.0008	0.0066	0.0040*	0.0277**	-0.0097***	-0.0323*
	(0.0019)	(0.0149)	(0.0020)	(0.0181)	(0.0018)	(0.0112)	(0.0018)	(0.0104)
MKTDIST	0.0006	0.0027	-0.0012	-0.0105	-0.0072**	-0.0524***	0.0073**	0.0343
	(0.0023)	(0.0181)	(0.0027)	(0.0243)	(0.0024)	(0.0157)	(0.0019)	(0.0116)
TIGRAY	-0.0967***	-0.6873***	-0.0521***	-0.4637***	-0.0920***	-0.5473**	0.2560***	1.6426***
	(0.0288)	(0.2111)	(0.0283)	(0.2487)	(0.0283)	(0.1798)	(0.0353)	(0.1417)
AMHARA	-0.0541***	-0.3332**	-0.0675***	-0.6221***	-0.0090	-0.0665	0.1865***	0.9150***
	(0.0264)	(0.1957)	(0.0297)	(0.2517)	(0.0265)	(0.1677)	(0.0296)	(0.1395)
OROMYIA	-0.0527***	-0.3329**	-0.0582***	-0.5461***	-0.0571*	-0.3808*	0.3164***	1.6866***
	(0.0241)	(0.1795)	(0.0279)	(0.2557)	(0.0251)	(0.1655)	(0.0306)	(0.1214)

Correlation of unobservable between equations in MVP

ρNB*NS	-0.0829*** (0.0415)	ρBO*NS	-0.3929*** (0.0521)	ρBO*NB	- 0.4207*** (0.0407)
ρSO*NS	-0.3838*** (0.0401)	ρSO*NB	-0.1700*** (0.0379)	ρBO*SO	-0.3449*** (0.0497)

Covariance matrix in MVP

∑ NB*NS	-0.0831** (0.0418)	∑ BO* NS	-0.4153*** (0.0617)	∑ BO* NB	-0.4485*** (0.0495)
∑ SO *NS	-.4045*** (0.0471)	∑ SO*NB	-0.1717*** (0.0390)	∑ BO*SO	-0.3596*** (0.0564)

Cross equation correlations in MVT

ρNS*NB	-0.0577* (0.0341)	ρNS*BO	0.3684*** (0.0484)	ρNB*BO	-0.4192*** (0.0396)
ρNS*SO	-0.4503*** (0.0349)	ρNB_SO	-0.1694*** (0.0380)	ρSO*BO	-0.4341*** (0.0392)

Covariance matrix in MVT

∑NS*NB	-0.0578* (0.0342)	∑NS*BO	-0.3866*** (0.0560)	∑NB*BO	-0.4468*** (0.0481)
∑NS*SO	-0.4851*** (0.0438)	∑NB*SO	-0.1710*** (0.0392)	∑SO*BO	-0.4650*** (0.0483)

LR of MVP is chi2(6) = 455.663 P-value = 0.0000 **LR of MVT is $chi^2(6) = 699.273$, P value = 0.0000**

Notes: robust standard errors are reported in parentheses. ***, ** and * indicate that statistically significant at 1%, 5% and 10% level, respectively.
Source: Own estimations based on IFPRI 2007/08 data

Crop diversification significantly increased with the probability and the extent of market participation of SO, while decreased BO's participants, as expected. The partial effect indicated that ability of the households to diversify crops leads to increase the opportunity and income of SO participants by 12.30% and 82.95%, respectively, while it decreased the probability of BO participant by 11.2% and the expense of BO participant by 55.23%. This implies farmers had a long tradition on producing some crops for market like *teff* or wheat and the other for home consumption, which may contribute for the high linkage of crop diversification with market participations (buyers and sellers). Similarly Davis and Gillespie (2007) found that agricultural diversification influences farmer choice of hog market outlets. Moreover farm diversification on number of plots had positive effect on farm output (Kan *et al*., 2006); hence, high output in turn will encourage sellers' market participation and it will discourage buyers' market participation.

The production was significantly increased with the households' choice of participation and level of participation in grain market both as a NS and SO. However, volume of production in the households significantly discouraged buyer (NB and BO) households. An addition of one kg of grain production leads to increase the probability of NS households by 0.23% and SO's by 0.41%, while it increased income of NS by 1.71% and SO's by 2.95%. As grain production increased by one kg, the probability of NB reduced by 0.05% and BO's by 0.91%, as reduced the expenses of NB by 0.47% and BO's by 4.99%. The implication is that production will lead to a subsequent increase in market sellers' and decrease in buyers' participations. The volume of agricultural output influenced surplus market participations (Rehima, 2006; Pender and Dawit, 2007; Adugna, 2009; Assefa, 2009; Omiti *et al.*, 2009; Astewel, 2010).

Other income of the households significantly decreased the likelihood and level of market participation of SO and increased the likelihood and intensity of f grain market participation of BO. As non-grain income increased by one Birr the probability and income of SO participants decreased by 1.32% and 7.9%, respectively, whereas the probability and expense of BO increased by 1.89% and 11.38%, respectively. This shows that when households have access to non-farm income, they may not necessarily participate in grain sales and not endure by food shortages since non-farm income cover household needs. The literatures underscore the valuable contribution of non farm income in easing liquidity and facilitating market access to constrained households; meaning non farm income affected sellers negatively and buyers positively (Alene *et al.*, 2008; Omiti *et al.*, 2009; Komarek, 2010; Ouma, *et al.*, 2010).

The predicted livestock income was negatively associated with the likelihood and the level of market participation of NS, as positively associated with the participation decision and the level of BO market participation. As the livestock income increased by one Birr the probability of NS reduced by 0.04% and income of NS by 0.31%. Conversely a one birr increase in livestock income leads to increase both the probability by 0.15% and expense by 0.48% of BO households. The result explains that income from livestock sale that would ease the stress on farm households from

exhaustively selling their crop output and less concern about food insecurity. This finding similar with (Rehima, 2006; Ouma *et al.,* 2010) that livestock is taken as an alternative means of livelihood of the farm households. However, some scholars revealed that ownership of livestock was positively related to the level of cereal sales market participation (Makhura, *et al*., 2001; Alene *et al.,* 2008; Siziba *et al*., 2011).

Ownership of transport animal has a negative and significant influence on the probability and the extent of market participation of SO. Having a donkey leads to decrease SO's probability of market participation by 5.63% and income of SO by 37.32%. This implies that donkey ownership measures wealth of the household; accessing to the animal may incur cost, hence transaction cost may hinder SO households in to the market. This result consistent with the findings of (Goetz, 1992; Renkow, *et al*., 2004; Jagwe, *et al*., 2010; Ouma *et al*., 2010) that truck, car, bicycle and transport equipments negatively affected sellers' market participation decision. Ownership of donkey significantly increased the likelihood and intensity of BO market participation. Households with pack animal increased the probability and the expenditure of BO households by 7.2% and 45.13%, respectively. This implied that access to pack animal increases the ease to access to market which, may lead to encourage the households to buy. Evidence revealed that transport equipment has a positive and significant influence on the probability of maize supply (Alene, *et al*., 2008).

Distance to all-weathers-road significantly and positively affected the probability and the intensity of SO market participation, as it affected BO's, negatively. Market access is not uniform because households may face different transaction costs to market participation (Key *et al*., 2000; Renkow *et al*., 2004) and that geographic condition of markets may likewise be different. As a result the a one minute increase in walking to reach the all-weather-road leads to increase the probability and income of SO market participation by 0.4% and 2.77%, respectively. This implies bad market access due to poor feeder roads, farmers incur high transportation costs; therefore, the remote farmers more likely to be on-farm sellers or to fetch better price the farmers may supply to distant market. Maize farmers in Kenya complained of the bad state of the roads from their farms to retail open air markets (Omiti *et al.,* 2009). Conversely, as the time taken to all-weather-road reduced by one minute the likelihood and expense of BO households increased by 0.97% and 3.23%, respectively. This implies that the adjacent to all-weather-road enables households to buy more probably because of low transportation and search costs.

An increase in time taken to reach the nearest market decreased the probability and the intensity of sellers' market participation by. The marginal effect indicated that a one minute increase in walking time leads to decrease the probability and income of SO households by 0.72% and 5.12%, respectively. This shows the poor market access raises marketing costs, which may discourage the households to supply more while the nearest households have more opportunity to supply to the market. The result is consistent with others findings that the sellers' market participation is negatively

affected by market distance (Alene et al., 2008; Agbola *et al*., 2010**:** Komarek, 2010; Siziba *et al.*, 2011). However, Siziba *et al.* (2010) reported that distant markets positively correlated with volume of cereals supply due to better price offer than in nearer local markets. Ethiopian small farm households in remote areas incur high transaction costs (Eleni, 2001). Transaction cost related to market negatively affected both buyers and sellers (Ouma *et al.*, 2010). However, market distance significantly and positively affected buyers' participation decision. Households who reside a one minute far from the nearest market increased the probability of BO households by 0.73%. Thus, the results suggest that those households which can "reach" the desired market distance are more likely due to quality, availability of different crops and low producer margin. Similarly, Bellemare and Barrett (2006) found that variable transaction costs positively affected livestock buyers.

Regional locations were significant in explaining different market participations. SNNPR was used as a bench mark and it left out from the regression to avoid the dummy variable trap. The households in Tigray by 9.67%, Amhara by 5.41% and Oromiya by 5.27% were less likely to participate in NS markets than in the SNNPR. Similarly, NS participants in Tigray, Amhara and Oromiya obtained less income than SNNPR by 68.73%, 33.32% and 33.29%, respectively. Moreover, the probability of households in Tigray and Oromiya were less likely to participate in SO markets than in SNNPR's by 9.2% % and 5.71%, respectively. The SO participants in these regions also obtained less income than SNNPR's by 54.73% and 38.08%, respectively. These results reflect regional differences in transaction costs and productive capacity for grains. Grain is produced throughout the country, but production is concentrated more heavily in the SNNPR.

In NB markets, households in Tigray Amhara and Oromiya were less likely to participate than in SNNPR's by 5.21%, 6.75% and 5.82%, respectively. Also the respective regions NB participants' food expense was less than SNNPR's by 46.37%, 62.21% and 54.61% respectively; this implies different production capacity and food habit of the regions. Households from Tigray, Amhara and Oromiya were more probably to participate in BO markets than from SNNPR's by 25.6%, 18.65% and 31.64%, also these households from the respective regions also had more food expenditure than that of SNNPR by 164.26%, 91.50% and 168.66%, respectively in BO market. This result consistent with findings of (Seid, 2011) that expenditure on cereal crops (maize, sorgham, wheat and *teff*) in Tigray, Amhara and Oromiya are more than SNNPR's food expenditure. This implies probably because of production capacity of root crops and cereal production capacity of SNNPR may less participate and spend on grain than other regions.

The main purpose of this study was to investigate, the determinants of market participation of small farm household in the four regions, particularly the effects of transaction costs. The MVP was used to examine the effects of transaction costs and other socioeconomic factors on the discrete decision and MVT model was applied the subsequent stage of the analysis dealt with the continuous decision on the intensity of

participation. The likelihood and intensity of sellers and buyers are shown to be dependent on each other. Age matters in market participation as buyers and sellers. Policy instruments such as promotion, demonstration and propagation of technology and farmers training are essential. More household dependants led to purchase and reduce the surplus market participation; hence, this can be checked through family planning. Production assets (land and oxen) enhanced production in turn affected marketed surplus, hence condition should be ease for farmers to have oxen through availability of credit, rent and it should be supported with modern agricultural implements. Availability of modern technology is also important to maximize productivity and production of the land. However the positive effect of land size on NB market participation needs further investigation. Rented in land had a negative contribution for buyers in the market, hence, the existing rent in or rent out policy should be strengthened, and open and well-regulated rental market is essential. Fertility condition of the land matters sales market participations of the households, therefore soil conservation and availability of fertilizer on time with proper distributions is crucial to maintain fertility of land.

For the success of the current development strategy, crop diversification, appropriate institutional arrangements should be made to promote and integrate diversification with surplus market participation which may alleviate food shortage as well. High production enhanced surplus market participation and alleviates food shortage; hence, to maximize these benefits government should promote technologies through incentive (for farmers and extension workers), improve extension system, and technical supervision and follow up are crucial. Income diversity (through livestock and other income) lowers risk and it is vital to assure food and income security, this underline the need for designing integrated agriculture system (crop-non crop). Transaction costs associated with transportation and market information (ownership of donkey, and access to road and market) had highly negative and/or positive effects on market participation. Accordingly policies should give more attention on improving rural-urban infrastructures (telephone, internet, main roads and feeder roads) and establish grain collecting stations. Regional characteristics (distances, agro-climatic conditions, *etc*.) were highly affected the market participation of the households. This underline the need to focus on strategies aimed at improved marketing of grain and production potential of these regions to improve incomes and alleviate food shortage of the farm households.

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