Does Participation In The Land Rental Market Improve The Welfare of The Rural Poor?
Panel Data Evidence From Tigrai, Northern Ethiopia.

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Abstract

The purpose of this study is to analyze the factors affecting land rental market participation` and its welfare effect on smallholder farmers. The data for this study come from three rounds of balanced panel data collected from 320 smallholder farmers in 2005/06, 2009/10, and 2014/15 cropping seasons from rural Tigrai, northern Ethiopia. A correlated random effect Tobit models were used to estimate factors affecting the extent of land rental market participation from the demand and supply sides. Household-level fixed effects with a control function approach were used to assess the impact of land rental market participation on rural farm households' welfare. Variation in resource endowments explains land rental market participation across landlords and tenants, reflecting the role of non-land resource inequality in driving land rental market development. The results support the general positive returns of smallholders' welfare improvement to renting land from the landlord household and the tenant household on average. The findings in this paper highlight those vital public interventions that may facilitate land rental market development should be sought. This may encompass efforts to illuminate rental rights through securing landholders and interventions that reduce transaction costs such as information sharing, network development, and contract enforcement.

Keywords*:* Ethiopia, Fixed effect, Land, Welfare

JEL: Q12, Q15, Q24, R14

1 Introduction

The emergence of the land rental market in developing countries, including Ethiopia, has improved land use efficiency and productivity among farm households (Gebregziabiher & Holden, 2011; Holden et al., 2013; Holden & Otsuka, 2014). In a traditional tenure system, there is a misperception between land rental and land sale markets. However, the current empirical evidence suggests that the land rental market is more pronounced than commonly perceived (Chamberlin and Gilbert, 2016). This misperception also leads to a clear understanding of the factors affecting the development of rental land markets and their socioeconomic impacts. This has become a considerable concern for researchers and policy-makers in sub-Saharan Africa (SSA). For instance, Holden and Bezabih (2008), Jin and Deininger (2009), Jin and Jayne (2013), and Aryal and Holden (2013) reported that land tenure security increases the probability of land market participation among farm households.

Promoting the land rental market for smallholder agriculture is one instrument for rural development, poverty reduction, and welfare improvement. Policymakers of Ethiopia and elsewhere in developing countries perceived that the land rental market is an important part of agricultural efficiency and the transformation of the economy from subsistence agriculture towards more productive, rapid, and sustainable growth (Alemu, 2007). Recent empirical evidence also revealed that participation in the land rental market is an important source of household income, welfare, and capital (Kan et al., 2006; Alemu, 2007; Holden & Bezabih, 2008; Martey et al., 2012; Jin & Jayne, 2013;).

Theoretically, there are three primary channels through which the land rental market affects smallholder agriculture. First, equity benefits are represented in terms of equality in which the land rental market reallocates land and non-land resources across households, leading to the equilibrium point. Second, efficiency gains are associated with the transfer of land from less efficient farmers to more efficient and more productive farmers. Third, welfare gains through the land rental market appear to be effective in generating higher household income and welfare associated with equity and efficiency (Chamberlin and Gilbert, 2016). Although previous works have

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addressed factors that affect the land rental market participation and the corresponding impacts on equity and efficiency of the land use, still there is secant empirical work on the impact of the land rental market on comprehensive welfare effect in developing countries. With the exception of Rickert Gilbert and Chamberlain (2016), there are very limited studies that dealt with the land rental market and the welfare of smallholder farmers in developing countries (Malawi and Zambia). However, their work is not comprehensive, and they suggest future research with recent data in a densely populated economy. This research gap motivated me to develop the current paper in a land-scarce economy and recently exercised the land rental market. The study region is a densely populated semi-arid area dominated by smallholder agriculture, and effective operation of the land rental market has important implications for poverty reduction and welfare enhancement. With these thoughts in mind, using three rounds of household-level balanced panel data collected in the 2005/06, 2009/10, and 2014/15 production seasons from rural Tigrai, northern Ethiopia, this study seeks to achieve two main objectives. First, it aimed to estimate the factors affecting the participation of rural smallholders in the land rental market. Second, to measure the direct impacts of land rental market participation on the welfare of households from the landlord and tenant household perspectives.

The current study uses farm household balanced panel data and combines three novel approaches. First, land rental market participation is a potential endogenous regressor in welfare models. To fix the endogeneity issue, this study employs a control function approach developed by Wooldridge (2010). According to the control function approach; there is a need for at least one variable that indirectly affects farm households' welfare outcomes through land rental market participation. In other words, the exclusion variable affects land rental market participation directly and is excluded from welfare models, while its welfare effect occurs through influencing the rental market process. Satellite rainfall data for the rainy seasons with two years of lagged rainfall variability were used as exclusion restriction/instrumental variable. Second, to fix the effect of time-invariant variables in the land rental market participation model, this study employs a correlated random effect Tobit (CRE-Tobit). Third, to fix the unobservable heterogeneity effect in the welfare models, the study uses a household-level fixed effect estimator. A disaggregated analysis of food secured and food insecure households also allow us to test whether participation in the land rental market is pro-poor or neutral in its impact. In addition, the application of a farm household-level panel and geospatial data helps to control for contextual factors such as access to roads, markets, and distance to plots, which may explain households' land rental market participation and welfare measures.

The rest of this article is organized as follows. In the next section, the conceptual framework for land rental market participation and its subsequent welfare impacts on smallholder agriculture are reviewed. In section 3, the data sources and variables of interest for the analysis are presented. The second part of section 3 addresses the empirical model specifications and identification strategies. The descriptive statistics and results of the regression analysis are reported in section 4. The last section contains conclusions and policy implications.

2 Conceptual framework

Following Holden et al. (2007) and Chamberlin and Ricker-Gilbert (2016), a farm household model in which the land rental market is centered to minimize the difference between the desired and actual farm sizes. In the presence of transaction costs and poor proxies for sharecropping in rental market pricing systems, reducing the distance between the desired and actual farm sizes becomes incomplete. In turn, the incomplete in operating farm size arrangement leads to rationing in smallholders' land rental market participation decisions. Likewise, due to imperfect information about rental partners and the fear of losing tenure rights due to secured land ownership, landlord households may also be reluctant to rent out land, which can also affect tenants' land rental market participation (Holden et al., 2007).

The adjustment to the desired farm size and the decision to participate in the land rental market (rented in and rented out) are conditional on many factors. Household endowments essentially include non-land resources (Z), observable and unobservable household characteristics (H), previous participation in the land rental market (, and community-level factors such as population density, market access, and rainfall variability (V). In a panel data set, farm households' land rental market participation decisions are formulated as follows:

$$Q_{ijt} = F\left(H_{ijt}, Q^{*}_{ijt-1}, V_{it}\right) + C_i + \theta \bar{F}_{ijt} + \varepsilon_{ijt} \quad (1)$$

Where Q is the extent of rented in or rented out of land by smallholder farmers, and Q> 0. F¯ is the pre-rental farm size, which denotes the extent to which a household has tenure or cultivation rights. F is a function of the optimal (desired) farm size, refers to one-year lagged land rental market participation (1=yes, 0 otherwise), and V is a

community-level variable such as rainfall. C is the unobservable heterogeneity effect, which is observed by the individual but not by the researcher.ε is an error term. "i", "j" and "t" are individual, rental market regimes (i.e., as a tenant or landlord) and time identifiers, respectively. The coefficient estimate of θ indicates the degree to which the actual landholding size explains the area rented in or rented out. If θ approaches -1, a household is characterized as a tenant, and if θ approaches 1, a household is characterized as a landlord. If these conditions are effective, the land rental market will be fully efficient, and the distance between the desired and actual farm sizes will decline (Skoufias, 1995). Given these premises, farm households' land rental market participation decision is conceptualized as a continuous response variable, where the household considers renting in or renting out of an extra land size measured in hectares. The land rental market decision is based on the expected marginal benefit and associated costs.

3 Data and estimation methods

3.1 The data

The data used in this paper come from the balanced panel of 320 household surveys conducted in 2005/06, 2009/10, and 2014/15 cropping seasons from 16 communities in rural Tigrai, northern Ethiopia. To obtain representative sample households as two-stage sampling technique was used as described by Hagos and Holden (2003). The first stage involves the selection of communities based on variations in agricultural production potential, access to services, markets, irrigation, population density, and agroecology diversification. The second stage involved the random selection of 24 to 25 farmers from each community for a detailed interview.

The household-level data includes household composition and socioeconomic characteristics such as head sex, age, level of education, and active labor force. These variables help to assess their role in production, consumption, and input and output market participation. The wealth and resource endowment of farm households were expressed in terms of their own farm size, oxen, and non-oxen livestock measured in TLU. These variables are expected to explain households' land rental market participation decisions and welfare outcomes. The baseline survey is the 2005/06 cropping season with 320 households. In the subsequent surveys, there were no attrite households, but there were some changes in the head's age and gender. This is because, in the long panel, the unit of analysis is a plot, and if the household head who was involved in the previous survey period migrated or passed away, the household was not excluded from the sample unit in the next survey period. Instead, the household remains in the sample as long as plots are still managed by an existing member of the household who steps into the headship as either a spouse or a descendant family member (son/daughter).

3.2 3.2 Estimation methods and identification strategy

The model specifications below allow us to achieve the stated research objectives. First, factors affecting participation in the land rental market were estimated. Second, the impact of land rental market participation on the welfare of land-poor and non-land-poor farming households was estimated. To address the first objective, the model specification is formulated as follows:

$$Q_{ijt} = \gamma Q*_{ij,t-1} + \theta F_{ijt} + \beta R'_{ijt} + \phi H'_{ijt} + \alpha_i + \sigma V'_{it} + \chi Y_t + \mu_{ijt} \quad (2)$$

Where Q refers to farm households' extent of land rental market decisions measured in hectares and $Q*i$,j,t−1 refers to a dummy of one-year lagged land rental market participation (1= yes, 0 otherwise). The statistical significance of γ tests whether the hypothesis of state dependency matters in the land rental market. F¯ refers to the initial landholding size of the farm household. The statistical significance and sign of θ indicate whether the land rental market promotes land use efficiency. The parameter to be estimated for the household endowment, such as family labor and other non-land resource endowments is represented by the vector R. Other control variables, such as age, sex, and the literacy status of the household head (H), are also expected to influence land rental market participation. The community-level variables in equation (2) are represented by V, with the corresponding parameter σ including the distance to market, access to irrigation, distance to plot from the homestead, and lagged rainfall. The lagged rainfall variable is defined as four months of rainy seasons with a two-year lag in average rainfall and rainfall variability relative to the survey period. This variable serves as a farmers' expectation of weather shock in the next production season when land rental market participation decisions are made. Year dummies (Yt) are included in the land rental participation models to capture decision variation in the rental process over time. αi is an individual unobservable heterogeneity effect, and μ refers to the error term that captures the unobservable effect of the land rental market. ''i'', ''j'' and ''t'' are individual, rental market participation regimes (such as landlord or tenant), and time identifiers, respectively. The dependent variable in equation (2) is the extent of land rented in and rented out measured in hectares and estimated using a corner

solution model. This is because not all farm households have participated in renting in or rented out the land, but for those who have participated, the extent of land rented is censored at zero (Wooldridge, 2010).

The second part of the empirical model estimates the impact of participation in the land rental market on a set of farm household welfare outcomes, including the value of crop income, off-farm income, total household income (which captures self-produced crops and off-farm earnings), and the probability that a household is food secured. For this purpose, rural farm households were categorized into food-secured and food-secured households using the Food Security Index (Titus & Adetokunbo, 2007). The food security index is computed by dividing the per capita food consumption expenditure by two-thirds of the average per capita food consumption expenditure of all households. A household with per capita food expenditure that falls below two-thirds of the mean per capita food expenditure is considered food secure. In contrast, a household with a per capita food expenditure that falls above two-thirds of the mean per capita food expenditure is treated as food insecure. A dummy variable is constructed and explained with a value of one for food-insecure households and zero otherwise. The welfare indicators are specified by Y and modeled as follows.

$$Y_{ijt}= \gamma_1 Q_{ijt}+ \gamma_2 R'_{ijt}+ \gamma_3 H'_{ijt}+ \alpha_i+ \gamma_4 V'_{it}+\epsilon_{ijt.} \quad (3)$$

The welfare model specification of equation (3) is estimated when Q is treated as the extent of land subject to renting decisions. The other variables specified in equation (3) are many of the same variables in equation (2), but some variables are quite different. For instance, the rainfall variables in equation (3) are the four-month rainy seasons of the production season, while the four-month rainy seasons of two years lag to the survey period in equation (2). The vector of parameters in equation (3) can be estimated using a household-level fixed effect (FE) model so that the selection bias issue due to the time-invariant household factor (αi) is removed by the demeaning procedure. A fixed-effect linear probability model is also employed to estimate the probability of food insecurity. A detailed discussion of the identification strategies is presented in the next section.

3.3 Identification Strategy

This study uses observational data, and not all farm households have equal access to participate in the land rental market as a landlord or as a tenant. Thus, the variable land rental market participation is non-random. From this perspective, there are two sources of selection bias in the land rental market and welfare estimations, which are discussed as follows.

(i) Unobservable heterogeneity effect

The individual unobservable heterogeneity effect is a time-invariant variable that may be correlated with the explanatory variables in the land rental market participation and welfare outcome models. For instance, a farmer with better farm management skills, closer social connections with rental partners, and a lower degree of risk aversion may vehemently participate in the land rental market. In addition, such a household may experience greater welfare outcomes than a farm household with limited social connection, farm management, and high-risk aversion. Since the data set is a balanced panel, the time-invariant variable will be removed by using a fixed effect estimator (FE) in equation (2). However, the FE estimator is a workhorse for linear models but is not suitable for nonlinear models. On the other hand, if a random effect model is used, the unobservable heterogeneity effect will be uncontrolled. Thus, pure fixed effect or pure random effect estimators are not suitable. Instead, a unify of the two and develop the correlated random effect or the Mundlak-Chamberlain approach following the work of Mundlak (1978) and Chamberlain (1992). One benefit of the CRE estimator is that it includes the mean value of time-varying household variables in the regression analysis to control for the time-invariant variable (Wooldridge, 2009). In the Mundlak-Chamberlain equation, the time-invariant variable in equation (2) is expressed as a function of the average of households' time-variant variables.

$$\alpha_i= \psi + \mathrm{Y}X_i+ a_i, \text{ where } a_i= (0, \delta^2) \text{ and assume } a_i+\mu_{ijt.} = \zeta_{ijt} \quad (4)$$

Equation (4) is substituted into equation (2), and the full MC specification and estimate are obtained using the CRE Tobit.

$$Q_{ijt}= \gamma Q*_{ij,t-1}+ \theta \bar{F}_{ijt} + \beta'_{ijt}+ \phi H'_{ijt}+ \sigma V'_{it}+ \chi Y_t+\psi + \mathrm{Y}\overline{X\iota}+ a_i+ \zeta_{ijt} \quad (5)$$

Next, a household-level fixed effect estimator is used to fix the problem of unobservable heterogeneity effects in equation (3).

(ii) Observable heterogeneity effect (endogeneity)

To achieve the second objective, a model of inflation-adjusted household welfare indicators is expressed as a function of the extent of land rental market participation along with a variety of predetermined household and community-level variables. Nevertheless, uncontrolled endogeneity caused by an observed variable of land rental market participation in the welfare model may lead to biased estimates. The intuition is that the unobservable factors embodied in the error term influence the welfare variable and may also correlate with the endogenous regressor (decision on the extent of rental market participation) (Chamberlin & Ricker-Gilbert, 2016). One possible way to solve the endogeneity problem is to use the instrumental variable method. Alternatively, for linearly endogenous regressors, the control function approach relies on similar kinds of identification conditions (Wooldridge, 2009, 2010). To simplify the issue, two separate models are specified. These are the extent of rental market participation (first stage) equation (6) and the welfare indicators (second stage) equation (7).

$$Qijt = \gamma_1 Z'ijt + \gamma_2 X'ijt + \gamma_3 Dv + \gamma_4 \overline{Xi} + \mu ijt \quad (6)$$

$$Y_{ijt} = \rho Q_{jit} + \hat{\mu}_{ijt} + \phi X'_{ijt} + \vartheta D_v + \epsilon_{ij} \quad (7)$$

The control function approach requires exclusion restriction variables that are used in the reduced-form equation (6). The exclusion restriction variables are uncorrelated with the error term in the outcome or the second-stage equation (7); $cov\ (Z'ijt, \epsilon ijt) = 0$ but are correlated with the potentially endogenous variable $(Qijt, Z'ijt) \neq 0$. Equation (6) is estimated using the CRE Tobit. The residual (the difference between the predicted and observed extent of area renting, $\hat{\mu}$) is collected and included in the welfare outcome models as a control variable. In this case, the mean rainfall variability (standard deviation) of the rainy season (June to September) with a two-year lag to the survey period was used as an exclusion restriction variable in the equation. Intuitively, the greater rainfall variability of the two-year lagged rainy season leads to increased participation in the current rental market. In high-risk agriculture, landlords prefer to share production risk and are motivated to increase the extent of the area rented out in the post-rainfall season. This, in turn, creates a conducive environment for potential tenants renting in extra units of land. The statistical validity is tested by including the instrument in the welfare equations on the landlord and tenant models in one specification. If the instrument was insignificant in the welfare models but significant in the area rented in the equation and if the error term from the first-stage model was significant in the welfare models, then endogeneity is an issue and was corrected with the control function.

4 Results and discussion

4.1 4.1 Descriptive analysis

Table 1 presents the land rental market status of smallholders in terms of participation rates across the survey periods. The percentage of tenant households declined from 28.1% in 2005/06 to 17.5%in 2009/10 but increased to 23.1% in the 2014/15 production season. The reason for this variation may be the change in the gender of the headship within the same household, as the head's gender (female =1) increased from 28.4% in 2005/06 to 32.1% in 2009/10 and then decreased to 23.4% in the 2014/15 production season (see Table 4). This finding implies that female-headed households are more likely to participate in the land rental market as a landlords. The landlord households were classified as partial or pure landlords. Partial landlords rented out part of their land, while pure landlords rented out all of their landholdings.

As tenants and landlords are different people with different motives, the extent of the area rented in and rented out might differ. This may suggest that, on average, the area rented out may be greater or less than the extent of the area rented in and vice versa. In this case, the extent of the area rented out is greater than the extent of the area rented in. The possible justification could be as follows: First, there might be tough competition among tenant households to obtain a fraction of land from potential landlords, and some tenants may be withdrawn from renting extra units of land in different periods. Second, landlords may rent their land to potential tenants who are not within the sample households.

Table 1: Rental status of the sampled households by cropping season (mean value/std error)

Rental status variables	Survey period			
	2005/06	2009/10	2014/15	Average
Dummy: Household is a tenant (1=yes)	0.281(0.025)	0.175(0.021)	0.231(0.023)	0.229(0.013)
Dummy: Household is self-operator(1=yes)	0.521(0.027)	0.596(0.027)	0.543(0.027)	0.554(0.016)
Dummy: household is landlord (1=yes)	0.240(0.023)	0.231(0.023)	0.256(0.024)	0.242(0.013)
Dummy: household is pure landlord (1=yes)	0.118 (0.018)	0.128(0.018)	0.150(0.019)	0.132(0.010)
Area rented in (ha)	0.410(0.047)	0.258(0.036)	0.26(0.039)	0.310(0.023)
Area rented out (ha)	0.149(0.020)	0.158(0.026)	0.181(0.025)	0.163(0.014)
Self-operated area (ha)	0.899(0.054)	0.884(0.040)	0.958(0.047)	0.892(0.025)
N	320	320	320	960

Note: Numbers in parentheses are standard errors: Source NMBU & MU, household panel.

Table 2 presents the mean and standard error comparison of key household-level variables across the land rental market participant categories. Several of the variables convey significantly different effects between tenant and landlord households. The data set contains 960 households, of which 23% and 24% on average are tenant and landlord households, respectively, while 55%are self-operators. The data set is consistent with the observation of McClung (2012) that almost half of Tigrean farmers were engaged in the land rental market, with the vast majority of sharecropping contracts with neighbors, relatives, and in-laws.

Table 2: Socioeconomic characteristics of the land rental market participants.

Variable's description	Tenant HH (N=220)	Sig diffe	Landlord HH (N=223)	Self-operator (N=527)
Gender of household head (female=1)	0.073(0.018)	<***	0.452(0.034)	0.289(0.019)
Head's age below 35 years (1=yes)	0.0293(0.011)	<*	0.061(0.016)	0.075(0.011)
Head's age b/n 35 to 60 years (1=yes)	0.643(0.033)	>***	0.495(0.034)	0.505(0.021)
Head's age above 60 years (1=yes)	0.326(0.032)	<**	0.442(0.034)	0.419(0.021)
Head's education (1= illiterate)	0.624(0.033)	<***	0.776(0.028)	0.748(0.018)
Male adult (number)	2.208(0.089)	>***	1.37(0.086)	1.78(0.057)
Female adult (number)	1.65(0.069)	>***	1.36(0.074)	1.55(0.043)
Oxen owned (number)	1.49(0.064)	>***	0.580(0.060)	0.934(0.040)
Area planted (ha)	1.37(0.068)	>***	1.113(0.055)	0.913(0.027)
Non-ox -Tropical Livestock Unit (TLU)	3.26(0.194)	>***	1.54(0.164)	2.01(0.105)
Own land (ha)	0.976(0.054)		1.08(0.054)	0.892(0.025)

Note that ***, **, and * indicate significance at the1%, 5%and 10% levels, respectively. The numbers in parentheses are standard errors. Source: NMBU & MU household panel.

Table 2 also indicates that there is a significant difference in the age and gender of heads between landlord- and tenant-headed households. This implies that on average, a greater portion of landlord households were headed by female and aged people with less potential to operate their land themselves. This finding supports the efficiency hypothesis of the land rental market in which land is transferred from less efficient farmers (landlords) to more efficient farmers (tenants). The data set also shows that landlord households were poorer than tenants in terms of

oxen, total non-oxen livestock, and male and female adults, and the difference was statistically significant at the 1% level. This finding supports the equity hypothesis of the land rental market.

Table 3 shows the comparison of welfare indicators among the land rental market participants (tenants vs. landlords). Tenant households earn significantly more crop and total income and total household food consumption than do landlord households. The positive correlation between the likelihood of being a tenant and welfare outcomes may thus be attributable to the impact of land rental market participation on welfare rather than the effect of welfare on land rental market participation. There is little variation among land rental market participants as far as earnings from off-farm activities are concerned.

Table 3: Household well-being measures for land rental market participants (tenants vs landlords)

Variable	Tenant	Sig diff	Landlord	Self-operator
Total crop income (Birr/hh)	8,725(1348)	>**	5,638(5773)	7,039(2120)
Total income (Birr/hh)	10,433(1414)	>**	7,409(621)	9,7942310)
Off-farm income (Birr/hh)	1,708(260)		1,771(173)	2,754901)
Total food consumption (Birr/hh)	5,183(324)	>***	40,76(297)	4,147(168)
Probability of food in secured (1=yes)	0.463 (0.033)	<***	0.605(0.032)	0.609(0.032)

Note: ***, and ** indicate significance at the 1% and 5% levels, respectively. The monetary values of the outcome variables are inflation-adjusted in reference to the 2005/06 base year price. The numbers in parentheses are standard errors. Source: NMBU and MU household panel.

Table 3 also shows that tenant households are less likely to be food insecure than landlords, and the difference is statistically significant. The descriptive statistics of the variables used in the econometric analysis are presented in the next table.

Table 4: Descriptive statistics of the variables used in the econometric analysis by survey period (mean).

	Survey period			
Variables' description	**2005/06**	**2009/10**	**2014/15**	**Average**
Head's gender (female=1)	0.284(0.025)	0.321(0.026)	0.234(0.023)	0.280(0.014)
Head's age (year)	54.143(0.785)	55.9(0.766)	61.45(0.769)	57(0.457)
Head's education (illiterate =1)	0.800(0.022)	0.690(0.025)	0.687(0.025)	0.726(0.014)
Male adult (number)	1.500(0.064)	1.64(0.072)	2.17(0.079)	1.77(0.042)
Female adult (number)	1.46(0.047)	1.41(0.053)	1.71(0.066)	1.53(0.032)
Oxen owned (number)	0.937(0.055)	0.993(0.052)	1.00(0.054)	0.979(0.031)
Non ox Tropical Live Stock (TLU)	1.35(0.087)	1.58(0.091)	3.57(0.190)	2.17(0.082)
Own land (ha)	0.958(0.041)	0.949(0.035)	0.932(0.038)	0.946(0.022)
Dummy: households was a tenant, one year Lag(1=yes)	0.228(0.023)	0.165(0.020)	0.225(0.023)	0.206(0.013)
Dummy: household was landlord , one year Lag(1= yes)	0.287(0.025)	0.215(0.023)	0.200(0.022)	0.234(0.013)
Mean rainfall of rainy season (June_September) two years lag (mm)	194(3.79)	218(4.46)	263(4.59)	225(2.64)
Mean rainfall variability (std.dev) rainy season (June-September two years lag (mm)	130(2.07)	94.2(1.66)	187(2.91)	137(1.80)
Mean rainfall of rainy season (June _September)of production year (mm)	90.0(2.38)	107(3.07)	164(4.79)	120(2.29)
Mean rainfall variability of rainy season(June-September) of production year (mm)	19.7(0.253)	36.9(0.595)	46.5(0.508)	34.4(0.450)
Walking distance to district office (hour)	2.92(0.096)	2.92(0.093)	2.63(0.097)	2.82 (0.055)
N	320	320	320	960

Note: Numbers in parentheses are standard errors. Source: NMBU & MU household panel.

4.2 Econometric results

4.2.1.1 Intensity of rented-out land

Table 5 presents the correlated random effect Tobit model results for land rental market participation. According to the results from the landlord side, households with abundant labor and extra oxen were less likely to rent out additional units of land, cetirus paribus.

Table 5: Factors explaining land rental market participation (average partial effect after tobit)

	Extent of land rental market participation	
Explanatory variables	**Area rented out(ha)**	**Area rented in (ha)**
Dummy: Household was landlord one year lag (1=yes)	0.013 (0.022)	
Dummy: Household was tenant one year lag (1=yes)		0.640***(0.036)
Head's gender (female=1)	-0.005(0.028)	-0.004(0.055)
Head's age (years)	0.001(0.001)	0.000(0.002)
Male adult (number)	-0.025**(0.012)	-0.018(0.020)
Female adult (number)	-0.024**(0.010)	-0.004(0.015)
Own land (ha)	0.031(0.022)	-0.111***(0.042)
Oxen owned (number)	-0.053***(0.015)	0.080***(0.018)
Non ox livestock (TLU)	-0.003(0.006)	-0.010(0.008)
Plot distance (hr.)	0.077***(0.022)	0.024(0.041)
Mean rainfall of rainy season (June- September) two years lag(mm)	0.001**(0.001)	-0.003**(0.001)
Rainfall variability (std, dev.) of rainy season (June-September) of two years lag (mm)	-0.001**(0.000)	0.003***(0.001)
Year dummy = 2009/10	-0.058*(0.033)	0.101(0.067)
Year dummy= 2014/15	0.024(0.045)	-0.069(0.071)
Community fixed effect	yes	yes
Constant	-0.534(0.437)	-0.342(0.740)
Wald chi2(33)	208.27	358.66
Prob>chi2	0.0000	0.0000
Left-censored observations	728	755
Uncensored observations	232	205
Total observations	**960**	**960**

Dependent variable: the extent of area rented out and rented in. Correlated random effect Tobit models included as the means of all time-varying variables in the Mundlak-Chamberlin device (not reported) extracted from a three-year panel model for the rental market *: 10%, **: 5%, ***: 1%, indicate the level of significance. The numbers in parentheses are standard errors. Source: NMBU and MU household panel survey.

In response to an extra number of male and female adults, the APEs decreased the area rented out by 0.025 to 0.024 ha, respectively. This is quite intuitive. Farming is a labor-intensive activity, and households with more adult laborers prefer to operate by themselves to rent out extra hectares of land. The effect of the transaction cost defined by plot distance from the homestead on the extent of the area rented out has a positive and significant effect at the 1% level for the landlord households. The marginal effect shows that households living at a distance of one hour from their plots increased renting out of the land by 0. 077 hectares. This result is consistent with the prior expectation that long distances traveled to reach the plot increase the transaction cost and inspire farmers to rent out extra units of plot by potential landlords, ceteris paribus.

Table 5 also shows a positive and significant correlation between the average rainfall in rainy seasons with a two-year lag and the extent of the area rented out. The APEs show that an increase in the average monthly rainfall (Table 5) in a (mm)is associated with a 0.001 hectare of area rented out. However, there is a negative effect on the

extent of area rented out when rainfall is highly variable during rainy seasons with a two-year lag. The possible justification could be. First, in the post-good rain season, landlord households suffer from cash constraints, and they prefer to rent out extra hectares of land holding to meet household liquidity requirements. During the post-bad rain season, the risk-averse landlord household strives to reduce the risk of future consumption shortfalls by operating his/her land by him/herself and reducing the extent of the land he/she expects to rent out. On the other hand, given that landlords are relatively poor in terms of non-land resources, they want to meet immediate needs as a distressed land rental, and the extent of the area rented out in the sharecropping contract declined after such shocks. On average, for an increase in the standard deviation of rainfall in two years lagged to the survival period by one mm, the mean is associated with a 0.001% decrease in the area rented out, ceteris paribus (Table 5).

4.2.2 Intensity of rented in land.

The APEs for rented in area presented in Table 5, column 3. The area rented in is positively and significantly explained by the one-year lag rental market participation as a tenant. It is significantly larger for households than were tenants last year by 0.640-hectare, ceteris paribus. This indicates that past rental experience has implications for later rental market participation as a tenant and supports the theory of state dependency (Holden et al, 2007). The APF results indicate that for an extra ox ownership, the intensity of the area rented increased by approximately 0.08 hectare. Importantly, the intensity of area rented in with the pre-rental land holdings, is highly significant, with a negative sign at the 1 % level. The APE results revealed that for an increase in landholding by one hectare, the intensity of the area rented in decreased by approximately 0.11 hectares, ceteris paribus. This finding supports the allocative efficiency of the land rental market, but the magnitude of the coefficient is significantly greater than -1.

An increase in the average rainfall of the rainy season with a two-year lag has a negative and significant effect on the intensity of rent in land at the 1% level. The reason is that in the post-good harvest season, landlords prefer another form of rental contract to sharecropping and reduce the extent of the area rented out by potential landlords. This, in turn, limits access to rent in extra units of land by potential tenants. On the other hand, weather shocks (rainfall variability) in previous periods also affect the intensity of rent in land. In Table 5, column 3, there is a positive and significant effect of rainfall variability in the rainy seasons with a two-year lag on the extent of area rented in, keeping other variables constant.

4.3 Welfare impact of land rental market participation

The follow-up discussion refers to the broad range of welfare impacts of land rental market participation on the landlord and tenant sides. Before discussing the results, it is important to review how the endogeneity issue associated with land rental market participation in welfare models is fixed. This is because the extent of renting land is self-selective and uncontrolled to this leads to biased estimates in welfare models. As discussed in the identification strategy section, previous period rainfall variability was an instrument in the first-stage Tobit specification on the landlord and tenant models (Table 5). The instrumental variable (exclusion restriction) is included in the second-stage welfare models to test the statistical validity, and the results are presented in Annex Table 1a and Table 1b. As shown, the instrument has a significant effect on the first-stage Tobit model at the 1% level (Table 5) on the landlord and tenant models, but insignificant effect on the standard test levels in the second-stage models (Annex Table 1a & 1b). Furthermore, the fixed effect model results included the residual from the first-stage area renting in and renting out models along with the observed endogenous variable. The inclusion of the residuals test and control for the endogeneity of renting of land. Standard errors are estimated using the bootstrap method to account for the two-stage estimation in this control function procedure. The coefficient of the residual is significant for all of the welfare outcomes of the tenant and landlord models (Table 6a & 6b). This implies that the extent of land rental market participation is potentially endogenous, as expected; therefore, the control function approach works nicely.

Table 6a presents the effect of the extent of land renting on a broad range of welfare variables from the landlord model. The table includes four different specifications of the second stage. Model 1 presents the value of crop income. Model 2 represents off-farm income, and Model 3 represents total household income. Model 4 refers to the probability of being food insecure. The continuous outcome variables are specified in logarithm form; for an extra unit change in continuous explanatory variables and a change from zero to one for dummy variables, the outcome results are changed by percentage, ceteris paribus.

The first model (column 2 of Table 6a) estimates the factors affecting the value of total crop income, where the extent of renting out land is among the others. The results show that the extent of renting out land has a positive and significant effect on this measure. On average, crop income increased by approximately 19.3% at 1%, for an extra hectare of renting out of land, which is expected. This implies that landlords are less likely to operate their land themselves, and renting out extra units of land has a comparative advantage of generating better crop income compared to operating by themselves. The results from Model 2 in Table 6a also show that renting out of land has a negative and significant effect on off-farm income, suggesting the crowding out effect of renting out of land on the off-farm income of landlord households. There is no good economic reason for this unexpected result. However, landlords are most likely elderly and female-headed households with limited human capital available to join the formal labor market, and the amount of income earned from such activities is expected to decline. The coefficients of the fixed effect estimates reveal that renting out land has a positive and significant effect on total income at the 1% level (Model 3). For extra units of area rented out, the total income of the landlord increased by approximately 11.6%, ceteris paribus.

The results indicate a negative and significant relationship between renting out land and the probability of food in secured households at the 1% level (Model 4). This result is consistent with the study of Holden and Ghebru (2013), who reported that poor households, especially female-headed households, are more likely to rent out their land, obtain income from their lands, and reduce household-level poverty. The welfare impact results in Table 6a have several implications. First, the positive and significant correlations between renting out of land and household welfare outcomes are consistent across multiple indicators except for off-farm income. This indicates that relatively non-land-resource-poor households are benefited from renting out their land. These findings are consistent with the study of Chamberlin and Gilbert (2016) in Malawi, which showed that renting out land has a positive effect on the welfare of poor households. Table 6b also shows the factors explaining the welfare outcomes of tenant households. The same estimation procedures are also applied here as for the landlord.

Table 6a: Fixed effect estimation results of factors affecting household welfare: Landlord model

	(1)	(2)	(3)	(4)
Explanatory variables	Log of total crop income	Log of off-farm income	Log of total income	Probability of being food insecured(1=yes)
Residual from first stage	-0.189***(0.031)	0.546*** (0.107)	-0.109*** (0.028)	0.034**(0.014)
Area rented out (ha)	0.193***(0.034)	-0.514*** (0.105)	0.116*** (0.030)	-0.037**(0.015)
Head's gender (female=1)	-0.023 (0.136)	0.262 (0.402)	-0.028 (0.122)	-0.005 (0.056)
Head's age (year)	-0.008 (0.005)	0.033* (0.018)	-0.001(0.005)	0.002 (0.002)
Head's education (illiterate=1)	0.066 (0.116)	-0.559 (0.430)	0.048 (0.098)	0.013 (0.048)
Male adult (number)	0.283***(0.054)	-0.530*** (0.191)	0.203*** (0.050)	-0.010 (0.023)
Female adult (number)	0.287***(0.052)	-0.888***(0.221)	0.179*** (0.026)	-0.016 (0.025)
Oxen owned (number)	0.431***(0.090)	-1.577*** (0.363)	0.198** (0.087)	-0.043 (0.042)
Non ox livestock (TLU)	0.078***(0.020)	0.127 (0.095)	0.098*** (0.021)	-0.037***(0.011)
Distance to district office (hr.)	0.017 (0.027)	0.182* (0.100)	0.028 (0.050)	-0.002 (0.011)
Access to irrigation (1=yes)	0.300** (0.135)	0.525 (0.473)	0.313** (0.132)	-0.156** (0.062)
Mean rainfall of cropping season (mm)	0.005*** (0.001)	-0.008 (0.006)	0.003** (0.001)	-0.001(0.001)
Rainfall variability (std dev.) of cropping season	0.006 (0.004)	-0.013 (0.018)	0.010**(0.004)	-0.003 (0.002)
Constant	7.428***(0.418)	3.140**(1.367)	7.357***(0.377)	0.747***(0.178)
R-squared	0.398	0.130	0.356	0.177
N	960	960	960	960

Dependent variable: An inflation-adjusted welfare variable in log form for continuous variables and the probability of being food secure for landlords. Selection bias in relation to the area rented out was tested with a control function approach using rainfall variability with a two-year lag to the survey periods as an instrument. *: 10%, **: 5%, ***: 1%, refers to the level of significance. The numbers in parentheses are standard errors bootstrapped at households with 400 replications. Source: NMBU and MU panel household survey.

The fixed effect estimation results for tenant households indicate that renting in the land has a statistically strong effect on all welfare models, with the expected sign. On average, an extra unit of renting in land provides tenant households with an extra benefit of crop income of approximately 21.4%. That is expected. Tenant households are wealthier in nonland resources, renting in more extra land, operating efficiently, and generating higher marginal returns. This study also attempts to examine whether renting in land has a crowding-in or crowding-out effect on off-farm activities. The coefficient estimate of Table 6b shows a negative and significant correlation between renting extra units of land and the extent of off-farm income.

Table 6b: Fixed effect estimation results of factors affecting household welfare: Tenant model

	(1)	(2)	(3)	(4)
Explanatory variables	Log of crop income	Log of off-farm income	Log of total income	Probability of being food in secured (1=yes)
Residual from the first stage	-0.198*** (0.029)	0.551*** (0.100)	-0.113*** (0.028)	0.036** (0.014)
Area rented in (ha)	0.214*** (0.030)	-0.586*** (0.105)	0.117*** (0.030)	-0.036** (0.015)
Head's gender (female=1)	-0.019 (0.125)	0.239 (0.417)	-0.028 (0.123)	-0.005 (0.052)
Head's age (years)	-0.008* (0.005)	0.034** (0.017)	-0.001 (0.004)	0.002 (0.002)
Head's education (illiterate=1)	0.064 (0.109)	-0.561 (0.423)	0.047 (0.106)	0.013 (0.045)
Male adult (number)	0.292***(0.054)	-0.549*** (0.194)	0.205*** (0.050)	-0.010 (0.023)
Female adult (number)	0.302*** (0.050)	-0.916*** (0.218)	0.183*** (0.050)	-0.017 (0.024)
Oxen owned (number)	0.422*** (0.085)	-1.530*** (0.342)	0.199** (0.087)	-0.044 (0.043)
Non ox livestock (TLU)	0.081*** (0.020)	0.121 (0.104)	0.099*** (0.021)	-0.037*** (0.010)
Distance to district (hr.)	0.017 (0.027)	0.184* (0.105)	0.028 (0.027)	-0.002 (0.011)
Access to irrigation (1=yes)	0.288** (0.135)	0.579 (0.499)	0.314** (0.138)	-0.157*** (0.060)
Mean rainfall of cropping season (mm)	0.005*** (0.001)	-0.007 (0.006)	0.003** (0.001)	-0.001 (0.001)
Rainfall variability (std dev.) of cropping season (mm)	0.008* (0.004)	-0.016 (0.017)	0.010** (0.005)	-0.003 (0.002)
Constant	7.453*** (0.389)	3.273***(1.232)	7.390*** (0.350)	0.734*** (0.180)
N	960	960	960	960
R-squared	0.406	0.134	0.356	0.177

Dependent variable: Inflation-adjusted welfare variables in log form for continuous variables and probability of being food secure for landlords. Selection bias in relation to the area rented in was tested with a control function approach using rainfall variability with a two-year lag to the survey periods as an instrument. *: 10%, **: 5%, ***: 1%, refers to the level of significance. The numbers in parentheses are standard errors bootstrapped at households with 400 replications. Source: NMBU and MU household panel.

Participating in the land rental market on the tenant side also has a positive and significant effect on total household income (Table 6b, column 3). This implies that for extra hectare of renting in the land, ceteris paribus, the total income of tenant households increased by approximately 11.7% on average. The results of Model 4 of Table 6b also show that for each extra hectare of renting in the land, the probability of a farm household being food insecure decreases by 3.6%, ceteris paribus. Overall, the welfare benefits of participating in the land rental market from the tenant side support all of the findings. However, the benefits are much greater for tenant households than for landlord households, especially for crop income. This might be due to the non-land

endowment effect in which productivity is more likely to be associated with wealthier households (tenants) than with landlords.

5 Conclusions

In the absence of a land sales market in Ethiopia, as is also the case in developing countries, the land rental market can be an alternative avenue for the efficient allocation of land in smallholder agriculture. This study uses three rounds of balanced panel data from 320 households to estimate the factors affecting households' participation decisions in land rental markets and their subsequent impact on a broad range of welfare in rural Tigrai, northern Ethiopia. A correlated random effect Tobit model was used to estimate the factors affecting the extent of land rental market participation on the landlord and tenant sides. A household-level fixed effect model with a control function was used to assess the impact of land rental market participation on welfare outcomes.

The main findings of the study are presented as follows. First, relatively, land- and non-land-rich households were more likely to participate as landlords and tenants, respectively. This supports the allocative efficiency and equity of the land rental market in the study region. Second, the results indicate that both rental market participants seem to benefit from renting land in the share tenancy market. The findings are consistent across the landlord and tenant households, but comparatively greater benefits are channeled to the tenant (total crop income). This is quite pretty. Compared with landlords, tenants are wealthier in nonland resources, which may also attenuate welfare impacts. Furthermore, the findings show a significant reduction in the probability of being food insecure for land rental market participants.

6 Recommendation

From a policy perspective, the results of this study might have several implications.

First, remarkable participation in the land rental market results in positive welfare outcomes. Thus, public interventions that may facilitate rental market development should be sought. This may encompass efforts to illuminate rental rights through securing the tenure of landholders.

Second, strategies that reduce transaction costs, such as information sharing, network development, and contract enforcement, should be encouraged.

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Appendices

Annex Table 1a: Second-stage instrument validity test (rainfall variability during the rainy season with a two-year lag, treated as exogenous, APEs after the Tobit data): Landlord models

Explanatory variables	(1) Log value of crop production	(2) Log of Off-farm income	(3) Log of total income	(4) Probability of being food in secured(1=yes)
Mean rainfall of rainy season (June-September) two years lag(mm)	0.01***(0.00)	-0.01(0.01)	0.01***(0.00)	-0.003***(0.00)
Instrument in first stage estimation: Rainfall variability of rainy season (June_ September) two years lag (mm)	0.00(0.00)	-0.01**(0.01)	-0.01(0.00)	0.00(0.00
Area rented in (ha)	0.14 (0.15)	-0.05(0.51)	0.11(0.14)	0.04(0.08)
Head's gender(female=1)	-0.15(0.12)	0.66*(0.40)	-0.09(0.12)	0.02(0.05)
Heads' age(year)	0.01(0.01)	-0.00(0.02)	0.01(0.00)	0.00(0.00)
Head's education (illiterate=1)	0.09(0.12)	-0.65(0.45)	0.06(0.10)	0.01(0.05)
Male adult (number)	0.11**(0.04)	0.01(0.16)	0.10**(0.04)	0.02(0.02)
Female adult (number)	0.09**(0.05)	-0.30(0.19)	0.01(0.04)	0.02(0.02)
Oxen owned (number)	-0.03(0.06)	-0.30(0.23)	-0.07(0.05)	0.04(0.04)
Non ox Tropical Livestock (TLU)	0.07***(0.02)	0.15(0.10)	0.09***(0.07)	-0.03***(0.01)
Distance to district(hr.)	0.05*(0.03)	0.06(0.09)	0.04*(0.02)	-0.01(0.01)
Access to irrigation (1=yes)	0.24*(0.14)	0.57(0.48)	0.26**(0.13)	-0.14**(0.06)
Rainfall of (June-September) of production year	0.004***(0.002)	0.00(0.01)	0.003*(0.00)	-0.00(0.00)
Rainfall variability (tsd.dev) of (June-September) of production year	0.00(0.01)	-0.03(0.02)	0.00(0.01)	-0.00(0.00)
Constant	4.7***(0.39)	9.44***(1.48)	5.52***(0.34)	1.42**(0.15)
R-squared	0.38	0.12	0.36	0.19
N	960	960	960	960

*: 10%, **: 5%, ***: 1%, refers to the level of significance. The numbers in parentheses are standard errors bootstrapped at households with 400 replications. Source: NMBU and MU panel household survey

Annex Table 1b: Second-stage instrument validity test (rainfall variability in the rainy season with a two-year lag treated as exogenous): Tenant model

Explanatory variables	(1) Log of value of crop production	(2) Log of off-farm income	(3) Log of total income	(4) Probability of being food in secured(1=yes)
Mean rainfall of rainy season (June-September) two years lag(mm)	0.01***(0.00)	-0.01(0.01)	0.01***(0.00)	-0.003***(0.00)
Instrument in first stage estimation: Rainfall variability of rainy season	0.00(0.00)	-0.01(0.01)	-0.00(0.00)	0.00(0.00)

(June_ September) two years lag (mm)				
Area rented in (ha)	0.13*(0.07)	-0.20(0.23)	0.03(0.06)	-0.01(0.03)
Head's gender(female=1)	-0.16(0.13)	0.66(0.40)	-0.11(0.12)	0.02(0.05)
Heads' age(year)	0.01(0.00)	-0.00(0.02)	0.01(0.00)	0.00(0.00)
Head's education (illiterate=1)	0.09(0.10)	-0.65(0.44)	0.06(0.10)	0.01(0.05)
Male adult (number)	0.10**(0.04)	0.01(0.17)	0.10**(0.04)	0.02(0.02)
Female adult (number)	0.09**(0.04)	-0.31*(0.18)	0.06(0.04)	0.02(0.02)
Oxen owned (number)	-0.05(0.06)	-0.26(0.21)	-0.07(0.05)	0.04(0.03)
Non ox Tropical Livestock (TLU)	0.08***(0.02)	0.14(0.09)	0.09***(0.02)	-0.03***(0.01)
Distance to district(hr)	0.05*(0.03)	0.06(0.09)	0.05*(0.03)	-0.01(0.01)
Access to irrigation (1=yes)	0.23*(0.14)	0.59(0.49)	0.26*(0.12)	-0.13**(0.06)
Rainfall of (June September) of production season	0.003**(0.00)	0.00(0.01)	0.003*(0.00)	-0.00(0.00)
Rainfall variability of (June- September) of production season	0.00(0.01)	-0.03(0.02)	0.00(0.01)	-0.00(0.00)
Constant	4.63***(0.40)	9.57***(1.43)	5.51***(0.31)	1.42***(0.16)
R-squared	0.38	0.11	0.30	0.19
N	960	960	960	960

*: 10%, **: 5%, ***: 1%, refers to the level of significance. The numbers in parentheses are standard errors bootstrapped at households with 400 replications. Source: NMBU and MU panel household survey.