Appendix A

A farm household and land rental market transaction costs model

Assuming a farm household endowed with land $(\bar{A})$ and labour $(\bar{L})$ has the potential to trade these resources to achieve desired levels of resource use on the farm. Such a household would have the ability to either rent-in or out land or else hire-in or out labour resources in short to medium term. The household intermediate resource use functions would be $A = \bar{A} + A^i - A^o$ and $L = \bar{L} + L^i - L^o$. Where A and L is the level of land and labour used on the farm, A^i and L^i is the amount of land and labour rented or hired in, while A^o and L^o is the amount of land and labour rented or hired out, respectively. The $\bar{A}$ is for all pieces of the land area owned by the household and $\bar{L}$ is the sum of time labour used for work (L_u) and for leisure (L_e) given as $[\bar{L} = L_u + L_e]$. Following Singh, Squire, and Strauss (1986), the decision to trade resources in the market implicitly captures the time used for work and leisure at the household level. Furthermore, total labour endowment is equal to the total number of household individuals in adult equivalent, that assign total time to work and leisure (Singh, Squire, and Strauss 1986). Thus, the intermediate land and labour resource use function will hold if;

(i) $A^i > 0 \; and \; A^o = 0$	(ii) $L^i > 0 \; and \; L^o = 0$	for renting or hiring in
(iii) $A^o > 0 \; and \; A^i = 0$	(iv) $L^o > 0 \; and \; L^i = 0$	for renting or hiring out
(v) $A^o = 0 = A^i$	(vi) $L^o = 0 = L^i$	for not participating

Following Singh, Squire, and Strauss (1986), the problem for such a farm household is to maximise income $[Y]$ utility generated from using these resources. The utility function is given as $Max \, U = U[Y]$, where the function is a twice differential quasi concave function. Assuming a perfect market with linear market costs, equation (i) specifies the income utility function.

$$\max_{A^i, A^o, L^i, L^o} U[Y] = U[P_q q(A, L) - \rho A^i + \rho A^o - \omega L^i + \omega L^o - P_m M] \quad \text{(i)}$$

and $A^i \geq 0, A^o \geq 0, L^i \geq 0, L^o \geq 0$

Where A^i, A^o, L^i, L^o are the decision variables are for renting or hiring in and out of land and labour, as discussed above. The $[Y]$ is the household income function that is twice differentiable and quasi-convex.

From equation (i), the (ρ) is the land rent or land price, and (ω) is the wage rate in the labour markets. The revenue function has (P_q) for output prices and $q(A, L)$ is a production function that is also a function of land (A) and labour (L) use on own farm. The (M) is for other market input with (P_m) as the input market price. Thus, the income function (Y) is the net market equivalent output value after from production revenue less expenditure. The income function is assumed to be equivalent to the consumption goods acquired by the household either through their farm production or markets (Singh, Squire, and Strauss 1986). The basic assumption in equation (i) is that households can freely trade in the land, labour and all other markets (like credit and other inputs) and that markets work perfectly without constraining the household decision to trade.

Binswanger and Rosenzweig (1986) indicated that the immobility of land, the incentive and moral hazard problems in labour market results in high labour transaction costs from negotiating and monitoring contracts while the long gestation period and poor collateral suitability of agriculture sector limit access to credit and capital. This result in imperfect land, labour and credit markets, characterised by market fragmentation; information asymmetry and enforcement problems (Binswanger and Rosenzweig 1986; Fafchamps 2004; Holden, Otsuka, and Place 2010). Such transaction costs may restrict potential households from participating in the land or labour markets. For simplicity, we assume away liquidity constraints related to credit and output markets because of delayed output in agriculture and the associated production and price risks in outputs markets (Carter and Yao 2002). The agricultural output may also depend on individual household risk preferences and crop choices (Holden and Quiggin 2016). Thus, we normalise to one the output (P_q) and input (P_m) prices for all goods, hence we dropped them going forward. With imperfect markets that lead non-linear transaction costs, the income utility function [$Max\, U = U(Y)$] would be;

$$\max_{A^i, A^o, L^i, L^o} U[Y] = U[q(A, L) - \{\rho A^i + \eta(A^i)\} + \{\rho A^o - \theta(A^o)\} - \{\omega L^i + \tau(L^i)\} + \{\omega L - \varphi(L^o)\}] \qquad \text{(ii)}$$

and $\quad L^i \geq 0, L^o \geq 0, A^i \geq 0, A^o \geq 0$

In equation (ii), the land rent (ρ) and the wage rate (ω) are assumed to be constant while having variable non-linear transaction cost with respect to land and labour. Thus, the parameters (η), (θ), (τ) and (φ) reflect variable non-linear transaction costs in land and labour markets. For the transaction costs, we assume that the level of variable transaction costs for those renting-in land or hiring-in labour to be different from those renting-out land or hiring-out labour, respectively because of differences in market supply and demand functions. We further assume these costs to be higher for those renting-in land or hiring-in labour because households demanding land are more likely to incur higher search costs than those supplying the land (Binswanger and Rosenzweig 1986). Thus, the new variables compared to equation (i) are (η) and (θ) for transaction costs when renting-in or out land while the (τ) and (φ) are for transaction costs for hiring in and out labour, respectively. Where (η) > (θ) and (τ) > (φ) because of differences in supply and demand functions. All other variables remain as above. Thus, equation (ii) indicates that a household renting-in land will incur a cost, given as the sum of land rent plus transaction costs as a function of area rented-in. For households renting out land, they will gain land rent less transaction costs a function of land area transacted. These conditions also apply to the labour market.

So far in the model, we have looked at joint land and labour market decisions for a farm household. However, the availability or seasonality of agricultural labour markets throughout the production season implies that households might sequence their decisions, starting with land trade decision at the start of the production season and later make labour market decisions within the season. Based on this assumption, we hold the household decision to trade labour constant and focus on land rental decisions relative to labour endowment. We abstract from the fact that agricultural land rental market is spatially fragmented into many poorly integrated markets. On the one hand, spatial isolation and variable transportation distances determine linear land rent while information asymmetry and market fragmentation imply variable non-linear transaction costs. Thus, holding the labour decisions constant, the farm household objective function becomes;

$$\underset{A^i,A^o,L}{\text{Max}}\, U[Y] = U[q(\bar{A} + A^i - A^o, L) - \{\rho A^i + \eta(A^i)\} + \{\rho A^o - \theta(A^o)\} - \omega L] \qquad \text{(iii)}$$

and $A^i \geq 0, A^o \geq 0, L > 0$

The $q(\bar{A} + A^i - A^o, L)$ is a production function where $(A = \bar{A} + A^i - A^o)$ for land resource use and L is the net labour use $(L = \bar{L} + L^i - L^o)$ on the farm. Recall that the $(\bar{L})$ includes time spent working and for leisure. Thus the (ωL) is a cost function in the labour market, and ω is the market wage rate or shadow wage rate for non-traded labour. All other variables are the same as above.

Using duality theory and taking the derivatives of twice differential quasi-convex income function from equation (iii), the first-order conditions (FOCs) with respect to land and labour variables are;

Rent-in land

$$\frac{\partial Y}{\partial A^i} = \frac{\partial q}{\partial A^i} - \rho - \frac{\partial \eta}{\partial A^i} \leq 0 \qquad \perp \qquad A^i \geq 0 \qquad \text{(iv)}$$

That is, the net return in income with respect to rented-in land $\left(\frac{\partial Y}{\partial A^i}\right)$ is equal to the marginal change in revenue on rented in land $\left(\frac{\partial q}{\partial A^i}\right)$ less land rent (ρ) and marginal change in transaction costs with respect to rented-in land $\left(\frac{\partial \eta}{\partial A^i}\right)$, which is non-linear. Using the complementary slack conditions, we derive the optimal conditions for renting land as specified in equation (v).

$$\text{i.e. } \frac{\partial q}{\partial A^i} = \rho + \frac{\partial \eta}{\partial A^i} \quad \text{if } A^i > 0 \quad \text{or} \quad \frac{\partial q}{\partial A^i} < \rho + \frac{\partial \eta}{\partial A^i} \quad \text{if } A^i = 0 \tag{v}$$

Equation (v) shows that a household renting-in the land will maximise income if the marginal revenue from rented-in land $\left(\frac{\partial q}{\partial A^i}\right)$ is greater or equal to the marginal cost of renting-in land $\left(\rho + \frac{\partial \eta}{\partial A^i}\right)$. Secondly, rented-in land will be zero if the marginal revenue is less than the marginal cost of renting-in land.

Rent-out land

$$\frac{\partial Y}{\partial A^o} = -\frac{\partial q}{\partial A^o} + \rho - \frac{\partial \theta}{\partial A^o} \leq 0 \qquad \perp \qquad A^o \geq 0 \tag{vi}$$

Like in equation (iv), the non-linear transaction costs are not constant, and the marginal change in equation (vi) depends on the land area rented out. Solving equation (vi) and using the complementary slack conditions, equation (vii) derives the optimal conditions for renting out land as;

$$\rho - \frac{\partial \eta}{\partial A^o} \leq \frac{\partial q}{\partial A^o} \Rightarrow \frac{\partial q}{\partial A^o} \geq \rho - \frac{\partial \theta}{\partial A^o} \tag{vii}$$

$$\frac{\partial q}{\partial A^o} = \rho - \frac{\partial \theta}{\partial A^o} \quad \text{if } A^o > 0 \quad \text{or} \quad \frac{\partial q}{\partial A^o} > \rho - \frac{\partial \theta}{\partial A^o} \quad \text{if } A^o = 0$$

Equation (vii) indicates that households will only rent out land if the marginal benefit on land to be rented out $\left(\frac{\partial q}{\partial A^o}\right)$ is less or equal to net return $\left(\rho - \frac{\partial \theta}{\partial A^o}\right)$ and that they will not rent out land if marginal benefit on land to be rented out is greater than the net return.

Net farm labour use

For labour use, we specify the optimal conditions in equation (viii) below.

$$\frac{\partial Y}{\partial L} = \frac{\partial q}{\partial L} - \omega < 0 \qquad \perp \qquad L > 0 \tag{viii}$$

$$\text{i.e.} \frac{\partial q}{\partial L} = \omega \quad \text{if } L > 0$$

The optimal labour conditions imply that the marginal revenue with respect to labour should be greater or equal to the market or shadow wage rate.

Non-participating households

Based on the FOCs in equations (v) and (vii), the optimal conditions for non-participating household or the shadow value with respect to the land endowment is given in equation (ix) below.

$$\rho - \frac{\partial \eta}{\partial A^o} < \left(\frac{\partial q}{\partial A}\right) < \rho + \frac{\partial \eta}{\partial A^i} \tag{ix}$$

Equation (ix) indicates that non-participating households consider their shadow value to land to be greater than the net return from renting out the land and at the same time, less than the marginal cost of renting-in land. Hence, they fall within a threshold. Table 1 gives a summary of the optimal conditions for participating in the land markets.

Table A1: Summary of household optimal decisions in the land markets

	Land rental market		
	Net buyer	***Non-participant***	***Net seller***
	$(\boldsymbol{A^i > 0})$	$(\boldsymbol{A^0 = 0 = A^i})$	$(\boldsymbol{A^o > 0})$
Net farm labour use	Land poor	Land sufficient	Land rich
$(\boldsymbol{L > 0})$	$MR_{A^i} = MC_{A^i}$	$MR_{A^o} < MR_A < MC_{A^i}$	$MR_{A^o} = MC_{A^o}$

To further assess if these conditions hold, we review the second-order conditions (SOC) and the associated Hessian matrix as sufficient conditions below.

Using equations (iv) and (vi), we derive the SOCs as follows;

Net buyer of land

$$\frac{\partial^2 Y}{\partial A^i \partial A^i} = \frac{\partial^2 q}{\partial A^i \partial A^i} - \frac{\partial^2 \eta}{\partial A^i \partial A^i} \leq 0 \qquad \text{or} \qquad \frac{\partial^2 Y}{\partial A^i \partial A^i} = q_{A^i A^i} - \eta_{A^i A^i} \leq 0 \tag{x}$$

Net seller of land

$$\frac{\partial^2 Y}{\partial A^o \partial A^o} = \frac{\partial^2 q}{\partial A^o \partial A^o} - \frac{\partial^2 \theta}{\partial A^o \partial A^o} \leq 0 \qquad \text{or} \qquad \frac{\partial^2 Y}{\partial A^o \partial A^o} = q_{A^0 A^0} - \theta_{A^0 A^0} \leq 0 \tag{xi}$$

Cross derivatives

$$\frac{\partial^2 Y}{\partial A^i \partial A^o} = -q_{A^i A^o} = \frac{\partial^2 Y}{\partial A^i \partial A^o} \tag{xii}$$

If transaction costs are linear, the SOCs would be $\frac{\partial^2 q}{\partial {A^i}^2} \leq 0$ or $\frac{\partial^2 q}{\partial {A^o}^2} \leq 0$ (as expected). However, with non-linear transaction cost, the second-order conditions are $\frac{\partial^2 q}{\partial {A^i}^2} \leq \frac{\partial^2 \eta}{\partial {A^i}^2}$ and $\frac{\partial^2 q}{\partial {A^o}^2} \leq \frac{\partial^2 \theta}{\partial {A^o}^2}$. That is, the extent of resource trade adjustment depends on the level of variable non-linear transactions costs. Equations (xiii) and (xiv) below presents a 2 by 2 Hessian matrix and its determinant for assessing the convexity of these transaction costs.

$$[H] = \begin{bmatrix} f_{11} & f_{12} \\ f_{21} & f_{22} \end{bmatrix} \Rightarrow \begin{bmatrix} q_{A^i A^i} - \eta_{A^i A^i} & -q_{A^i A^o} \\ -q_{A^o A^i} & q_{A^0 A^0} - \theta_{A^0 A^0} \end{bmatrix} \begin{bmatrix} dA^i \\ dA^o \end{bmatrix} \geq 0 \tag{xiii}$$

$$|H| = \left(q_{A^i A^i} - \eta_{A^i A^i}\right)\left(q_{A^0 A^0} - \theta_{A^0 A^0}\right) \geq (q_{A^i A^o})^2 \tag{xiv}$$

The $|H|$ implies that, depending on the extent of transaction costs, the Hessian matrix may not satisfy the sufficient conditions for a global maximum solution. Thus, to understand this convexity in transaction costs, we use the comparative statics. We assess that the marginal variable transaction costs are non-linear, that is $\frac{\partial A^i}{\partial \bar{A}} \neq -1$ and $\frac{\partial A^o}{\partial \bar{A}} \neq 1$ following Bliss and Stern (1982).

Comparative Statics

Using Kuhn-Tucker conditions and solving the FOCs, one can determine the demand functions that we denote as $A^*(\omega, \rho, \bar{L}, \bar{A})$ for land and $L^*(\omega, \rho, \bar{L}, \bar{A})$ for labour, considering that we normalised the output and input prices to one. Using the Jacobian Matrix, we solve for $\frac{\partial A^i}{\partial \bar{A}} = -1$ and $\frac{\partial A^o}{\partial \bar{A}} = 1$. Assuming an interior solution for households renting in or out land ($A^i > 0$; $A^o > 0$) the associated marginal change in resource use derived from equations (iv) and (vi) are

$$-[H_j] = -\begin{bmatrix} \frac{\partial^2 Y}{\partial A^i \partial \omega} & \frac{\partial^2 Y}{\partial A^i \partial \rho} & \frac{\partial^2 Y}{\partial A^i \partial \bar{L}} & \frac{\partial^2 Y}{\partial A^i \partial \bar{A}} \\ \frac{\partial^2 Y}{\partial A^o \partial \omega} & \frac{\partial^2 Y}{\partial A^o \partial \rho} & \frac{\partial^2 Y}{\partial A^o \partial \bar{L}} & \frac{\partial^2 Y}{\partial A^o \partial \bar{A}} \end{bmatrix} \begin{bmatrix} d\omega \\ d\rho \\ d\bar{L} \\ d\bar{A} \end{bmatrix} \Rightarrow -[H_j] = \begin{bmatrix} 0 & -1 & -q_{A^i\bar{L}} & -q_{A^i\bar{A}} \\ 0 & 1 & q_{A^o\bar{L}} & q_{A^o\bar{A}} \end{bmatrix} \begin{bmatrix} d\omega \\ d\rho \\ d\bar{L} \\ d\bar{A} \end{bmatrix}$$

Thus, the changes in land rental markets with respect to the endowment will be;

1. *The change in land renting-in with respect to the land endowment is*

$$\frac{\partial A^i}{\partial \bar{A}} = \frac{|H_{jA^i}|}{|H|} = \frac{\begin{bmatrix} -q_{A^i\bar{A}} & -q_{A^iA^o} \\ q_{A^o\bar{A}} & q_{A^oA^o} - \theta_{A^oA^o} \end{bmatrix}}{\begin{bmatrix} q_{A^iA^i} - \eta_{A^iA^i} & -q_{A^iA^o} \\ -q_{A^oA^i} & q_{A^oA^o} - \theta_{A^oA^o} \end{bmatrix}} = \frac{-q_{A^i\bar{A}}(q_{A^oA^o} - \theta_{A^oA^o}) + (q_{A^iA^o} * q_{A^o\bar{A}})}{(q_{A^iA^i} - \eta_{A^iA^i})(q_{A^oA^o} - \theta_{A^oA^o}) - (q_{A^iA^o})^2} \quad \text{(xv)}$$

Assuming the shadow return to own land is equal to rented-in land values, then

$$q_{A^i\bar{A}} = q_{A^iA^i} - \eta_{A^iA^i} \quad \text{and} \quad q_{A^o\bar{A}} = q_{A^oA^i} \quad \text{(xvi)}$$

Equation (xvi) indicates that the transaction costs will be equal to -1 iff $\eta_{A^iA^i} = 0$ and that rate of market adjustment depends on $q_{A^i\bar{A}} = q_{A^iA^i} - \eta_{A^iA^i}$. That is, the change will be either $\frac{\partial A^i}{\partial A} > -1$ if increasing marginal variable transaction costs or $\frac{\partial A^i}{\partial \bar{A}} < -1$ if decreasing marginal variable transaction costs.

2. *The change in land renting out with respect to the land endowment is*

$$\frac{\partial A^o}{\partial \bar{A}} = \frac{|H_{jA^o}|}{|H|} = \frac{\begin{bmatrix} q_{A^iA^i} - \eta_{A^iA^i} & -q_{A^i\bar{A}} \\ -q_{A^oA^i} & q_{A^o\bar{A}} \end{bmatrix}}{\begin{bmatrix} q_{A^iA^i} - \eta_{A^iA^i} & -q_{A^iA^o} \\ -q_{A^oA^i} & q_{A^oA^o} - \theta_{A^oA^o} \end{bmatrix}} = \frac{q_{A^o\bar{A}}(q_{A^iA^i} - \eta_{A^iA^i}) - (q_{A^iA^o} * q_{A^o\bar{A}})}{(q_{A^iA^i} - \eta_{A^iA^i})(q_{A^oA^o} - \theta_{A^oA^o}) - (q_{A^iA^o})^2} \quad \text{(xvii)}$$

If the shadow return to own land is equal to net return to renting out land, then

$$q_{A^i\bar{A}} = q_{A^iA^o} \quad \text{and} \quad q_{A^o\bar{A}} = q_{A^oA^o} - \theta_{A^oA^o} \qquad \text{(xviii)}$$

Where the solution is equal to 1 iff $\theta_{A^oA^o} = 0$. Thus, the rate of market adjustment depends on $q_{A^o\bar{A}} = q_{A^oA^o} - \theta_{A^oA^o}$ and the change will be either $\frac{\partial A^o}{\partial \bar{A}} > 1$ if increasing marginal variable transaction costs or $\frac{\partial A^o}{\partial \bar{A}} < 1$ if decreasing marginal variable transaction costs.

Overall, the model implies that land market transaction costs can increase to ration out potential participant or decrease to promote participation, subject to factors that influence transaction costs and access to information.

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Appendix B

Table B1: Probit model for attrition bias from 2010 baseline year

	Attrition Probit Model	
VARIABLES	Coefficient	Robust standard error
Sex of HH head (1=female)	-0.176	0.15
Age of HH head (years)	-0.004	0.00
Household size	-0.120****	0.03
Total Livestock Units (TLU)	-0.131	0.15
One-year lag TLU	-0.106	0.23
Reside (1= urban)	1.092****	0.12
Population density	-0.313****	0.05
Constant	0.118	0.22
LR Chi (7)	134.49	
Prob > chi2	0.000	
Observations	1,619	

Note: The attrition: 1= dropout from 2010 and 0 otherwise. The asterisks show **** = p<0.001, *** = p<0.01, **= p<0.05, *= p<0.1

Table B2: Dynamic random effects probit and Tobit models for renting-in land (coefficients)

VARIABLES	P1	P2	P3	P4	T1	T2	T3	T4
Initial year (2010) rent-in dummy	1.126**	1.141**	1.217**	1.042**	0.459**	0.456**	0.472**	0.370**
	(0.45)	(0.45)	(0.49)	(0.41)	(0.19)	(0.19)	(0.19)	(0.17)
Lag rent-in dummy	0.722**	0.704**	0.661**	0.641**	0.284	0.269	0.253	0.247
(previous survey round)	(0.30)	(0.30)	(0.32)	(0.29)	(0.17)	(0.17)	(0.17)	(0.16)
Initial year (2010) rent-in land (ha)					0.636**	0.664**	0.694**	0.532*
					(0.32)	(0.31)	(0.31)	(0.29)
Lag total rent-in land (ha)					0.366	0.327	0.291	0.340
(previous survey round)					(0.24)	(0.23)	(0.23)	(0.22)
Own farmland (ha)	-0.274***	-0.164	0.050	-0.055	-0.145***	-0.066	0.076	0.016
	(0.10)	(0.10)	(0.16)	(0.17)	(0.05)	(0.06)	(0.10)	(0.10)
Landless/zero own farmland (1= yes)		0.240**	0.194	0.378***		0.176**	0.145*	0.244***
		(0.12)	(0.13)	(0.14)		(0.08)	(0.08)	(0.08)
Own farmland to labour ratio			-0.819	-1.028			-0.523*	-0.643**
(ha/adult equiv. labour unit)			(0.54)	(0.64)			(0.30)	(0.32)
Share of male labour			0.184	0.002			0.121	-0.013
			(0.23)	(0.28)			(0.15)	(0.18)

Share of purchased own farmland	-0.198	-0.103	-0.131	-0.062
	(0.31)	(0.31)	(0.18)	(0.17)
Sex of HH head (1=female)		-0.384***		-0.270***
		(0.15)		(0.09)
Age of HH head (years)		-0.006		-0.004
		(0.00)		(0.00)
Education of HH head (years)		-0.004		0.001
		(0.01)		(0.01)
Household size to labour ratio		0.174*		0.121*
(No. of persons/adult equiv. labour unit)		(0.10)		(0.07)
Total Livestock Units (TLU) to labour		0.049		0.034
ratio *(TLU No./ adult equiv. labour unit)*		(0.04)		(0.04)
One-year lag TLU to labour ratio		0.041		0.032
(lag TLU No./ adult equiv. labour unit)		(0.04)		(0.04)
Distance to urban centers (km)		0.018****		0.012****
		(0.00)		(0.00)
Regional dummy (Compared to Central)				
Northern region		-1.300****		-0.842****

				(0.31)				(0.16)
Southern region				-0.429***				-0.266****
				(0.14)				(0.07)
2016.year	-0.138*	-0.144*	-0.143*	-0.103	-0.096*	-0.097*	-0.094*	-0.068
	(0.08)	(0.08)	(0.08)	(0.09)	(0.06)	(0.06)	(0.06)	(0.06)
Constant	-1.735****	-1.879****	-1.951****	-1.986****	-1.226****	-1.316****	-1.339****	-1.356****
	(0.21)	(0.25)	(0.29)	(0.43)	(0.08)	(0.10)	(0.12)	(0.25)
lnsig2u	-0.547	-0.496	-0.372	-0.531				
	(0.72)	(0.71)	(0.70)	(0.70)				
sigma_u					0.522****	0.538****	0.557****	0.480****
					(0.12)	(0.11)	(0.11)	(0.11)
sigma_e					0.708****	0.694****	0.681****	0.674****
					(0.07)	(0.07)	(0.07)	(0.06)
Observations	2,960	2,960	2,960	2,960	2,960	2,960	2,960	2,960
Left Censored (_n)					2,679	2,679	2,679	2,679
Uncensored (_n)					281	281	281	281
Number of Panel households	1,480	1,480	1,480	1,480	1,480	1,480	1,480	1,480

Note: The asterisks denote levels of significance at **** = p<0.001, *** = p<0.01, ** = p<0.05, and * = p<0.1. Standard errors in parentheses. For the probit model, the standard errors are cluster robust, clustered at the household level. The Tobit model presents normal standard errors in the parenthesis.

Table B3: Dynamic random effects probit and Tobit models for renting-in land (coefficients) – with inverse mills ratio

VARIABLES	P1	P2	P3	P4	T1	T2	T3	T4
Initial year (2010) rent-in dummy	1.112**	1.125**	1.207**	1.034**	0.446**	0.442**	0.461**	0.358**
	(0.45)	(0.45)	(0.49)	(0.42)	(0.19)	(0.19)	(0.19)	(0.18)
Lag rent-in dummy	0.728**	0.711**	0.665**	0.645**	0.291*	0.277	0.259	0.253
(previous survey round)	(0.30)	(0.31)	(0.32)	(0.30)	(0.18)	(0.17)	(0.17)	(0.16)
Initial year (2010) rent-in land (ha)					0.639**	0.668**	0.698**	0.536*
					(0.32)	(0.31)	(0.31)	(0.29)
Lag total rent-in land (ha)					0.365	0.326	0.290	0.340
(previous survey round)					(0.24)	(0.23)	(0.23)	(0.22)
Own farmland (ha)	-0.278***	-0.167	0.039	-0.063	-0.149***	-0.069	0.065	0.007
	(0.10)	(0.10)	(0.16)	(0.17)	(0.05)	(0.06)	(0.10)	(0.10)
Landless/zero own farmland (1= yes)		0.242**	0.197	0.381***		0.178**	0.148*	0.249***
		(0.12)	(0.13)	(0.14)		(0.08)	(0.08)	(0.08)
Own farmland to labour ratio			-0.786	-1.002			-0.492	-0.612*
(ha/adult equiv. labour unit)			(0.54)	(0.64)			(0.30)	(0.32)

Share of male labour	0.183	0.001	0.120	-0.013
	(0.23)	(0.28)	(0.15)	(0.18)
Share of purchased own farmland	-0.196	-0.100	-0.128	-0.057
	(0.31)	(0.31)	(0.18)	(0.17)
Sex of HH head (1=female)		-0.383***		-0.269***
		(0.15)		(0.09)
Age of HH head (years)		-0.007*		-0.004
		(0.00)		(0.00)
Education of HH head (years)		-0.004		0.001
		(0.01)		(0.01)
Household size to labour ratio		0.174*		0.121*
(No. of persons/adult equiv. labour unit)		(0.10)		(0.07)
Total Livestock Units (TLU) to labour		0.048		0.034
ratio *(TLU No./ adult equiv. labour unit)*		(0.04)		(0.04)
One-year lag TLU to labour ratio		0.040		0.031
(lag TLU No./ adult equiv. labour unit)		(0.04)		(0.04)
Distance to urban centers (km)		0.018****		0.012****
		(0.00)		(0.00)

Regional dummy (Compared to Central)								
Northern region				-1.285****				-0.825****
				(0.32)				(0.16)
Southern region				-0.431***				-0.269****
				(0.14)				(0.07)
2016.year	-0.138*	-0.144*	-0.142*	-0.103	-0.096*	-0.097*	-0.094*	-0.067
	(0.08)	(0.08)	(0.08)	(0.09)	(0.06)	(0.06)	(0.06)	(0.06)
Inverse mills ratio, attrition	0.691	0.743	0.532	0.403	0.659	0.701	0.550	0.523
	(0.89)	(0.89)	(0.89)	(1.13)	(0.66)	(0.66)	(0.67)	(0.70)
Constant	-2.253***	-2.437****	-2.352***	-2.280**	-1.723****	-1.845****	-1.756****	-1.741***
	(0.73)	(0.74)	(0.76)	(0.94)	(0.51)	(0.51)	(0.52)	(0.58)
lnsig2u	-0.563	-0.514	-0.382	-0.541				
	(0.73)	(0.72)	(0.71)	(0.71)				
sigma_u					0.517****	0.533****	0.553****	0.475****
					(0.12)	(0.11)	(0.11)	(0.11)
sigma_e					0.709****	0.696****	0.682****	0.676****
					(0.07)	(0.07)	(0.07)	(0.06)
Observations	2,960	2,960	2,960	2,960	2,960	2,960	2,960	2,960

Left Censored (_n)					2,679	2,679	2,679	2,679
Uncensored (_n)					281	281	281	281
Number of Panel households	1,480	1,480	1,480	1,480	1,480	1,480	1,480	1,480

Note: The asterisks denote levels of significance at **** = $p<0.001$, *** = $p<0.01$, ** = $p<0.05$, and * = $p<0.1$. Standard errors in parentheses. For the probit model, the standard errors are cluster robust, clustered at the household level. The Tobit model presents normal standard errors in the parenthesis.