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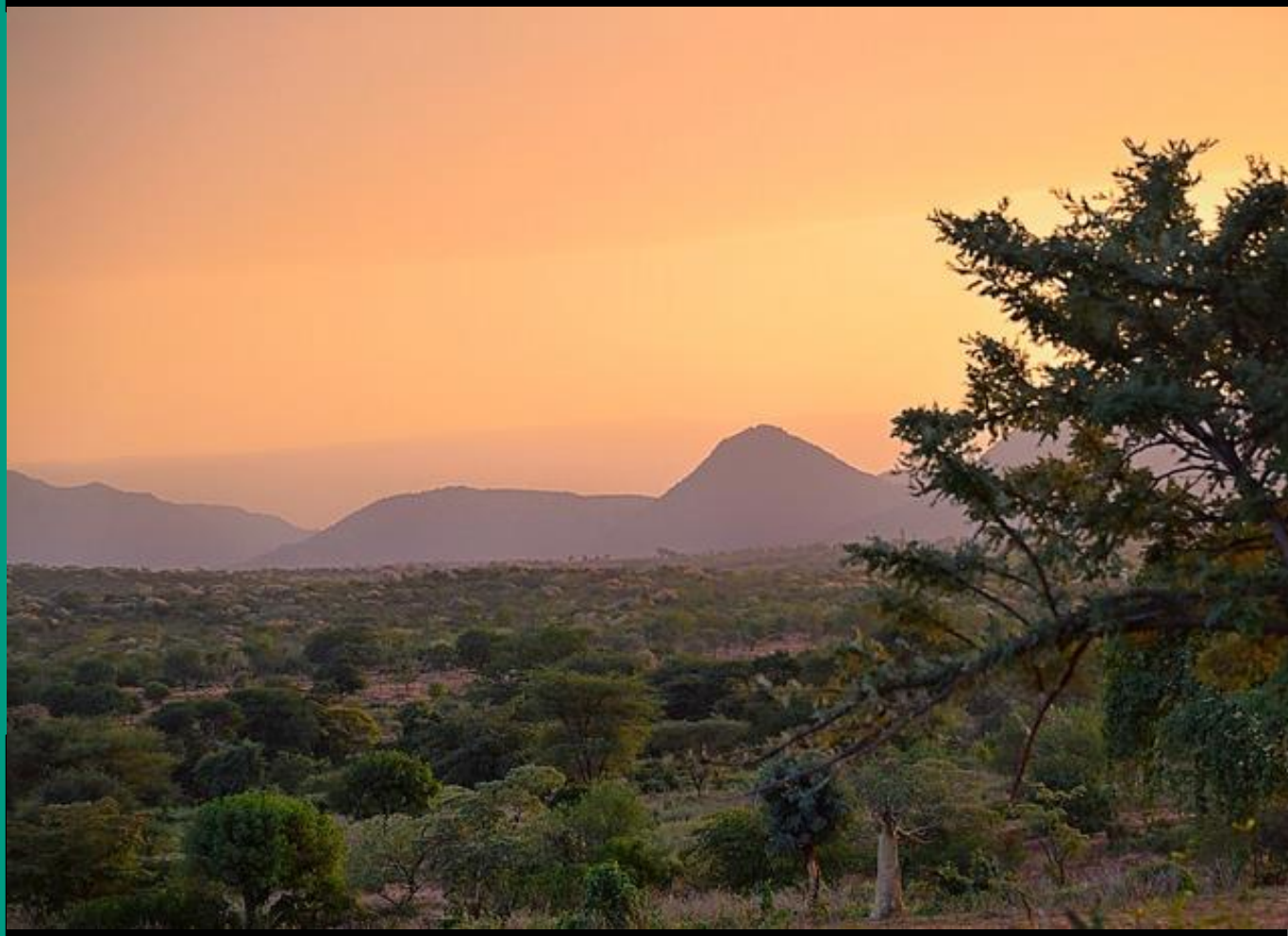

Norwegian University of Life Sciences
Centre for Land Tenure Studies

Centre for Land Tenure Studies Working Paper 10/17

Can the land rental market facilitate smallholder commercialization? Evidence from northern Ethiopia

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Abstract

The paper utilizes household panel data to investigate whether the land rental market can facilitate improved access to land for land-poor tenant households over time and thereby facilitate expansion of their farming activity. The paper utilizes data 8-17 years after land certification to assess the long-term effect of land certification on the allocative efficiency in the land rental market in areas where land certification stimulated land renting in the early years after certification. The paper uses three rounds of balanced panel data collected from 320 smallholder farmers in 2006, 2010 & 2015 from rural Tigrai, northern Ethiopia. Random effects dynamic probit and Tobit models were used to assess factors that may explain access, participation, and intensity of participation on the tenant side of the tenancy market. Tenants' access to land was found to be severely constrained. Previous access and participation had strong positive effect on access and participation and intensity of participation in later periods. Non-convex transaction costs and entry barriers, therefore, appear as severe constraints towards the land rental market facilitating smallholder commercialization through

tenancy access to land. More active land rental market coordination interventions are needed to boost the land rental market as a vehicle for facilitation of smallholder commercialization.

Keywords: Land rental market, tenants' land access, dynamic probit, dynamic tobit, Tigrai, Ethiopia.

JEL codes: Q15.

1. Introduction

In developing countries, land is one of the vital productive livelihood assets of rural societies. The way that land is used, owned and transferred has essential implications for productivity, equity, welfare, market integration, economic diversification and growth (Deininger et al., 2008). The emergence of land rental markets in developing countries, including Ethiopia, has improved access to land for the land-poor and is of considerable interest in its effect on equity, efficiency, and welfare of farm households. In Sub-Saharan Africa, land rental markets are more active than land sale markets within the smallholder production systems (Holden et al. 2008; Jin & Jayne, 2013).

Land rental markets can facilitate the transfer of land from less productive and less efficient to more productive and efficient producers (Holden et al., 2008). The land rental markets where sharecropping dominates, as it does in Ethiopia, may, however, not enhance land use efficiency as much if Marshallian disincentive effects are present and undermine producer incentives. Allocative efficiency in the sharecropping type of land rental market may also be hampered by rationing of tenants, as these markets do not have a price that clears the market (Holden et al. 2008). This may constrain the transition from more subsistence-oriented to more market-oriented agriculture.

This study investigates the extent to which the land rental market in northern Ethiopia can facilitate better land access for land-poor tenant households and thereby make them more able to produce a

surplus for the market. The study uses three waves of balanced panel data and a combination of estimation methods, including dynamic probit and dynamic Tobit models in the analysis.

The land rental market has been stimulated by the low-cost land registration and certification reform that took place in 1998-99 in the Tigrai region (Holden et al., 2009). The reform enhanced the tenure security of landholders and made non-land resource poor (potential) landlord households, especially female-headed households, more willing to rent out their land (Holden et al., 2011). It is therefore in the interest to assess how this enhanced tenure security further has enhanced the land rental market and stimulated rural transformation another five to ten years down the road as the early studies looked at the effects from 1998 to 2006 (Holden et al., 2007; 2009; 2011). In this study, we use 2006 as the baseline and investigate how land access through the land rental market has improved in 2010 and 2015 for the same panel of households.

High risk in production and the dominance of sharecropping in the rental market may affect tenants' access to land as access may depend on trust and kinship arrangements (Holden and Bezabih, 2008; Ghebru and Holden, 2014b; Holden et al., 2016). Land rental market legal restrictions that were introduced from 2006 in the study region state that not more than 50 % of the farm area can be rented out and these restrictions may also contribute to undermining land rental market activity (Holden and Ghebru, 2016). Such restrictions may also constrain land access of potential tenants and prevent them from scaling up their production and market integration in the long run.

The poverty-reduction strategy adopted by Ethiopia seeks to achieve growth and transformation through increasing smallholder's market participation. To facilitate the transformation, the government has been undertaking substantial measures (Sharp et al., 2007). Among the others, the emerging of land rental market since the mid of the 1990s lays a favorable ground for the land size adjustment among farmers. This land use transfers through rental markets enable to create market-oriented

potential farmers and facilitate the transformation process (Teklu and Lemi, 2004). The implementation of formal and legitimate land rental market that aims to change the welfare of the rural society through improving land use efficiency is one of the core agenda of the regional Growth and Transformation Plan (GTP-1) of Tigrai (the study area) (BoFED Tigray 2010). Hence, this study aims to explore how dose the momentum of the land rental market is in a position to create market-oriented tenant farmers in the region?

The remaining parts of the paper are organized as follows. We first develop the share tenancy theoretical framework as a basis for analysis. The data and methods of analysis are reported in the third section. We present and discuss the findings in the results section four and section five provides conclusions and policy implications.

2. Theoretical framework

Early studies of transaction costs and adjustment in the land rental market include Bliss and Stern (1982), Bell and Sussangkarn (1988) and Skoufias (1995). We have developed theoretical models of landlord and tenant behavior in the land rental market where tenure insecurity and transaction costs are taken into account. We build on Holden et al. (2007) who use a transaction cost approach and dynamic probit and dynamic Tobit models to assess the effects of transaction costs in the land rental market in Ethiopia and the more general theoretical framework of Holden et al. (2008). Transaction costs in the land rental market are a function of tenure security that again depends on trust and the current and past land policies. This implies that transaction costs are non-convex in emerging markets where trust-based trade relationship among partners tend to develop gradually (Fafchamps, 2004). Past trade experience as landlord or tenant, therefore, affects current rental market access and degree of participation (Holden et al., 2007). This could be due to trust as well as reputation effects. The spatial and intertemporal nature of the market contributes to this. It implies that we should expect to

find state dependency when analyzing farm household panel data capturing land rental market participation over time.

We are primarily interested in the tenant side of the market in this study but the landlord side is crucial for access to the tenant side. We, therefore, start by briefly outlining the landlord side.

2.1 Landlord renting out decisions

Holden et al. (2007) outlined the landlord model in a land rental market dominated by sharecropping as follows. For simplicity, it is assumed that as a landlord the household maximizes expected income (y) from production on own self-operated land, rental income from rented out land (R) and income from the off-farm activity. The landlord household has a fixed endowment of land ($\overline{A}^L$) and non-land resources ($\overline{N}^L$). The non-land resources may be used in farm production or to generate off-farm income (wN_w). The landlord gets a share $(1-\alpha)$ of the output (q) from rented out land. Production risk may be one of the important reasons for preference for sharecropping contracts and depends on the variability of rainfall during the production year. Risk related to tenure insecurity is also considered. Land and non-land resources are assumed complementary in agricultural production with the standard assumptions for the production functions described as follow (positive first derivatives and negative second order derivatives yielding a strictly concave function);

$$q = q(A,N); q_A > 0; q_N > 0; q_R > 0; q_{AA}, q_{NN}, q_{RR} < 0; q_{AN}, q_{NA}, q_{RN}, q_{NR} > 0 . \quad (1)$$

Where q_A is the marginal product from owner-operated land, q_N refers the marginal product of the non-land resource endowment. The notation q_R refers to marginal product from area rented out in the share tenancy market of which the landlord only gets a share. The notations q_{AA}, q_{NN} and q_{RR} are the second order partial derivatives.

The transaction costs in the land rental market affecting the area rented out and are captured by a transaction cost function, which implicitly captures trust and tenure insecurity, and is a function of past and current land policies, earlier trade experience, landlord and community level characteristics.

It is trivial to show that area rented out will decrease with increasing transaction cost. Holden et al. (2007) show that tenure insecurity due to land policies, like frequent land redistributions or restrictions on land renting, or lack of trust in tenants, reduce willingness to rent out land. On the other hand, previous trade experience with tenants, and policies that enhance tenure security, like land registration and certification, should stimulate land rental activity. How quickly this effect appears depends on the speed of the dissemination of information and the trust in the government. How well the market works after a tenure-security enhancing reform such as land registration and certification depends on the remaining transaction costs in the market.

The inter-temporal and spatial nature of the market implies that there are search and negotiation costs related to finding new partners and monitoring costs for the landlord to ensure that the tenant operates the land according to expectations. The landlord typically also has to participate during harvest to get her /his share of the output. Choice of tenant partner is more critical in sharecropping than with fixed rent contracts as the performance and agricultural skills of the partner have direct effect on the payment in form of output share to the landlord. This contributes to the tendency of rationing of tenants in the market. Trust and reputation as a good farmer are essential for access to land in the market. Landlords may also possess limited information about the skills and reliability of alternative potential tenants. They are more likely to choose those they know, such as close neighbors and relatives. It makes it hard for young potential tenants to enter the market unless they are given priority by some relatives. Contracts with kin are therefore more common in sharecropping contracts than in fixed-rent contracts (Holden et al. 2016). In this paper, we are interested in the access to land

for tenant households as it is these tenants that potentially may scale up their production for the market as smallholder commercial operators. The small average farm size implies that households have to rent in additional land to be able to produce a surplus for the market.

2.2 Tenant rental market access model

Given the dominance of sharecropping in northern Ethiopia (Holden et al., 2007; 2011; Ghebru and Holden, 2014b), we have explained why potential tenants are likely to still be rationed in the land rental market after removal of tenure insecurity through land registration and certification. With the new land rental restriction introduced in the revised regional land proclamation in 2006 stating that maximum 50 % of the land can be rented out, the tenants' access to land could be restricted as especially many female landlords rent out more than 50 % of their land as they typically lack Oxen to cultivate the land themselves (Holden and Ghebru, 2016). Tenure insecurity may thus still play a role in the market after 2006 and may cause landlords to be cautious in their land renting-out decisions. Trust, reputation and earlier experience with tenants may, therefore, be important for their access. Thus, tenant's access to land can be specified by the following equation:

$$\overline{R}_t^T = \sum_L \overline{R}_t^{TL}\left(c_t^{TL}\left[c_0 + c_t^{TL}\left\{\overline{A}_t^T, \overline{N}_t^T, k_t^{LT}, \overline{R}_{t-n}^{TL}, \mathrm{W}_{t-1}, \int_{t-s}^{t} Pdt; z_t^V\right\}\right]\right) \quad (2)$$

The equation states that a tenant's access to land is the sum of access to land from a number of landlord households (*L* superscript) and this itself is a function of the transaction costs (*c*) that consists of a minimum irreducible component (c_0) and a part that depends on the land and non-land resources of the tenant; k_t^{LT} - the number of kin potential landlords the tenant has; $\overline{R}_{t-n}^{TL}$ - earlier participation in

the land rental market[1]; W_{t-1} - lagged climatic conditions; and $\int_{t-s}^{t} Pdt$ - past policies such as registration and certification policies and land rental restrictions. Kinship networks may reduce the transaction costs and reduce the initial entry barrier. It may also allow the tenant to prove himself as a good tenant (reputation effect) and thus give him a higher probability of getting his contract renewed or getting additional contracts from other potential landlords. Climate shocks as captured by the lagged climate (rainfall precipitation) variable may affect access to land in the rental market as landlords may have to rent out more land to meet immediate needs, a form of distress rental coping strategy after such drought shocks (Gebregziabher and Holden, 2011). This may thus enhance tenants' access to land through renting the year after such shocks. Tenants that are wealthier than the landlords are less vulnerable to such shocks than poor landlords. Holden et al., (2011) reported positive effects of first stage land registration and certification that enhanced tenure security of potential (often-female) landlords and their willingness to rent out their land. The spatial nature of the market also implies that access is location-specific and conditional on local community characteristics (z^V) such as overall land scarcity, agro-ecological conditions, and market access.

Based on this theoretical framework, we derive the following hypotheses:

(H_0). *The land rental market operates efficiently and facilitates easy land access for potential tenants.* This is the outcome of the land certification program that has enhanced tenure security. This implies no state dependency on the market and no advantage from earlier participation in the market (insignificant lagged participation variables). This paves the way for smallholder commercialization by tenants motivated to produce for the market to become able to rent in additional land.

[1] This term is split in three, one for the initial survey year (t = 0), one for the previous survey round (t-n) and one for last year (t-1).

(H_1). *There is persistent state dependency in the land rental market causing rationing on the tenant side of the market and selective access.* This is due to the non-convex nature of the transaction costs in spatially limited rental markets dominated by sharecropping, risky production and continued reliance on kinship-based personalized contracts (Holden et al. 2007). This implies that lagged participation variables are significant and low coefficients for non-land resource endowments.

(H_2). *Kinship contracts remain important for tenants to access land in the rental market and particularly for young tenants.* This is assessed by observing whether the share of kinship contracts has changed over the period from 2006 to 2015 and by assessing factors associated with tenants having rental contracts with kin or non-kin and how much of the land accessed is from kin and non-kin partners.

(H_3). *Rainfall shortage and rainfall variability during the rainy season have a lagged positive effect on land access of tenants in the land rental market.* These are indicators of climate shocks that may lead to more distress rental contracts in the following year (Gebregziabher and Holden, 2011). We test the hypothesis by including average rainfall and rainfall variability over four months in the rainy season two years ago to assess whether these variables affected access to land in the land rental market one year ago for the survey year production.

(H_4). *Access to land in the land rental market has continued to improve for tenants after 2006.* This is due to a continued positive effect of the land registration and certification reform (Holden et al. 2011; Holden and Ghebru, 2016).

(H_5).*The expansion of the land rental market has stagnated after 2006*. This may be due to the introduction of the new renting out restriction in 2006, no remaining tenure security effect from the 1998 land registration and certification reform, and the pervasive non-convex transaction costs and

information asymmetries in the market. We assess this by examining the change in the extent of access to land for tenants in the market.

3. Data and descriptive statistics

3.1 The data

The data used in this paper come from a household panel survey conducted in 2006, 2010 and 2015 in rural Tigrai, northern Ethiopia and that expands on the panel analyzed by Holden et al. (2007; 2009; 2011). All households in the sample were rural households with farming as the main source of livelihood (crop and livestock production). The sampling design of the 1998 baseline survey is described in Hagos and Holden (2003, reprinted in 2015). A two-stage stratified random sampling technique was applied. The first stage stratified communities based on the variations in agricultural production potential, access to irrigation, distance to market, and population density. In the second stage, communities were randomly sampled within each stratum and a random sample of households was taken from the sampled communities. The initial survey covered 400 households in 16 communities. While the baseline survey took place in 1998, we used data only from survey rounds in 2006, 2010 and 2015 and the previous period has already been analyzed for land rental market participation (Holden et al., 2007; 2011). Households were re-interviewed in the subsequent survey rounds and we finally used a balanced panel data set of 320 households.

The loss of households may potentially cause attrition bias in the estimation. A probit model was used to assess and control for attrition bias exploiting the baseline data from 1998. The dropped out and remaining households in 2006 were used to construct the dependent dummy variable, see the section on estimation.

The surveys were conducted as a collaboration between Norwegian University of Life Sciences (NMBU), Norway and Mekelle University (MU), Ethiopia. The survey included detailed questions on current and past land rental market participation and the degree of participation. The household and farm plot survey was supplemented by community level information such as access to market, all-weather roads, and rainfall data. The monthly mean rainfall data from the nearest weather stations to the study communities were obtained from the Ethiopian Meteorology Agency (EMA, Mekelle branch).

3.2 Descriptive statistics

The mean and standard errors of variables used in the analysis are presented in Table A1 in the Appendix. Table A1 shows that the percentage of tenant households declined from 28.1 % in 2006 to 17.5 % in 2010 and then in 2015 it increased to 23.4 %. The average area rented in declined from 0.41 ha in 2006 to 0.25 ha in 2010 and increased to 0.27 ha in 2015. We also see that the share of kinship contracts has increased slightly from 2010 to 2015.

3.3. Estimation strategy

A balanced sample of households for the years 2006, 2010 and 2015 was constructed in order to implement the estimation of dynamic Probit and Tobit models. To handle potential attrition bias, a probit model was estimated on the baseline data from 1998 and estimate an Inverse Mills Ratio (IMR). The probit model results are included in Appendix Table A2. It can be seen that several of the variables were significant and attrition was therefore non-random and may potentially lead to bias. To correct for this potential bias, the IMR was included in the dynamic Probit and Tobit models described in more

detail below. The IMR becomes a time-invariant variable in the balanced data set. It was not significant in any of the models[2].

The dynamic probit and dynamic Tobit models (Wooldridge, 2005) are used to assess the dynamics of tenancy market participation and degree of participation by potential tenants and to test the hypotheses in section 2. The dynamic probit model incorporates the initial or base year ($\tau_{i,0}^{TL}$), ($\tau_{i,t-n}^{TL}$), and one survey round lagged land rental market participation dependent variable ($\tau_{i,t-1}^{TL}$), along with other exogenous variables ($Z_{it,}$) with standard random effects as follows (Wooldridge, 2005);

$$P(\tau_{it}^{TL} = 1|\tau_{i,t-n}^{TL}, \tau_{i,t-1}^{TL}, Z_{it,}c_i) = \Phi(\mathrm{Z'}_{it}\beta + \rho_1\tau_{i,t-n}^{TL} + \rho_2\tau_{i,t-1}^{TL} + c_i) \quad (3)$$

τ_{it}^{TL} represents the land rental market participation by tenant dummy variable conditioned on the initial ($\tau_{i,0}^{TL}$) and one survey round (n years between survey rounds) and one year lagged land rental market participation (dependent variables), and the vector of exogenous variables (Z'_{it}) and unobservable household heterogeneity (c_i). The unobservable heterogeneity is additive inside to the standard normal cumulative distribution function (Φ) and is modeled on the initial condition of the dependent variable (τ_{i0}) and the exogenous variables (Z_i) (Wooldridge, 2005):

$$c_i = \alpha_0 + \alpha_1\tau_{i,0}^{TL} + Z_i\alpha_2 + \alpha_i \quad (4)$$

The statistical significance of the ρ coefficients in equation (3) assesses the adjustment friction in the land rental market.

The vector of exogenous variables Z'_{it} includes tenant households' wealth endowments proxied by land ($\overline{A}$) and non-land resources ($\overline{N}$), age, and sex of the head, and the lagged rainfall variables. The

[2] To get corrected standard errors for the IMR we attempted to use bootstrapping, resampling households. This worked only the dynamic Tobit models. The standard errors for IMR in the dynamic Probit model are therefore cluster robust with households as cluster units.

non-land endowments, for example, livestock, oxen and labor endowments may be complementary resources in production and enhance the likelihood that land is rented in. Oxen are used in land cultivation and may be important for the tenants' ability to rent in and cultivate land. These non-land endowments may not be considered as strictly exogenous and we run models without and with these variables. When including them we include their time invariant means as well as deviations from the means. While this is like using the Mundlak-Chamberlain device (Mundlak 1978; Chamberlain 1984), it also allows us to assess the importance of resource endowment levels versus changes in these. As a cautious approach and robustness assessment, we include one of these endowment variables at the time and inspect the effects on the Average Partial Effects (APEs). Moreover, community and year dummies (Z^v) were included among the exogenous variables to control for the variation in the rental process across time and space.

Next, we use dynamic Tobit model to assess the extent of participation as tenants in the land rental market. This model controls for unobservable household effects in a similar way as the dynamic Probit model except that it treats the extent of area rented in with a corner solution approach (Holden et al., 2007). This is because many farmers in the sample do not participate in the land rental market as a tenant, and thus, the areas rented in (current and lagged) are censored at zero. In the dynamic Tobit model area rented in (R_{it}^{TL}) is regressed on lagged areas rented in ($R_{i,t-n}^{TL}$), lagged tenant participation variables and a vector of other exogenous variables (Z'_{it}) as follows:

$$R_{it}^{TL} = \max[0, \beta\, Z'_{it}, g(\tau_{i,t-1}^{TL}, \tau_{i,t-n}^{TL}, R_{i,t-n}^{TL})\rho + c_i + \mu_{it}] \quad (5)$$

$$\mu_{it.} | \tau_{i,t-1}^{TL}, \tau_{i,t-n}^{TL}, R_{i,t-n}^{TL}, R_{i,0}^{TL}, \tau_{i,0}, Z_i, \alpha_i \sim Normal(0, \delta_u^2) \quad (6)$$

For t = 1, 2,…, T time period and i= 1, 2,…, N households in each cross section. R_{it}^{TL} equals zero with positive probability, but is continuously distributed over strictly positive values. The functional

expression $g(.)$ allows the effect of lagged values of the dependent variable to be different depending on whether the previous response was a corner solution or not and if positive, includes the area rented in in the previous survey round. The unobservable household effect is, like in the dynamic Probit, modelled on the initial participation, including area rented in, and the strictly exogenous variables[3]. A balanced panel data is a requirement for the application of the dynamic specification (Wooldridge, 2005).

A large share of the rental contracts are with kin partners. The extent to which tenants have access to land from kin partners may be important for their overall access to rented land but is also endogenous. We approach this tricky simultaneous endogeneity (access to kin and non-kin contracted land) by estimating the dynamic Probit and Tobit models without and with a dummy for having kin partners. The complexity of partner choice is such that it requires a paper on its own and we leave that for future work.

4. Results and discussion

4.1 Tenant participation in the land rental market

The results in form of Average Partial Effects of the dynamic probit models for land rental market participation of tenant households with alternative specifications are presented in Table 1. We use the alternative model specifications to evaluate the robustness of the results to the inclusion of potentially endogenous household endowment variables and having land rental contracts with kin partners, which may improve access in the market.

Table 1 shows that the one year and one survey round lagged dependent variables were significant in all model specifications while the initial year (2001) variable was insignificant. This indicates state dependency in the market. The coefficients show that a household that participated in the land rental

[3] We do not have data for the one year lagged area rented in, only for whether they participated in the land rental market or not.

market in the previous year had a 24 % higher probability of participating in the survey year, *ceteris paribus.* A household that participated as a tenant in the previous survey round (4-5 years earlier) had a 3 % higher likelihood of participating in the following survey round, *ceteris paribus.* These results point in direction of rejecting hypothesis H_0 while hypothesis H_1 cannot be rejected. The year dummy variables provide additional evidence as the dummies for 2010 and 2015 are significant and with negative signs. The probability of accessing land by tenants in the rental market has declined by 4-5 % from 2006 and to the next two survey rounds. This implies that hypothesis H_4 has to be rejected while hypothesis H_5 cannot be rejected.

Model 2 in Table 1 shows that households with kinship contracts had a significantly higher (5.8%)probability of accessing land as tenants in the market, *ceteris paribus,* assuming that the dynamic Probit specification has controlled adequately for endogeneity related household unobservables. We see that the inclusion of the kinship contract dummy reduced the coefficients of the significant lagged dependent and year dummy APEs. Together with the descriptive finding in Table A1 that the share of tenants with kinship contracts remains high, this indicates that we cannot reject the first part of hypothesis H_2.

The two lagged rainfall variables were insignificant in all models and we, therefore, have to reject hypothesis H_3 that rainfall shocks improve the probability of land access for tenants through the land rental market in the following years.

Table 1 here

The robustness assessment specifications (Models 3 and 4 in Table 1) with additional potentially endogenous resource endowment variables, household labor, Oxen and other livestock endowments demonstrated that the key results remained stable. Several of the household characteristics variables, specified as time-invariant means and deviations from means were significant, including the potentially

endogenous household endowment variables. More specifically, a higher mean age of household head is associated with a lower probability of being a tenant while a change in age of the tenant is associated with a higher probability of being a tenant. This may indicate that on average older household heads are less likely to be tenants while for households that have had a change in head of household to a relatively younger head may face a greater difficulty in accessing land and therefore be less likely to be a tenant. This points towards further strengthening of the rejection of the second part of hypothesis H_2. We see that female-headed households are less likely to be tenants than male-headed households while higher labor and oxen endowments are associated with higher probability of accessing land in the rental market as a tenant. An increase in the oxen endowment by one unit is associated with a 2 % higher likelihood of becoming a tenant so the effect is not very strong given the importance of oxen in land cultivation. We will further assess the consistency and robustness of these findings and hypothesis tests by inspecting the results from the dynamic Tobit models in the next section.

4.2. Intensity of land rental market participation

The results of the dynamic Tobit models for area rented in by tenants are presented in Table 2. These models also assess the extent of state dependency and control for unobserved heterogeneity using lagged dependent variables and time-invariant exogenous variables (Wooldridge, 2005).

Our initial hypothesis (H_0) states that the land rental market operates efficiently and facilitates easy land access for potential tenants. To this end, we look at whether the magnitude of the coefficient for own land holding is significantly different from -1 in the tenant model and that there are no signs of state dependency. As we observe from Table 2, the APEs for own land holding are in the range 0.10-0.12, implying that a one ha reduction in own holding is associated with a 10-12% increase in area

rented in and is significantly different from zero (at 1% level of significance). Therefore, the APE is also highly significantly larger than -1 and we can reject hypothesis H_0 with high confidence.

A further inspection of the degree of state dependency can be observed from the APEs for the lagged area rented in variable. We did not have the one year lagged observations for areas rented in and could only include the one survey round and initial year area rented in variables.

Among these lagged variables, only the one year lagged tenant participation variable is significant but it is highly significant and with positive APE in all model specifications, indicating state dependency. The areas rented in are significantly larger for households that were tenants last year (0.60-0.65) ha larger, ignoring the model with the kinship variable for now), *ceteris paribus*. This lends more support to hypothesis (H_1) demonstrating the presence of state dependency and fits the theory on non-convex transaction costs in the land rental market in the study communities.

The positive and statistically significant (at the 1% level) APE for the kinship variable in Model 2 also provides strong evidence supporting hypothesis H_2 that states that kinship contracts remain important for tenants to access land in the rental market. The result demonstrates that those with kinship contracts access about 0.11ha additional land in the market compared to those without kinship contracts, *ceteris paribus.*

Table 2 here

Hypothesis H_3 states that access to additional land through the land rental market is affected by the previous periods' rainfall distribution and rainfall variability. While no such significant effect is found in the dynamic probit model for access to rented land, in Table 2 we find very significant and robust indications that those already in the market as tenants benefit from such lagged rainfall shocks by accessing additional land. A 10 mm lower average monthly rainfall is associated with a 0.03 ha larger area rented in. A one standard deviation increase in monthly rainfall variability is associated with 0.23

ha additional land accessed in the land rental market. Relating these findings to those in Table 1 for the dynamic Probit models indicate that climate shocks create lagged effects in the land rental market but primarily tenants already in the market benefit in terms of improved access to land while those initially rationed out of the market do not. Therefore we cannot reject hypothesis H_3 but acknowledge that rainfall shocks only affect the intensity of land market participation by tenants, not the probability of participation. These results are consistent with the findings of distress rental contracts after rainfall shocks of Gebregziabher and Holden (2011).

Among the other household characteristics, mean age of household head was significantly negatively associated with area rented in, consistent with the findings in Table 1, but a change in the age of household head was not significantly associated with area rented in. Access to one additional Ox is associated with a 0.09 ha larger area rented in which is not much, given the plowing capacity of an Ox.

A look at the year dummy variables to assess changes over time shows that only the year dummy for 2015 is significant. It is highly significant and with a negative sign. This indicates a reduced access to areas for renting in. This reduction is 0.14-0.16 ha in 2015 as compared to 2006. Certainly, it points towards a further rejection of hypothesis H_0.

5. Conclusions and policy implications

Considering the absence of the land sales market in Ethiopia (as in many developing countries), the land rental market can be an alternative avenue for efficient allocation of land in agriculture. Previous research found that land registration and certification had enhanced the land rental market in Ethiopia (Holden et al. 2011; Deininger et al. 2011; Besabih et al. 2015) and one could hope that this also could facilitate smallholder commercialization as progressive tenants could scale up their production by accessing additional land through land renting. On the other hand, pervasive transaction cost in the market due to its spatial and inter-temporal nature in areas exposed to climate risks and uncertainty

may limit the potential of the market even after tenure security has been improved. This is what we have investigated in this paper. We utilize household panel data covering a 15 year period. We use dynamic probit and tobit models to control for unobserved heterogeneity and test for state dependency in the market. We tested a number of hypotheses and assessed the robustness of the findings to alternative model specifications. The key results appeared very robust.

From the policy perspective hoping that the land rental market can be an efficient tool for facilitating smallholder commercialization without further interventions, the findings were disappointing. It appears that the improvements achieved in the period 1998-2006 through land registration and certification that improved tenure security and land rental market performance, have not resulted in further improvement of the market in the period 2006-2015. Rather we see a stagnation and even signs of contraction in the market in the later period. Potential tenants remain severely constrained and rationed in the market. Sharecropping and kinship contracts continue to dominate and this does not facilitate a price mechanism for market clearing. Climate shocks (low seasonal rainfall and high rainfall variability) result in temporal improvements in land access in the following years for tenants already in the rental market but does not facilitate broader access to rented land for potential tenants.

It appears that additional interventions are needed to stimulate smallholder commercialization through the land rental market. Such interventions may include improving market access in general, improving access to irrigation, improving access to improved agricultural technologies, and possibly orchestrated coordination of the land rental market to reduce transaction cost and information asymmetries in the market. This is based on the perception that significant coordination failures still remain in the market which holds potential for improvements in efficiency. We leave this for future research.

Acknowledgments

Data collection has been funded by NORAD through the NOMA and NORHED programs, especially the "Climate-Smart Natural Resource Management and Policy" (CLISNARP) collaborative research and capacity-building program between the School of Economics and Business at Norwegian University of Life Sciences, Mekelle University, Ethiopia, and LUANAR in Malawi.

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Table 1. Dynamic (random effects) probit models of land rental market participation (Average Partial Effects)

Explanatory variables	Model_1	Model_2	Model_3	Model _4
Dummy: tenant the year before the survey year (yes =1)	0.244***	0.208***	0.243***	0.240***
	(0.023)	(0.042)	(0.023)	(0.022)
Dummy: tenant in the previous survey round (yes =1)	0.032 **	0.032*	0.031**	0.029**
	(0.015)	(0.018)	(0.015)	(0.015)
Dummy: tenant in the initial period (year_2001, yes =1)	0.008	0.008	0.004	0.004
	(0.015)	(0.014)	(0.015)	(0.016)
Deviation (gender of household head, female =1)	-0.030	-0.032*	-0.028	-0.027
	(0.020)	(0.019)	(0.020)	(0.020)
Deviation (age of household head in year)	0.002**	0.002**	0.002**	0.002**
	(0.001)	(0.001)	(0.001)	(0.001)
Deviation (landholding in ha)	-0.001	0.001	0.001	-0.002
	(0.016)	(0.013)	(0.016)	(0.015)
Deviation (rental contract is kin related, yes=1)		0.058***		
		(0.018		
Deviation (family labor in number)			0.001	
			(0.006)	
Deviation (Oxen owned in number)				0.019**
				(0.004)
Deviation (Topical Livestock Unit own in TLU)				-0.005
				(0.003)
Monthly mean rainfall (June- September) two years lag (mm)	-0.0004	-0.0005	-0.0004	-0.0005
	(0.0004)	(0.0004)	(0.0004)	(0.0004)
Monthly mean rainfall variability (Std.dev) (June-	0.0002	0.0001	0.0002	0.0003
_September) two year lag (mm)	(0.0004)	(0.0003)	(0.0003)	(0.0004)
Mean (household head's gender)	-0.065***	-0.063***	-0.053**	-0.060**
	(0.024)	(0.024)	(0.024)	(0.025)
Mean (household head's age)	-0.002**	-0.001**	-0.001**	-0.001**
	(0.001)	(0.001)	(0.001)	(0.0001)
Mean (landholding)	0.007	0 .0005	-0.005	0.0004
	(0.014)	(0.012)	(0.014)	(0.015)
Mean (rental contract is kin related)		-0.001		
		(0.022)		
Mean (family labor in number)			0.010**	
			(0.004)	
Mean (Oxen own in number)				0.012
				(0.012)
Mean (Tropical Livestock Unit in TLU)				0.001
				(0.004)
Year_2006 = base year				
Dummy year = 2010	-0.044**	-0.044**	-0.047**	-0.047**
	(0.022)	(0.022)	(0.022)	(0.021)
Dummy year = 2015	-.045**	-0.038**	-0.045**	-0.035*
	(0.018)	(0.018)	(0.019)	(0.020)
Inverse Millis Ratio (IMR)	0.115	0.007	0.085	0.102
	(0.097)	(0.094)	(0.098)	(0.097)
Community Fixed Effects	yes	yes	yes	yes
Wald chi2 (34)	227.74	45.53	217.23	218.15

Prob > chi2	0.0000	0.0000	0.0000	0.0000
Number of Observations	960	960	960	960
Number of Households	320	320	320	320

Source: NMBU and MU household panel survey. *Note* Standard errors in parentheses. Significance levels: ***,** and * indicate 1, 5 and 10 % levels, respectively.

Table 2. Dynamic tobit model for area rented in (Average Partial Effects)

Explanatory variables	Model_1	Model_2	Model_3	Model_4
Dummy: tenant one year before the survey round (yes=1)	0.645*** (0.045)	0.604*** (0.052)	0.643*** (0.045)	0.624*** (0.046)
Dummy: tenant in the previous survey round (yes=1)	0.022 (0.054)	0.027 (0.055)	0.020 (0.055)	0.017 (0.052)
Dummy : Tenant in the initial period (year_2001, yes =1)	0.052 (0.053)	0.048 (0.055)	0.048 (0.053)	0.051 (0.054)
Area rented in (ha), initial period (2001)	0.023 (0.059)	0.023 (0.063)	0.024 (0.061)	-0.014 (0.069)
Area rented in (ha), previous survey round	0.011 (0.027)	0.015 (0 .030)	0.010 (0.031)	0.012 (0.028)
Deviation (gender of household head, female =1)	-0.010 (0.054)	-0.015 (0.049)	-0.011 (0.056)	0.002 (0.053)
Deviation (age of household head in years)	0.0003 (0.002)	0.001 (0.002)	-0.0003 (0.002)	0.001 (0.002)
Deviation (land holding in ha)	-0.110** (0.044)	-0.104** (0.046)	-0.108*** (0.045)	-0.118*** (0.043)
Deviation (rental contract is kin related ,yes=1)		0.113*** (0.038)		
Deviation (family labor in number)			-0.007 (0.015)	
Deviation (Oxen owned in number)				0.093*** (0.027)
Deviation (Tropical Livestock Unit own in TLU)				-0.013 (0.008)
Monthly mean rainfall (June -September) two years lag (mm)	-0.003** (0.001)	-0.003** (0 .001)	-0.003** (0.001)	-0.003** (0.001)
Monthly mean rainfall variability (std.dev) (June-September) two years lag (mm)	0.003*** (0.001)	0.003*** (0.001)	0.003*** (0.001)	0.003*** (0.0001)
Mean(household head's gender)	-0.077 (0.077)	-0.077 (0.077)	-0.055 (0.077)	-0.054 (0.079)
Mean (household head's age)	-0.004** (0.002)	-0.003** (0.002)	-0.003** (0.002)	-0.003** (0.001)
Mean (landholding)	0.032 (0.044)	0.029 (0.043)	0.021 (0.052)	0.029 (0.048)
Mean (rental contract is kin related)		-0.049 (0.068)		
Mean (family labor in number)			0.017 (0.012)	
Mean (Oxen own in number)				0.046 (0.030)
Mean (Tropical Livestock Unit _TLU)				-0.003

				(0.010)
Year_2006 = base year				
Year dummy=2010	0.021	0.024	0.023	0.017
	(0.061)	(0.069)	(0.067)	(0.063)
Year dummy=2015	-0.160***	-0.163***	-0.153***	-0.140**
	(0.045)	(0.045)	(0.046)	(0.055)
Inverse Millis Ratio (IMR)	0.285	0.243	0.227	0.279
	(0.276)	(0.245)	(0.258)	(0.257)
Community Fixed Effects	yes	yes	yes	yes
Wald chi2 (32)	520.74	575.05	508.86	523.87
Prob > chi2	0.0000	0.0000	0.0000	0.0000
Left-censored observations	755	755	755	755
Uncensored observations	205	205	205	205
Number of observations	960	960	960	960
Number of households	320	320	320	320

Source: NMBU and MU panel survey. *Note* Standard errors in parentheses bootstrapping at household level with 400 replication. ***,** and * indicate 1, 5 and 10 % levels of significance, respectively.

Appendix

Table A1. Summary statistics of variables used in the dynamic Probit and Tobit models

	2006 (N=320)	2010 (N=320)	2015 (N=320)
Variable description	Mean	Mean	Mean
Dummy tenant in the initial condition (year_ 2001 = yes =1)	0. 303	0.303	0.303
	(0.025)	(0.025)	(0.025)
Initial condition area rented in (year_2001 in ha)	0.112	0.112	0. 112
	(0.303)	(0.303)	(0. 303)
Dummy tenant in the previous survey round (yes =1)	0.303	0.281	0.175
	(0.025)	(0.025)	(0.021)
Dummy tenant one year lag (yes =1)	0.228	0.165	0.225
	(0.023)	(0.020)	(0.023)
Dummy tenant in the actual survey year (yes =1)	0.281	0.175	0.250
	(0.025)	(0.021)	(0.023)
Previous survey round area rented in (ha)	0.112	0.410	0.252
	(0.016)	(0.047)	(0.036)
Area rented in, actual survey period(ha)	0.410	0.252	0.268
	(0.047)	(0.036)	(0.039)
Rental partner is kin related (yes=1)	0.390	0.375	0.403
	(0.027)	(0.025)	(0.027)
Gender of household head (female=1)	0.284	0.321	0.234
	(0.025)	(0.026)	(0.023)
Age of household head (year)	54.14	55.91	61.4
	(0.785)	(0.766)	(0.769)
Family labor (Count)	2.96	3.06	3.88
	(0.087)	(0.092)	(0.108)
Tropical livestock units (without oxen)(TLU)	1.35	1.58	3.57
	(0.087)	(0.091)	(0.190)
Oxen (count)	0.937	0.993	1.00
	(0.055)	(0.052)	(0.054)
Land holding (ha)	0.952	0.949	0.932
	(0.041)	(0.035)	(0.038)
Monthly mean rainfall (June-September) two years lag (mm)	128.5	120.5	146.7
	(2.40)	(2.14)	(3.20)
Monthly mean rainfall variability (std .dev) (June-September) two years lag (mm)	83.83 (1.84)	42.76 (1.26)	104 (2.42)

Source: NMBU & MU panel survey. Standard errors in parenthesis.

Table A2. Probit estimation of attrition based on the baseline sample of 1998 and dropped out households in 2006 (Dependent variable: Drop out in 2006 =1, otherwise=0)

Explanatory variables	
Gender of Household head (female =1)	0.316*
	(0.179)
Age of household head (year)	0.001
	(0.004)
Family size (count)	-0.059*
	(0.035)
Tropical Livestock Unit (TLU)	0-.042
	(0.050)
Oxen won (count)	0.166*
	(0.087)
Land holding (ha)	0.397***
	(0.108)
Constant	-1.020***
	(0.317)

Source: NMBU & MU panel survey. *Note* Standard errors in parentheses. ***,** and * indicate 1, 5 and 10 % levels of significance, respectively.