

Tenure Insecurity, Gender, Low-cost Land Certification, and Land Rental Market Participation

Stein T. Holden^{a*}, Klaus Deininger^b and Hosaena Ghebru^a

^a Department of Economics and Resource Management, Norwegian University of Life Sciences, P.O. Box 5033, 1432 Ås, Norway.

^b World Bank - MSN 3305, 1818 H St. NW, Washington DC, 20433, USA.

*Corresponding author: Phone: +47 64 96 56 99/ 57 00, Fax: +47 64 94 30 12

E-mail address: stein.holden@umb.no (S.T. Holden)

E-mail addresses of coauthors: kdeininger@worldbank.org; hosaenag@yahoo.com

Stein T. Holden and Hosaena Ghebru are professor and PhD-student in Department of Economics and Resource Management, Norwegian University of Life Sciences. Klaus Deininger is lead economist in the World Bank's Development Economics Research Group. We are grateful for valuable comments on earlier versions of this paper from Katleen Van den Broeck and Christopher Udry and participants in the Nordic Development Economics Conference in Copenhagen in June 2007. We acknowledge funding for data collection from Research Council of Norway, Norwegian Ministry of Foreign Affairs, NORAD and Norwegian Trust Fund and the data collection efforts of Fitsum Hagos and two groups of MSc-students from Norwegian University of Life Sciences. We also acknowledge logistical support from Mekelle University.

Tenure Insecurity, Gender, Low-cost Land Certification and Land Rental Market Participation

Abstract

There is a renewed interest in whether land reforms can contribute to market development and poverty reduction in Africa. This paper assesses effects on the allocative efficiency of the land rental market of the low-cost approach to land registration and certification of restricted property rights that was implemented in Ethiopia from the late 1990s. Four rounds of balanced household panel data collected from 16 villages in northern Ethiopia are used. Land certification initially enhanced land rental market participation of (potential) tenant and landlord households and especially participation of female-headed landlord households.

JEL classification: Q15

Key words: tenure insecurity, land certification, land rental market participation, allocative efficiency, female landlords, unobserved heterogeneity, state dependency

I. Introduction

New Land Reforms are again high on the global development agenda as illustrated by the establishment Commission on Legal Empowerment of the Poor. Another evidence is the large expansion in the number of land reform projects funded by the World Bank; from 3 projects in FY 1990-94 to 19 (US\$0.7 billion) and 25 (US\$1 billion) in the 1995-99 and 2000-2004 periods (World Bank, 2006). Yet the empirical evidence on impacts of land reforms is mixed and there exist very few rigorous studies assessing their impacts. Most studies have focused on investment impacts and among these few have controlled for endogeneity of land rights (Brasselle et al. 2002). Exceptions in Africa include Besley (1995) in Ghana, Carter et al. (1994) and Place and Migot-Adholla (1998) in Kenya, Jacoby and Minten (2007) in

Madagascar, Moor (1998) in Zimbabwe, and Holden et al. (in press) in Ethiopia. There are, however, very few rigorous studies of such impacts on the allocative efficiency of land sales and land rental markets. Place and Migot-Adholla (1998) find no evidence of increased land market activity after land titling in Kenya although one of the objectives of the Swynnerton plan was that titling should lead to transfer of land to more able, energetic and rich farmers, creating a landed and a landless class (Swynnerton, 1954; cited in Place and Migot-Adholla, 1998). Jacoby and Minten (2006) also find no significant effect of titling on land leasing in Madagascar. The main novel contribution of this paper is to provide a rigorous assessment of the impact of the recent low-cost land registration and certification reform in Tigray region in Ethiopia on land rental market activity. It is an important policy issue whether land reforms can contribute to enhance the allocative efficiency and thus enhance the productivity and poverty reduction effects of land rental markets (Otsuka, 2007; de Janvry et al., 2001; Holden et al., 2008). Besley (1995) and Brasselle et al. (2002) identified three main types of effects that could contribute to enhanced investments, land productivity and land market activity related to land reforms. These are the assurance (tenure security), realisability (gains from trade) and collateralisation effects. In Ethiopia we may ignore the collateralisation effect as land sales and mortgaging of land remain illegal while the first two effects may potentially be important given the past tenure policies that created tenure insecurity and suppressed land transfers. About 50% of the households in our baseline survey in 1998 feared to lose land in future expected land redistributions.

Bliss and Stern (1982), Bell and Sussangkarn (1988) and Skoufias (1995) have made important contributions to the analysis of allocative efficiency of land rental markets. Holden et al. (2008) provide new evidence of the emergence of land rental markets in Africa. Several of the case studies from Ethiopia, Kenya, Malawi and Uganda revealed that land rental markets are good for poverty reduction because they enhance access to land for the poor but

also revealed that there are significant transaction costs undermining the potential of these markets given that these transaction costs are reducible. This article provides new insights to this literature by a) developing a theoretical model that puts land rental market development into a dynamic setting where land certification may enhance gender-specific tenure security of potential landlords and therefore make them more willing to rent out land, b) assessing empirically whether low-cost land certification has contributed to improve the allocative efficiency of land rental markets. Earlier studies of allocative efficiency in land rental markets have typically had a static focus and have depended on cross-section data in the empirical analysis making it impossible to control for unobservable household heterogeneity. Access to a unique balanced household panel data set allows us to combine two novel approaches, based on Holden et al. (in press) to control for endogeneity in allocation of certificates, and on Wooldridge (2005) to control for time-invariant household heterogeneity in the probit and tobit market participation panel data models. This is an approach to dynamic, nonlinear, unobserved effects panel data models building on earlier work by Arellano and Carrasco (2003), Honoré (1993), Honoré and Kyriazidou (2000), Blundell and Bond (1998) including lagged dependent and initial condition variables.

The low-cost land registration and certification program provided land certificates to more than 80% of the rural farm households in Tigray within a period of about one year in 1998-99. The costs were low and affordable because only local tools were used in demarcation and measurement of plots. Only staff with very limited training were organising the work, while strong local participation in the implementation was required. Land registries were established at village and district levels in form of handwritten registry books. Certificates were issued in form of a single page with name of the head of household (the husband for married households), and details about the size, location and land quality of farm plots and the names of the neighbours for each plot. Female-headed households (widows, divorced and single

women) also received certificates in their name for land in their possession. Traditionally, women move to the home of the husband upon marriage, the husband is in charge of land management and only men can cultivate with oxen. Female-headed households therefore face problems with own land management and commonly rent out much of their land (Ghebru and Holden, 2008). Their relative weak position makes them more tenure insecure because of their limited ability to till the land (the “land to the tiller”-philosophy) and the demand for land by in-laws and blood-relatives. Their receipt of land certificates is likely to have strengthened their position and ability to rent out land without losing it. We develop a theoretical model which shows that asset poverty enhances and tenure insecurity suppresses female landlord households’ land renting activity, while land certification that strengthens their tenure security should enhance such activity.

A unique household panel data set covering 400 households in 16 communities in Tigray region, where the first round survey was carried out one year (1997-98) before the land registration and certification took place, with three follow-up survey rounds about two, five and eight years after the land reform, was used for the analysis.

The analysis reveals a significant and positive effect of land certification on land rental market participation and degree of participation for female-headed households on the landlord side of the market. On the tenant side of the market land certification increased tenants’ access to land after the reform.

The rest of the paper is organised as follows. An overview of the Ethiopian land policy changes over time is presented in part II, followed by a presentation of the theoretical models in part III. The data and descriptive statistics are presented in part IV, methods in part V, the results and discussion in part VI, followed by conclusions in part VII.

II. The Ethiopian Land Policy: A Brief Review of Recent Land Reforms

The Ethiopian land reform in 1975 made all land state land and eliminated the wealthy rural landlord elite, prohibited land sales and rentals and hiring of labour (Rahmato 1984). Based on the “Land to the tiller”-ideology, communities (Peasant Associations established by the new regime) distributed land to households based on their family size (their need and ability to cultivate), creating an egalitarian land distribution that required follow up redistributions to be maintained and provide land to new households. However, the redistributions also created tenure insecurity which was thought to undermine investment incentives (Alemu, 1999; Holden and Yohannes, 2002; Deininger and Jin, 2006). Households that rented out their land could easily be judged to be unable to operate the land themselves and feared the risk of losing it in the next redistribution.

After a long civil war in northern Ethiopia, the military government was overthrown and a new government formed in 1991. Eritrea was separated out and a more market-friendly policy introduced. Some authority was devolved from the federal to the regional governments. This was also the case for land policies where a new federal land proclamation was introduced in 1995 and followed up by regional land proclamations at different points in time after that allowing for some variation in the land laws across regions as long as these did not violate the federal land law.

A regional land law was passed in our study region, Tigray, in 1997. Land continued to belong to the state, land sales were still prohibited and land redistributions stopped, while households were given perpetual user rights and allowed to make short-duration land rental contracts.

The Tigray region was the first to start a land certification process in 1998-99 and used simple traditional methods in the implementation. More than 80% of the population in the region had received land certificates when the process was interrupted by the war with Eritrea. This was

at the time a unique large-scale low-cost approach that may set a new standard for land reforms which involves much lower costs than the traditional piecemeal high-tech approach that has dominated in most countries until recently (Deininger et al., 2008). The approach gives hopes that also the poor may benefit from land reforms while they most often have been excluded in countries where the high-cost high-tech methods have been used (Besley and Burgess, 2000; Cotula et al., 2004; Deininger, 2003). This is therefore an excellent opportunity to study one of the possible benefits and related poverty implications of this low-cost approach.

Other regions in Ethiopia have already learnt from the Tigray experience and have started to implement similar land registration and certification programs. The Amhara Region started land registration and certification in 2003 with some donor support and used and tested more modern equipment. The Oromia and Southern Regions started more recently (2004) and the process is not yet completed in these three regions. The variation in the methods of the reforms across regions and communities gives excellent opportunities for research that can give useful insights about costs and benefits of alternative low-cost reform designs. The lessons from Ethiopia may also be highly relevant in some other poor countries characterised by high land pressure, tenure insecurity, severe rural poverty and land degradation (Deininger et al., 2008a).

Even though the 1975 land reform in Ethiopia contributed to an egalitarian land distribution, land rental markets are very active and are dominated by sharecropping arrangements (Teklu and Lemi, 2004; Holden and Ghebru, 2006; Bezabih and Holden, 2006; Pender and Fafchamps, 2006; Deininger et al., 2008b; Tadesse et al., 2008). Ghebru and Holden (2008) found the land rental market in Tigray to be characterised by substantial transaction costs and asymmetries due to rationing on the tenant side. Many tenants and potential tenants failed to rent in as much land as they wanted to (Ghebru and Holden, 2008). A large share of the

contracts was among kin and kinship ties appeared to improve access to land in the market (Holden and Ghebru, 2006). Another study in the Amhara region of Ethiopia (Deininger et al. 2008) also found signs of high transaction costs in the land rental market. Similarly, Tikabo et al. (2007) found significant transaction costs in the land rental market in Eritrea.

Important policy concerns are whether the land reform in form of registration and certification has contributed to increased tenure security, especially for the poor, including women. Anecdotal evidence from Tigray (Haile et al., 2005; MUT, 2003) that women think differently about their land certificates than men do as their tenure rights have been less secure than that of men, may imply that the certificates have a higher value to women than they have to men. Furthermore, the cultural rule against women cultivating their land cause single women to depend on assistance from men or renting out or sharecropping out their land. This cultural taboo causes female-headed households in Tigray often to be landlords and among the poorest of the poor (MUT 2003). Having a certificate may thus have strengthened the bargaining power of these female-headed households in the land rental market and this may have a poverty-reduction effect.

MUT (2003) suggested that land certificates may not be important for land rental contracts and found no sign of changes in the land rental markets due to certificates. Their qualitative evidence from tenants indicated that tenants did not care whether the landowner has a certificate or not. What was more important was that they could trust the other party. With trust the certificate is unimportant. They also made the point that high enforcement costs may reduce the value of the certificate as an instrument to enforce contracts through the social court. Our data allow us to make quantitative assessments of whether certificates enhance participation in the land rental market. Trust and enforcement possibilities are clearly important determinants of the transaction costs and have implications for the extent to which land certification can enhance the allocative efficiency of the land rental market.

III. Theoretical models

Early studies of transaction costs and adjustment in the land rental market include Bliss and Stern (1982), Bell and Sussangkarn (1988) and Skoufias (1995) who developed static models for analysis of land rental market participation in the presence of transaction costs. These early studies relied on cross-section data and could not control for unobserved household heterogeneity. We develop theoretical models of landlord and tenant behaviour in the land rental market building on these earlier contributions, taking tenure insecurity into account, and putting them into a dynamic context. 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 may be non-convex in emerging markets where trust-based trade relationships among partners tend to develop gradually (Fafchamps, 2004). Past trade experience as landlord or tenant may therefore matter for current market access and degree of participation (Holden and Ghebru, 2006). This could be due to trust as well as reputation effects. This also implies that we should expect to find state dependency when analysing panel data for such market participation.

Landlord model

Tenure insecurity is captured as an asset loss probability that may reduce future income.

Renting out of land today will increase the probability of losing the rented out land in the future. The probability of losing the land in the future (ξ) depends on gender (g), where

$g = \{1 = \text{female}, 0 = \text{male}\}$. Female-headed households are more tenure insecure than male-

headed households¹, $\xi_g > 0$. Tenure insecurity also depends on whether the household has a

land certificate for the land, \mathbb{C} . The basic idea of the land certification is that $\xi_{\mathbb{C}} < 0, \xi_{\mathbb{C}g} < 0$,

that is; tenure insecurity is reduced for households having a land certificate, and tenure

insecurity is reduced more for those that are initially more tenure insecure, like female-headed households receiving a land certificate.

There is a transaction cost (c) in the land rental market and this transaction cost is non-decreasing in area rented outⁱⁱ. It is lower the more land the household rented out in the previous period since contracts typically are renewed (Fafchamps, 2004; Holden and Ghebru, 2006), therefore; $c = c(R, R_{t-1}), c_R \geq 0, c_{R_{t-1}} < 0$. Established landlords are likely to face lower transaction costs in the land rental market as they have already established trade relationships with tenants. This implies that we assume there are non-convexities in the land rental market and this may hinder market participation for those who are not yet in the market and face entry barriers, and it may also constrain the ability to expand market participation for those inside the market.

Land is rented out through a sharecropping contract assuming that the share of the output that the landlord gets, $(1 - \alpha)$, is fixed and non-negotiable in the short to medium run that the model coversⁱⁱⁱ. For simplicity it is assumed that the returns in the land rental market are linear in area rented out, $q_R = 1, q_{RR} = 0$ (where q is output). For simplicity we also ignore production risk which possibly could be one reason for preference for sharecropping contracts.

Production on own land (q) is a function of owner-operated land area, $(A - R)$, a tradable factor (L), and a non-tradable factor (N). These are assumed to be complements in production. There is a significant difference in the endowment of the non-tradable factor for male- and female-headed households, $N = N(g), N_g < 0$. This is because acquiring farming skills is culturally the responsibility of men and because cultivation of land with oxen only can be done by men, while oxen rental markets are missing, in the setting we are studying. The standard assumptions apply for the functional forms of the value and utility functions. The landlord's optimisation problem is formulated with a Bellman equation:

$$(1) V(A_t) = \underset{R,L}{\text{Max}} U \left[\left\{ \begin{array}{l} pq(A-R, L, N(g)) + p(1-\alpha)q(R) \\ -c(R, R_{t-1}) - wL \end{array} \right\} + \beta V \{ A - \xi(C, g) R \} \right]$$

The Kuhn-Tucker conditions, allowing non-participation in the land rental market are:

$$(2) \begin{array}{l} V_R = U_Y \{ p(1-\alpha) - pq_A - c_R \} - \beta V_{A_{t+1}} \xi \leq 0 \perp R \geq 0 \\ V_L = U_Y \{ pq_L - w \} = 0 \end{array}$$

A simple inspection of the corner solution indicates that non-participation in the land rental market is more likely the lower the share of the output the potential landlord gets, the higher the marginal return under owner-cultivation, the higher the marginal transaction cost, the higher the tenure insecurity of the rented out land, and the higher the discount factor (β). If females have less of non-tradable non-land resources (N)^{iv} they are likely to have lower marginal returns on own land and should be more likely to rent out land. On the other hand, if they are more tenure insecure they are less likely to rent out their land and the consequence may be that they cultivate their land but have lower land productivity like found by Holden and Bezabih (2008) in the Amhara region of Ethiopia.

By comparative statics, assuming that the second order conditions for maximum are satisfied^v, we get the following gender response in area rented out:

$$(3) R_g = H^{-1} \left\{ \begin{array}{l} U_Y pq_{AN} N_g - U_{YY} pq_N N_g (p(1-\alpha) - pq_A - c_R) - \beta (V_{A_{t+1}, A_{t+1}} R - V_{A_{t+1}}) \xi_g U_Y pq_{LL} \\ -(U_Y)^2 p^2 q_{LN} q_{AL} N_g \end{array} \right\}$$

This expression is positive if the endowment effect of gender dominates, that is female-headed households rent out more than male-headed households because they have less non-tradable endowments. On the other hand, it will be negative if the tenure insecurity effect dominates, that is the female-headed households rent out less because they are more tenure insecure.

The effect of receiving a land certificate on area rented out by landlords becomes:

$$(4) R_C = H^{-1} \left\{ \beta (V_{A_{t+1}} - V_{A_{t+1}, A_{t+1}} R) \xi_C U_Y p q_{LL} \right\}$$

The result is unambiguously positive when $\xi_C < 0$. If this tenure security enhancing effect of land certification is particularly strong for female-headed (potential) landlord households, they may have responded more strongly than male-headed households by renting out more land after receiving certificates.

The effect of earlier market participation on area rented out, assuming non-convex transaction costs over time due to build-up of trade experience and knowledge about alternative partners in the land rental market, is as follows:

$$(5) R_{R_{t-1}} = H^{-1} \left((U_Y c_{R, R_{t-1}} + U_{YY} c_{R_{t-1}} (p(1-\alpha) - p q_A - c_R)) U_Y p q_{LL} \right)$$

Earlier market participation has a positive effect on current market participation if

$U_Y c_{R, R_{t-1}} + U_{YY} c_{R_{t-1}} (p(1-\alpha) - p q_A - c_R) < 0$. This requires the first term to dominate the second term and being negative, that is that transaction costs are lower the more land was rented out in the previous period and that the dampening effect due to diminishing marginal return to renting out more land is relatively small. A positive effect of earlier market participation on area rented out is consistent with non-convex transaction costs which may take form of fixed entry costs into the market which may be lower for those already inside the market (Fafchamps, 2004). It is furthermore easy to show that households with a higher discount factor (lower discount rate) will rent out less land when there is tenure insecurity because they value the future more.

Tenant model

Potential tenants are land-constrained households that have complementary non-land assets that they can increase the returns to by renting in additional land. Sharecropping and tenure insecurity are likely to lead to rationing in the tenancy market (Otsuka, 2007). Therefore, as a

recursive outcome of the landlord model, we simply derive a reduced form model where their access to land in the land rental market is a function of their observable and unobservable characteristics, their earlier market participation, and the time since land certification to capture the possible effect of the land reform. If the land reform enhances the tenure security of potential landlords and they therefore rent out more land, this should also increase the probability of potential tenants being able to rent in land and also increase the area tenants can rent in after the reform. The simple model is:

$$(6) R^T = R(R^T_{t-1}, \tau_c, N(g))$$

Where R^T is area rented in by the tenant during the current period, R^T_{t-1} is area rented in during the previous period, τ_c is years since land certification, N is the amount of observable and unobservable endowments that depend on gender of household head (g). Testable assumptions:

$$R^T_{Rt-1} > 0, R^T_{\tau_c} > 0, R^T_N > 0.$$

Tenants face transaction costs in the land rental market and access to the market may depend on earlier participation. With entry barriers leading to non-convex transaction costs, earlier market participation and earlier degree of participation may affect access to land in the land rental market. The non-land resources of tenants that are observable by landlords have a positive effect on contract renewal as these resources should enhance the productivity of tenants and thus the rental income of landlords because sharecropping contracts are the dominant contract type.

Hypotheses

The reduced form models for empirical testing highlight that policy effects tend to be dynamic and may depend on past and initial conditions before the land reform was introduced. The following hypotheses are tested:

H1. Female-headed households are more likely to rent out land and rent out more land than male-headed households (due to their poverty in non-tradable non-land resources) vs.

H2. Female-headed households rent out less land than male-headed households because they are more tenure insecure.

H3. Landlords that received certificates rent out more land after the reform (due to increased tenure security).

H4. Female landlords that received land certificates rent out more land as a response to getting land certificates compared to male landlords that received land certificates (because they initially were more tenure insecure and land certificates increased their tenure security relatively more).

H5. Land rental market participation has increased after the land registration and certification (because land certificates have increased the feeling of tenure security among landlords, making them more willing to rent out their land).

H5a. Access to land in the land rental market has improved for tenants after the reform (follows if landlords have become more willing to rent out).

H6. There is state dependence in the land rental market such that lagged market participation has a positive effect on later market participation. This may be explained by the non-convex nature of the transaction costs (households that have not been in the market before face entry barriers) (Fafchamps, 2004).

We come back to how we test these hypotheses in part IV below.

IV. Data and Descriptive Statistics

Data

A unique household panel data set from Tigray in northern Ethiopia consisting of 400 households in 16 different communities was used for the analysis. These communities are a sub-sample of communities included in an IFPRI community and household survey and cover

the main variation in agro-climate, market access and population densities in the highlands in the region. The households have been surveyed four times, covering the years 1997/98, 2000/01, 2002/03 and 2005/06 while land certification was implemented in all communities in 1998/99.

Descriptive Analysis

Table 1 shows that the percentage of households renting out land increased from 23.6% in 1997 to 27.2% in 2000 and to 26.2 and 28.9% in 2003 and 2006. The percentage of households that rented in land (tent) increased from 7.9% in 1997 to 30.8% in 2000 and then down to 27.5 and 26.6% in 2003 and 2006. The mean area leased in increased from 0.15 tsimdi^{vi} in 1997 to 0.77 tsimdi in 2000 and then down to 0.69 and 0.52 tsimdi in 2003 and 2006. Average area leased out increased from 0.52 tsimdi in 1997 to 0.73 tsimdi in 2000, 0.80 in 2003 and down to 0.74 tsimdi in 2006.

The percentage of the households with certificate increased from 0 in 1997 to 95.1% in 2000 and to 89.2% in 2003 and declined to 88.8% in 2006. The reason for the reduction may be that some households have lost their certificate or due to inheritance (change in head of household) that also may have involved a subdivision of the land holding without receiving new certificate. The share of households that are female-headed increased from 12.8% in 1997 to 30.5% in 2006.

Table 2 characterises the households that either participated in the land market as landlords or tenants or did not participate in the land market and whether their characteristics have changed over time. Landlord households were significantly poorer in oxen, other livestock, male labour and female labour than tenants and households not participating in the land rental market, while they were not poorer in terms of land endowment. Similarly tenant households were richer than non-participating households in oxen, other livestock and male labour endowment but not in female labour endowment while their land endowment was slightly

higher. This pattern remained fairly stable over the years the data covered. Oxen are crucial for land cultivation and a pair of oxen is needed for that. Households with one ox may pair their ox with another household also having one ox. Households without oxen typically face a severe difficulty in accessing oxen for land cultivation as the market for oxen renting is almost non-existent.

V. Methods

Econometric approach

Test for attrition bias. The requirement that all households need to be included in all years (balanced panel) reduced the sample size to 303 households. There is a chance that this leads to attrition bias in the analysis. A high attrition rate was due to collective non-cooperation in one of the 16 communities. Attrition rates were also higher in more remote communities. The attrition models are available from authors upon request. Village dummy variables were found to be the best instruments for prediction of attrition as very few of the 1997/98 household characteristics variables appeared to have any effect. Attrition bias was tested and corrected for using Deaton's approach of including a polynomial form of the predicted probability of households being in the balanced household sample from the attrition model (Deaton, 1997, p.105). Due to multicollinearity only the third polynomial was retained in the final regressions after having removed the first and second polynomials due to their higher variance inflation numbers. While a significant attrition bias was found with some specifications of models, the final models included here show no significant attrition bias and the conclusions were not sensitive to the inclusion of correction for attrition bias.

Identification strategy. We cannot rule out that allocation of land certificates partly could be determined by endogenous factors like observable and unobservable household

characteristics. It was not possible to find good instruments for identification that satisfy the requirements of being exogenous, correlated with allocation of certificates and uncorrelated with the outcome variables, participation and degree of participation in the land rental market. A novel approach proposed and tested by Holden et al. (in press) and found to give more robust results than alternative approaches, is used. Instead of looking for exogenous instruments an opposite strategy is used where household fixed effects are used on the panel data in the instrumentation equation to clean out all possible observable and unobservable time-invariant determinants of allocation of certificates, and using the residual for the testing of the impact of random certification. A linear probability model is used for the instrumentation equation and to create the predicted certificate and residual variables. A large positive residual implies that the household has a certificate but is predicted not to have one, and a large negative residual implies that the household does not have a certificate but was predicted with a high probability to have one. While the random certification residual variable was included to test for the effect of random certification, models with and without the predicted certificate variable were run in combination with the Wooldridge (2005) approach described below to control for unobserved household heterogeneity in the random effects panel probit and tobit models. Inclusion of the predicted certificate variable from the linear probability model with household fixed effects may be seen as an additional control for unobserved household heterogeneity in the renting out models. Bootstrapping, by re-sampling households was used to obtain corrected standard errors.

Dynamic panel data modelling approach. An approach to dynamic probit and tobit models suggested by Wooldridge (2005) has been used. The dynamic panel data models with binary and censored response variables included controls for unobserved time-invariant heterogeneity. The probit form was used for the binary land rental market participation

models and incorporated a lagged dependent variable along with strictly exogenous variables with standard random effects, following Wooldridge (2005).

The dynamic probit model is specified as follows;

$$(12) \quad P(y_{it} = 1 | y_{i,t-1}, \dots, y_{i0}, z_i, c_i) = \Phi(z_{it}\gamma + \rho y_{i,t-1} + c_i)$$

where y is the dependent variable conditioned on the lagged dependent variables, exogenous variables (z_i) and unobserved household heterogeneity (c_i). The unobserved heterogeneity is assumed to be additive inside the standard normal distribution function (Φ) (ibid.). The model allows us to test for state dependence. Previous participation in the land rental market may matter for current participation. This is modelled as an AR1 process. This is considered acceptable when there are three years between each year observed.

The unobserved heterogeneous effect is modelled as (Wooldridge, 2005)

$$(13) \quad c_i = \alpha_0 + \alpha_1 y_{i0} + z_i \alpha_2 + \alpha_i$$

on the initial condition and exogenous variables to get a likelihood function that does not depend on the unobserved individual effects. This allows deriving the likelihood function by integrating over the distribution of α_i and we get the same structure as the standard random effects probit model except that the explanatory variables at time period t are

$$x_{it} = \{1, z_{it}, y_{i,t-1}, y_{i0}, z_i\}$$

It is possible to include interactions between y_{i0} and z_i provided the model is linear in parameters.

The dynamic Tobit model with unobserved effects is specified as follows (Wooldridge 2005);

$$(14) \quad \begin{aligned} y_{it} &= \max\left[0, z_{it}\gamma + g(y_{i,t-1})\rho + c_i + u_{it}\right] \\ u_{it} | y_{i,t-1}, \dots, y_{i0}, z_i, c_i &\sim \text{Normal}(0, \sigma_u^2) \end{aligned}$$

for $t=1,2,\dots, T$ time periods and $i=1,2,\dots,N$ households in the cross-section. The $g(\cdot)$ function is formulated to allow the effect of lagged y to be different depending on whether it was a

corner solution or not^{vii}. Wooldridge (ibid.) has shown how to obtain root- N -consistent estimates of the parameters. The model may be used to obtain average partial effects.

The dynamic corner solution model controlling for time-invariant unobserved heterogeneous effects for land rented in or rented out can therefore be modelled as a random effects tobit model where the explanatory variables at time t are $x_{it} = \{z_{it}, g_{i,t-1}, r_{i0}, z_i\}$, where $g_{i,t-1} = g(y_{i,t-1})$ and $r_{i0} = r(y_{i0})$ ^{viii}. The latent variable model may be written as

$$(15) \quad y_{it}^* = z_{it}\gamma + g_{i,t-1}\rho + c_i + u_{it} = z_{it}\gamma + g_{i,t-1}\rho + \alpha_0 + r_{i0}\alpha_1 + z_i\alpha_2 + u_{it}$$

after plugging in for c_i . The likelihood function and consistent estimator are derived similarly to as for the probit model. The consistent estimator of the expected value is

$$(16) \quad \hat{y}_{it} = N^{-1} \sum_{i=1}^N m\left(w_t \hat{\beta} + \hat{\alpha}_0 + r_{i0} \hat{\alpha}_1 + z_i \hat{\alpha}_2, \hat{\sigma}_a^2 + \hat{\sigma}_u^2\right)$$

where $E(y_{it} | w_t = w_{it}, c = c_i) = m(w_t \beta + c, \sigma_u^2)$ and $w_t = (z_t, g_{t-1})$.

The analysis requires balanced panel data. Unbalanced panel data would require estimation of a different conditional distribution of c_i for each configuration of the missing data that may be feasible for balanced sub-panels when there is no selection bias. The balanced panel data requirement caused us to lose almost 25% of the initial households and this may lead to attrition bias unless there is independence between the selection of the balanced observations and the process determining the outcomes.

Variable inclusion. Dependent variables in the analyses of land rental market participation are dummy variables for participation in the land rental market as landlords or tenants and land area rented out or rented in. Lagged dependent variables and initial year participation were included to test for state dependence and to correct for time-invariant unobserved heterogeneity, based on the new approach proposed by Wooldridge (2005) and described above. Variable names and descriptions are presented in Table 1.

An interaction variable between the sex of household head and the random certificate residual variable was created and included in the renting out models to test for the gender impacts of land certification. The “years since certification” variable was used to test for the effect of certification on tenants’ access to land in the land rental market. Tenant’s possession of certificates was not considered important for such access. The own farm size variable was included to test for allocative efficiency in the land rental market. The variable is considered to be exogenous to households as selling of land is prohibited. Other household endowment variables were not included for the same reason, but the key results of the paper were not significantly affected by their inclusion.

Testing of hypotheses. Hypotheses H1 vs. H2 are tested by assessing the sign of the sex of household head variable in the landlord and area rented out models. A positive sign indicates that the endowment effect (H1) dominates and a negative sign indicates that the tenure insecurity effect dominates (H2).

Hypothesis H3 is tested with the random certificate residual variable and hypothesis H4 is tested with the interaction variable between sex of household head and the random certificate residual variable in the landlord and area rented out models. The test of H4 is also implicitly a test of H2 which may be true even if the endowment effect (H1) dominates over the tenure insecurity effect.

Hypothesis H5 and sub-hypothesis H5a are tested by assessing whether the linear trend variable (years since certification is positive and significant in the landlord, area rented out, tenant and area rented in models.

Hypothesis H6 is tested with the lagged dependent participation and degree of participation variables. Positive and significant parameters for the lagged dependent variables together with a low response to the own land variables are interpreted as a sign of state dependency and non-convex transaction costs. This implies that those who are already in the market adjust more easily because they face lower marginal transaction costs.

VI. Results and Discussion

Land Reform and Participation in the Land Rental Market

The results of the land rental market participation probit models are presented in Table 3. In the landlord models without (Landlord 1) and with (Landlord 2) the predicted certificate variable, the lagged market participation variable is highly significant and positive indicating the presence of state dependence, in line with hypothesis H6. Earlier market participation as landlords is strongly correlated with being a landlord in later periods after we have controlled for unobserved time-invariant household heterogeneity (with the initial market participation variable (in both models) and the predicted certificate variable (in the Landlord 2 model)).

The sex of household head variable was highly significant (at 0.1% levels) in both models and with a positive sign, supporting hypothesis H1, indicating that the endowment effect strongly dominates the tenure insecurity effect. The random certificate residual variable was insignificant in both models but the interaction variable between the random certificate residual and sex of household head was significant at 10% level in both models and with a positive sign. Hypotheses 4 and 2 cannot therefore be rejected. Households with larger land endowment were significantly (at 5% level) more likely to rent out their land but the coefficient was close to zero and indicating high transaction costs in the market. Together

with the lagged participation variable this indicates that there are initial entry costs for households that have not participated in the market before.

The tenant probit model in Table 3 also has the lagged participation dummy variable as highly significant (0.1% level) and with a positive sign demonstrating again the state dependence in the land rental market (hypothesis H6) while the own farm size variable was insignificant. Households that have established themselves as tenants are more likely to continue as tenants. This holds true after we have controlled for unobserved time-invariant heterogeneity with the initial condition variable. The years since certification variable was significant (at 5% level) and with a positive sign indicating that access to land for potential tenants has improved after land certification.

Land Reform and Degree of Participation in the Land Rental Market

The results of the household random effects tobit panel data models are presented in Tables 4 for the area rented out models and in Table 5 for the area rented in models.

(i) *Area rented out models.* In order to test all our hypotheses and assess the robustness of the findings with respect to possible endogeneity of certificate, we specified four alternative models without and with the random certificate residual and sex of household head interaction variable and without and with the predicted certificate variable as an additional control for unobserved household heterogeneity. An additional robustness test was implemented by using two alternative form of the lagged dependent variable, $g(y_{i,t-1})$, and the initial condition, $r_{i0}(y_{i0})$, but only the specification with both the initial period landlord dummy as well as the initial period area rented out is presented. The major conclusions remained the same with all specifications lending confidence to the key findings.

Hypothesis H1 is strongly supported by all models as the sex of household head variable is highly significant (at 0.1% levels) and with a positive sign meaning that female-headed

households rent out significantly more land than male-headed households. Controlling for unobserved household heterogeneity by inclusion of the predicted certificate variable in addition to doing so by inclusion of the initial areas rented out and initial period landlord dummy variables did not change this.

The random certification residual variable was insignificant in all models while the interaction variable between the random certificate residual and sex of household head was significant (at 5% level) in the two models where it was included. It had a positive sign indicating that female-headed landlord household that received land certificates increased the area they rented out due to the certification. The random certification residual variable changed sign from positive to negative (although insignificant) when the interaction variable was included, indicating that landlord households in general, and male landlord households especially did not rent out more land after receiving land certificates. This result implies that hypotheses H4 and H2 cannot be rejected while hypothesis H3 is partly rejected. Land certification has made female landlord households more willing to rent out their land, probably because they have become more tenure secure. This finding is also supported by perception data collected from the households in the last survey round in 2006.

The farm size variable was also highly significant (1% level in three of the models and at 0.1% level in one specification) but with a low parameter value in the range 0.16-0.17, a sign of significant transaction costs and limited adjustment. This finding is consistent with the finding of highly significant (0.1% level) state dependency for the lagged landlord dummy variable and the significant (5% level) lagged area rented out variable, both having positive signs. These findings are consistent with potential landlords facing high initial transaction costs (entry barrier) in the land rental market. This implies that it is easier to adjust and stay in the market when you are already inside. The low adjustment coefficient for own farm size is consistent with recent studies in Ethiopia and other African countries (Holden et al. 2008).

(ii) *Area rented in models.* The random effects tobit models for land area rented in are presented in Table 5. The two models have alternative specifications for the lagged dependent and initial condition variables as a robustness check of the results. The lagged dependent variable was significant (1% level) and with positive sign in the Area rented in 1 model, but this variable became insignificant when the lagged dummy variable for market participation was included. This lagged dummy variable became significant at 0.1% level and confirms the state dependence in line with the state dependence hypothesis (H6) that also implies that the land rental market is characterised by allocative inefficiency and entry barriers. This can also be seen by the parameter on the farm size variable being insignificant and close to zero.

The years since certification variable was highly significant (0.1% level) and with a positive sign in both models, consistent with the finding in Table 3, giving strong support for hypotheses H5 and H5a that access to land in the land rental market has improved for potential tenants after land registration and certification. However, access is better for those already in the market which may partly be explained by them being able to renew their contracts with the same landlord partners. Earlier market participation appeared important for access to land through the land rental market, in line with the findings for other emerging markets in Africa where trust and reputation play important roles (Fafchamps, 2004).

Female-headed households rented in significantly less land consistent with the finding in Table 3 showing that these households are much more likely to be landlords than tenants relative to male-headed households, consistent with them being relatively poorer in non-land endowments (see Table 2).

The Findings in a Wider Perspective

Studies of the impacts of land titling in Kenya (Place and Migot-Adholla, 1998) and Madagascar (Jacoby and Minten, 2006) found no effects on land sales and land rental markets. It may then appear strange that provision of weaker property rights in Ethiopia has given such significant positive effects on land rental market activity as demonstrated in this paper and on investments and land productivity as demonstrated by Holden et al. (in press). We think important explanations are: First, the collateralisation effect is not important in any of the African studies eliminating one important reason while land titling potentially could have had a stronger effect on land markets than the provision of the more restricted rights in the case of Ethiopia. Second, the initial conditions with even more restricted and insecure land rights in Ethiopia created a local demand for certificates which also has been demonstrated by Deininger et al. (2008a) in a national survey. Third, there was strong local participation in the land registration and certification process which helped to sort out eventual disputes, clarify farm plot borders and ownership (Holden et al. 2008b). This is also due to the established local institutional structures in form of Peasant Association since the 1975 land reform, social courts and local conflict mediators for conflict resolution, and committees for land distribution that had experience with measurement and distribution of land to households. Fourth, the low cost and wide coverage within a short period of time prevented elite capture and ensured that the reform was not biased against the poor (Holden and Tefera 2008). The reform was also not a threat to the local elite and was in most cases implemented through a transparent process where neighbours walked the fields together and agreed on the demarcation of plot borders and ownership.

Contrary to this the reform in Madagascar was implemented in a setting where there was little perceived danger of expropriation by squatting tenants (Jacoby and Minten, 2006; 2007). In their study in Kenya, Place and Migot-Adholla (1998) found that the indigenous tenure systems accommodated the development of land markets and that the addition of land titles

had no significant effect on land markets. They found low activity in the land rental markets and land sales had not increased following the land titling reform. Land titles appeared not to have provided full transfer rights as approvals by the family, the community and District Land Control Boards are still required (Platteau 1995). Given the high costs of obtaining land titles in both Madagascar and Kenya much land remained without titles because titles were provided based on individual demand unlike in Ethiopia where registration and certification was implemented through a low-cost concerted action. Furthermore, the studies in Madagascar and Kenya found no significant investment effects from land titling but it would be premature on the basis of a few studies to conclude that interventions to strengthen land rights in Africa does not work (Besley, 1995). Several studies elsewhere in Africa, like Besley (1995) in Ghana and Hayes et al. (1997) in the Gambia, find that stronger land rights lead to more investment. One of the reasons for lack of significant impacts of land titling programs may therefore be that they have failed to strengthen tenure security and may even have had the opposite effect in many cases (Cotula et al., 2004; Jacoby and Minten, 2007; Benjaminsen et al., 2008).

7. Conclusion

The analysis of the panel data from Tigray has demonstrated a significant and positive effect of the low-cost land certification that took place in the late 1990s on the amount of activity in the land rental market. The reform appears to have reduced transaction costs in the land rental market by making poor female (potential) landlord households more willing to rent out their land. It has therefore also become easier for (potential) tenants to access land for renting in. It appears that the security (assurance) and gains from trade (realisability) effects are interlinked because security enhances the gains from trade effects as demonstrated with a simple theoretical model. Unlike the model of Besley (1995), the main effect is by land being

reallocated to more efficient producers rather than leading to a higher rental price of land. In the absence of a rental price due to the predominance of sharecropping as the major contract form and where the share is “sticky”, the main gain from rental trade is in the productivity differential between owner-operation and tenant operation of the land.

The analyses demonstrate that transaction costs in the land rental market remain high and there should be scope for further reducing them by facilitating land rental transactions at the local level. However, care should be exercised when reforming land rental markets to ensure that the benefits from the reforms are higher than the costs. A system for voluntary registration of land rental contracts may be better than the system with compulsory registration of all land rental contracts that is now attempted imposed by law in Ethiopia.

Another important contribution of this paper was to apply a new approach to generate a random policy variable for unbiased impact assessment in a situation where endogeneity is a potential problem and no good instruments for identification are available. This approach deserves wider application and may reduce the need for randomised experiments to tease out impacts of policy reforms particularly in limited dependent panel data models.

References

- Alemu, T. (1999) Land tenure and soil conservation: Evidence from Ethiopia. Unpublished PhD-dissertation, Göteborg University, Göteborg.
- Arellano, M. and Carrasco, R. (2003) Binary choice panel data models with predetermined variables. *Journal of Econometrics* 115, pp. 125-157.
- Bell, C, and Sussangkarn C. (1988) Rationing and Adjustment in the Market for Tenancies: The Behavior of Landowning Households in Thanjavur District. *American Journal of Agricultural Economics* 70(4), pp. 779-789.

- Bezabih M., and Holden S.T. (2006) Tenure Insecurity, Transaction Costs in the Land Lease Market and their Implications for Gendered Productivity Differentials. Invited paper presented at The 26th International Conference of the International Association of Agricultural Economists Brisbane, Australia.
- Besley, T. (1995) Property Rights and Investment Incentives: Theory and Evidence from Ghana. *Journal of Political Economy* 103(5), pp. 903-37.
- Besley, T. and Burgess, R. (2000) Land Reform, Poverty Reduction, and Growth: Evidence from India. *The Quarterly Journal of Economics* 115(2), pp. 389-430.
- Bliss, C.J. and Stern, N.H. (1982) *Palanpur: The Economy of an Indian Village* (Delhi and New York: Oxford University Press).
- Blundell, R.W. and Bond, S. (1998) Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics* 87, pp. 115-143.
- Brasselle, A. S., Gaspart, F. and Platteau, J.-P. (2002) Land tenure security and investment incentives: puzzling evidence from Burkina Fasso. *Journal of Development Economics* 67, pp. 373-418.
- Carter, M., K. D. Weibe, and B. Blarel (1994) Tenure Security for Whom? Differential Effects of Land Policy in Kenya, in: J.W. Bruce, and Migot-Adholla. *Searching for Tenure Insecurity in Africa*, (Dubuque, Iowa, Kendall/Hunt), pp. 141-168.
- Cotula L., Toulmin C., and Hesse C. (2004) Land Tenure and Administration in Africa: Lessons of Experience and Emerging Issues. International Institute for Environment and Development, London.
- Deininger K. *Land Policies for Growth and Poverty Reduction* (Washington, DC; The World Bank).
- Deininger, K., Ali, D.A., Alemu, T. (2008b). Adjustment Through the Land Rental Market: Transaction Costs and Tenure Insecurity in Rural Ethiopia, in: Holden ST, Otsuka K,

- Place F (eds), *The Emergence of Land Markets in Africa: Assessing the Impacts on Poverty, Equity and Efficiency*, (Washington, D.C.: Resources For the Future Press), pp. 55-73.
- Deininger, K., Ali, D.A., Holden, S.T., and Zevenbergen, J. (2008). Rural land certification in Ethiopia: Process, initial impact, and implications for other African countries. *World Development* 36(10), pp.1786-1812.
- de Janvry, A., Gordillo, G., Platteau, J.P., and Sadoulet, E. (2001). *Access to Land, Rural Poverty, and Public Action* (Oxford: Oxford University Press).
- Fafchamps, M. (2004). *Market Institutions in Sub-Saharan Africa* (Cambridge, Massachusettes, London; The MIT Press).
- Finan, F., Sadoulet, E., de Janvry, A. (2005). Measuring the poverty reduction potential of land in rural Mexico. *Journal of Development Economics* 77(1), pp. 27-55.
- Ghebru, H. and Holden, S.T. Factor Market Imperfections and Rural Land Rental Markets in Northern Ethiopian Highlands, in: Holden, S.T., Otsuka, K., Place, F. (eds), *The Emergence of Land Markets in Africa: Assessing the Impacts on Poverty, Equity and Efficiency*, (Washington, D.C.: Resources For the Future Press), pp. 74-92
- Haile M, Witten W, Abraha K, Fissaha S, Kebede A, Kassa G, Redda G. (2005). Land Registration in Tigray, Northern Ethiopia. Research Report 2. Mekelle, University, Mekelle, Tigray.
- Hayes, J., Roth, M., and Zepeda, L. (1997) Tenure Security, Investment and Productivity in Gambian Agriculture: A Generalized Probit Analysis. *American Journal of Agricultural Economics* 79, pp. 369-382.
- Holden, S.T., and Bezabih, M. (2008) Gender and Land Productivity on Rented Out Land: Evidence from Ethiopia, in: Holden ST, Otsuka K, Place F (eds), *The Emergence of*

- Land Markets in Africa: Assessing the Impacts on Poverty, Equity and Efficiency*, (Washington, D.C.: Resources For the Future Press), pp. 179-196
- Holden, S.T. and Ghebru, H. (2006) Kinship, Transaction Costs and Land Rental Market Participation. Working Paper, Norwegian University of Life Sciences, Ås.
- Holden, S.T. and Tefera, T. (2008). Early Impacts of Land Registration and Certification on Women in Southern Ethiopia. Final Research Report submitted to UNHABITAT, Shelter Branch, Land Tenure and Property Administration Section. Nairobi.
- Holden, S.T. and Yohannes, H. (2002) Land Redistribution, Tenure Insecurity, and Intensity of Production: A Study of Farm Households in Southern Ethiopia. *Land Economics* 78(4), pp. 573-590.
- Holden, S. T., Deininger, K. and Ghebru, H. (2008b). Impact of Land Certification on Land-related Conflicts. Working Paper, Norwegian University of Life Sciences, Ås.
- Holden, S. T., Deininger, K. and Ghebru, H. (In press). Impacts of Low-cost Land Certification on Investment and Productivity. *American Journal of Agricultural Economics* (Forthcoming).
- Holden ST, Otsuka K, Place F (Eds) (2008) *The Emergence of Land Markets in Africa: Assessing the Impacts on Poverty, Equity and Efficiency*, (Washington, D.C.: Resources For the Future Press).
- Honoré, B.E. (1993) Orthogonality conditions for Tobit models with fixed effects and lagged dependent variables. *Journal of Econometrics* 59, pp. 35-61.
- Honoré, B.E. and Kyriazidou, E. (2000) Panel data discrete choice models with lagged dependent variables. *Econometrica* 68, pp. 839-874.
- Jacoby, H. G. and Minten, B. (2007) Is Land Titling in Sub-Saharan Africa Cost-Effective? Evidence from Madagascar. *The World Bank Economic Review* 21(3), pp. 461-485.

- Jacoby, H. G. and Minten, B. (2006) Land Titles, Investment, and Agricultural Productivity in Madagascar: A Poverty and Social Impact Analysis. The World Bank, Washington, D.C.
- Moor, G. M. (1998) Tenure Security and Productivity in the Zimbabwean Small Farm Sector: Implications for South Africa. *Development Southern Africa* 15(4), pp.609-620.
- MUT. (2003) Securing land rights in Africa: Can land registration serve the poor? Interim Report of Mekelle University Team, Mekelle University, Mekelle, Tigray, Ethiopia.
- Otsuka K. (2007) Efficiency and Equity Effects of Land Markets. In: Evenson RE, Pingali P (eds), *Handbook of Agricultural Economics*, Volume III, (Amsterdam: Elsevier).
- Otsuka, K., Chuma, H., and Hayami, Y. (1992) Land and Labour Contracts in Agrarian Economies: Theories and facts. *Journal of Economic Literature* 30 (4), pp. 1965-2018.
- Pender, J., and Fafchamps, M. (2006) Land Lease Markets and Agricultural Efficiency in Ethiopia. *Journal of African Economies* 15(2), pp. 251-284.
- Place, F., Migot-Adholla, S., 1998. The economic effects of land registration on smallholder farms in Kenya: evidence from Nyeri and Kakamega districts. *Land Economics* 74, pp. 360–373.
- Rahmato, D. (1984) Agrarian Reform in Ethiopia. Uppsala: Scandinavian Institute of African Studies, Uppsala.
- Skoufias, E. (1995) Household Resources, Transactions Costs, and Adjustment Through Land Tenancy. *Land Economics* 71(1), pp. 42-56.
- Tadesse, M., Holden, S.T., Øygaard, R. (2008) Cost-sharing and Endogenous Land Rental Contract Choice: Theory, and Evidence from Southern Highlands of Ethiopia. in: Holden ST, Otsuka K, Place F (eds), *The Emergence of Land Markets in Africa: Assessing the Impacts on Poverty, Equity and Efficiency*, (Washington, D.C.: Resources For the Future Press), pp. 157-178.

Teklu, T. and Lemi, A. (2004) Factors affecting entry and intensity in informal rental land markets in Southern Ethiopian highlands. *Agricultural Economics* 30, pp. 117-128.

Tikabo, M.O., Holden, S.T., Bergland, O. (2007) Factor Market Imperfections and the Land Rental Market in the Highlands of Eritrea: Theory and Evidence. Unpublished. Department of Economics and Resource Management, Norwegian University of Life Sciences, Ås.

Wooldridge, J. (2005) Simple Solutions to the Initial Conditions Problem in Dynamic, Nonlinear Panel Data Models with Unobserved Heterogeneity. *Journal of Applied Econometrics* 20, pp. 39-54.

World Bank (2006) Land Policy and Administration. The World Bank, Washington D.C.

Table 1. Summary statistics for land rental market participation and land certificate distribution by year

year	stats	Landlords, percentage	Land rented out, tsimdi	Tenants, percentage	Land rented in, tsimdi	Land certificate, percentage
1997	mean	0.24	0.52	0.08	0.15	0.000
	se(mean)		0.08		0.04	
2000	mean	0.27	0.73	0.31	0.77	0.951
	se(mean)		0.09		0.09	
2003	mean	0.26	0.80	0.28	0.69	0.892
	se(mean)		0.10		0.09	
2006	mean	0.29	0.74	0.27	0.52	0.889
	se(mean)		0.09		0.07	
Total	mean	0.26	0.70	0.23	0.53	0.683
	se(mean)		0.05		0.04	

Note: se(mean) is the standard error of the mean. 1 tsimdi=0.25 ha.

Table 2. Summary statistics for key endowment variables of landlord, non-participant and tenant households

Tenure class	stats	% female headed	Adult females	Adult males	Oxen	Other livestock	Farm size, tsimdi
Landlord	mean	0.42	1.23	0.97	0.40	1.14	4.48
	se(mean)	0.03	0.04	0.06	0.04	0.10	0.17
Non-participant	mean	0.17	1.31	1.36	0.85	2.04	4.00
	se(mean)	0.02	0.03	0.04	0.03	0.08	0.16
Tenant	mean	0.05	1.23	1.70	1.36	3.66	4.64
	se(mean)	0.01	0.04	0.06	0.06	0.19	0.22
Total	mean	0.20	1.27	1.34	0.85	2.19	4.27
	se(mean)	0.01	0.02	0.03	0.03	0.07	0.10

Note: Se(mean) is the standard error of the mean. Other livestock measured as tropical livestock units (tlu). 1 tsimdi=0.25 ha.

Table 3. Determinants of participation in the land rental market

Variables	Landlord 1	Landlord 2	Tenant model
Landlord dummy, lagged one period	1.422****	1.421****	
	(0.15)	(0.15)	
Landlord dummy, initial year	0.588**	0.605***	
	(0.23)	(0.22)	
Tenant dummy, lagged one period			1.089****
			(0.16)
Tenant dummy, initial year			0.574*
			(0.29)
Random certificate, residual	0.047	0.066	
	(0.40)	(0.37)	
Years since certification	0.016	-0.002	0.048**
	(0.02)	(0.03)	(0.02)
Sex of household head	0.560****	0.566****	-1.045****
	(0.14)	(0.15)	(0.25)
Sex of household head*Random certificate, residual	1.822*	1.687*	
	(0.95)	(0.93)	
Own farm size	0.031**	0.031**	0.013
	(0.02)	(0.02)	(0.02)
Predicted certificate, control for unobservable household heterogeneity		0.234	
		(0.18)	

Attrition bias test	-0.276	-0.271	-0.149
	(0.26)	(0.24)	(0.26)
Constant	-1.445*****	-1.556*****	-1.074*****
	(0.19)	(0.18)	(0.20)
Lnsig2u _cons	-12.827*****	-13.039*****	-12.062*****
	(0.18)	(0.16)	(0.17)
Prob > chi2	0.000	0.000	0.000
Number of observations	1212	1212	1212

Note: Bootstrapped standard errors in parentheses, re-sampling households, using 300 replications. * significant at 10%; ** significant at 5%; *** significant at 1%, **** significant at 0.1%.

Table 4. Area rented out models with gender and certificate interaction variables

Variables	Area rented out 1	Area rented out 2	Area rented out 3	Area rented out 4
Lagged land area rented out	0.231**	0.237**	0.232**	0.237**
	(0.10)	(0.11)	(0.10)	(0.11)
Land area rented out, initial year	0.542*****	0.548*****	0.551*****	0.556*****
	(0.15)	(0.16)	(0.15)	(0.15)
Landlord dummy, lagged one period	3.008*****	3.046*****	3.028*****	3.060*****
	(0.34)	(0.36)	(0.36)	(0.33)
Landlord dummy, initial year	-0.008	-0.035	0.043	0.02
	(0.42)	(0.42)	(0.40)	(0.41)
Random certificate, residual from prediction	0.839	-0.213	0.913	-0.065
	(0.70)	(0.73)	(0.68)	(0.75)
Years since certification	0.069**	0.071**	-0.021	-0.011
	(0.03)	(0.03)	(0.05)	(0.04)
Sex of household head	1.471*****	1.411*****	1.475*****	1.414*****
	(0.26)	(0.26)	(0.24)	(0.24)
Sex of household head*Random certificate, residual		4.264**		3.874**
		(1.71)		(1.61)
Predicted certificate, control for unobserved household heterogeneity			1.118*****	1.025***
			(0.34)	(0.36)
Own farm size	0.163***	0.160***	0.166*****	0.163***

	(0.05)	(0.05)	(0.05)	(0.05)
Attrition bias test	-0.772	-0.784	-0.754	-0.763
	(0.48)	(0.53)	(0.49)	(0.56)
Constant	-4.182*****	-4.154*****	-4.667*****	-4.603*****
	(0.47)	(0.51)	(0.53)	(0.57)
Sigma u _cons	0	0	0	0
	(0.17)	(0.17)	(0.16)	(0.17)
Sigma_e _cons	2.774*****	2.752*****	2.750*****	2.732*****
	(0.18)	(0.17)	(0.17)	(0.16)
Prob > chi2	0.000	0.000	0.000	0.000
Number of obs.	1212	1212	1212	1212

Note: Bootstrapped standard errors in parentheses, re-sampling households, using 300 replications. * significant

at 10%; ** significant at 5%; *** significant at 1%, **** significant at 0.1%.

Table 5. Land area rented in models

Variables	Area rented in 1	Area rented in 2
Lagged land area rented in	0.302*** (0.11)	0.072 (0.14)
Initial year land area rented in	1.104**** (0.24)	0.118 (0.36)
Tenant dummy, lagged one period		2.346**** (0.41)
Tenant dummy, initial year		1.590* (0.85)
Years since certification	0.203**** (0.04)	0.138**** (0.04)
Sex of household head	-3.555**** (0.66)	-3.319**** (0.63)
Own farm size	0.066 (0.05)	0.085* (0.05)
Attrition bias test	-0.491 (0.73)	-0.382 (0.66)
Constant	-3.328**** (0.55)	-3.566**** (0.52)
Sigma u _cons	1.849**** (0.22)	1.120**** (0.20)
Sigma_e _cons	2.969****	3.145****

	(0.16)	(0.17)
Prob > chi2	0.000	0.000
Number of obs.	1212	1212

Note: Bootstrapped standard errors in parentheses, re-sampling households, using 300 replications.

* significant at 10%; ** significant at 5%; *** significant at 1%, **** significant at 0.1%.

Appendix 1. Instrumentation models for land certificate

A linear probability model with year and household fixed effects was used to predict land certificate. The residual, actual certificate – predicted certificate, was generated and included in the landlord and land leased in models as a random certificate variable cleaned for unobserved household heterogeneity, eliminating endogeneity bias. The same random certificate residual variable was interacted with the sex of household head variable. The predicted certificate variable was also included in the landlord random probit and land area rented out random tobit models as additional control for unobserved household heterogeneity in addition to the initial year lagged participation and degree of participation dependent variables (Wooldridge 2005). Summary statistics for the predicted variables are presented in Table A1.

Table A1. Summary statistics for land certificate, predicted certificate, residuals and interaction variables

Variable	Obs	Std.			
		Mean	Dev.	Min	Max
Land certificate	1220	0.683	0.466	0.000	1.000
Predicted land certificate	1220	0.683	0.430	-0.683	1.018
Random certificate, residual from predicted certificate	1220	0.000	0.178	-0.768	0.683
Sex of household head*Random certificate, residual	1220	0.000	0.076	-0.706	0.482

End notes

ⁱ This is an assumption that holds widely, especially in patriarchal societies.

ⁱⁱ An initial fixed transaction cost for searching and negotiating with potential partners will be there always and there is likely to be an additional variable transaction cost element with a marginal transaction cost that may go

towards zero as area rented out increases. The transaction cost function can be more complex if the household has several geographically dispersed plots, see Holden, Otsuka and Place (2008) for further elaboration on this.

ⁱⁱⁱ We have strong empirical evidence showing that this is the case in our study area.

^{iv} This is usually the case, female-headed households tend have less endowments of labour, livestock and other assets.

^v Strong non-convexities in the transaction cost function can cause these not to hold.

^{vi} One tsimdi is approximately 0.25 ha and is the area of land that a pair of oxen can cultivate in a day.

^{vii} In our analysis we only used two alternative specifications, first we included the lagged variable directly since we have a small T and there is 3 years between each observation. In the second specification we included a dummy for whether the lagged variable was positive or not. We treated the initial value for the dependent variable in the same way, see endnote vii below.

^{viii} We use two alternative specifications; the first is $g(y_{i,t-1}) = y_{i,t-1}$ and $r_{i0} = r(y_{i0}) = y_{i0}$, the others also include dummies $g(y_{i,t-1}) = \{1[y_{i,t-1} = 0], 1[y_{i,t-1} > 0] y_{i,t-1}\}$ and $r_{i0} = \{1[y_{i0} = 0], 1[y_{i0} > 0] y_{i0}\}$.

Table 4 contains models only with the second formulation while Table 5 contains models with both specifications. For Table 3 the response variable is binary, leading also to inclusion of only binary lagged variables.