Modes of Land Access and Welfare Impacts in Uganda

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Abstract

This article estimates the poverty reducing impact of land access in rural Uganda. Using balanced panel data for 309 households in 2001, 2003, and 2005, models that control for unobserved household heterogeneity and endogeneity of land acquisition and disposition are employed to measure the poverty-reduction effect of land on household income and expenditure per adult equivalent. Significant poverty reduction effects of increased land access in form of owned, operated and market-accessed land were found. The poverty reduction effect for land accessed through the market was significantly larger than the poverty reduction effect of land accessed through inheritance.

Key words: Endogeneity of land access, unobserved heterogeneity, poverty impacts.

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1. Introduction

Empirical research indicates that land acquired through markets or otherwise may play an important role for rural household welfare (de Janvry *et al.* 2001; Pender *et al.* 2004). A recent study shows that access to a small amount of land can permit mobilization of family assets to create large income gains for the poor (Finan *et al.* 2005). Land markets may enable land transfers from less able to more skilled households, and particularly land rental markets may provide affordable means through which the land-poor can gain access to more land to promote productivity and welfare (Deininger and Feder 1998; de Janvry *et al.* 2001). Conversely, there are concerns that poverty reduction effect of access to land through the market may be inadequate, due to land markets that can increase land concentration among the rich and inefficient producers at the expense of the land-poor (Holden et al. 2008), who are also susceptible to lose their land through distress sales. In this paper, we argue that poverty reduction effect of land can be effective when more efficient farmers are able to acquire additional land through a mode of land access with stronger welfare increasing effects. Recent evidence on access to land through the market has been provided for several African countries, including Uganda, by Holden et al. (2008) in their study of emerging land markets in parts of Africa where land scarcity is getting severe. However, they did not study the welfare effects of land access through different means, including through the market. This study makes a novel contribution by providing evidence on the impact of land access through market and non-market avenues on household welfare in form of income per adult equivalent and expenditure per adult-equivalent of rural households in Uganda. We are not aware of any other studies in Africa that have been able to do this while controlling for endogeneity of land access and unobserved household heterogeneity.

Land rental and sales markets are reported to be active and widespread throughout Uganda and seem not to lead to a more unequal land distribution (Deininger and Mpunga 2008), but there is limited empirical evidence on how rental and sales markets influence patterns of poverty in rural areas. There are methodological difficulties in making unbiased estimates of welfare effects of land and other endowments due to their endogeneity and the fact that they may be correlated with unobservable household, farm and community characteristics. There can also be severe difficulties in finding suitable instruments to predict land access, given the requirement that the instruments should be exogenous and uncorrelated with the outcome. This even calls for caution about assuming that inherited land can be considered as exogenous. Here we apply a new estimation method, based on Holden et al. (2009), which allows us to control for such endogeneity and unobservable household heterogeneity in assessing the welfare impacts of land access through a) inheritance, b) a combination of inheritance and other methods of acquisition, and c) through market access and borrowing. This allows us to assess whether the welfare effects are significantly different for the different forms of land access and to measure the marginal poverty reduction effect of land access.

2. Poverty, economic policies and recent land reforms in Uganda

Poverty eradication is a major national goal for the Ugandan government, and was adopted in 1995 with a long term goal of reducing the incidence of income poverty to less than 10% by 2017. A recent study on poverty trends and expenditure in Uganda shows that poverty levels[1] dropped from 38.8% in 2003 to 31.1% in 2006, while poverty in rural areas is reported to be high at 34.2% compared to 13.7% in urban areas (Uganda Bureau of Statistics 2006). Efforts to alleviate persistent poverty in rural areas of Uganda lead to the launching of two closely linked national plans; the "Poverty Eradication Action Plan (PEAP)" and the "Strategic Plan

[1] In absolute numbers, a total of 8.4 million Ugandans live in poverty, and of these 7.9 (94%) live in rural areas (UBOS, 2006). Appleton (2001) indicates that the proportion of Ugandans estimated be living below poverty line was 34% in 1999/2000.

for Modernisation of Agriculture (PMA)". The two plans were adopted in 1997, and are being implemented to among other objectives, increase the ability of the poor to raise their income, improve agricultural productivity and boost marketed output of the rural poor (Ellis and Bahiigwa 2003).

Land legislation in Uganda started in 1900, with the signing of the Uganda Agreement of 1900 with the British Government, where *mailo* land tenure was created by giving large tracts of land measured in miles to Kabaka (king) of Buganda Kingdom and his notables. Since then, there have been several legislations including the Busulu (annual dues) and Envujo (levy per acre) Law of 1927, the 1969 Public Land Act, the 1975 Land Reform Decree, and the 1998 Land Act (Hunt 2004). For many decades, land under customary tenure was not legally recognized, while policies to nationalize land created unintended consequences such as land grabbing, unlawful evictions and poor implementation. Rural areas as a result experienced low investment, limited land transactions, limited access to credit and, rampant land conflicts (Deininger 2003). Recent land reforms started with the 1995 Uganda constitution that has provisions to strengthen land rights on customary land, especially rights of the underprivileged groups of women and children. The 1998 Land Act emphasizes resolving historical tenure problems by defining and entrenching land rights of all Ugandans to increase the efficiency of land use for economic growth (Bosworth 2003). The Act not only sets out procedures to regularize the position of tenants on *mailo* land to acquire certificates of occupancy, but also lays out a framework under which holders of customary land can acquire certificates of customary ownership, and how these certificates of ownership can be converted to freehold. This is expected to enhance the functioning of land markets in a manner that can reduce inequality in land holding, enhance agricultural productivity and household welfare. Therefore, it is of national interest to know the poverty reduction effects of land access, especially for the poor.

3. Data and welfare indicators

3.1. Data

This study utilizes a three-period household panel data set collected in 2001, 2003, and 2005 by two research projects. The first survey was conducted in 2001 by International Food Policy Research Institute (IFPRI), and covered two thirds of Uganda including southwest, central, and eastern and some areas in Northern Uganda. A stratified sampling procedure was employed based on a classification of Uganda's territory according to the agricultural potential, market access and population density. A total of 450 households in 107 communities were interviewed in 2001. The subsequent two surveys were conducted in 2003 and 2005 as part of the Research on Poverty, Environment, and Agricultural Technologies (REPEAT) project, conducted by the Foundation for Advanced Studies on International Development (FASID). In these surveys, 3 districts that were part of the earlier IFPRI study areas were dropped due to insecurity in the north and northeastern parts of Uganda, and instead 94 out of 107 communities that were previously covered by the IFPRI survey in 2001 were selected. Only 333 households out of the 450 households in the baseline survey of 2001 were included in the 2003 REPEAT survey due to the change in the sampling frame in 2003. In addition, out of the 333 sample of households, 20 households dropped out for various reasons in the 2005 survey, while 4 more households with outliers and conflicting values of land access were also dropped from data analysis. This study is therefore based on a balanced panel data of 309 households, and data analysis was conducted on 927 observations from 26 districts of Uganda.

Tables 1 and 2 provide descriptive statistics for key variables on land access and poverty indicators. Table 1 shows a significant growth in household income between 2001 and 2005, while growth in household expenditure is trivial and smooth in the same period. Results in Table 1 further shows that more households gained access to more land (0.64 acres per adult-

equivalent) through the market compared to 0.5 acres per adult-equivalent through inheritance mode of land access. Inequality in land distribution appears to be moderate as illustrated by the gini coefficient values for land owned per adult-equivalent. A lower gini coefficient on land operated per adult-equivalent compared to that on land owned suggests that different modes of land access including through the market, might be helpful in promoting equity in land access for agricultural production.

Table 1
Household poverty indicators and land access between 2000 and 2005

	2001		2003		2005		Overall	
	N	Mean	N	Mean	N	Mean	N	Mean
Per adult-equivalent								
Household income (Ug.shs)	309	213481.10	309	340229.30	309	376035.00	927	309915.10
		(17246.66)		(28717.71)		(24578.79)		(14023.04)
Household expenditure (Ug.shs)	309	345035.70	309	386107.50	309	387652.80	927	372932.00
		(15033.22)		(37832.47)		(20196.59)		(15145.67)
Land owned (acres)	309	1.04	309	0.98	309	1.24	927	1.09
		(0.07)		(0.08)		(0.10)		(0.05)
Gini coefficient of land owned by district	309	0.46	309	0.44	309	0.47	927	0.45
		(0.01)		(0.01)		(0.01)		(0.00)
Land operated (acres)	309	1.12	309	1.05	309	1.31	927	1.16
		(0.07)		(0.08)		(0.10)		(0.05)
Gini coefficient of land operated by district	309	0.43	309	0.41	309	0.45	927	0.43
		(0.01)		(0.00)		(0.01)		(0.00)
Land purchased (acres)	269	0.67	269	0.49	269	0.60	807	0.59
		(0.06)		(0.07)		(0.08)		(0.04)
Land inherited (acres)	256	0.54	256	0.51	256	0.45	768	0.50
		(0.05)		(0.05)		(0.04)		(0.03)
Land sold (acres)	19	0.11	19	0.00	19	0.11	57	0.07
		(0.08)		(0.00)		(0.03)		(0.03)
Land bequeathed (acres)	55	0.61	55	0.00	55	0.04	165	0.22
		(0.14)		(0.00)		(0.02)		(0.05)
Land acquired through renting and borrowing (acres)	174	0.16	174	0.15	174	0.21	522	0.17
		(0.03)		(0.02)		(0.03)		(0.01)
Land rented-out and borrowed -out (acres)	55	0.02	55	0.03	55	0.28	165	0.11
		(0.02)		(0.02)		(0.07)		(0.03)
Land acquired through renting, borrowing & purchases (acres)	291	0.71	291	0.54	291	0.68	873	0.64
		(0.06)		(0.06)		(0.08)		(0.04)

Note: (i) Standard errors are in parentheses; (ii) Income and expenditure per adult equivalent in real income (2005 value).

Table 2 describes changes in poverty status of the households in the sample. We note that 31.07% of the households were food poor in 2001, and this reduced to 29.13% in 2005. Also, households that were in general poverty reduced from 51.78% in 2001 to 43.04% in 2005.

Table 2 further points out that 62 (20.06%) of the households were never poor, 50 (16.18%) households were in chronic poverty, whilst 197 (63.75%) households were in transitory poverty. Out of these, 101 (32.69%) households fell into poverty at least once, whereas 96 (31.07%) fell into poverty twice in the three periods. This implies that a very large share of rural households is in transitory poverty.

Table 2
Household poverty status between 2000 and 2005

	2001	**2003**	**2005**	**Overall**
Food poverty				
Headcount ratio %	31.07	36.25	29.13	32.15
Poverty gap ratio %	10.90	12.31	8.88	10.70
Sen index *100	14.28	16.66	12.22	14.44
General poverty				
Headcount ratio %	51.78	48.54	43.04	47.79
Poverty gap ratio %	18.24	19.26	15.49	17.66
Sen index *100	24.89	25.52	20.61	23.74
Gini coefficient for households below poverty line	0.199	0 .215	0.187	0.202
Change in general poverty status				
Never poor			62	20.06%
Poor in one period (transitory poverty)			101	32.69%
Poor in two periods (transitory poverty)			96	31.07%
Always poor (chronic poor)			50	16.18%
Total number of households			309	100%

1. Food poor is defined as households whose real expenditure on food per adult equivalent is less than Ug.shs 199024.4 (2005 price level), (ii) Generally Poor is defined as households whose real general expenditure per adult equivalent is less than Ug.shs 261717.1 (2005 price level).
2. Headcount ratio (Po) is the fraction of the population below the poverty line.
3. Poverty gap measure (P1) is the per capita measure of the total shortfall of individual welfare levels below the poverty line; it is the sum of all the shortfalls divided by the population and expressed as a ratio of poverty line itself.
4. Sen's measure of poverty (Ps) is a weighted average of the headcount, the poverty gap and the Gini coefficient of the poor

3.2. Household welfare or poverty level

We computed income per adult equivalent and expenditure per adult equivalent as measures of household poverty levels. Given that the outcome of any development policy intervention and the associated welfare enhancing effects are absorbed and reflected in the individual household members (Ringein 1996), analysis of poverty can be conducted at the household and individual levels. Household income in a year was computed from the summation of

value of home crop production net of the cost of inputs, value of home produced livestock that were consumed, cash income from sale of livestock and livestock products net of livestock production costs, and cash income from seasonal and monthly off-farm activities. Distinctively, household total expenditure was constructed from cash expenditure for consumption and home produced goods. Both measures of household poverty levels were adjusted to 2005 prices.

4. Econometric model estimation and specification

We expect land access that includes a) land owned, b) land operated, and c) land acquired through the market, all to be endogenous. The lack of good instruments makes it impossible to apply the standard Instrumental Variable (IV) approach that otherwise may have been an effective method in controlling bias due to endogeneity. An alternative approach is employed, based on Holden et al. (2009) where each of the endogenous land access variables is first regressed on exogenous variables using household fixed effects to control for unobservable and observable time-invariant household, farm and village characteristics. The error terms from these models may then be seen as random land access variables cleaned for bias due to unobserved heterogeneity. The impact of land access on welfare is then estimated by including these random land access variables in the second stage of poverty impact equations where also household fixed effects are used to control for welfare measure biases due to unobserved household heterogeneity.

In case of c), land acquired through the market, this is a limited dependent variable while in cases a) and b) these are continuous variables. The censoring in case of c) may therefore cause biased estimates if a standard fixed effects approach is used. In order to assess this, an alternative panel Tobit random effects model controlling for unobserved household heterogeneity (Wooldridge 2005) was used to predict land access through the market and to

generate the random land access variable. Extreme regression outliers were removed to produce unbiased results, and bootstrapping was employed to get corrected standard errors by re-sampling households.

Land access per adult equivalent for a household i in year t is denoted as L_{it}^{a}. We estimate equation (1) below using household panel fixed effects models, while for equation (2), a random effects dynamic panel Tobit model based on Wooldridge (2005) is employed. Unobserved heterogeneity is controlled for or at least significantly reduced in equation (2) by including two lagged dependent variables for the initial year in form of degree of market participation and a dummy for market participation. The models are formulated as follows:

$$L_{it}^{o} = \alpha_0 + \beta X_{it} + \alpha_1 D_t + c_i + u_{it} \tag{1}$$

$$\begin{aligned} &L_{it}^{m} = \max(0, \beta X_{it} + \alpha_1 D_t + c_i + u_{it}^{*}) \\ &u_{it}^{*} \left| (X_{it}, D_t, c_i) \approx Normal\left(0, \sigma_u^2\right)\right. \\ &c_i = \psi + \eta L_{i0}^{m} + \lambda D_{i0}^{lm} + a_i \\ &a_i \left| L_{i0}^{m}, D_{i0}^{lm}, \approx Normal\left(0, \sigma_a^2\right)\right. \end{aligned} \tag{2}$$

The model can therefore be stated as:

$$L_{it}^{m} = \max(0, \beta X_{it} + \alpha_1 D_t + \psi + \eta L_{i0}^{m} + \lambda D_{i0}^{lm} + a_i + u_{it})$$

where $u_{it} \left| (X_{it}, L_{i0}^{m}, D_{i0}^{lm}, D_t, a_i) \approx Normal\left(0, \sigma_u^2\right)\right.$, a_i denotes unobserved effect that may persist in the model, L_{it}^{o} denotes land owned or operated per adult equivalent, L_{it}^{m} denotes land accessed through the market (rental, purchases and borrowing), X_{it} is a set of exogenous variables that are time variant including inherited land per adult equivalent, gini coefficient of land owned per adult equivalent by district, age of the household head, and age of the household head squared, L_{i0}^{m} represents initial market acquired land per adult equivalent in 2001 and D_{i0}^{lm} denotes a dummy variable for whether land was acquired through the market in 2001. D_t represents year effects in form of dummy variables for time periods, c_i is the unobserved effect that is controlled for with household fixed effects (or random effects in

combination with lagged dependent variables for the initial period in the censored Tobit panel specification), u_{it} is the error term.

We estimate the poverty reducing impacts of land access using unobserved household fixed effects models as specified below:

$$y_{it} = \beta_0 + \beta_1 Z_{it} + \beta_2 \hat{L}^a_{it} + \beta_3 \left(L^a_{it} - \hat{L}^a_{it} \right) + \beta_4 D_t + \varsigma_i + e_{it} \quad (3)$$

where y_{it} is either income per adult equivalent or expenditure per adult equivalent, Z_{it} denotes the exogenous inherited land per adult equivalent, $\hat{L}^a_{it}$ is the predicted land access per adult equivalent in form of owned, operated, or land acquired through the market, $\left(L^a_{it} - \hat{L}^a_{it} \right)$ is the random land access error variables for owned, operated, or market acquired land used for impact assessment, D_t represents year effects through dummy variables for time periods, ς_i is the welfare effect due to unobserved and observed time-invariant household heterogeneity, and e_{it} is an error term.

Controlling for ς_i is crucial in case there are important omitted variables. The key concern is whether or not ς_i is uncorrelated with observed explanatory variables. The method we employ generates random variables for land access that are not contaminated by such spurious correlation and can therefore be used to generate an unbiased estimate of the poverty reduction impacts of random variation in land access which may be the best option when randomized experimental data are not available. Holden et al. (2009) used the same approach to estimate investment, productivity and land market participation impacts of land certification in Ethiopia.

5. Results and discussion

Results for the first stage estimation of determinants of different modes of land access are indicated in Tables 5 and 6 in the Appendix. Table 3 presents results for the poverty reduction effects of land access for owned land, operated land and market-acquired land for income and expenditure per adult-equivalent of households in the balanced panel sample. The random land access error variables are significant and with positive signs in all models. This is strong evidence on the significance of land as an important determinant of household welfare in rural Uganda, implying that land acquired through the market as well as through other means has strong positive welfare effects.

The models for market accessed land (including borrowing), the four last columns in Table 3, denotes that the welfare improving effects of land obtained through the market are significantly larger than the welfare improving effects of accessing land through inheritance after correcting for unobserved heterogeneity. We see that the coefficients on inherited land are significantly smaller than those on the random (error) land access through the market. This may be explained by the fact that the market transfers land to more efficient producers while inheritance to a less extent does so. Given that the magnitude of the estimated effects were larger on market accessed land than on inherited land, this is a further indication that access to additional land through the market, including borrowing, may be associated with stronger poverty reduction effects compared to additional land that is accessed through non-market modes. We conducted a robustness check on these models by incorporating sex of the household head as an additional exogenous independent variable, and results[2] did not change significantly. Similarly, alternative models (See Table 4, Appendix A) that compare welfare effects of the random land access through inheritance to that on random land access through a combination of renting-in and purchases, without borrowing were estimated.

[2] Results can be obtained from the authors upon request.

Table 3
Impact of land access on household income and expenditure per adult equivalent

	Per adult-equivalent (AE) land access, income and expenditure							
	Land owned		Land operated		Land acquired through the market (includes purchases)			
					Based on FE Land Access		Based on RE Tobit Land Access	
	Inc./AE	Exp./AE	Inc./AE	Exp./AE	Inc./AE	Exp./AE	Inc./AE	Exp./AE
Independent variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Per adult-equivalent land inherited	-1.541	1.453	-2.780	-1.030	7.150**	3.961*	7.645***	5.658***
	(7.16)	(9.12)	(8.24)	(11.69)	(2.85)	(2.25)	(2.52)	(2.02)
Predicted per adult-equivalent land access	7.439	1.960	8.603	4.502	11.708	4.647	15.466***	20.402**
	(7.15)	(8.38)	(8.33)	(10.98)	(10.83)	(13.94)	(3.37)	(9.39)
Random land access error component	10.683***	12.895*	10.980***	13.972*	15.528***	20.725**	15.503***	21.009**
	(2.93)	(6.64)	(3.01)	(7.41)	(3.41)	(9.52)	(3.68)	(10.51)
Dummy variable of year 2001	-14.668***	-3.988	-14.464***	-3.357	-17.225***	-4.734*	-17.474***	-6.704
	(3.42)	(3.60)	(3.62)	(3.92)	(2.86)	(2.85)	(3.31)	(4.25)
Dummy variable of year 2003	-1.570	0.286	-1.293	1.022	-2.473	0.232	-2.034	2.062
	(3.77)	(5.51)	(4.03)	(5.95)	(3.17)	(4.37)	(2.99)	(4.21)
Constant	28.967***	35.798***	27.412***	33.273***	27.490***	34.333***	24.908***	23.553***
	(6.59)	(7.39)	(8.18)	(10.18)	(7.56)	(9.37)	(2.99)	(6.30)
Household fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	927	927	927	927	927	927	927	927
Number of households	309	309	309	309	309	309	309	309
Chi2 statistic	53.537	13.425	53.008	12.799	60.675	19.023	65.354	29.493
Prob > chi2	0.000	0.020	0.000	0.025	0.000	0.002	0.000	0.000
R2-within	0.155	0.123	0.162	0.145	0.202	0.216	0.201	0.216
R2-between	0.189	0.215	0.205	0.198	0.246	0.266	0.244	0.278
R2-overall	0.167	0.157	0.176	0.165	0.218	0.235	0.217	0.239
Panel-level standard deviation	25.001	25.406	24.802	25.613	24.087	24.485	24.119	24.285
Standard deviation of error term	36.828	41.687	36.683	41.159	35.795	39.398	35.798	39.421
Rho (Panel fraction of variance)	0.315	0.271	0.314	0.279	0.312	0.279	0.312	0.275

Note: Bootstrap (399 replications) standard errors are in parentheses. * Significant at 10%; ** significant at 5%; *** significant at 1%

Results still confirm that the estimated coefficients on the two random land access variables are not only positive and significant, but also significantly larger on random land access through the market (renting-in and purchases) than on random land access through inheritance. Whether we used the random effects dynamic censored Tobit panel model or the fixed effects model, estimation of the welfare effects of land acquired through the market did not lead to a significant difference in the parameter estimates for the random land access variables. This confirms that the conclusions are robust to these alternative model specifications.

6. Conclusions

Increasing land scarcity has made land access an important poverty and welfare indicator in Uganda where more than 90% of the poor live in rural areas. Our analysis shows that land, whether accessed through the market or non-market ways, is an important determinant of household welfare. Households with more of either owned land, operated land, or market-accessed land were shown to gain a significant welfare-improving effect of this better land access after we have controlled for endogeneity in land access and for unobserved heterogeneity effects on welfare. The other significant finding was that better land access through the market has a stronger welfare-improving effect than better land access through inheritance. This is likely to be the case because land markets to a larger extent transfer land to more efficient producers. Access to a balanced panel data set and application of appropriate panel data methods has made it possible to estimate these new results which demonstrate that land markets enhance efficiency as well as contribute to poverty reduction.

References

Appleton, S., 2001. Education, incomes and poverty in Uganda in the 1990s. CREDIT Research Paper No. 01/22: Centre for Research in Economic Development and International Trade, University of Nottingham, pp. 1-35.

Bosworth, J., 2003. Integrating land issues into the broader development agenda: Uganda. Land Reform, Land Settlement, and Cooperatives 11, 233-248.

de Janvry, A., Platteau, J.P., Gordillo, G., Sadoulet, E., 2001. Access to Land and Land Policy Reforms. In: A. de Janvry, G. Gordillo, J.-P. Platteau, and E. Sadoulet (Eds), Access to Land, Rural Poverty and Public Action. Oxford: Oxford University Press.

Deininger, K., 2003. Land policies for growth and poverty reduction. Washington, D.C. and Oxford: The World Bank and Oxford University Press.

Deininger, K., Feder, G., 1998. Land institutions and land markets. World Bank Policy Research Working Paper No. 2014. Washington, D.C.: The World Bank.

Deininger, K., Mpuga, P., 2008. Land Markets in Uganda: Incidence, Impact, and Evolution over Time. In: S. T. Holden., K. Otsuka., and F. M. Place, (Eds.), The Emergence of Land Markets in Africa: Impacts on Poverty, Equity and Efficiency. Washington, D.C.: Resources For the Future Press.

Ellis, F., Bahiigwa, G., 2003. Livelihoods and Rural Poverty Reduction in Uganda. World Development 31, 997-1013.

Finan, F., Sadoulet, E., de Janvry, A., 2005. Measuring the poverty reduction potential of land in rural Mexico. Journal of Development Economics 77, 1-27.

Holden, S., Otsuka, K., Place, F., 2008. The Emergence of Land Markets in Africa: Impacts on Poverty, Equity and Efficiency. Washington, D.C.: Resources For the Future Press.

Holden, S. T., Deininger, K., Ghebru, H., (2009). Impacts of Low-Cost Land Certification on Investment and Productivity. American Journal of Agricultural Economics, 91(2): 359-373.

Hunt, D., 2004. Unintended Consequences of Land Rights Reform: The Case of the 1998 Uganda Land Act. Development Policy Review 22(2), 173-191.

Pender, J., Ssewanyana, S., Edward, K., Nkonya, E., 2004. Linkages between Poverty and Land management in Rural Uganda: Evidence from the Uganda National Household Survey, 1999/2000. Policy Brief 2. International Food Policy Research Institute, Washington, D.C.

Ringein, S., 1996. Household, goods, and well-being. Review of Income and Wealth Series 42 (4), 421-431.

Uganda Bureau of Statistics, 2006. Distribution and Evolution of Poverty and Inequality in Uganda. The New Vision; Uganda's Leading Website. http://www.newvision.co.ug/

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

Appendix A

Table 4

Impact of land access through "Renting-In and Purchases" and "Inheritance" on household income and expenditure per adult equivalent

	Per adult-equivalent (AE) land access, income and expenditure							
	Land rented-in and purchased		Land inherited		Land rented-in and purchased		Land inherited	
	Based on household FE Land access				Based on household RE Tobit Land access			
Independent variables	Inc./AE (1)	Exp./AE (2)	Inc./AE (3)	Exp./AE (4)	Inc./AE (5)	Exp./AE (6)	Inc./AE (7)	Exp./AE (8)
Per adult-equivalent land inherited	7.330**	3.636			7.934***	6.004***		
	(3.05)	(2.31)			(2.56)	(1.95)		
Sex of the household head (1= Male, 0= Female)			-5.236	-0.513			-5.203	0.043
			(7.16)	(6.41)			(7.05)	(6.30)
Predicted per adult-equivalent land access	11.352	2.031	7.186	19.572	15.415***	20.473**	6.157**	3.673*
	(11.43)	(12.96)	(21.30)	(15.68)	(3.46)	(9.59)	(2.53)	(2.20)
Random land access error component	15.478***	20.784**	5.398**	3.039	15.464***	21.103**	8.327***	4.746**
	(3.48)	(9.66)	(2.56)	(2.41)	(3.77)	(10.64)	(2.58)	(2.11)
Dummy variable of year 2001	-17.423***	-4.652	-16.713***	-5.776*	-17.804***	-7.360	-21.395***	-6.903**
	(2.99)	(2.98)	(3.38)	(3.00)	(3.48)	(4.59)	(3.55)	(2.99)
Dummy variable of year 2003	-2.841	-0.133	-4.008	-1.096	-2.483	1.477	-3.931	-0.315
	(2.99)	(3.99)	(2.99)	(3.65)	(2.96)	(4.01)	(3.11)	(4.01)
Constant	28.348***	36.244***	39.688***	31.940***	25.773***	24.582***	39.541***	37.111***
	(7.24)	(8.04)	(9.89)	(8.01)	(2.97)	(6.02)	(7.29)	(6.27)
Household fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	927	927	927	927	927	927	927	927
Number of households	309	309	309	309	309	309	309	309
Chi2 statistic	58.627	18.143	36.445	8.258	65.697	26.577	49.438	11.100
Prob > chi2	0.000	0.003	0.000	0.143	0.000	0.000	0.000	0.049
R2-within	0.199	0.215	0.055	0.006	0.199	0.214	0.062	0.007
R2-between	0.236	0.259	0.012	0.012	0.232	0.269	0.008	0.004
R2-overall	0.213	0.232	0.037	0.008	0.211	0.235	0.039	0.006
Panel-level standard deviation	24.233	24.599	27.440	28.437	24.285	24.431	27.518	28.528
Standard deviation of error term	35.860	39.437	38.938	44.365	35.863	39.467	38.801	44.357
Rho (Panel fraction of variance)	0.314	0.280	0.332	0.291	0.314	0.277	0.335	0.293

Note: Bootstrap (399 replications) standard errors are in parentheses. * Significant at 10%; ** significant at 5%; *** significant at 1%

Appendix B

Table 5
Determinants of per adult-equivalent land access

	Panel Models with Household Fixed- Effects (FE)			Panel Tobit RE Model
	Per adult equivalent			
Independent variables	Owned land (1)	Operated land (2)	Market acquired Land (3)	Market acquired Land (4)
Inherited land per adult-equivalent	0.958***	0.963***	-0.137**	-0.304***
	(0.09)	(0.09)	(0.05)	(0.10)
Gini coefficient of land owned per adult-equivalent by district	1.196*	1.331**	0.876	0.785
	(0.61)	(0.63)	(0.58)	(0.53)
Age of household head	0.034*	0.010	0.014	0.011
	(0.02)	(0.02)	(0.02)	(0.02)
Age of household head squared	-0.000	-0.000	-0.000	-0.000
	(0.00)	(0.00)	(0.00)	(0.00)
Market acquired land per adult-equivalent in 2001				0.997***
				(0.03)
Dummy variable for access to land through the market in 2001				8.582***
				(1.91)
Dummy variable of year 2001	-0.254**	-0.237**	0.060	-9.016***
	(0.11)	(0.11)	(0.09)	(1.89)
Dummy variable of year 2003	-0.237***	-0.234***	-0.072	-0.131*
	(0.08)	(0.09)	(0.07)	(0.07)
Constant	-0.787	-0.156	-0.229	-0.253
	(0.60)	(0.64)	(0.57)	(0.56)
Panel level standard deviation (sigma_u)				
Constant				0.685***
				(0.12)
Standard deviation of error term (sigma_e)				
Constant				0.910***
				(0.12)
Number of observations	927	927	927	927
Number of households	309	309	309	309
F statistic/Wald chi2	26.341	22.755	4.121	1207.654
Prob > F/ chi2	0.000	0.000	0.001	0.000
R2-within	0.247	0.244	0.030	
R2-between	0.172	0.160	0.042	
R2-overall	0.214	0.208	0.036	
Panel level standard deviation (sigma_u)	0.864	0.850	0.729	
Standard deviation of error term (sigma_e)	1.183	1.189	0.987	
Rho(fraction of variance due to u_i)	0.348	0.338	0.353	0.362
Uncensored observations				679.000
Left-censored observations				248.000
Right-censored observations				0.000
Log likelihood				-1131.877

Note: (i) Robust standard errors for models 1- 3, and Bootstrap (399 replications) standard errors for model (4) are in parentheses; (ii) * Significant at 10%; ** significant at 5%; *** significant at 1%.

Appendix C

Table 6
Determinants of per adult-equivalent land (acres) access through "renting-In and purchases" and "inheritance"

	Panel household FE Models		Panel Tobit RE Model	
	Per adult equivalent			
Independent variables	Land rented-in and purchased (1)	Land Inherited (2)	Land rented-in and purchased (3)	Land Inherited (4)
Inherited land per adult-equivalent	-0.153***		-0.361***	
	(0.05)		(0.11)	
Gini coefficient of land owned per adult -equivalent by district	0.620	0.633*	0.791	0.061
	(0.58)	(0.36)	(0.57)	(0.24)
Age of household head	0.021	-0.027	0.019	-0.048**
	(0.02)	(0.02)	(0.02)	(0.02)
Age of household head squared	-0.000	0.000	-0.000	0.000**
	(0.00)	(0.00)	(0.00)	(0.00)
Land per adult equivalent "rented-in & purchased" or "inherited" in 2001			1.016***	1.003***
			(0.04)	(0.04)
Dummy variable for land "rented and purchased" or "inherited " in 2001			9.067***	4.975***
			(1.98)	(0.41)
Dummy variable of year 2001	0.074	0.089	-9.378***	-5.141***
	(0.09)	(0.06)	(1.95)	(0.40)
Dummy variable of year 2003	-0.050	0.057	-0.108	0.041
	(0.06)	(0.04)	(0.07)	(0.04)
Constant	-0.342	0.780**	-0.582	1.361***
	(0.56)	(0.37)	(0.58)	(0.43)
Panel level standard deviation (sigma_u)				
Constant			0.719***	0.542***
			(0.13)	(0.05)
Standard deviation of error term (sigma_e)				
Constant			0.939***	0.571***
			(0.13)	(0.07)
Number of observations	927	927	927	927
Number of households	309	309	309	309
F statistic/Wald chi2	4.416	1.743	924.215	1070.215
Prob > F/ chi2	0.001	0.140	0.000	0.000
R2-within	0.031	0.019		
R2-between	0.054	0.000		
R2-overall	0.041	0.007		
Panel level standard deviation (sigma_u)	0.717	0.482		
Standard deviation of error term (sigma_e)	0.981	0.661		
Rho(fraction of variance due to u_i)	0.348	0.347	0.370	0.474
Uncensored observations			627.000	551.000
Left-censored observations			300.000	376.000
Right-censored observations			0.000	0.000
Log likelihood			-1097.163	-751.121

Note: (i) Robust standard errors for models 1 & 2, and Bootstrap (399 replications) standard errors for models 3 & 4 are in parentheses; (ii) * Significant at 10%; ** significant at 5%; *** significant at 1%.