A Multivariate Tobit Estimation of Rural Land Rental and Labor Market Participation Decisions of Farm Households in Ethiopia

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multivariate Tobit model, rural land rental market, rural labor market, endogeneity

Abstract
The paper tries to identify factors that affect rural households' joint participation in rural labor and land rental markets. The study used a multivariate Tobit/mixed model that considers the existence of endogeneity and cross-equations interdependences to analyze rural land rental and labor markets. The estimation results show households who are well endowed with economically active labor force, oxen, a social network, and farming resources are more likely to participate as a tenant in land rental markets. Similarly, landless and near-landless households as well participate as a tenant in land rental markets. In contrast, households who are less endowed with farming skills and farming inputs are more likely to rent out their land and then engage in off-farm work. As a result, it is momentous to design a proper policy that promotes and re-shapes the rural financial service for smallholder farmers for both on-farm and off-farm activities. We found that education is the most valuable asset for rural farm households to pursue opportunities in agriculture, obtain skilled off-farm work, and start a business in the rural non-farm economy. Yet, the education level in rural Ethiopia is very low. Hence, it is important to design appropriate basic adult educational programs, and open farmers training centers for rural farmers that promote technical and business skills in the agriculture and rural off-farm economy. Off-farm employments absorb surplus labor from agriculture. Hence, it is important to design appropriate policy in order to improve the rural off-farm economy in a rural part of the country. Finally, we recommend policy makers to see the off-farm economy as one component of rural growth and transformation strategy and remove any barriers that limit farmers' entry to off-farm employments.

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1. Introduction

1.1. Background and justification

Ethiopia is the second populous country in Africa. As in many developing countries, agriculture has a significant role in the economy. In 2017, the share of agriculture in Ethiopia's gross domestic product (GDP) was about 35.8 percent, the industry contributed about 22.2 percent, and the service sector contributed about 42 percent. Agriculture is a source of livelihoods for most of rural people in the country.

The World Bank (2008) proposed three complementary pathways to move households in the rural area out of poverty. The first pathway is through farming that needs access to land. The second pathway is through the rural labor market and the rural off-farm economy to diversify livelihoods and eventually leave agriculture. The last one is migrating to cities or other countries. Farming can facilitate the labor and migration pathways, and off-farm income from the rural off-farm economy can help and facilitate farming as a pathway to move out of poverty in the rural area of developing countries. The proposed pathways are complementary and interdependent. They are not separate; one pathway facilitates the other pathway.

Based on the findings of the previous studies, land rental markets encourage farm productivity and remarkably increase incomes of land-constrained households for some reasons (Jin and Jayne 2013; Deininger and Jin 2002). The first one is that a land rental allows the marginal productivity of land to be the same across farm households with different land-labor endowment ratios, and it increases allocative efficiency. Secondly, a land rental allows households with a relative advantage in agriculture or off-farm employments to specialize, hence it increases both farm and off-farm incomes. Finally, a land rental market also increases households' on land investment incentives, because households that participate in such investments can collect the benefits through higher land rental prices when they engage in off-farm employment in the future.

Secure and well-defined land rights are critical to facilitate low-cost transfers of land in order for the non-farm economy to develop (Deininger 2005). In contrast, insecure land rights influence rural households' labor allocation, and shorten migration duration for off-farm activities, preventing rural people from moving out of agriculture to off-farm activities.

The development of off-farm employment plays a significant role in improving agricultural productivity and rural household incomes (Taylor et al. 2003). First, off-farm employment can absorb surplus labor from the agriculture sector. The remaining households in agriculture can consolidate their farmland, enlarge the scale of farming, and specialize in labor-intensive and high-value agricultural production. As a result, it increases the productivity of both land and labor. Second, off-farm income can supplement households' income and increase households' ability to invest in agricultural inputs. Finally, off-farm work can diversify households' income and lessen the risks resulting from relying only on agricultural production.

Taking this into account, off-farm work has recently become one of the major income diversification strategies practiced by landless and smallholder farmers in developing countries. Off-farm work offers employment opportunities for increasing rural population. The importance of off-farm activities as a source of income, and way out of poverty among farm households in developing countries is well known. Although agriculture is the dominant sector in most developing countries, the rural economies in such countries are composed of both off-farm and farm activities. Generally, off-farm work is an essential component of the rural economy in most developing countries.

In Ethiopia, during the socialist era, households were legally restricted from participating in land rental and labor markets from 1975 to 1991. The new land reform in 1995 officially allowed land rental and labor markets in the country. After the reform, participation in labor and land rental markets has increased, even though rural land and labor markets are still poorly developed (MoARD 2010). Rural off-farm activities also play an important role in income generation, employment creation, and enhancing farm production, though agriculture is the main sector where many households make living in the country.

Pereira and Sumner (1990) suggested that in most developing countries, farm households' decisions regarding farm operation and off-farm income diversification employment are closely related. But, most of the literature concerning land market and off-farm development in rural Ethiopia has focused on either the land or the off-farm activities. Several studies in Ethiopia have analyzed separately household's participation decisions in off-farm employment (Zegeye and Kim 2016; Woldenhanna and Oskam 2001). In the same way, there are several studies on land rental markets participation of the farm households (Deininger et al. 2011; Holden et al. 2011). However, these studies ignored the potential interdependence of land rental market and off-farm work participation decisions on each other in rural areas. The analyses of land market and off-farm employment participation decisions should take into account the potential interdependence of land and labor allocation decisions.

Thus, looking into the link between off-farm work and land rental market, and identifying determinants of participation is very important before policy measures are taken to promote rural labor market and land market in the country. It is our understanding that there is no research that analyses households' joint participation decisions on land market and off-farm employment in rural Ethiopia. The objective of this study is to examine determinants of farm households' joint participation decision in off-farm employment and land rental markets. The findings of the study have important policy implications: given high-income return from off-farm employment, the government should design proper policies to improve the performance of rural land and labor markets.

The remaining parts of the study are ordered as follows. Section 2 reviews some important related literatures. Section 3 describes a brief theoretical framework of how farm household derives income from agricultural production, land rental market, and off-farm employment, and describes the source of data and model estimation strategy. Section 4 focuses on the synthesis of empirical evidence on joint determinants of a land rental market and off-farm employment in the study area. Finally, section 5 of the paper presents conclusions and policy implications of the study.

2. Literature Review

Previous studies disclosed that as a result of the prevalence of multiple market imperfections farm households' decisions regarding farm operation and off-farm employment are made jointly (Binswanger & Rosenzweig 1986; Pereira & Sumner 1990). The link between land rental markets and off-farm employment is well documented in the literature (Kung 2002; Yao 2000; Zhang et al. 2004). Some of these studies showed that access to employment opportunities off the farm was associated with more transactions in land rental markets. Others showed that the development of a land rental market encouraged participation in off-farm employment activities (Shi, Heerink, & Qu 2007). These results suggest that any gain from participation in land rental markets can be affected by the availability of off-farm employment opportunities in rural areas. Likewise, demand for land can improve the development of land rental markets, thereby encouraging land supply to the market and participation in off-farm jobs. This implies that participation in the off-farm jobs in rural areas is contingent on the presence of well-functioning land rental markets and institutional settings that improve the security of tenure of farm households in developing countries.

2.1. Determinants of farm households' participation in land rental markets

The presence of multiple market imperfections in non-land factors was suggested as being the rationale for the emergence of tenancy markets in rural areas (Binswanger & Rosenzweig 1986; Pereira & Sumner, 1990). For instance, a credit market imperfection may prevent small-scale farmers with liquidity constraints, as well as landless workers, from borrowing in the same way as the better-off households on the on-going market price. This implies that despite their family labor advantage, credit-constrained small-scale farmers and landless workers may find it difficult to get access to land through a land market and finance their

production costs.

Moreover, transaction costs in land rental markets affect farmers' participation decisions in land rental markets (Key, Sadoulet, & de Janvry 2000). Transaction costs in land rental markets imply that the effective rent price paid to rent in a land by the lessee is greater than the effective rented out price received by the lessor (Key, Sadoulet, & de Janvry 2000). The larger the gap between these prices the greater a number of households that opt not to participate in land rental markets.

But, in perfectly functioning factor markets, transaction costs are close to zero, and participation in land and labor markets depends on the relative prices of land and labor, the land to labor ratio, and the amount of other non-tradable inputs in the household (Otsuka 2007). And labor provided from within the family is perceived as having a high incentive to provide effort when compared with labor hired from elsewhere, suggesting that small-scale farmers prefer to fully utilize their family labor by renting-in more land.

Related studies conducted in Ethiopia showed that an improvement in security of tenure was associated with a higher propensity for land renting transactions (Deininger et al. 2011; Holden et al. 2011). Farmers' participation decisions in land rental markets are also affected by labor market imperfections in rural areas. Lack of off-farm employment opportunities in rural areas increases the propensity of farm households to farm their own land, thereby decreasing their propensity to supply land to the market. Similarly, binding constraints on hired labor can limit the demand for renting in additional land, while these constraints increase the propensity of labor-constrained farm households to supply land (Pereira & Sumner 1990). In addition, land rental transactions in rural areas have been affected by the availability of other non-land factor endowments, and farming or managerial ability.

2.2. Importance of off-farm work

On the other hand, off-farm employment is a broader concept used to denote all work performed outside the own farm including agricultural and non-farm activities. Different kinds of literature have identified that between 40 and 50 percent of households' income in rural Africa originates from rural off-farm enterprises (Lanjouw and Lanjouw 2001). Sara (2007) in her study found that on average around 75% of households in rural Ethiopia participate in off-farm work and about 31% of the farm households' income is generated from off-farm work implying that income from farm is not enough to support the households economy. The result implies that the off-farm income is important for rural households in Ethiopia.

The motivations to engage in off-farm activities are different across geographical areas, communities, and households. However, studies suggest that two factors initiate participation in off-farm activities. The *push* factors force farmers to participate in off-farm activities to manage income risk, with off-farm income used as a coping mechanism. These factors include shortfalls of agricultural production resulting from temporary failures due to unexpected drought or long-term factors like shortage of farmland, poor land fertility, and failures in input and credit markets (Reardon 1997; Barrett et al. 2001). Smallholder productions are generally characterized by low access to improved technologies, financial services, modern inputs, agricultural markets and irrigations services. This is attributed to the variability of incomes from the farming sector and thus households are forced to participate in off-farm activities to overcome these obstacles. But, the *pull* factors are incentives that attract households when off-farm activities offer a higher return than the farm activities (Barrett et al. 2001).

Likewise, Barrett and Reardon (2000) have attempted to answer why rural households diversify their livelihood and income diversification strategies in rural Africa. They stated that farm household diversification into off-farm activities emerges from time-varying or diminishing returns to factors of production, from market failures for instance for credit, from ex-ante risk management, or from ex-post coping of adverse shocks. When returns to

productive assets differ across time, households will diversify their assets and incomes. Besides, incomplete markets may encourage farm households to diversify households' income. For instance, a smallholder household endowed with much labor but comparatively little land applies some labor to its own farm and hires some out for off-farm work.

2.3. Determinants of farm households' participation in off-farm work

Many kinds of literature have identified possible factors that influenced farm households' participation in off-farm work. Farm household characteristics that influenced off-farm diversification behavior of the household include age, gender, education of the household head and household endowments (Lanjouw and Lanjouw 2001; Escobal 2001).The literature has also shown that the available infrastructures that influenced off-farm participation decision of farm households are roads, electricity and communication facilities (Lanjouw and Lanjouw 2001; De Janvry and Sadoulet 2001; Escobal 2001).

There are barriers that prevent some farm households from diversifying into off-farm enterprise activities. The identified barriers include lack of access to formal credit, social capital, and market information. Studies report that the lack of household access to formal credit has a negative influence on off-farm work participation decision (Woldenhanna and Oskam 2001). The reviewed literature revealed that geographical location is another key determinant of household off-farm participation decision. The location captures the differences in socioeconomic characteristics and resource endowment of the localities of the individual households.

De Janvry and Sadoulet (2001) used a multinomial model to examine determinants of participation in off-farm work in rural areas. The study identified that the presence of economically active family has a higher probability of participation in off-farm activities. Regarding the effect of education, they found that households with more years of schooling have a higher likelihood of participation over those with fewer years. Greater access to land

reduces participation in off-farm wage work.

Babatunde and Matin (2010) in Nigeria tried to examine the determinants of off-farm work participation. The study used a multivariate probit model to predict the factors that affect participation in different off-farm employment activities. And the Tobit model was used to determine the determinants of off-farm income. Education of both the household head and other adults, availability of agricultural and non-agricultural machinery, access to electricity and water, and households headed by male positively and significantly affect off-farm employment participation. Distance to market and family size on the other hand significantly hinder participation. Household assets, access to electricity and pipe water encourage off-farm employment.

3. Methodology

3.1. Study area

The study was conducted in Ethiopia. Ethiopia is the second most populous African country. It has nine politically autonomous regional states and two chartered cities. The current population of Ethiopia is about 105 million.

Among the nine politically autonomous regional states and two chartered cities, Oromia is the biggest and densely populated regional state in Ethiopia. The population of the region is about 34 million. Compared to other regions, rural infrastructure is better developed in the rural area because it is located in the central part of the country. Most of the big cities and towns of the country are found in this region compared to other regions, and this creates opportunities for farm households to participate in off-farm activities. The land rental market was noticeably developed where population pressure was high, and where land was a scarce resource. Even

though the number of administrative zones changes from time to time in the region, during the study the region has 16 rural administrative zones and two special cities. Each zonal administration is subdivided into administrative districts. Similarly each district is subdivided into administrative peasant associations (PAs).

3.2. Theoretical framework

The following conceptual model is adopted from Vranken and Swinnen (2006) and modified based on an agricultural household model with imperfect factor markets. The model incorporates many factor market imperfections, which are common in the study area.

Consider a household with endowments of land ($\overline{A}$), labor ($\overline{L}$), and initial wealth ($\overline{W}$) and there is no restriction in the participation of land rental and labor markets. This implies that the household can generate income from its own farm (I^{Farm} = farm income), land rental, off-farm employment (I^{off} = off-farm income) and migration. Migration and local off-farm employment are the two basic categories of off-farm employment. The income from local off-farm employment includes income from wage work and income from self-employment.

Agricultural output is modeled according to the following function.

$$Q = f(A, L^a, X, Z^h, Z^q) \quad [1]$$

Here, f is strictly increasing, quasi-concave, and twice differentiable. A is the land used and it includes land initially owned ($\overline{A}$ and land rented in (A^{in}) minus land rented out (A^{out}) (i.e. A = $\overline{A}$ + A^{in}-A^{out}). The transaction cost (T^A) is a cost used for searching, negotiating the terms of the contract, increase price for land rented in (r + T^A) to be higher than land rented out (r - T^A) at *ceteris paribus* for land rent (*r)*. In the current Ethiopian context, land rent in is almost made between relatives and very close households due to tenure insecurity. That is the landlord

fears losing the land because of policies like the land to the tiller program if they rent out land to people who are not close to them. In addition, a land rental market is made between the two parties that are between the household heads who rent in land and rent out land; as a result, the transaction cost is almost insignificant ($T^A \approx 0$). In the study area, farm households may face constraints in searching off-farm work opportunities, and in hiring in agricultural labor. This results in labor markets imperfection. The significant on farm labor (L^a) is almost family labor (L^f), hired labor is insignificant at the current economic condition of Ethiopia. Labor endowment of the household $\overline{L} = L^f + L^{off} + T_L$ here the notations L^f is on−farm family labor, L^{off} is local off-farm employment and T_L is leisure. In the model, X is inputs used with price vector of p_x, Z^h is household characteristic, and Z^q is managerial or technical skills.

In the model assumption of rationed off-farm employment opportunities is included by setting an upper limit or maximum ($L^{off}\max$) to the amount of labor employed off-farm (L^{off}). The existing non-land agricultural inputs impose a ceiling or maximum on the amount of land to be rented ($A^{in}\max$) on the household for optimal use of land in (A^{in}). The household can rent out (A^{out}) land from their holding and the upper limit or the maximum size that the household can rent out ($A^{out}\max$) is total farm plot size of the household.

A household can have income (y) from on-farm, off-farm work, and from land rental. A household chooses $L^a, L^{off}, T_L, and\ A^{in}, A^{out}$ to maximize utility as follows:

$$\underset{L^a, L^{off}, T_L, A^{in}, A^{out}}{maximize} \quad U(y, T_L, Z^h) \qquad [2],$$

with $y = f(A, L^a, X, Z^h, Z^q) - Xp_x - rA^{in} + rA^{out} + I^{off}$ [3]

subject to

$$L^{off} \leq L^{off}\max \qquad [4]$$

$$\overline{L} = L^f + L^{off} + T_L \qquad [5]$$

$$A - \overline{A} + A^{in} - A^{out} \qquad [6]$$

$$A^{out} \leq A^{out}\max \quad [7]$$

$$A^{in} \leq A^{in}\max \quad [8]$$

$$L^{f}, L^{off}, T_L, A^{in}, A^{out}, X \geq 0 \quad [9]$$

The first order conditions (FOC) of equations (2 to 9) give the optimal allocation of labor and land, and suggest the following structural form of system of equations:

$$A^{in} = A^{in}(I^{off}; \overline{A}, \overline{L}, X, Z^{h}, r, I^{Farm})$$

$$A^{out} = A^{out}(I^{off}; \overline{A}, \overline{L}, X, Z^{h}, r, I^{Farm})$$

$$I^{off} = I^{off}(\overline{A}, \overline{L}, X, Z^{h}, r, I^{Farm}) \quad [10]$$

3.3. Data source

The study was conducted in the Oromia Regional State in Ethiopia. The regional state was deliberately selected because it is the biggest and densely populated regional state in the country. For this study, 4 zones were randomly selected from 16 rural zonal administrations of the region. As a result, East Showa, Arsi, East Hararge, and Bale zones were selected for the study. Arsi, East Showa, Bale, and East Hararge zones have 24 districts, 20 districts, 20 districts, and 19 districts respectively. The study included 2 districts from each randomly selected zone. As a result a total of 8 districts were randomly selected. That is Tiyo and Munessa districts from Arsi zone, Lome and Boset districts from East Showa, Girawa and Fadis districts from east Hararge zone, and Dinsho and Sinana districts from Bale zone were selected for this study. Continuing the process, randomly 2 peasant associations (PAs) were selected from each randomly selected district. Based on this process, a total of 16 PAs were randomly

selected from the selected districts. Following a multistage sampling, 25 (twenty-five) farmers from each PA were selected. The 25 farmers were selected by proportional allocation to land rent participant and non-participant farm households. Land rent participant farmers were randomly selected from the lists of the farmers' land rental contractual agreement document available in the PAs' office. The non-participating farmers were randomly selected from the lists of the farmers' available in the PAs' administrative office. For the study, 400 (=25 * 16) farmers were randomly selected using the methods above. The data was collected by questionnaire method. During data collection, the household head of the family participated in the survey. Unavailable farmers during data collection were replaced by the other farmers from the list of farmers in PAs administrative office.

3.4. Hypothesis (H) and stylized facts

The following hypotheses are stated based on existing literature about factors that affect rural households land size rent in, land size rents out and off-farm employment income.

H1: The more land (in hectares) the household owns, at ceteris paribus condition, the less likely it is to participate in rent in and off-farm employment, however, the more it is likely to rent out land if the land size owned is beyond the management of the household. However, households with large farm size are more likely to participate in rent in for economic scale (Kung 2002).

H2: On the other hand, as land rental price per hectare increases in ETB (Ethiopian Birr), the demand for renting in decreases but renting out and off-farm employment participation increase (Vranken and Swinnen 2006).

H3: The link among individual households through which money, goods or services flow is known as social networking. Informal labor sharing is one type of social network in Ethiopia. In labor sharing arrangements a household head invites a member of other households in his system to help him or her with different on-farm and off-farm activities. During the request, the

household responds not based on wages, but due to the expectation that the household will reciprocate the labor supply when they organize a similar request another time in the future when needed (Debebe 2010). The variable informal labor sharing is incorporated in the model to capture if a social interaction affects the land rental market and off-farm employment. Hence, it is hypothesized that informal labor sharing positively affects land rent in, and off-farm activities participation, but negatively affects land to rent out. Informal labor sharing is equal to 1 if the household has participated in informal labor sharing and zero otherwise.

H4: Access to productive credit from formal institutions for agricultural activities positively affects land rent in, but negatively affects rent out of land and participation in non-farm activities (Vranken and Swinnen 2006). Credit from a formal institution is a dummy variable and equal to 1 if the household can borrow money from formal institutions for agricultural production and zero otherwise.

H5: Non-land assets ownership (in ETB): it is hypothesized that availability of non-land assets positively influenced households land rent in and it will negatively affect land rent out, and off-farm employment participation decision of the households (Vranken and Swinnen 2006). When households' non-land asset is decreasing the households face financial problems to buy agricultural input, in particular, seed and fertilizer. As a result, they rent out their land and participate in off-farm work at *ceteris paribus condition*.

H6: The availability of economically active household member (Labor) positively affects the decision to rent in a land (Vranken and Swinnen 2006), and off-farm participation decisions, but negatively influences the decision to rent out land. Economically active farmers mostly participate in land rent in, and the older farmers mostly rent out land (Teklue and Lemi 2004).

H7: It is assumed that the age of the household head and rent in are positively related until the age of a farmer is economically active, but age and land rent in are negatively related when a farmer becomes older. However, age and land rent out are positively correlated. It is expected that economically active farmers participate more in off-farm activities than the older farmers do. Hence, age and off-farm employment participation have a positive relationship for an

economically active farmer, but the negative relationship as the farmer becomes older and older.

H8: The probability of being a tenant is more for a male-headed household compared to female-headed households because female-headed households are mostly either widowed or divorced, and they lack labor. It is assumed that being male-headed household positively affects land rent in (tenant), and off-farm employment, but negatively land lease out. Hence, gender is equal to 1 if the household head is male, and zero otherwise.

H9: Moreover, an educated household head is believed to have a chance to diversify household's income sources, and manage their farm (Teklue and Lemi 2004). Education is a human capital and it is hypothesized that the more the household head is educated (in the number of years a farmer attended school), more s/he is likely to participate in off-farm work and land rent out compared to less educated one, but less likely to participate in land rent in activities. But, a farmer with lower education level is more likely to participate in land rent in and off-farm work and less likely to participate in land rent out market.

H10: Oxen are sources of draught power in Ethiopia because most land is tilled using oxen except a few farmers using a tractor. Consequently, oxen ownership affects land rental and labor market participation decision of the household. It is assumed that more number of oxen ownership affects land rent in positively, and land rents out and off-farm employment decision of the household negatively. If the household has no or not enough draught power, the farm household is more likely to engage in land rent out and off-farm employment decisions (Holden et al. 2007; Kung 2002).

H11: An off-farm labor market is considered to be a significant determinant of the emergence of a land rental market (Deininger and Jin 2005). When farmers are able to earn more off-farm income, they begin to consider ways to rent-out their land. On the other hand, it is hypothesized that when households participate in off-farm employment, they are less likely to be a tenant, however, more likely to be a landlord. In the analysis, the study uses lag-off-farm income (in ETB).

H12: it is assumed that wage rate per day affects off-farm participation, land rent in, land rent out participation positively, negatively and positively respectively.

H13: The study zones, namely Arsi, East Showa and East Hararge zones are also incorporated in the analysis in the form of dummy variables (cf. Bale zone), and equal to 1 if the household belongs to Arsi, East Showa and East Hararge and zero otherwise. East Hararge zone is one of the zones in the country that face severe food shortage because of drought and erratic rainfall. It is assumed that in response to economic hardship, households in East Hararge zone participate in off-farm work activities, but East Hararge has a negative impact on land rental market participation of the households because of frequent drought and erratic rainfall in the zone. East Showa is very close to the capital city of the country, and most industrial zones of the country are found in this zone. Hence, it is assumed that East Showa zone has a positive impact on land rental market and off-farm participation of the farm households. Likewise, Arsi zone is one of the zones that produce surplus especially wheat. Hence, it is assumed that Arsi zone has a positive impact on land rental market participation of the farm households.

3.5. Estimation

A farm household can make different decisions in a given production year regarding participation in the land and labor markets. Some of the decisions are to be a landlord (by renting out land), to be a tenant (by renting in a land), and to participate in off-farm activities. Also, to rent in and rent out a land, land autarky (no participation in a land rental market), labor autarky (no participation in the labor market), and to hire in and hire out labor are some of the possible decisions. However, numbers of farm households that engage in both land rent in and rent out, labor hired in, joint labor hire in, and hire out are so small, as a result, excluded from further analysis.

The above equations (2 to 9) illustrate that households' land rental and off-farm work participation are interdependent. Moreover, the structural form of specification in Equation (10)

requires one dependent variable be included in other equations as explanatory variable, which induces a likelihood of endogeneity.

If there is an endogeneity, estimation is inconsistent and does not converge to the population parameter; as a result it estimates biased coefficients. Endogeneity arises when a regressor has a correlated relationship with error term. There are three conditions where the exogeneity situation is violated and endogeneity exists in the model. The first one is errors-in-variables and it occurs when the true value of a regressor is unobserved. The second one is due to omitted variables and occurs when a model incorrectly leaves one or more relevant variables (Wooldridge 2006). The last one is because of simultaneous causality and it happens when the causality runs in both from regressors to dependent variable and from dependent variable to the direction of the regressors in the model.

Furthermore, some sample households choose not to participate in land rental markets, which means the dependent variables are censored. As a result, the study uses a Tobit model to identify determinants of households' participation in off-farm work and land rental markets. If employing a univariate model to each equation separately induces a possibility of endogeneity, then a multivariate Tobit model is used for analysis. A multivariate Tobit (MVT) model is estimated to account for the potential interdependence, endogeneity, and censored issues synchronously. In detail, the empirical model corresponding to equation (10) can be represented by the structural equations (11 to 16). Explicitly, Tobit specifications equations 11 and 12 are for land rent in, equations 13 and 14 are for land rent-out, and equations 15 and 16 are for off-farm market participations.

$$A_i^{in*} = \emptyset_1 I_i^{off*} + \alpha X_i + \varepsilon_i^{in} \quad [11]$$

$$A_i^{in} = \begin{cases} A_i^{in*} \ if \ A_i^{in*} > 0 \\ 0, \quad otherwise \end{cases} \quad [12]$$

$$A_i^{out*} = \emptyset_2 I_i^{off*} + \beta X_i + \varepsilon_i^{out} \quad [13]$$

$$A_i^{out} = \begin{cases} A_i^{out*} \ if \ A_i^{out*} > 0 \\ 0, \quad otherwise \end{cases} \quad [14]$$

$$I_i^{off*} = \gamma X_i + \varepsilon_i^{off} \quad [15]$$

$$I_i^{off} = \begin{cases} I_i^{off*} \ if \ I_i^{off*} > 0 \\ 0, \quad otherwise \end{cases} \quad [16]$$

The dependent variables are land size rent in, land size rent out (in hectares), and lag off-farm incomes (ETB) for a tenant, landlord, and off-farm equations respectively. Here, in the equations (11 to 16), the superscript asterisks represent the unobservable latent variables, and X_i is a vector of exogenous variables. The unknown parameters in the models are denoted by $\emptyset_1$, $\emptyset_2$, α, β , and γ ; and ε_i^{in}, ε_i^{out} and ε_i^{off} are random disturbances terms.

The Tobit normal regression is estimated with a two-step estimator, proposed by Smith and Blundell (1986) to test exogeneity. In the first step, equations for off-farm employment are estimated to obtain consistent estimates of unknown parameters and to calculate residuals.

$$I_i^{off*} = \gamma X_i + \varepsilon_i^{off} \quad [17]$$

$$I_i^{off} = \begin{cases} I_i^{off*} \ if \ I_i^{off*} > 0 \\ 0, \quad otherwise \end{cases} \quad [18]$$

Where r is a vector of off-farm income parameter to be predicted, and ε_i^{off} is the error term in the off-farm income equation. In the second step, from the first-steps, both residuals and the observed values are inserted into the right-hand side of Equations (11 and 13) as additional variables as follows:

$$A_i^{in*} = \omega_1 I_i^{off*} + \omega_2 X_i + \omega_3 R_i + v_{iA} \quad [19]$$

$$A_i^{out*} = \tau_1 I_i^{off*} + \tau_2 X_i + \tau_3 R_i + \epsilon_{iA} \quad [20]$$

Here, I_i^{off*} is a vector of the observed variable for off-farm work; R_i is the residual term of lag off-farm income, and v_{iA} and ϵ_{iA} are error terms of equations (19) and (20). As noted by Smith and Blundell (1986), the Tobit estimates of ω_1 and τ_1 in equations (19) and (20) are consistent, and the procedure yield consistent joint estimates of the equations, and is commonly adopted to address the censoring with endogenous explanatory variables. If in the second step, the estimated coefficient of the residual term is significantly different from zero, then the off-farm employment can be deemed endogenous. If the residual term is insignificant, then it is weakly exogenous (Smith and Blundell 1986).

If the residual terms in the second steps are significant, the study employs a multivariate Tobit estimator. The univariate model is a special case of the multivariate one, in the sense that the correlation coefficients rho (ρ) between the error terms are forced to be zero. As a result, likelihood ratio (LR) test will be done on the multivariate regression and it is stated that the null hypothesis of correlation coefficients rho (ρ) equals to zero. If the corresponding statistics reject the null hypothesis, then a multivariate Tobit estimator should be performed to attain more efficient estimates. Otherwise, the univariate model should be selected to separately estimate each equation. The multivariate Tobit model is estimated by the simulated maximum likelihood (SML) method. Moreover, the Geweke–Hajivassiliou–Keane simulator is used, and Halton sequences are employed, to generate the multivariate normal random draws to reduce the computational burden (Train 2009). The model parameters were estimated using multivariate Tobit by SML estimation procedure using Stata (13) statistical software.

3.6. Data and descriptive statistics

Data source and sampling technique: Careful and sufficient thought was given to the sampling framework and the preparation of the fieldwork questionnaire. The questionnaire was designed to collect diverse information on all aspects of rural land tenure especially land rental markets, off-farm activities, farmers' perceptions and smallholder agriculture in general.

Sample cases for the rural survey were selected based on established criteria to capture as many factors as possible that are thought to have an influence on land rental markets, rural labor markets, agriculture and rural life in general. The study was done in Oromia Regional state in Ethiopia. Oromia regional state was deliberately selected because it is the biggest and highly populated regional state in Ethiopia. Compared to other regions, rural infrastructure is better developed in Oromia regional state, the central region of the country. A land rental market is noticeably developed where population pressure is high and where there is a scarcity of land. The regional state has 16 (sixteen) zonal administrations.

For this study, four zones were randomly selected. As a result, east Showa, Arsi, East Hararge and Bale zones are randomly selected among sixteen zonal administrations in the regions. It was decided to include 2 (two) districts, from each randomly selected zones. A total of 8 (eight) districts were randomly selected. Continuing the process, randomly two peasant associations (PA) from each randomly selected district were chosen again. Based on this process, 16 (sixteen) PAs were randomly selected from the selected districts. Following a multistage sampling, 25 (fifty-two) farmers from each PA were selected randomly. For the study, a total of 400 farmers were randomly selected, and the data was collected by questionnaire method in 2014 production year.

Level of participation in off-farm employment and land rental market: Tables 1 and 2 present the level of sample household participation in off-farm employment and land rental market. In case of land rental markets households were grouped into four possibilities: households who rent in a land (tenant), who rent out (landlord), who rent in and rent out, and households who

neither rent in nor rent out a land. Similarly, the households were grouped into off-farm participant and non-participant. Among the sampled households 25 percent of them participated in land rent in markets. Eighty percent of the tenants who rent in land are involved in the off-farm employment. On the other hand, among the sampled households 27.25 percent and 1.75 percent of them joined in land rent out, and land rent in and out markets respectively.

Table 1. Sample households participation in land rental markets

Total sample households = 400					
	Land Rent in	Land Rent out	Land Rent in & rent out	Autarky	Total
Number	100	109	7	184	400
Percent	25.0	27.25	1.75	46.0	100

Source: Own computation

Among the households, 80 percent of those who rent in land, 80.7 percent of those who rent out land, and 49.1 percent of autarky participated in the off-farm employment (Table 2).

Table 2. Off-farm participation given land rental market participation

	Land Rent in (n =100)		Land Rent out (n =109)		Land Rent in & out (n = 7)		Autarky (n =184)	
	No	Percent	No	Percent	No	Percent	No	Percent
Off-farm participant (n = 266)	80	80.0	88	80.7	6	85.7	83	45.1
Off-farm non-participant (n =134)	20.0	20	21	19.3	1	14.3	101	54.9

Source: Own computation

From the sampled households 66.5 percent of the respondents disclosed that they participated in off-farm activities. On the other hand, 30.5 percent, 33.5 percent, and 2.3 percent of the households who participated in off-farm employment participated in land rent in, land rents out, and land rent in and out respectively (Table 3). Moreover, 33.8 percent of them neither

participated in land rent in nor rent out markets.

Among off-farm non-participant households, 14 percent, 14.7 percent, and 0.7 percent of them participated in land rent in, land rents out, and land rent in and out respectively (Table 3). Among off-farm non-participants, 70.6 percent of them are an autarky.

Table 3. Participation in land rental markets given off-farm participation (%)

	Off-farm participant (n = 266)		Off-farm Nonparticipant (n =134)	
	No	Percent	No	Percent
Land Rent in	81	30.5	19	14.0
Land Rent out	89	33.5	20	14.7
Land Rent in & out	6	2.3	1	0.70
Land autarky	90	33.8	95	70.6
Total	266	100%	134	100%

Source: Own computation

Table 4 shows the mean household head age during the survey period was about 53 years. On average, the household heads attended education for five years. The mean economically active family labor that is from the age 15 to 65 years is 2.55 per household. The average land size per household at the time of the survey was about 1.5 hectares. The land to labor ratio, land to the economically active family member, was 0.59 during survey time. The mean livestock and number of oxen owned are 3.7 and 1.8 respectively. There is no such gap between the means of land rent in and rent out prices.

Table 4. Summary of Descriptive Statistics of Continuous Variables

Continuous Variables	Mean	SD
Household head age (in years)	52.55	9.33
Total household size (number)	5.4	1.7
Economically active family labor in number (Labor)	2.55	1.01
Household head education level (years)	5.16	3.60
Wage rate per day	68.93	7.92
land size rented out (hectare)	0.95	0.56
land size rented in (hectare)	0.84	0.4721
Land rental price (ETB per hectare)	4300	680
Household Land size owned in hectares	1.50	0.90
Per capita land size	0.28	0.15
Non-land asset (ETB)	3200	2140
Income from a crop in ETB	34500	20860
Lag off-farm income	11300	8900
Livestock holdings (in TLU)	3.7	2.1
Oxen owned (Number)	1.80	1.20

Source: Own computation

Table 5 shows that 92.5 percent of the sampled households are male-headed households. Households that get a loan from a formal financial institution, almost from microfinance, were only 20.75 percent at the time of the survey. Around 80% of the respondents had no access to loan because of inadequate credit supply, high interest rate and defaulting. Households in the study area had constraints of loan access. During the survey period, 24 percent of the households reported that they had working financial constraints especially to buy seed and fertilizer. The farmers tried to solve their financial problems through social networking that is by the informal access to loan through mutual lending among households. During the survey period around half of the respondents reported that they participated in labor sharing arrangements and informal loan through mutual lending among households. The result shows that the households in the study area have an active social network.

Table 5. Descriptive Statistics of Dummy Variables

Dummy Variables	Number (n = 400)	Percentage
Gender of household head (1 = male)	370	92.5
Formal loan for Agricultural production (1= yes)	83	20.75
Labor sharing arrangements among households (1 = yes) to indicate Social networking	201	50.25
Land fertility (1 = fertile)	135	33.75
The problem of working capital (1 = yes)	96	24.00

Source: Own computation

4. Results and Discussions

4.1. Statistical diagnostic tests of multicollinearity and heteroscedasticity

The results of estimations of the models about determinants of households' participation decisions in land rent in, land rent out, and off-farm activities are presented in Table 7. The problems of multicollinearity and heteroscedasticity are very common in cross-section data while analyzing econometric models. Hence the data must be cleared before it is used for analysis. Tolerance (TOL) and variance inflation factor (VIF) methods were used to detect multicollinearity of explanatory variables. The larger the value of VIF_i, the more troublesome or collinear the explanatory variable is in the analysis. One cause of high VIFs value is the inclusion of powers or products of other explanatory variables. Specifically if in the econometric model, we specify both the variable and its square, there is a high chance that those two variables will be highly correlated. Adding in our model the non-linearity of age which is age squared, and the non-linearity of education which is education squared allow us to model more correctly the effect of age and education respectively, which may have a non-linear relationship with the dependent variable. As a result, VIFs show a high correlation between age and age squared, and education and education square. Hence, to consider non-linearity, we

reduced the correlation of age and age squared; education and education square "centering" age and education (that is subtracting the means of age and education) were done before we square age and education respectively.

Tolerance is equal to 1-R_k^2 and VIF = 1/ tolerance. Then, R_k^2 is the R^2 value obtained when the k^{th} predictor is regressed on the other independent variables in the model. The greater value of R_k^2, the greater the linear dependence among the predictor x_k and the other predictors. As a rule of thumb, if the VIF of a variable exceeds 10 (this happens if R_i^2 exceeds 0.9), that variable is said to be highly collinear (Gujarati 2004). Table 6 shows the VIF and TOL values of the explanatory variables. As a result, tropical livestock unit (TLU) owned is removed from further analysis because of collinearity with the number of oxen owned. Similarly, per capita land size and total income from crop production are removed from further analysis because of collinearity with land size owned. Total family size is highly correlated with family labor. Variables that have no serious problems of multicollinearity were included in the models for further analysis (Table 6).

Table 6. Variance Inflation Factor and Tolerance/ Collinearity Diagnostics

Variable	VIF	Tolerance	R_k −Squared
Lag off-farm	4.34	0.23	0.77
Age	5.00	0.20	0.80
Age square	1.41	0.71	0.30
Gender	1.27	0.79	0.21
Labor	3.71	0.27	0.73
Education	4.55	0.22	0.78
Education square	2.86	0.35	0.65
Oxen	3.49	0.29	0.71
Production loan	1.44	0.70	0.31
Labor share	7.60	0.13	0.87
Land size	3.76	0.27	0.73
Non-land Asset	3.05	0.33	0.67
Land rental price	4.05	0.25	0.75
Wage rate	2.92	0.34	0.66
East Hararge	2.00	0.50	0.50
East Showa	1.58	0.63	0.37
Arsi	2.06	0.49	0.51

Source: Own computation

We expect heteroscedasticity of the error terms of cross-sectional data with heterogeneous households. As a result, a user-written program in Stata called tobithetm: Tobit Multiplicative regression (Tobit normal regression) is used.

4.2. Testing for regressor endogeneity

The Tobit normal regression is estimated with a two-step estimator, proposed by Smith and Blundell (1986). In the first step, an equation for lag off-farm work activities is estimated to obtain consistent estimates of unknown parameters to calculate residuals. Then Residual of lag off-farm income is incorporated in equations (19) and (20) to check if there is an endogeneity in the model. The Tobit regression result shows that Residual of lag off-farm income is significant in land rent in and land rent out Tobit models (Table 7). Hence, the lag off-farm income can be deemed endogenous, that is it is not exogenous.

In the presence of endogeneity, we cannot run a univariate model because the estimation is inconsistent, produces biased estimator, called simultaneity bias, and the result could not converge to the population parameter. One of the causes of endogeneity is simultaneity between a predictor and the outcome. Hence, to take into account the potential interdependence and existence of endogeneity, we apply generalized univariate Tobit models to systems of equations namely Multivariate Tobit model to determine joint determinants of land rental markets and off-farm activities participation in the next sections.

Table 7. Tobit normal regression (Single Equations) results of determinants of joint land rental markets and off-farm work participation and Testing endogeneity

	First stage	Second stage	
	Lag off-farm	Land rent in	Land rent out
Independent variables	Coef.(Std.Err)	Coef.(Std.Err)	Coef.(Std.Err)
Lag Off-farm		-.010(.047)	.021 (.009) **
Wage Rate	.197 (.106) **	-.066(.506)	.175(.215)
Gender (M=1)	1.430(2.189)	.262(.222)	-.061(.117)
Age	.110(.532)	.014(.038)	.059 (.027) **
Age Square	-.002(.005)	-.001(.004)	.002 (.001) **
Labor	3.407 (.604) *	.108 (.048) **	-.235 (.072) *
Labor Share (1=yes)	8.397 (1.508) *	.097(.127)	-.089(.115)
Education	.092(.184)	.245(.125) *	-.050(.119)
Education Square	-0.015(.012)	-.029 (.014) **	.022(.019)
Land Rental Price	.590 (.432)	-.038(.167)	.841(.637)
Land Size Owned	-4.364 (.830) *	-.345 (.075) *	.358 (.064) *
Non-land Asset	-.044(.022)	.002 (.001) **	-.004 (.002) **
Oxen	-2.771 (.648) *	.166 (.046) *	-.202 (.069) *
Production Loan	-1.524(1.021)	.064(.104)	-.055(.123)
Zone Dummy (cf. Bale Zone)			
East Hararge Zone	.473(1.645)	-.145(.112)	.035(.096)
East Showa Zone	.342(.676)	-.157(.119)	.069(.095)
Arsi Zone	.184(.164)	.081(.113)	-.083(.101)
Residual Error Term of Lag Off-farm		-.012 (.004) *	-.030 (.012) *
_cons	-52.87 (17.5) *	.098(1.087)	-3.610 (.896) *

Source: Model output. Number of observations= 400; left-censored obs. At <= 0 are 134, 300, and 291 for lag off-farm, land rent in and land rent out respectively. * <= 1%, and ** <= 5% probability level. Log likelihood, and LR Chi^2 are -1057.56 and 376.94* for lag off-farm, -124.99 and 346.19* for land rent in and -51.27 and 552.69* for land rent out.

4.3. Model diagnostics of multivariate Tobit model

A system of equations is generated from equations in which the lag off-farm income of the households', households' land size rented in, and land sizes rented out are the dependent variables. The multivariate Tobit model considers the existence of endogeneity is used to

analyze rural land and labor markets participation. This approach provides a more robust methodology that takes into consideration commonly unobserved characteristics. The correlation coefficient *rho* is explained as a relation between unobservable independent variables of the equations in the multivariate Tobit model. When *rho* is zero, it means that the outcome variable in one equation is uncorrelated with that of the error term of other equation of the model. But, if *rho* is not zero, they will be correlated.

A multivariate Tobit specification, as indicated in Table 8, is tested against univariate specifications. The LR joint test of *rho* is rejected (the null hypothesis is that correlation across different equations is equal to zero). The result shows that the correlation between the errors (*rho*) is statistically significant at less than 1% probability level. The LR joint test of rho (ρ) rejects the null hypothesis that the correlation across different equations is equal to zero. As an alternative, the z test suggests the *rho*12 and *rho*13 are statistically different from zero at 1% and 1% significant level respectively. The tests illustrate the existence of cross-equation interdependencies, and multivariate Tobit approach is more appropriate to estimate the system of equations than estimating the three equations separately. This implies the equations needed to be estimated simultaneously.

Table 8. Cross-equations correlation Tests

rho12 =-.536*; rho13 =-.748*; and rho23 =.204
Likelihood ratio test of rho12 = rho13 = rho23 = 0: Chi2(3) = 25.81 Prob > chi2 = 0.0005

Source: Models output. 1= equation of rent in, 2= equation of rent out, and 3 = equation of lag off -farm.

* and ** indicate significance level at less than 1% and 5% respectively.

4.4 Determinants of joint rural off-farm income and land rental markets

In estimating the joint determinants of a land rental market and off-farm employment, a multivariate Tobit (MVT) model made of seventeen explanatory variables was specified and estimated. A multivariate Tobit analysis framework was used to find the determinants of rural land rental markets and off-farm employment income participation of the farm households. The result of the analysis, presented in Table 9, shows that among twenty variables included in the estimation of the model, eleven of the specified variables were found to have significant influence on lag off-farm employment, and ten of the specified variables were found to have significant influence on land rent in (Tenant), and nine of the variables have a significant effect on rent out. The explanatory variables that influenced jointly rural land and off-farm work activities significantly were presented as follows.

Lag off-farm income: Income from off-farm work activities affects significantly and positively the decision to participate in a land rent out activity. The effect of off-farm employment on rent out participation is strong and robust. The result confirms that off-farm work opportunities can increase the supply of land and it is a major factor driving the development of village land rental markets. Households who participate in off-farm work are more probable to participate in a land rent out activity. The income from off-farm labor market correlates negatively with land rent in participation. Households that participate in off-farm work are predicted to be less likely to participate in land rent in. The result of the analysis supports the stated hypothesis.

Age of household head: The model output indicates that the age of the household head affects positively farm households' income from off-farm work and land size rent in by the household. The result of the analysis also suggests the quadratic effect of age on the level of land rent in and off-farm work. The coefficient of age square of the land rent in equation and off-farm work income equations are negative. This implies that participation in land rent in and off-farm work activities increases as age increases, but as the household head gets older the probability of

participation in off-farm work and land rent in activities declines. That is as the household head becomes about 54 years old the probability of participation in land rent in activities declines. Likewise, as the household head becomes about 57 years old the probability of participation in off-farm work activities declines. The effect of age on land size rented out is positive and significant at less than 5% probability level. The coefficient of age square of the land rent out equation is positive, which indicates the effect of age is more on land rent out participation decisions. That is the size of land rent out increases as the household gets older and older.

Numbers of economically active household labors in the household: The number positively affected land size rent in and off-farm work income of the household. But it negatively affected land size rented out of the farm household. As the household has a number of economically active labor endowments, the household is more likely to rent in larger land and earn higher income from off-farm work by diversifying its income both in agriculture and in off-farm activities. This implies that having a more labor force gives the household an opportunity to assign labor both on farm and off-farm work. The result also indicates that as the economically active labor in the household increases, the household is less likely to rent out land because they can manage the land at *ceteris paribus condition*. Thus, the result agrees with the hypothesis that the household labor supply affects positively land size rented in (Vranken and Swinnen 2006), and off-farm participation income, but negatively influences land size rented out.

Education: Education has a positive impact on households' income generated from off-farm work participation and land size rented in, but it has a negative effect on land size rented out. However, the estimate on education shows that the effect of education on off-farm participation, land rent in, and land rent out is indeed non-linear. The effect is significantly positive up to a certain educational level and it becomes negative thereafter, as indicated by the education square coefficient for land rent in, and it is positive for education square coefficient for off-farm income. This may imply that household heads with a basic level of education are more likely to participate in land rent in decision than those with a higher level of education. The positive effect of basic education on off-farm participation decision may reflect the

co-existence of off-farm that requires little skills and training in rural areas of Ethiopia. As households' education level becomes higher (8 years of schooling), their participation in land rent in decreases. But as the household heads' education level increases and they attain education for 11 years, the probability of participation in land rent out activities increases and the households participate more in off-farm activities by renting out their land that required more skills and training in rural areas of the country. The result of the study implies basic education helps the farmers to diversify their income both in agriculture and off-farm sectors. However, as the education level of farm households becomes higher, the farm households move from the agriculture to off-farm sectors that need more skills and training. Hence, education has an important role to transform the rural economy from agriculture based on non-farm / off-farm economy.

Land size owned: As hypothesized, the area of land operated affects negatively and significantly participation in land rent in, and off-farm employment of households at less than 1% probability level. But, it has a positive influence on land rent out participation decision of households in the study area. This implies that the probability to be a tenant and participate in off-farm work decreases as the size of land owned increases. This result suggests that households become a tenant or participate in off-farm employment when they are landless or have smaller land size. Households that have more land and lack agricultural inputs were more likely to rent out their land to the landless and to a household that has a little land. In this way, land rental markets enhance an allocative efficiency of land and labor. Large farm size helps farmers to cultivate and produce more, which in turn increases farm income and improves the livelihood of a household. The area of land operated influences negatively off-farm participation because most farmers participate in off-farm activities for push reasons. The results prove that small holder farm households have high demand for rental land. As the farm size decreases, households participate in off-farm activities in order to diversify their incomes. The analysis also predicted that households with large land endowment are less likely to participate in land rent in markets and become specialized farmers, by seeking economies of scale.

Numbers of oxen owned: Numbers of oxen owned affect positively and significantly land rent in of farm households. However, it affected negatively households' participation decision in land rent out market, and off-farm employment at less than 1% probability level. The result indicates as numbers of oxen owned increase the household mostly focuses on on-farm activities rather than off-farm work. As the household has a number of oxen, it is more likely to rent in land, but, less likely to rent out, and to participate in off-farm activities, at *ceteris paribus condition*. The result implies that when the farm households have a number of oxen, they mostly focus on on-farm activities besides their farm by renting in instead of off-farm work because oxen are inputs in traditional and subsistence agriculture. In the highland of Ethiopia, as the land is tilled using oxen, ownership of oxen affects land rental and labor market participation decision of the households. The result agrees with the stated hypothesis. If the household rents in more land, consequently, it is less likely to participate in off-farm activities. If the household has no or not enough draught power, the farm household is more likely to engage in land rent out and off-farm employment decisions (Holden et al. 2007; Kung 2002).

Informal labor sharing: Informal labor sharing is one type of social network in Ethiopia. The coefficient of informal labor sharing is positive and significant in the tenant equation, while it is negative in the landlord equation suggesting that access to labor via labor sharing arrangements was associated with more likelihood of land renting in because having a social network reduces transaction costs of searching partners that participate in land rental agreements and enforce these contracts and less likelihood of land renting out. Informal kinship and connections with the community can serve as an alternative to facilitate access to credit through mutual lending among households; as a result, it is less likely to rent out land due to agricultural inputs constraints. In labor sharing arrangements one household asks members of other households that have a good relation with it to help it with different on-farm activities. Labor sharing is made for quick completion of tasks, unavailability of hired in labor, high wage rate of hired labor, to complete tedious activities in a group as a result of synergy as workers' performance improves when working with other group members, and the household may be sick or old.

During the request, the household responds not based on wages, but due to the expectation that the household will reciprocate the labor supply when they organize a similar request another time (Debebe 2010). Participation in local labor sharing arrangements was also associated with more likelihood of supplying labor to off-farm jobs. The result suggests that a social network plays a positive role in participating in off-farm work activities. The result is in line with the hypothesis that having a social network through labor sharing among households encourages land rental market participation. Similarly, the existence of a social network can help households to find job information and therefore will positively affect off-farm employment.

Production loan: Even though the result is not highly significant, access to production loan affects negatively land rent out participation as hypothesized at 10% significant level. The result shows that poor farmers that had problems of agricultural inputs took production loan, rather than renting out their land. Around 20.75 % only had access to loan from microfinance institutions; the majority of the households had no access to credit service.

Non-land assets: The coefficients of non-land assets influenced positively and significantly land rent in participation of the sampled households. But it negatively affected land rent out participation of the households. The result implies that when households' non-land asset is decreasing the households face financial problems to buy agricultural inputs, in particular, seed and fertilizer. As a result, they rent out their land and participate in off-farm work at *ceteris paribus condition*. One possible reason is that agriculture requires finance to buy selected seed, fertilizer, pesticides, and herbicides. If the farm households have a financial problem, then the likelihood of renting out their land is very high. On the other hand, availability of non-land assets for agricultural production purpose especially to buy seeds and fertilizer positively affects land rent in, but it negatively affects land rent out and participation in non-farm activities (Vranken and Swinnen 2006). The result supports the hypothesis. Conversely, if off-farm options can be accessed easily, but credit markets are incomplete, non-farm earnings can be an important means for overcoming working capital constraints to purchase necessary variable inputs for agriculture or to make capital improvements to farms (Woldehanna & Oskam 2001).

Location variables: The location of East Hararge has an impact on off-farm activities participation. Households in East Hararge are more likely to participate in off-farm work activities in response to economic hardship. The push factors of rural households' participation in off-farm activities are frequent drought and erratic rainfall in the East Hararge zone. East Hararge zone has access to large labor markets because it is closer to big cities like Harar and Dire Dawa towns. Small-scale trades run by farm households are also very common in eastern Ethiopia in general and east Hararge zone, in particular.

The households residing in rural parts of East Showa zone are more likely to diversify into off-farm activities because of pull factors of off-farm activities. East Showa zone has access to large labor markets and infrastructures because it is closer to big cities including the capital city of the country and has access to small-scale industries. Arsi zone is one of the zones that produce surplus especially wheat. Hence Arsi zone has a positive impact on land rent in participation of the farm households. The result showed that there are location differences in rental and off-farm participation of the households.

Table 9. Determinants of joint land rental markets and off-farm work participation decisions, Multivariate Tobit/mixed model

Independent variables	Land rent in	Land rent out	Lag Off-farm
	Coef.(Std.Err)	Coef.(Std.Err)	Coef.(Std.Err)
Lag Off-farm	-.018(.015)	.049 (.018) **	
Wage Rate	-.008 (.026)	.261(.194)	.178(.201))
Gender (M=1)	.173(.227)	-.067(.115)	.944(2.272)
Age	.108 (.021) **	.573(.374)	1.129 (.537) **
Age Square	-.002 (.001) **	.001(.005)	-.010 (.001) *
Labor	.299 (.075) *	-.208 (.092) **	3.539 (.605) *
Labor Share (1=yes)	.424 (.195) **	-.038(.163)	3.055(1.973)
Education	.372 (.0146) *	-.517 (.0112) **	.051 (.0101) *
Education Square	-.024 (.012) **	.023 (.011) *	.025 (.012) **
Land Rental Price	-.044 (0.035)	.098(.070))	.274(.688)
Land Size Owned	-.559 (.1016) *	.363 (.107) *	-4.362 (.838) *

(Continued)

Independent variables	Land rent in	Land rent out	Lag Off-farm
	Coef.(Std.Err)	Coef.(Std.Err)	Coef.(Std.Err)
Non-land Asset	.049 (.013) *	-.005 (.002) **	-.045(.036)
Oxen	.124 (.043) *	-.195 (.071) *	-2.816(.648)
Production Loan	.069(.118)	-.053 (.030) ***	-1.328(1.519)
Zone Dummy (cf. Bale Zone)			
East Hararge Zone	-.153(.1277)	+.014(.1002)	.112 (.066) **
East Showa Zone	-.075(.1364)	.046(.0960)	1.115 (.372) *
Arsi Zone	.125 (.069) **	-.101(.102)	.912(1.731)
_cons	.614(1.202)	-3.885 (.947) *	-39.056 (14.540) *

Source: Models output. Log likelihood = -1223.32; Wald chi^2 = 1137.25*, Number of obs.=400
*, **, and *** indicate significance level at less than 1%, 5%, 10% respectively.

5. Conclusions and Recommendations

The paper tries to identify factors that affect rural households' joint participation in rural labor and land rental markets. The study used a multivariate Tobit model that considers the existence of endogeneity and cross-equations interdependence to analyze determinants of farm households' rural land size rented in, land size rented out, and off-farm income.

Estimation results showed households who were well endowed with the economically active labor force, oxen, and farming resources were more likely to participate as a tenant in land rental markets. Similarly, landless and near-landless households were more likely to participate as a tenant in land rent in markets. In addition, households who have a social network and access to credit through mutual lending among households were more likely to participate as a tenant in land rental markets. Land rental markets improve an allocative efficiency of land.

In contrast, households who were less endowed with agricultural inputs (oxen, seed, fertilizer, and labor), and have more land are more likely to rent out their land and then work off-farm jobs. Even though more landowners participate in land rent out market, mostly farmers

that have a problem of agricultural inputs like labor, oxen, seed, and fertilizer rent out their land and participate in off-farm employment.

There is inadequate credit supply in rural part of Ethiopia. A large number of the rural farm households still lack access to financial services especially to use for agricultural production. The performance of the microfinance institutions in rural Ethiopia is low because of inadequate credit supply. Lack of access to financial service forces low-income farmers to rent out their farmlands when they face a financial constraint for agricultural inputs. Hence, the government should promote and improve microfinance institutions to reach smallholder farmers. The financial institutions should also boost their loan service to farmers. Strengthening rural financial institutions can provide low-income rural households with consistent cash flow. Also, we recommend the government to reshape alternative rural financial services for smallholder farmers' on-farm inputs and the rural off-farm economy. For instance, government‐sponsored agricultural lending institutions have been successful in the republic of Korea and Taiwan.

Education is the most valuable asset for rural farm households to pursue opportunities in agriculture, obtain skilled off-farm work, start a business in the rural non-farm economy. Yet education levels in rural Ethiopia are very low. Farmers who have had education are better farmers and similarly more capable of finding non-farm employment. Hence, we recommend that the government should design appropriate basic adult educational programs for rural farmers, and open farmers training centers that promote technical and business skills in both the agriculture and rural non-farm economy. Furthermore, an amount of income from off-farm work affects significantly rural households' participation in a land rent-out and land rent in markets. Off-farm employments absorb surplus labor from agriculture. The rural poor can use the off-farm economy as a potential pathway out of rural poverty. Landless farmers depend on off-farm income. To benefit from the off-farm economy, we recommend policy makers to see the off-farm economy as one component of rural growth and transformation strategy and remove any barriers that limit farmers' entry to off-farm employments.

References

Babatunde, R.O and Matin Q. 2010. "Off-farm labor participation in rural Nigeria: Driving Forces and Household Access." Contributed paper for the 5th World Bank Conference. May 03 − May 04, 2010, Cape Town, South Africa

Barrett, C.B. and Reardon, T. 2000. "Asset, activity and income diversification" among African agriculturalists. doi: 10.2139/ssrn.257344

Barrett, C., Reardon, T., & Webb, P. 2001. "Non-farm Income Diversification and Household Livelihood Strategies in Rural Africa." Policy Implications. *Food Policy*, 26(4), 315−31. doi: 10.1016/s0306-9192(01)00014-8

Binswanger, P., & Rosenzweig, M. 1986. "Behavioral and Material Determinants of Production Relations in Agriculture." *Journal of Development Studies*, 22(3), 503-39. doi: 10.1080/00220388608421994

De Janvry, A. and Sadoulet, E. 2001. "Income strategies among rural households in Mexico: The role of off-farm activities." *World Development,* Vol.29, No.3, pp.467-80. doi: 10.1016/s0305-750x(00)00113-3

Debebe, Z. 2010. "Child Labor, agricultural shocks and labor sharing in rural area of Ethiopia." International Institute of Social Study.

Deinger, K and Jin, S. 2002. "Land Rental Market as an Alternative to Government Reallocation: Equity and Efficiency Considerations in the Chinese Land Tenure System." Policy Research Working Paper. Washington D.C.: The World Bank. doi: 10.1596/1813-9450-2930

Deininger, K., & Jin, S. 2005. "The potential of land markets in the process of economic development: evidence from China." *Journal of Development Economics*, 78(1), 241−270. doi: 10.1016/j.jdeveco.2004.08.002

Deininger, K., D.A. Ali, and T. Alemu .2011. "Impacts of land certification on tenure security, investment, and land market participation," *Land Economics* 87(2): 312-334. doi: 10.3368/le.87.2.312

Deininger, K. 2005. "Land Policies for Growth and Poverty Reduction": Challenges and Key issues.

Escobal, J. 2001. "The determinants of non-farm income diversification in Peru." *World Development* 29(3): 497-508 doi: 10.1016/s0305-750x(00)00104-2

Gujarati, D. N. 2004. *Basic Econometrics*. Third Edition. McGraw-Hill, New York. 1002pp.

Holden, S.T., Deininger, K., Hosaena, G. 2007. "Impact of land certification on land rental market participation" in Tigray Region, Northern Ethiopia. doi: 10.2139/ssrn.1019996

Holden, S. T., K. Deininger, and H. Ghebru. 2011. "Tenure Insecurity, Gender, Lowcost Land Certification and Land Rental Market Participation in Ethiopia." *The Journal of Development Studies 47(1): 31-47.* doi: 10.1080/00220381003706460

Jin, S., Jayne, T.S. 2013. "Land rental markets in Kenya: Implications for efficiency, equity, household income, and poverty." *Land Economics*. 89 (2), 246−271. doi: 10.3368/le.89.2.246

Key, N., Sadoulet, E., & De Janvry, A. 2000. "Transactions costs and agricultural household supply response." *American Journal of Agricultural Economics*, 82(2), 245-259. doi: 10.1111/0002-9092.00022

Kung, J.K., 2002. "Off-farm labor markets and the emergence of land rental markets in rural China." *Journal of Comparative Economics* 30, 395−414. doi: 10.1006/jcec.2002.1780

Lanjouw, J.O., and P. Lanjouw. 2001. "The rural non-farm sector: issues and evidence from developing countries." *Agricultural Economics* 26 (1): 1-23. doi: 10.1111/j.1574-0862.2001.tb00051.x

MoARD (Ministry of Agriculture and Rural Development). 2010. "Ethiopia's Agricultural Sector Policy and Investment Framework 2010-2020". Draft final report. Addis Ababa Ethiopia: Author.

Pereira, M., & Sumner, D. 1990. "Rigidities in Rural Labour Markets: An Empirical Test." *The Review of Economics and Statistics*, 72(4), 569-577. doi: 10.2307/2109596

Reardon, T. 1997. "Using evidence of household income diversification to inform a study of the rural nonfarm labor market in Africa." *World Development*, 25(5), 735-747. doi: 10.1016/s0305-750x(96)00137-4

Sara W. 2007. "Livelihood strategies of rural women with emphasis on income diversification." The case of Wolonkami, Oromya regional state . Working papers on population and land use in Ethiopia, p. 9, Addis Ababa University.

Shi, X., Heerink, N, & Qu, F. 2007. "Choices between different off-farm employment subcategories: An empirical analysis for Jiangxi Province, China." *China Economic Review*, 18(4), 438－455. doi: 10.1016/j.chieco.2006.08.001

Otsuka, K. 2007. "Efficiency and equity effects of land markets. In R. Evenson & P.Pingali (Eds.)", *Handbook of Agricultural Economics* (Vol. 3, pp. 2671-2703). Amsterdam: Elsevier. doi: 10.1016/s1574-0072(06)03051-9

Deininger, K., D.A. Ali, and T. Alemu. 2009. "Land Rental Markets: Transaction Costs and Tenure Insecurity in Rural Ethiopia. In S.T. Holden, K. Otsuka, &, F. M. Place (Eds.), The Emergence of Land Markets in Africa Impacts on Poverty, Equity, and Efficiency" (pp.57-73). Washington, DC: Resources for the Future Press.

Smith, R.J.; Blundell, R.W. 1998. "An Exogeneity Test for a Simultaneous Equation Tobit Model with an Application to Labor Supply." *Econometrica* 1986, 54, 679－685. doi: 10.2307/1911314

Taylor, J.E., A. Yunez-Naude and G. Dyer. 2003. "Dissagregated Impacts of Policy Reform: Description of a Case Study Using Data from the Mexico National Rural Household Survey," prepared for the Global Forum on Agriculture, 10-11 December, OECD, Paris.

Teklu, T., Lemi, A. 2004. "Factors affecting entry and intensity in informal rental land markets in Southern Ethiopian highlands." *Agricultural Economics* 30, 117－128. doi: 10.1111/j.1574-0862.2004.tb00181.x

Train, K.2009. "Discrete Choice Methods with Simulation, 2nd ed." Cambridge University Press: New York, NY, USA.

Vranken, L., & Swinnen, J. 2006. "Land rental markets in transition: Theory and evidence from Hungary." *World Development*, 34(3), 481-500. doi: 10.1016/j.worlddev.2005.07.017

Woldenhanna, T., & Oskam, A. 2001. "Income diversification and entry barriers: evidence from the Tigray region of northern Ethiopia." *Food Policy*, 26(4), 351-365. doi: 10.1016/s0306-9192(01)00009-4

Wooldridge, J.M. 2010. "Econometric Analysis of Cross Section and Panel Data, 2nd ed." MIT Press: Cambridge, MA, USA.

World Bank Report. 2008. "Agriculture for Development." The World Bank. Washington, DC.

Yao, Y. 2000. "The development of the land lease market in rural China." *Land Economics*, 76(2), 252-226. doi: 10.2307/3147227

Zegeye Tirfe., & Kim Kyung Ryang. 2016. "Impact of Non-farm Income on Farm Households' Food security in Eastern Ethiopia." *Journal of Regional Studies and Development*, 25(1): 143-165. doi: 10.18350/ipaid.2016.25.1.143

http://scholar.dkyobobook.co.kr/searchDetail.laf?barcode=4010024898149#

Zhang, Q., Qingguo, M., & Xu, X. 2004. "Development of Land Rental Markets in Rural Zhejiang: Growth of Off-farm Jobs and Institution Building." *The China Quarterly*, 180, 1050-1072.

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