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What are the Drivers of Rural Land Rental Markets in sub-Saharan Africa, and how do they Impact Household Welfare? Evidence from Malawi and Zambia

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Abstract
This article uses nationally representative panel survey data from Malawi and Zambia to estimate the factors affecting a smallholder farm household's decision to participate in land rental markets as either a tenant or a landlord. We also estimate how land rental market participation influences various measures of household income and welfare. We find that land rental markets in both Malawi and Zambia promote efficiency by transferring land from less able to more able farmers. Land rental markets in Malawi promote equity by transferring land relatively labor-poor to labor-rich households, and in both countries we find evidence that land markets transfer land from land-rich to land-poor households. In both countries, we find evidence that renting in land has a positive effect on household income and reduces the probability of the household being in poverty. However, when we consider the full cost of renting in land, the positive impacts are much lower.

Key Words: land rental markets, Malawi, productivity, poverty, Zambia

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Introduction

Access to farmland in sub-Saharan Africa (SSA) is a key factor that determines whether or not rural households are poor, food insecure, and vulnerable to shocks. Although land rental and sales markets have typically not been regarded as features of traditional tenure systems, recent evidence suggests that land markets are far more widespread than commonly perceived (Holden, Otsuka and Place 2009a). This makes understanding the factors affecting land market development and their impacts of considerable interest to both researchers and policy makers. The empirical focus has been on rental markets in SSA as they generally face lower developmental barriers than sales markets and are consequently more prevalent within the region's smallholder production systems (Jin and Jayne 2013; Yamano et al. 2009; Otsuka 2007; Binswanger and Rosenzweig 1986).[1]

With these considerations in mind, this study uses nationally representative household-level panel data from two neighboring countries in Southern Africa – Zambia and Malawi – to make three main contributions to the literature on land rental markets in SSA. First, to our knowledge, the present study is the first to empirically evaluate the household-level and geographical determinants of rental market participation and farm-level impacts in a comprehensive way. The closest related works are by Jin and Jayne (2013), who investigate the impact of land rental markets on income and poverty in Kenya, and the case studies in Holden, Otsuka and Place (2009), which does not include Zambia and which investigates the determinants of participation, but not impacts, for Malawi.

Second, the present study measures rental market impacts on a broader range of income and welfare indicators than previous studies, including crop income, total household income, food security status, and poverty. Food security is an on-going concern in both Malawi (Ellis and Manda 2012) and Zambia (Chapoto *et al.* 2011); relating household food security outcomes to the emergent land rental markets is of high relevance for both land and social welfare policy.

Third, unlike previous studies we are able to more fully capture the costs and benefits of both of renting in land and renting out land in our analysis. We further extend this work by looking beyond the conditional mean impacts of land rental markets using quantile regression.

This enables us to estimate how renting land impacts smallholders at different points of the crop production distribution.

Theory suggests three primary channels in which land rental markets may impact smallholders: equity, efficiency and welfare (Holden, Otsuka and Place 2009a). The literature defines equity gains in terms of equality, as the reallocation of land across households with different assets occurs in a way that land and non-land factor ratios tend to equilibrate. Efficiency gains are associated with net land transfers from less to more productive users. Welfare gains are implied by greater access to land as the primary productive asset within smallholder production systems, but also derive from the higher household incomes and food security associated with enhanced equity and efficiency outcomes.

Malawi and Zambia together represent a wide spectrum of relative land scarcity and market access conditions. While there is a growing empirical literature on land markets in SSA little work has been done on these issues in Malawi, and no work has been done in Zambia to our knowledge. For Malawi, Lunduka, Holden and Øygard (2009) examine the relationship between tenure security and rental market participation in a cross-sectional context, while Lunduka (2009) examines the impact of tenure security on a range of farm investment outcomes, as well as on technical efficiency, but the household-level impacts of land rental participation have not yet been empirically explored in this setting. Our study aims to address this gap. Furthermore, all the existing empirical studies that we are aware of have focused on rental markets in high density areas (e.g. Uganda, Ethiopian highlands, and high density parts of Kenya). Little attention has been paid to the function and role of markets in (ostensibly) lower population density countries such as in Zambia, where land access may also be constrained (e.g. by competing land claims). More generally, no empirical studies have systematically investigated how both participation and impacts differ across a wide range of scarcity and productivity conditions.

In addition to panel data, geospatial data is used to control for contextual factors such as population density, which may affect household rental market participation, as well as characterize the impacts of rental markets on a range of welfare measures. This cross-country analytical approach offers rich insights and greater external validity for our results. We use panel estimation methods including the Mundlak-Chamberlain Device, and household fixed effects to deal with potential endogeneity of land rental market participation in the welfare models of interest in this article. Data from each country is analyzed separately, but we evaluate results comparatively and draw conclusions on this basis.

The rest of this article is organized as follows. We describe the current state of land rental markets in Malawi and Zambia in Section 2, along with the key features of their respective institutional and legal contexts. In section 3, review the conceptual arguments for rental market impacts in smallholder systems, as well as the extant empirical support. We discuss a conceptual model in Section 4, followed by our methodological approach in Section 5. Data is discussed in section 6, then estimation results are described in Section 7, followed by a summary of key findings and implications for policy in Section 8.

Rental markets and their contexts in Malawi and Zambia

Malawi and Zambia share similar environments in many important respects. Both countries are predominantly agricultural, and rural populations consist primarily of farm households.[2] The overwhelming majority of these households are smallholders, conventionally defined as farming 10 hectares or less. Even within the smallholder sector, median farm sizes are very small: 1.2 ha for Zambia; and 0.8 ha for Malawi.[3] The small farm sector is characterized by low productivity, low levels of market engagement, and high poverty.

Both countries recognize two major tenure regimes: private (or leasehold) and customary (or traditional) tenure.[4] Customary lands are under the localized management of chiefs according to customary law. Specific terms of customary law vary across localities, but generally adhere to a model wherein usufruct rights to land resources within a chiefdom are allocated by the chief (or sometimes via their subordinate networks of headmen and *indunas*) to clan members. Familiar usufruct rights are generally heritable, but ultimately subject to possible reallocation by the chief.

Under leasehold tenure, land allocation is regulated by the market: titled lands may be bought and sold without restriction. In order to formally access customary lands through this mechanism, they must be first transferred from customary to leasehold status, as provided by the respective Lands Acts in either country.[5]

The vast majority of smallholders operate farms under customary tenure. Although an increasing number of smallholdings have been converted to leasehold tenure over the last decade, such holdings remain a minority (Sitko, Chamberlin and Hichaambwa 2014; Chirwa 2008).[6] Within customary lands, the buying and selling of land has no legal basis (although it is frequently carried out clandestinely under the guise of traditional mechanisms for transferring permanent usufruct rights [Sitko 2010]). Meanwhile, renting of customary landholdings, while also legally ambiguous, is something that the chief may tacitly or explicitly endorse. Thus, land rentals are found both within formal and customary tenure systems, while sales are mostly confined to titled land. Evidence suggests that fixed cash rent contracts are the dominant contractual form when smallholders rent in and rent out land (Holden, Kaarhus and Lunduka 2006, for Malawi).[7] These contractual arrangements are usually undocumented.

While Malawi and Zambia have many economic, cultural, and institutional similarities, one of the major structural differences between the two countries is the substantial contrast in population density. Official population density estimates in Malawi stand at 139 people/kilometers squared, while Zambia's official population density estimate is just 19.3 people/kilometers squared. It seems possible that differences in population density between the two countries could affect demand for land and subsequently the development of land rental and sales markets.

Table 1 indicates that according to our data, markets are much more developed in Malawi than in Zambia, which may in fact be due in part to Malawi's much higher rural population density. Nonetheless the table shows that rental market participation is growing in both countries over time. In Zambia the growth in land rental markets may be fueled by perceptions of land unavailability, which are widespread, but particularly strong in Zambia's higher density areas (Sitko, Chamberlin and Hichaambwa 2014). Almost nobody both rents in and rents out land, indicating that tenants and landlords are two distinct groups of households.

In summary, Malawi and Zambia constitute a two-country setting which is characterized by predominantly small farm sizes and high rates of poverty and food insecurity, and similar institutional environments, in which customary tenure predominates. Rental markets are legally ambiguous in customary lands but are nonetheless on the rise, particularly within higher density areas.

[TABLE 1 ABOUT HERE]

Literature review

Understanding the drivers and welfare impacts of land rental markets in SSA is extremely important given the high population growth projections for the region and perception of high and rising constraints to accessing land and concerns about the unequal distributions of landholdings (Holden and Otsuka 2014). As mentioned in the introduction, a key result from theoretical assessments of rental markets is that they have the potential to improve farm efficiency by facilitating the equilibration of land and non-land factor ratios across farm households, when non-land factor markets are imperfect (Deininger 2003; Feder 1985).[8] Such gains may be further enhanced by the inverse farm-size-productivity relationship, under which net transfers of land from land-rich to land-poor households would contribute to overall efficiency gains, in addition to welfare improvements. However, there are several reasons why we might question the ability of land markets to deliver on these theoretical benefits.

First, in the presence of transactions costs, such efficiency gains may be limited (Skoufias 1995). The general idea is that the presence of such costs drive a wedge between optimal and actual efficiency gains. [9] Empirical support for transactions costs in rental markets is particularly high in areas where land rights are tenuous or ambiguous, frequently alleged characteristics of customary tenure systems in the region (Teklu and Lemi 2004; Tikabo, Holden and Bergland 2008; Deininger, Ali and Alemu 2009; Ghebru and Holden 2009; Yamano *et al.* 2009; Lunduku, Holden and Øygard 2009; Holden and Bezabih 2009; Kassie and Holden 2009; Jin and Jayne 2013).

Furthermore, under certain conditions (e.g. limited access to credit), land market participation may be systematically easier for wealthier, land-rich households (Deininger and Jin 2008). If so, land markets may actually have a regressive impact on equity and efficiency outcomes. Empirical evidence on this question for Africa is mixed, with some studies finding that markets result in a net transfer of land from land-poor to land-rich households (Andre and Platteau 1998, for Rwanda; Zimmerman and Carter 1999, for Burkina Faso; Deininger, Ali and

Alemu 2009 and Ghebru and Holden 2009, for Ethiopia), while others find net transfers in the opposite direction (Lunduka, Holden and Øygard 2009, for Malawi; Deininger and Mpuga 2009, for Uganda; Yamano *et al.* 2009 and Jin and Jayne 2013 for Kenya). These results seem closely aligned to conclusions about whether or not land rental markets serve as safety nets for poor rural tenants (Deininger, Ali and Alemu 2009; Ghebru and Holden 2009; although these same studies show that poor landlords may experience welfare gains from such market characteristics).

Conceptual Model

Following Bliss and Stern (1982) and Skoufias (1995), we assume a household utility maximization model which asserts that land rental decisions (renting in, renting out, and autarky) are made in an effort to minimize the distance between a household's actual and desired farm size. Achieving desired farm size is an efficient outcome, but if there are transactions costs in the land rental market then the distance between actual and desired farm size will be different from zero. Desired farm size (and thus, rental market participation decisions) is conditioned by household endowments of non-tradable non-land assets, such as household farming ability, family labor, and other household characteristics. Therefore, the land rental decision for household i in village j is represented as follows:

$$R_{ij} = \zeta A^*_{ij}\left(\alpha_{ij}, H_{ij}, V_j\right) + \delta \bar{A}_{ij} + \varepsilon_{ij} \qquad (1)$$

where R_{ij} is the amount of land rented in or out by the household. When $R_{ij} > 0$, the household rents in land, and when $R_{ij} < 0$ the household rents out land. Actual pre-rental farm size is represented by $\bar{A}_{ij}$, and A^*_{ij} represents optimal (desired) farm size.[10] Household farming ability is represented by α, while H denotes other household endowment factors, and V represents community conditioning variables that are exogenous to the household. The error term is represented by ε_{ij}.

In this context, the household will find itself in one of three rental regimes: renting-in ($R_{ij} > 0$), renting-out ($R_{ij} < 0$), and autarky ($R_{ij} = 0$). Following Jin and Jayne (2013) this can be thought of as an ordinal response where the household picks one of the rental regimes. The rental decision can also be conceptualized as a continuous response, where the household considers the decision to rent in or rent out an additional hectare of land based on the marginal returns to renting in (out) relative to the net of the costs of renting. The returns to renting are a function of the same household and community factor α, H, and V presented in equation 1, along with the direct rental income that accrues to landlords. The costs of renting include both rental costs that tenants incur, and the transactions costs associated with renting land.

Empirical model and identification strategy

We operationalize the conceptual model in order to estimate land rental market impacts in three steps. First we estimate a model of a household's farming ability. Ability is an important determinant on rental market participation as seen in equation 1. However, since farming ability is not observed directly, we estimate it as the time-invariant innovation component of a household-level fixed-effects (FE) production function, following Jin and Jayne (2013). The model takes a modified Cobb-Douglas functional form for household i, village j and year t as:

$$log(Q_{ijt}) = \alpha_i + \beta_1\, log(A_{ijt}) + \beta_2\, log(L_{ijt}) + \beta_3\, log(X_{ijt}) + \beta_4\, V_{jt} + \beta_5\, T_t + \varepsilon_{ijt} \qquad (2)$$

where Q_{ijt} is real value of rainy season agricultural production, A_{ijt} is landholding, L_{ijt} is labor availability measured in adult equivalents in the household, X_{ijt} is a vector of other inputs such as fertilizer use, V_{jt} are village-level shifters and T_t are year-dummies. The time-invariant intercept α_i corresponds to our indicator of household farming ability. This is easily recovered following FE estimation. The other parameters to be estimated in equation (2) are represented by β_{1-5}. The error term in equation (2) is represented by ε_{ijt}.

The second estimation step takes the derived coefficient of ability, $\hat{\alpha}_i$ from equation (2), and adds it as a covariate in the model of factors affecting land rental market participation as follows:

$$R_{ijt} = \delta_1 \hat{\alpha}_i + \delta_2 F_{ijt} + \delta_3 L_{ijt} + \delta_4 Z_{ijt} + \delta_5 V_{jt} + \delta_5 T_t + \delta_6 R_{ij} + \mu_{ijt} \qquad (3)$$

Where R represents the households land rental market participation decision (rent-in, rent-out, autarkic) as in equation 1. The statistical significance of $\hat{\delta}_1$ tests the hypothesis of whether or not participation in land rental markets increases efficiency. If $\hat{\delta}_1 > 0$ in the renting in equation, and $\hat{\delta}_1 < 0$ in the renting out equation, it would indicate that land rental markets are transferring land from less efficient to more efficient farmers. Pre-rental landholding is denoted by F, with δ_2 as the corresponding coefficient. The statistical significance and sign of $\hat{\delta}_2$ tests the hypothesis of whether or not land rental markets promote equity (equality) by transferring land from relatively "land rich" to relatively "land poor" households. The parameter to be estimated on household labor L, measured in adult equivalents, is represented by δ_3. The statistical significance of $\hat{\delta}_3$ tests the hypothesis of whether or not land rental markets transfer land from relatively "labor rich" to relatively "labor poor households."

Other variables in equation (3) include a set of household-level factors that may affect rental market participation. These factors are represented by Z, and include model include gender of the household head, education of the household head in years, value of livestock and durable assets, if there was a death in the family over the past 2 years, and if the household head is an immigrant to the area, The corresponding parameter vector is represented by δ_4. Community-level variables in equation (3) are again represented by V, with as the corresponding parameter vector δ_5. These factors include population density, distance to paved road, and lagged rainfall and if land inheritance goes to daughters in the village (Matrilineal variable in Malawi). In addition, year and region dummies are also included in T, with parameter δ_6 . The error term in equation (3) is represented by μ_{ijt}. The rental decision in equation 3 is treated as binary, (rent-out =-1), autarkic=0, and rent-in=1, and the model is estimated via ordered probit. Standard errors in the models presented in equation (2) and (3) are obtained via bootstrapping at 300 repetitions to account for the two-step estimation process.

The third part of our estimation procedure estimates a set of models that we estimate are to determine how land rental participation affects a set of production, income and welfare indicators.

$$Y_{ijt} = \gamma_1 R_{ijt} + \gamma_2 F_{ijt} + \gamma_3 L_{ijt} + \gamma_4 Z_{ijt} + \gamma_5 V_{jt} + \gamma_6 T_t + \gamma_7 R_{ij} + e_{ijt} \quad (4)$$

Where the relevant indicator is represented by Y. Land rental market participation of the households is represented by R, with corresponding parameter γ_1. The equation is estimated when R is treated as both a binary decision (rent in/out or not), and when the decision is continuous (hectares rented in/out). The other variables included in equation (4) represent the same covariates as in equation (3), with γ_{1-7} representing the parameters to be estimated. The error term in equation (4) is represented by e_{ijt}.

Identification Strategy

This study uses observational data, and given that households do not randomly choose to rent in and rent out land we must deal with potential endogenetiy in order to identify consistent coefficient estimates in our models. It seems that the most likely source of endogeneity bias in this context comes from an omitted variable as households who have better land, better management skills, more social connections or perhaps are less risk averse are more likely (or less likely) to participate in rental markets. Failure to control for this would likely lead to coefficients that overestimate the impact of land rental participation on the welfare indicators of interest in this study.

Fortunately we have panel data in both Malawi and Zambia that can help us overcome this concern. Furthermore, the unobservable factors that concern us, such as land quality, management skills, social-connections, and risk aversion are do not vary much over time. Therefore we can use panel estimators to remove these time-constant, unobservables from the model and obtain consistent coefficient estimates of land rental market impacts. First, since the land rental market participation model in equation (3) is non-linear estimated via ordered probit, we employ the Mundlak-Chamberlain (MC) device, following Mundlak (1978) and Chamberlain (1984). The MC device employs household-level averages of all time-varying components of the model in order to control for unobserved time-invariant heterogeneity (under the assumption that such heterogeneity is correlated with the time-averages; see Wooldridge 2010 for elaboration).

Second, the welfare models estimated in equation (4) are treated as linear so the time-constant unobservable factors that may bias the land rental coefficients are completely removed from the model through the time-demeaning process.

Even after removing time-constant unobservable factors from our model, it is possible that land rental participation could be endogenous do to potential correlation with left over time varying shocks. We control for this possibility by including the major shocks that might affect smallholder households as observed covariates in our models. These variables are i) whether or not there was an adult death in the household over the past two years and ii) rainfall during the growing season. Furthermore, a recent study uses the same data sets in both Malawi and Zambia as in the present article (Mason and Ricker-Gilbert, 2013). The authors use the control function approach and find that after controlling for time-constant unobservables, unobserved time-varying shocks do not have a significant effect on the variables of interest in their study. For these reasons we feel that in the present context it is safe to assume that left-over time varying shocks are uncorrelated with land rental market decisions. That being said, as with any study that uses observational data, assuming full causality of our results should be treated with caution.

Data

Data used in this study for the Malawi analysis come from three surveys of rural farm households. The first wave of data comes from the Second Integrated Household Survey (IHHS2), a nationally representative survey conducted during the 2002/03 and 2003/04 growing seasons that covers 26 districts in Malawi. The second wave of data comes from the 2007 Agricultural Inputs Support Survey (AISS1) conducted after the 2006/07 growing season. The budget for AISS1 was much smaller than the budget for IHHS2 and of the 11,280 households interviewed in IHHS2, only 3,485 of them lived in enumeration areas that were re-sampled in 2007. Of these 3,485 households, 2,968 were re-interviewed in 2007, which gives us an attrition rate of 14.8%.

The third wave of data comes from the 2009 Agricultural Inputs Support Survey II (AISS2) conducted after the 2008/09 growing season. The AISS2 survey had a subsequently smaller budget than the AISS1 survey in 2007, so of the 2,968 households first sampled in 2003 and again in 2007, 1,642 of them lived in enumeration areas that were revisited in 2009. Of the 1,642 households in revisited areas, 1,375 were found for re-interview in 2009, which gives us an attrition rate of 16.3% between 2007 and 2009.

We focus our analysis on the 1,375 households who were interviewed in all three surveys and the 1,593 households who were interviewed in just the first and second surveys. This gives us a total sample size of 7,311 observations in the unbalanced panel used in the Malawi analysis. Of this total, removal of households without any crop production results in a final sample of 6,942 households.

Smallholder household data for Zambia come from the Supplemental Surveys carried out by the Zambian Central Statistical Office in association with the Zambian Ministry of Agriculture and Michigan State University's Food Security Research Project. These surveys are linked with the 2000 Post Harvest Survey for small and medium scale holdings. We construct a panel of 3,736 smallholder households for 2001 and 2008.[11] The survey is nationally representative and the sampling frame includes villages in 70 of Zambia's 72 Districts.[12]

Since the MC device and household FE is used in both the Malawi and Zambia estimates, households who were only interviewed in the first survey wave are not included because those households have values for the household time averages that are equivalent to their year t values.

Spatial data on market access, population density, and climate were used in both countries. Market access is defined as estimated travel time to the nearest town of 50,000 or more inhabitants, based on a model using geospatial data on roads, town location and year 2000 populations, landcover and slope. Data on rural population densities were obtained from the GRUMP database (Balk and Yetman 2004). Rainfall data were obtained from the TAMSAT/TARCAT project (Maidment et al. 2014). The data were brought into a common geographic information system (GIS) framework, where they were associated with geo-referenced survey households at the village level.[13]

Dealing with potential attrition bias

Households leaving the survey for non-random reasons between waves can potentially cause attrition bias in our coefficient estimates, and must be addressed in this analysis. We deal with this issue in the following ways. First, we control for the time-constant unobservable factors that affect attrition using the MC device in the participation model and household FE in the welfare models (Wooldridge 2010). Second any remaining unobservable time-varying factor affecting attrition is controlled for using inverse probability weights (IPW). The IPW technique involves three steps: (i) use probit to measure whether observable factors in one wave affect whether a household is re-interviewed in the next wave; (ii) obtain the predicted probabilities (Pr_{it}) of being re-interviewed in the following wave; (iii) compute the IPW = ($1/Pr_{it}$) and apply it to all models estimated. (For more information on IPW see Wooldridge, 2010, and Baulch and Quisumbing, 2011). Results indicate that the coefficient estimates in any of the models do not vary in any meaningful way between when IPW's are included and when they are not, indicating that attrition bias should not be a major concern in this context.

Results

Descriptive statistics for both countries are shown in table 2a for Malawi and table 2b for Zambia. Female-headed households are more likely to participate in rental markets as landlords than as tenants in both countries. This may indicate a lack of available labor for female headed households, or the possibility of some distressed rental on the part of female headed households when their husbands die or leave the home for other reasons. Tenant households (i.e. those who rent in at least some farmland) tend to have larger labor endowments and smaller land endowments than landlord households in both countries, as would be expected. We also see evidence that population density seems to be rising over time in areas with more active land rental markets. Immigrants are much more likely to be tenants than non-immigrants, although they are less likely to be landlords than non-immigrants. This is what we would expect *ex ante*, as people likely migrate in search of land.

[TABLE 2a ABOUT HERE]

[TABLE 2b ABOUT HERE]

Table 3a presents the Cobb-Douglas production function estimates for factors affecting the value of crop production in Malawi. The model is estimated via household FE. Results indicate that households with greater labor endowments (measured as household size in adult equivalents), larger landholding, a higher value of livestock and durable assets, and who use more fertilizer per hectare, have a significantly higher value of crop production on average than do other households. As discussed earlier, we use the time-invariant error component from these results as a measure of farmer ability, which is then incorporated as a regressor in the models of rental market participation.

[TABLE 3a ABOUT HERE]

Table 3b shows the Cobb-Douglass production function estimates for Zambia. Results are very similar to those for Malawi.. Household adult equivalents, landholding, assets, and fertilizer use per hectare have a statistically significant and positive effect on the value of crop production. As in the Malawi production function, we obtain a household-specific estimate of farming ability as the fixed effect estimate ($\hat{u}_i$) from these results, which we use in the rental market participation models described below.

[TABLE 3b ABOUT HERE]

Table 4a presents the results for Malawi when we evaluate the determinants of rental market participation using an ordered probit estimator with MC device. In this specification households are in 1 of 3 regimes as a tenant, autarkic, or a landlord. The ability coefficient derived from the production function estimated in table 3 shows that farmers with greater farming ability are more likely to rent in land. This supports the contention that rental markets enhance efficiency, as more talented farmers rent in land from less talented farmers. This finding is consistent with previous literature such as Holden, Otsuka and Place (2009a) and Jin and Jayne (2013). In addition, when we analyze the results from the landlord side of the market we find consistent results as more talented farmers are also less likely to rent out their land. This is also consistent with the idea of a net transfer of land from less-efficient to more efficient producers.

However, these findings differ from those in Jin and Jayne for Kenya, who find that more able farmers are more likely to participate in rental markets as tenants and as landlords. In our view, the Malawi results are more consistent with a net transfer of land to the most able producers.

We also find evidence in table 4a that is consistent with the idea that land rental markets generate equity (equality) as households with larger landholdings are more likely to rent out land but less likely to rent in land. This suggest that land rental markets transfer resources from relatively land-rich, to relatively land-poor households. In addition, households with more adult equivalents are significantly more likely to rent in land and significantly less likely to rent out land, indicating that rental markets transfer land from relatively labor-poor to relatively labor-rich households.

Table 4a also shows that more education households are significantly more likely to rent in land, and significantly less likely to rent out land. This finding provides some evidence to support the idea that better educated households are able to take advantage of the opportunity to acquire more farm land that land rental markets provide to them. We also find that migrants are significantly more likely to rent in land and less likely to rent out land. This is consistent with the descriptive statistics in table 2, and is what we would expect as people likely move from one rural area to anther in search of land to farm.

[TABLE 4a ABOUT HERE]

Table 4b presents results for factors affecting land rental market participation in Zambia, also estimated via ordered probit with MC device. As in Malawi, Zambian households with greater farming ability are significantly more likely to rent in land and significantly less likely to rent out land (p-value<0.10). This finding provides further evidence to suggesting that rental markets facilitate a net transfer of land from less productive to more productive households. Furthermore, households who have smaller landholdings are marginally more likely to rent in than other households (p-value=0.099). This suggests that rental markets transfer land to relatively land-poor households.

Other coefficient estimates are generally of the same in sign and of similar magnitude in the Zambia model as in the Malawi results, although fewer covariates are statistically significant (e.g. for adult equivalents). This may be the result of lower statistical power for the Zambia data, due to fewer market participants. Nonetheless, results for both countries are notably similar, suggesting that many of the same factors are at play in both country contexts.[14]

[TABLE 4b ABOUT HERE]

Next, we examine the impact of rental market participation on a number of welfare outcomes in Malawi, the results of which are presented in table 5a. For each outcome, we present two model specifications, differing only in how they measure rental market participation: in the first, we use binary indicators (*tenant*, *landlord*); in the second, we use continuous measures of the amount of land rented in or out, in hectares.

The first model (columns 1-2) estimates the factors affecting the gross value of crop production.[15] Results indicate that renting in land has a strong positive effect, as participating in the rental market as a tenant increases the value of crop production by US $118 on average, and each additional hectare rented in increases value of crop production by US $208 on average. Conversely, the binary decision to rent out land in column 1 indicates that doing so is associated with an average decrease of $84 in value of crop production, and an extra hectare rented out is associated with an extra $106 decline in value of crop production. This is what we might expect, as renting out land means that the household has less land to cultivate.

Columns 3-4 indicates that renting in land has a positive impact on average crop income, net of rental costs, fertilizer costs, seed costs and hired labor. However, average profits for participating (shown in column 3) at $72 are just over 60% of revenue from participating (shown in column 1). In column 4, average profits for an extra hectare rented in are $181, about 87% of revenue (shown in column 2). As expected, the returns to net crop income for landlords are negative for both the binary participation specification (column 3) and for the continuous specification of number of hectares rented in (column 4).

We examine the impacts of renting land on off-farm income to see if there is any evidence of crowding out of off-farm work from land renting, the results of which are presented in columns 5 and 6. Coefficient estimates suggest that renting in and renting out land do not have statistically significant effects on off-farm income in any of the specifications. It is perhaps concerning that while we find evidence indicating that landlords have significantly lower value of crop production and net crop incomes than autarkic households (columns 1-4), columns 5 and 6 provide no evidence to suggest that landlords are able to generate higher off-farm income with the money they earn from renting out land.

Columns 7 and 8 present factors affecting net total household income, which includes all on- and off-farm activities during the year, excluding working as an agricultural laborer on other farms (called *ganyu* in both Malawi and Zambia). Results suggest that renting in land has a positive and statistically significant and economically meaningful effect in column 8. The average return to total household income from an additional hectare rented in is $153. The impacts are negative and statistically significant for renting out in both columns 7 and 8. This finding is consistent with the notion of distress sales by landlords as they rent out land to obtain money at planting, thus leading to lower crop income. In addition, landlords seem to be unable to invest the rental income in other activities that could provide a significant return to off-farm or total household income.

Columns 9 and 10 of table 5a measure the impact on the number of months a household expects staples to last. Responses range from 0 to 12 months. Coefficient estimates from column 9 indicate that participation as a tenant is associated with the household's staple crop production lasting 0.71 months longer than non-participants on average. An extra hectare rented in (column 10) is associated with a household's staple crop production lasting about 1.29 months longer than autarkic households on average. The impact of length of staple crop production lasting is not statistically significant for landlords in column 9, but an additional hectare of land rented out is associated with staple crop production lasting 0.98 months longer. This may seem surprising, but it could be that households who have enough land to rent out one hectare or more do so because they have sufficient land to produce enough food to meet their own consumption needs, relative to autarkic households.

Households' subjective assessments of wellbeing is measured on a scale of 1 to 5; Coefficient estimates are shown in columns 11 and 12 of table 5a. Results indicate a positive impact of rental market participation on these scores for tenants, while there is no evidence of any significant effect for landlords.

Columns 13 and 14 of table 9 present the determinants of the probability of falling below the poverty line (defined as under $1.25 per person per day in purchasing power parity terms)[16]. This is estimated via probit and the average partial effects indicate that renting in is associated with a 9.43 percentage point lower probability of being below this poverty line on average, while each hectare rented in is associated with 7.81 percentage point lower probability of being in poverty on average. The impact of renting out land on poverty is not statistically significant in either columns 13 or 14.

In summarizing the welfare results in table 5a, several observations stand out. First, the positive welfare impacts of renting in land are remarkably consistent across these multiple outcome indicators, indicating a positive impact from renting in land. Second, we generally find insignificant or negative impacts from renting out land. This would be consistent with a situation in which at least some tenants are engaging in stress rentals, in which welfare maximization is constrained by a smaller choice set (e.g. lower potential for own-farm production for female-headed and other resource-constrained households). Third, the continuous measures provide important information that compliments the binary measures of market participation. This indicates the importance of looking beyond simple binary participation variable; the extent of participation matters.

[TABLE 5a ABOUT HERE]

Table 5b present the factors affecting selected welfare outcomes for Zambia, which are a smaller set than is available for Malawi due to data limitations. Here we focus on 5 outcomes: i) gross value of crop production, iii) net crop income, iii) net off-farm income, iv) net total household income, and v) poverty status (i.e. under $1.25 per person per day in purchasing power parity terms).

Coefficient estimates for factors affecting gross value of crop production are presented in columns 1 and 2. Results indicate that renting in land has a strong positive impact on production in both specifications. Participating in renting in land is associated with an additional US $156 in crop production on average, while an additional hectare rented in provides the household with an extra US $138 on average. Renting out land does not have a statistically significant impact on value of crop production in column 2. Results for the determinants of net crop income (columns 3 and 4) are positive but smaller than for value of crop production as we would expect due to input costs. The coefficients are statistically insignificant in the binary tenant specification, but significant in continuous specification of hectares rented in. The coefficient estimates are statistically insignificant for landlords in either specification.[17]

As in the Malawi case, here we also examine the impact of renting in and renting out on net off-farm income to see if there is any crowding out of off-farm work as a result of rental market participation (columns 5 and 6). Our results indicate that the only coefficient estimate that is close to being statistically significant is participation as a landlord in column 5. In this specification being a landlord increases off-farm income by $357 on average (p-value=0.159). This finding is consistent with columns 7 and 8 which show factors impacting total household income for Zambia. Here again, the only marginally significant impact from land markets on income is through participating as a landlord (column 7). Estimation results suggest that participation as a landlord lifts total household income by $471 on average (p-value=0.084). These results suggest that landlords in Zambia are able to take the income that they earn from renting out land and reinvest it in off-farm activities.

In columns 9 and 10 we find that an additional hectare land rented in reduces the probability that a household is in poverty by 16.04 percentage points (0.050). The coefficient estimates on the landlord side indicate that renting out land reduces the probability that a household is in poverty by 46.57 percentage points in column 9 and by 44.81 percentage points in column 10. Poverty reduction for landlords appears to be working through households renting out their land and re-investing the money into off-farm income.

Overall, the welfare impacts from land rental markets in Zambia are generally positive , although somewhat less pronounced than in Malawi. This is possibly due to the relatively underdeveloped state of rental markets in Zambia, indicating that land renting has yet to have a statistically significant effect on well-being across the smallholder population in that country.

[TABLE 10 ABOUT HERE]

Distributional impacts of land rental markets

While the econometric results suggest a generally positive welfare impact of rental market participation, particularly for households in Malawi who rent in land, it is worth pushing the analysis further by estimating the magnitude of these impacts across the smallholder distribution.

Table 6 shows the distribution of rental rates as a share of the value of crop production per hectare in Malawi. At the median, rental rates are equal to about a quarter of the value of production (for renters; the share is slightly higher for the entire sample, as we would expect). However at the 75th percentile, almost half of the value of production on rented land is being consumed by rental costs. This indicates that, land renting is expensive relative to revenue. Furthermore, when other costs such as seed, fertilizer, and hired labor are considered it is likely to take a long time for many smallholder to generate substantial wealth through farming on rented land, if it is possible to do so at all.

[TABLE 6 ABOUT HERE]

To further examine the distributional welfare impacts of rental market participation, we estimate the net crop income model (originally presented in columns 3 and 4 of table 5a) for Malawi using quantile regression.[18] The results for the specification that treats rental market participation as binary are shown in table 7. Results suggest that the returns to being a tenant are much smaller at the lower end of the crop income distribution than they are at the top of it. The impact from being a tenant on net crop income only becomes marginally statistically significant at the median, with the median household earning at $10.91 from participating as a tenant, but this compares to a mean return of $72.39. The fact that the mean is so much higher than the median (the mean is substantially higher than the 75th percentile of the distribution) suggests that the benefits from renting in land may be skewed to a small group of people at the top of the distribution.

It appears that on the landlord side of the market most of the crop income losses occur to people in the upper end of the net crop income distribution as the mean loss is above the loss at the 90th percentile. This is not surprising as households who have higher crop income have more to lose when they rent out their land.

These findings provide evidence to suggest that while land rental markets may be facilitating transfer of land to more able households, and land-poor households, and labor-rich households which leads to income gains and poverty reduction on average, when we consider the cost of participating in land rental markets and look at the impacts across the distribution of smallholders, the results are less positive. Given the quantile regression results in table 7, it seems that returns to renting land are mainly going to top producers who likely have an easier time accessing land rental markets in the first place. This is especially the case when the costs of renting land are high and rising as evidenced by land rental prices in table 2, and when land rental costs constitute a substantial share of revenue, as shown in table 6. In addition, the predominance of upfront cash rental arrangements in Malawi likely makes it difficult for limited resource farmers to obtain the cash to even enter into these markets.

[TABLE 7 ABOUT HERE]

Conclusions

The objectives of this study are to determine the factors that influence smallholder African farmers' decisions to participate in rural land rental markets, and their subsequent impact on household welfare. The analysis is conducted in Malawi and Zambia, two neighboring countries in southern Africa that have many institutional, economic, and cultural similarities, but have very different rural population densities, representing a spectrum of land scarcity conditions. Our study indicates that while there are very different levels of participation in the two countries, rental markets in both countries are performing similarly in many respects. The main results of the study are as follows.

First, we find that rental markets are much more active in Malawi than in Zambia, with more than 15% of Malawian smallholders renting in some land in 2008/09, compared to 3% of households in Zambia in 2012/13. This difference may be driven in part by necessity, as Malawi has a significantly higher population density than Zambia, although we find no direct evidence of population density influencing rental market participation in our models. Second, we find that rental market participation is growing in both countries, for both tenants and landlords. Third, we find that land rental markets in both Malawi and Zambia promote efficiency by transferring land from less able to more able farmers. Fourth, land rental markets promote equity by transferring land from relatively land-rich to land-poor households, and (for Malawi only) from relatively labor-poor to labor-rich households. This is consistent with other recent literature indicating positive efficiency and equity impacts of rental markets (e.g. Holden, Otsuka and Place 2009a).

Fifth, while the determinants of land rental market participation are found to be similar in Malawi and Zambia, the direct impacts on household welfare differ across the two countries. In Malawi, we find clear evidence that renting in land has a positive effect on the value of crop revenue, crop income, off-farm income, total household income, food security and poverty reduction. Conversely, renting out land has a small negative (or no) impact on most of these outcomes. This may provide some evidence of distressed renting out in Malawi, as households who rent out land appear to be unable to take the rental income and engage in other on-farm or off-farm activities in a way that generates a positive and statistically significant return. The welfare impacts in Zambia suggest that landlords in Zambia are able to re-invest their income earned from renting out land in a manner that increases their household income and reduces poverty, compared to autarkic households in that country.

Sixth, while the Malawi results indicate that renting in land generates positive impacts on average, the cost of renting land has been increasing recently, and constitutes a significant share of crop revenue. Therefore, it may be difficult for limited resource households to access these markets, especially in the context where most of the rental arrangements are up-front cash rentals. Quantile regression results support this notion as most of the highest returns to renting in land go to those at the top of the crop income distribution. This indicates that returns to renting land are uneven, and there may be some inequality in these markets in terms of who obtains the majority of the benefits from participation.

The findings from this study suggest several important policy considerations, particularly with respect to rural welfare improvement objectives. Our study indicates that the welfare benefits of rental markets may be enhanced by lowering transactions costs, improving land and labor productivity (and thus, returns to cultivation) or both. While more research is needed to identify the nature of transactions costs, it is probably safe to assume that the ambiguity of usufruct rights in customary tenure systems represents and important set of costs, e.g. costs involving screening partners in settings where the sanctioning of land rentals by local authorities is uncertain. Thus, clarifying land rights in customary systems may play an important role in lowering costs of participation. Second, land and labor productivity is very low, on average, in both countries and this diminishes the potential returns to renting in land. Continued promotion of productivity-enhancing investments (which include, but are not limited to, inorganic fertilizer usage) may be very important in this context. Recognizing that the smallest (and poorest) farmers often have systematically disadvantaged access to input support and output marketing schemes is similarly important (Mason and Ricker-Gilbert 2013). Thus, the continued development of rural land markets is deeply connected with other policies designed to clarify resource rights and enhance productivity within the smallholder sector.

References

André, C., and J. Platteau. 1998. "Land relations under unbearable stress: Rwanda caught in the Malthusian trap." *Journal of Economic Behavior & Organization* 34:1-47.

Balk, D., and G. Yetman. 2004. "The Global Distribution of Population: Evaluating the gains in resolution refinement." Center for International Earth Science Information Network, (CIESIN), Columbia University, Palisades, NY.

Baulch, B., and A. Quisumbing. 2011. "Testing and adjusting for attrition in household panel data." Toolkit Note, Chronic Poverty Research Centre (CPRC), Institute for Development Policy and Management, School of Environment and Development, University of Manchester, Manchester, UK.

Binswanger, H. P., and M. Rosenzweig. 1986. Behavioral and Material Determinants of Production Relations in Agriculture. *Journal of Development Studies* 22(3): 503-539.

Bliss, C. J., and N. H. Stern. 1982. Palanpur: The Economy of an Indian Village. Delhi and New York: Oxford University Press.

Brown, T. 2005. "Contestation, confusion and corruption: Market-based land reform in Zambia." Chapter 3, in: Evers, S., M. Spierenburg, and H. Wels, eds. Competing Jurisdictions: Settling Land Claims In Africa, Brill Publishing, Leiden, pp. 79-107.

Chamberlain, G. 1984. "Panel Data". In: Grilliches, Z., Intriligator, M.D. (Eds.), Handbook of Econometrics, volume 2. North-Holland, Amsterdam, pp. 1248-1318.

Chapoto, A., D. Banda, S. Haggblade, and P. Hamukwala. 2011. "Factors Affecting Poverty Dynamics in Rural Zambia." Working Paper No. 55, Food Security Research Project, Lusaka, Zambia, July 2011.

Chirwa, E. 2008. "Land Tenure, Farm Investments and Food Production in Malawi." Institutions and Pro-Poor Growth (IPPG) Discussion Paper Series. No. 18.

Deininger, K. 2003. *Land policies for growth and poverty reduction.* World Bank Policy Research Report, World Bank and Oxford University Press.

Deininger, K., D. A. Ali and T. Alemu. 2009. "Land Rental Markets: Transactions Costs and Tenure Insecurity in Rural Ethiopia." Chapter 3 in Holden, S. T., K. Otsuka and F. M. Place, eds. *The Emergence of Land Markets in Africa: Impacts on Poverty, Equity and Efficiency*, Resources for the Future Press, Washington, D.C., pp. 57-73.

Deininger, K., and S. Jin. 2008. "Land Sales and Rental Markets in Transition: Evidence from Rural Vietnam." *Oxford Bulletin of Economics and Statistics* (70): 67–101.

Deininger, K., and P. Mpuga. 2003. "Land Markets in Uganda: Incidence, Impact and Evolution over Time." *Proceedings of the 25th International Conference of Agricultural Economists* (IAAE), 16-22 August 2003, Durban, South Africa.

Ellis, F. and E. Manda. 2012. "Seasonal Food Crises and Policy Responses: A Narrative Account of Three Food Security Crises in Malawi." *World Development* 40(7):1407–1417.

Feder, G. 1985. "The Relationship between Farm Size and Farm Productivity: The Role of Family Labor, Supervision and Credit Constraints." *Journal of Development Economics* 18(2–3): 297–313.

Ghebru, H. and S. T. Holden. 2009. "Factor Market Imperfections and Rural Land Rental Markets in Northern Ethiopian Highlands." Chapter 4 in: Holden, S. T., K. Otsuka and F. M. Place, eds. *The Emergence of Land Markets in Africa: Impacts on Poverty, Equity and Efficiency*, Resources for the Future Press, Washington, D.C., pp. 74-92.

Holden, S. T. and M. Bezabih. 2009. "Gender and Land Productivity on Rented Land in Ethiopia." Chapter 9 in: Holden, S. T., K. Otsuka and F. M. Place, eds. *The Emergence of*

Land Markets in Africa: Impacts on Poverty, Equity and Efficiency, Resources for the Future Press, Washington, D.C., pp. 179-198.

Holden, S. T., R. Kaarhus, and R. Lunduka. 2006. "Land Policy Reform: The Role of Land Markets and Women's Land Rights in Malawi." Noragric Report 36, Norwegian University of Life Sciences, Ås, Norway.

Holden, S. T., K. Otsuka and F. M. Place, eds. 2009a. *The Emergence of Land Markets in Africa: Impacts on Poverty, Equity and Efficiency*. Resources for the Future Press, Washington, D.C.

Holden, S. T., K. Otsuka and F. M. Place. 2009b. "Understanding land markets." Chapter 2 in: Holden, S. T., K. Otsuka and F. M. Place, eds. *The Emergence of Land Markets in Africa: Impacts on Poverty, Equity and Efficiency*, Resources for the Future Press, Washington, D.C., pp. 18-51.

Holden, S. T. and K. Otsuka. 2014. "The Roles of Land Tenure Reforms and Land Markets in the Context of Population Growth and Land Use Intensification in Africa." *Food Policy* 48:88-97.

Jayne, T. S., J. Chamberlin and D. Headey. 2014. Land Pressures, the Evolution of Farming Systems, and Development Strategies in Africa: A Synthesis. *Food Policy* 48:1-17.

Jin, S., and T.S. Jayne. 2013. "Land Rental Markets in Kenya: Implications for Efficiency, Equity, Household Income, and Poverty." *Land Economics* 89(2):246-271.

Kassie, M. and S. T. Holden 2009. "Kinship, Tenure Insecurity, Input Use and Land Productivity: The Case of Sharecropping in Ethiopia." Chapter 10 in: Holden, S. T., K. Otsuka and F. M. Place, eds. *The Emergence of Land Markets in Africa: Impacts on Poverty, Equity and Efficiency*, Resources for the Future Press, Washington, D.C., pp. 197-211.

Lunduka, R. 2009. "Land Rental Markets, Investment and Productivity Under Customary Land Tenure Systems in Malawi." PhD Thesis, Department of Economics and Resource Management, Norwegian University of Life Sciences, Ås, Norway.

Lunduka, R., S. T. Holden and R. Øygard. 2009. "Land Rental Market Participation and Tenure Security in Malawi." Chapter 6 in: Holden, S. T., K. Otsuka and F. M. Place, eds. *The*

Emergence of Land Markets in Africa: Impacts on Poverty, Equity and Efficiency, Resources for the Future Press, Washington, D.C., pp. 112-130.

Maidment, R. I., D. Grimes, R. P. Allan, E. Tarnavsky, M. Stringer, T. Hewison, R. Roebeling, and E. Black. 2014. "The 30-year TAMSAT African Rainfall Climatology and Time-series (TARCAT) Dataset." *Journal of Geophysical Research: Atmospheres* 119(18):10619–10644.

Mason, N. and J. Ricker-Gilbert. 2013. “Disrupting Demand for Commercial Seed: Input Subsidies in Malawi and Zambia.” *World Development* 45:75-91.

Mundlak, Y. 1978. “On the pooling of time series and cross section data.” *Econometrica* 46(1):69-85.

Otsuka, K. 2007. “Efficiency and Equity Effects of Land Markets.” In Evenson, R.E. and P. Pingali, eds. *Handbook of Agricultural Economics*, Vol. III, Elsevier, Amsterdam, pp. 2672-2703.

Otsuka, K., H. Chuma and Y. Hayami. 1992. “Land and Labor Contracts in Agrarian Economies: Theories and Facts.” *Journal of Economic Literature* 30 (4): 1965-2018.

Sitko, N. J. 2010. “Fractured governance and local frictions: the exclusionary nature of a clandestine land market in southern Zambia.” *Africa* 80(1):36-55.

Sitko, N. J., J. Chamberlin and M. Hichaambwa. 2014. “Does Smallholder Land Titling Facilitate Agricultural Growth? An Analysis of the Determinants and Effects of Smallholder Land Titling in Zambia.” *World Development* 64:791–802.

Skoufias, E. 1995. “Household Resources, Transaction Costs, and Adjustment through Land Tenancy.” *Land Economics* 71(1):42-56.

Teklu, T. and A. Lemi. 2004. “Factors Affecting Entry and Intensity in Informal Rental Land Markets in Southern Ethiopian Highlands.” *Agricultural Economics* 30(2)117-128.

Tikabo, M. O., S.T. Holden and O. Bergland. 2008. “Factor Market Imperfection and the Land Rental Market in the Highlands of Eritrea: Theory and Evidence.” Department of Economics and Resource Management, Norwegian University of Life Sciences, Ås, Norway.

Wooldridge, J. M. 2010. *Econometric Analysis of Cross Section and Panel Data*, 2nd Edition, MIT Press, Cambridge, MA.

Yamano, T., F. M. Place, W. Nyangena, J. Wanjiku and K. Otsuka. 2009. "Efficiency and Equity Impacts of Land Markets in Kenya." Chapter 5 in: Holden, S. T., K. Otsuka and F. M. Place, eds. *The Emergence of Land Markets in Africa: Impacts on Poverty, Equity and Efficiency*, Resources for the Future Press, Washington, D.C., pp. 93-111.

Zimmerman, F. J., and M. R. Carter. 1999. "A Dynamic Option Value for Institutional Change: Marketable Property Rights in the Sahel." *American Journal of Agricultural Economics* 81(2):467–478.

Table 1: Rental Status of the Sample by Survey Wave

	Malawi			Zambia		
	2002/03	2006/07	2008/09	2001/02	2008/09	2012/13
% of sample renting in land	7.5%	13.4%	15.4%	0.9%	1.2%	3.0%
% of sample renting out land	4.3%	5.3%	8.9%	0.1%	0.7%	0.5%
% of sample renting in and renting out land	0.004%	0.002%	0.002%	0.000%	0.000%	0.000%
% of sample that does not rent in or out	89%	80%	76%	99%	98%	97%
Average area rented in unconditional (hectares)	0.06	0.08	0.07	0.01	0.02	0.03
Average area rented out unconditional (hectare)	0.03	0.04	0.05	0.01	0.01	0.01
Average area rented in conditional on renting (hectares)	0.62	0.68	0.63	1.14	1.16	1.06
Average area rented out conditional on renting (hectare)	0.76	0.58	0.47	1.12	0.41	1.59
Median land rental price (Real 2009 Kwacha/hectare)	3,294	3,521	5,761	83,257	92,592	101,174
Median retail lean season maize price (Real 2009 Kwacha/kg)	22	22	40	--	--	--
Median agricultural wage rate (Real 2009 Kwacha/day)	159	170	286	--	--	--
Median commercial maize seed price (Real 2009 Kwacha/kg)	-	95	167	--	--	--
Median commercial NPK & urea price (Real 2009 Kwacha/kg)	63	83	130	--	--	--

Table 2a: Household Characteristics by Rental Status and Survey Wave in Malawi

	2002/03 & 2003/04			**2006/07**			**2008/09**		
Characteristics	*HH renting in*	*HH renting out*	*autarkic*	*HH renting in*	*HH renting out*	*autarkic*	*HH renting in*	*HH renting out*	*autarkic*
% female headed	17	29	25	18	24	26	22	28	30
Adult equivalents	4.5	4.1	3.7	4.6	4.2	4.1	4.8	4.4	4.3
Number of working age adults	4.5	3.9	3.5	4.6	4.2	4.0	4.8	4.4	4.2
Landholding (ha)	0.7	1.6	1.1	0.9	1.6	1.0	0.7	1.8	1.0
Value of assets ('000 kwacha)	78.5	29.9	33.0	70.5	37.6	47.5	59.1	52.4	56.8
% of household heads attending school	80	68	71	78	67	72	81	70	73
% staple deficit in maize last year	--	--	--	60	64	64	72	80	76
Distance to paved road	14.88	17.14	16.86	15.64	19.26	16.77	16.31	21.88	16.64
% in matrilineal villages	68	70	67	66	63	68	66	57	67
Population density (persons per sqr km)	183	174	169	229	201	209	289	216	257
Years HH head lived in village	23	31	30	25	32	30	24	33	30
# older men in HH, over 65	0.06	0.18	0.09	0.07	0.11	0.11	0.07	0.17	0.12
% immigrants	29	3	14	22	6	13	19	7	12
% farm credit access in village	47	28	30	28	35	30	32	40	31

Notes: HH=household; N=6,942

Table 2b: Household Characteristics by Rental Status and Survey Wave in Zambia

	2000/01			**2007/08**			**2011/12**		
Characteristics	*HH renting in*	*HH renting out*	*autarkic*	*HH renting in*	*HH renting out*	*autarkic*	*HH renting in*	*HH renting out*	*autarkic*
% female headed	5	20	56	7	23	10	15	31	24
Adult equivalents	7.0	4.9	4.7	6.7	5.2	5.5	4.8	5.4	4.4
Number of working age adults	3.5	3.0	2.7	4.2	3.1	3.1	3.1	3.2	2.6
Land owned (hectares)	0.7	3.2	9.6	1.7	3.1	4.1	1.9	2.6	1.6
Value of assets ('000 kwacha)	1,245	1,950	1,741	7,917	2,758	1,618	16.6	4.9	7.9
% of household heads attending school	97	82	100	89	84	100	94	84	87
% in matrilineal villages	55	40	31	39	40	36	36	55	36
Population density (persons per sqr km)	16.7	16.8	31.2	24.5	19.3	28.1	32.9	26.2	19.0
Years HH head lived in village	--	--	--	--	--	--	17	37	26
% immigrants	52	13	0	30	13	31	71	36	55

Notes: HH=household; N=7,860

Table 3a: Cobb-Douglass production function for Malawi

	(1)	
	Log value of crop production	
	coef.	p-value
Log fertilizer (kg/ha)	0.0908	(0.000)***
Log adult equivalents	0.1686	(0.001)***
Log landholding (ha)	0.4289	(0.000)***
Female (=1)	0.0430	(0.538)
Mortality (=1)	-0.0137	(0.777)
Log assets (USD)	0.1630	(0.000)***
Log rainfall (mm)	0.1292	(0.302)
Log pop. density	0.1618	(0.814)
2002	-0.3653	(0.121)
2003	-0.1483	(0.558)
2007	-0.8350	(0.000)***
N	6942	

Note: Table shows coefficient estimates from fixed effects regression. Standard errors are robust to clustering at the community level. Significance denoted by: * p<0.10, ** p<0.05, *** p<0.01

Table 3b: Cobb-Douglass production function for Zambia

	(1)	
	Log value of production	
	APE	p-value
Log fertilizer (kg/ha)	0.0939	(0.000)***
Log adult equivalents	0.1492	(0.001)***
Log landholding (ha)	0.2800	(0.000)***
Female head (=1)	-0.2081	(0.034)**
Mortality (=1)	-0.2069	(0.094)*
Log assets (USD)	0.0571	(0.000)***
Log rainfall (mm)	1.0532	(0.005)***
Log pop. density	-0.0250	(0.848)
2008	0.2773	(0.001)***
N	7860	

Note: Table shows coefficient estimates from fixed effects regression. Standard errors are robust to clustering at the community level. * $p<0.10$, ** $p<0.05$, *** $p<0.01$

Table 4a: Determinants of rental market participation in Malawi, estimated via ordered Probit.

	(1)		(2)		(3)	
	Renting in		Autarky		Renting out	
	APE	p-value	APE	p-value	APE	p-value
Ability	0.0196	(0.000)***	-0.0090	(0.000)***	-0.0106	(0.000)***
Adult equivalents	0.0126	(0.000)***	-0.0058	(0.000)***	-0.0068	(0.000)***
Landholding (ha)	-0.0354	(0.000)***	0.0162	(0.000)***	0.0192	(0.000)***
Female head (=1)	-0.0010	(0.882)	0.0005	(0.876)	0.0005	(0.888)
Education of head (years)	0.0054	(0.000)***	-0.0025	(0.000)***	-0.0029	(0.000)***
Age of head	-0.0004	(0.072)*	0.0002	(0.081)*	0.0002	(0.071)*
Assets ('000*USD)	0.0017	(0.575)	-0.0008	(0.563)	-0.0009	(0.587)
Immigrant (=1)	0.0859	(0.000)***	-0.0561	(0.000)***	-0.0299	(0.000)***
Mortality (=1)	0.0013	(0.927)	-0.0006	(0.932)	-0.0007	(0.923)
Matrilineal (=1)	-0.0073	(0.432)	0.0034	(0.454)	0.0038	(0.416)
Lagged maize price (rainy)	-0.0982	(0.652)	0.0450	(0.655)	0.0533	(0.650)
Lagged maize price (harvest)	0.4250	(0.083)*	-0.1946	(0.087)*	-0.2304	(0.085)*
Log rainfall	0.0233	(0.190)	-0.0107	(0.181)	-0.0126	(0.201)
Population density	0.0001	(0.335)	-0.0000	(0.326)	-0.0000	(0.347)
Km to road	0.0002	(0.193)	-0.0001	(0.209)	-0.0001	(0.188)
Central	0.0338	(0.001)***	-0.0134	(0.002)***	-0.0204	(0.003)***
South	0.0201	(0.077)*	-0.0066	(0.048)**	-0.0135	(0.102)
2002	0.0460	(0.037)**	-0.0210	(0.036)**	-0.0249	(0.042)**
2003	0.0165	(0.356)	-0.0076	(0.362)	-0.0090	(0.353)
2007	0.0517	(0.009)***	-0.0237	(0.008)***	-0.0280	(0.012)**
N	6942		6942		6942	

Note: Coefficient estimates are the Average Partial Effects (APE). All models are estimated via ordered probit with the Mundlak-Chamberlain device that includes time-averages of all time-varying covariates (not shown). Year and province dummies are included but not shown. Bootstrapped p-values shown in parentheses: * p<0.10, ** p<0.05, *** p<0.01.

Table 4b: Determinants of rental market participation in Zambia (partial effects from ordered Probit model)

	(1)		(2)		(3)	
	Renting in		Autarky		Renting out	
	APE	p-value	APE	p-value	APE	p-value
Ability	0.0034	(0.019)**	-0.0016	(0.035)**	-0.0018	(0.059)*
Adult equivalents	0.0002	(0.845)	-0.0001	(0.851)	-0.0001	(0.849)
Landholding (ha)	-0.0002	(0.099)*	0.0001	(0.137)	0.0001	(0.150)
Female head (=1)	-0.0042	(0.196)	0.0013	(0.659)	0.0029	(0.545)
Education of head (years)	-0.0000	(0.944)	0.0000	(0.946)	0.0000	(0.946)
Age of head	-0.0002	(0.116)	0.0001	(0.230)	0.0001	(0.096)*
Assets (1000s USD)	0.0006	(0.364)	-0.0003	(0.353)	-0.0003	(0.413)
Immigrant (=1)	0.0125	(0.028)**	-0.0092	(0.088)*	-0.0033	(0.000)***
Mortality (=1)	0.0031	(0.719)	-0.0018	(0.758)	-0.0012	(0.708)
Matrilineal (=1)	0.0030	(0.271)	-0.0015	(0.332)	-0.0015	(0.273)
Lagged maize price	0.0000	(0.379)	-0.0000	(0.407)	-0.0000	(0.405)
Log lagged rainfall (mm)	0.0095	(0.229)	-0.0045	(0.229)	-0.0049	(0.288)
Population density	-0.0001	(0.304)	0.0000	(0.342)	0.0000	(0.331)
Km to road	0.0001	(0.311)	-0.0000	(0.341)	-0.0000	(0.325)
2008	-0.0048	(0.591)	0.0023	(0.560)	0.0025	(0.634)
N	7698		7698		7698	

Note: Coefficient estimates are the Average Partial Effects (APE). All models are estimated via ordered probit with the Mundlak-Chamberlain device that includes time-averages of all time-varying covariates (not shown). Year and province dummies are included but not shown. Bootstrapped p-values shown in parentheses: * p<0.10, ** p<0.05, *** p<0.01.

Table 5a: Welfare impacts of rental market participation in Malawi

	Value of crop production (USD)		Net crop income (USD)		Net off-farm income (USD)		Net total household income (USD)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Tenant (=1)	118.2320		72.3953		-33.0360		42.3451	
	(0.000)***		(0.001)***		(0.463)		(0.389)	
Landlord (=1)	-83.7949		-95.0686		-26.5993		-145.1319	
	(0.033)**		(0.018)**		(0.467)		(0.027)**	
Ha rented in		208.1458		180.5940		-23.6094		152.9715
		(0.002)***		(0.002)***		(0.662)		(0.061)*
Ha rented out		-105.8355		-135.8716		-17.7318		-169.7044
		(0.012)**		(0.006)***		(0.764)		(0.068)*
landholding (ha)	104.0949	101.8167	81.4699	81.3692	-5.5808	-4.7401	77.1611	77.6824
	(0.000)***	(0.000)***	(0.005)***	(0.004)***	(0.847)	(0.873)	(0.052)*	(0.054)*
Adult equivalents	13.5286	12.9226	9.5188	8.4022	17.0574	16.8520	33.4392	32.2267
	(0.008)***	(0.010)**	(0.041)**	(0.067)*	(0.033)**	(0.037)**	(0.001)***	(0.001)***
Female head (=1)	-38.1711	-34.3301	-23.6926	-20.1489	-83.0672	-83.5216	-114.6998	-111.6097
	(0.059)*	(0.082)*	(0.204)	(0.269)	(0.009)***	(0.009)***	(0.003)***	(0.004)***
Assets (1000s USD)	30.9166	29.8337	17.3742	16.3625	29.6698	29.7904	58.0946	57.2671
	(0.149)	(0.151)	(0.225)	(0.228)	(0.188)	(0.187)	(0.159)	(0.159)
Fertilizer (kg/ha)	0.0657	0.0679	-0.0169	-0.0143	0.0108	0.0105	0.0032	0.0050
	(0.137)	(0.141)	(0.465)	(0.502)	(0.645)	(0.653)	(0.925)	(0.881)
Mortality (=1)	16.5927	17.5587	14.5764	14.8623	54.0538	53.3103	66.4409	65.9190
	(0.180)	(0.142)	(0.255)	(0.232)	(0.185)	(0.193)	(0.138)	(0.141)
Rainfall (mm)	0.0074	-0.0001	0.0349	0.0263	0.0387	0.0382	0.0526	0.0437
	(0.833)	(0.997)	(0.314)	(0.438)	(0.319)	(0.329)	(0.348)	(0.434)
2002	-118.4711	-123.0416	-81.8054	-85.2558	-64.2856	-62.7116	-168.9172	-170.6011
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.048)**	(0.050)*	(0.000)***	(0.000)***
2003	-85.7575	-93.4168	-56.4917	-61.9280	-33.6977	-31.3492	-94.5199	-97.5031
	(0.000)***	(0.000)***	(0.001)***	(0.000)***	(0.355)	(0.376)	(0.020)**	(0.013)**
2007	-104.0839	-105.3545	-60.5746	-61.4475	-171.2934	-170.5474	-280.3581	-280.2231
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
N	6942	6942	6942	6942	6942	6942	6942	6942

Note: All models are estimated using Fixed Effects. Coefficients from linear models are shown, with bootstrapped p-values (in parentheses) robust to clustering at the community level. * p<0.10, ** p<0.05, *** p<0.01

Table 5a, continued: Welfare impacts of rental market participation in Malawi

	Number of months staples expected to last		Subjective wellbeing (score:1-5)		Probability of poverty	
	(9)	(10)	(11)	(12)	(13)	(13)
Tenant (=1)	0.7085		0.1855		-0.0943	
	(0.027)**		(0.031)**		(0.000)***	
Landlord (=1)	0.1100		-0.0017		-0.0023	
	(0.782)		(0.988)		(0.913)	
Ha rented in		1.2905		0.0574		-0.0781
		(0.003)***		(0.546)		(0.000)***
Ha rented out		0.9751		-0.0857		-0.0088
		(0.041)**		(0.572)		(0.674)
Landholding (ha)	0.6221	0.5271	0.0772	0.0747	-0.0254	-0.0231
	(0.000)***	(0.001)***	(0.003)***	(0.005)***	(0.000)***	(0.000)***
Adult equivalents	-0.0872	-0.0887	-0.0061	-0.0046	0.0317	0.0313
	(0.359)	(0.357)	(0.736)	(0.803)	(0.000)***	(0.000)***
Female head (=1)	-1.2109	-1.2197	-0.0854	-0.0825	0.0211	0.0222
	(0.002)***	(0.002)***	(0.373)	(0.392)	(0.013)**	(0.009)***
Mortality (=1)	0.1798	0.1596	0.0358	0.0402	-0.0272	-0.0292
	(0.592)	(0.626)	(0.600)	(0.556)	(0.108)	(0.085)*
Assets (1000s USD)	0.1089	0.1089	0.0308	0.0307	-0.0061	-0.0057
	(0.000)***	(0.000)***	(0.001)***	(0.001)***	(0.095)*	(0.097)*
Fertilizer (kg/ha)	0.0051	0.0051	-0.0000	-0.0000	-0.0000	-0.0000
	(0.000)***	(0.000)***	(0.678)	(0.669)	(0.437)	(0.488)
Rainfall	0.0004	0.0004	-0.0002	-0.0002	-0.0000	-0.0000
	(0.375)	(0.372)	(0.235)	(0.243)	(0.122)	(0.127)
N	4149	4149	6940	6940	6942	6942

Note: Models 1-4 are estimated using fixed effects; models 13 & 14 are estimated with via Probit using the Mundlak-Chamberlain device that includes time-averages of all time-varying covariates (not shown). Year and province dummies and time-averages not shown. Average partial effects are shown for Probit estimation of models 13, and 14; coefficients from linear models shown elsewhere. Bootstrapped p-values (in parentheses) are robust to clustering at the community level. * p<0.10, ** p<0.05, *** p<0.01

Table 5b: Welfare impacts of rental market participation in Zambia

	Value of crop production (USD)		Net crop income (USD)		Net off-farm income (USD)		Net total household income (USD)		Probability of poverty	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Tenant (=1)	156.3135		68.5065		-335.5530		266.4897		-0.0347	
	(0.039)**		(0.194)		(0.226)		(0.639)		(0.534)	
Landlord (=1)	-4.3948		7.9198		356.7719		471.3896		-0.4657	
	(0.950)		(0.905)		(0.159)		(0.084)*		(0.000)***	
Area rented in (ha)		138.4439		47.0537		-10.1851		160.5974		-0.1604
		(0.000)***		(0.002)***		(0.898)		(0.226)		(0.050)**
Area rented out (ha)		-5.4491		-4.7631		6.7735		29.4092		-0.4481
		(0.122)		(0.131)		(0.245)		(0.007)***		(0.092)*
Female head (=1)	-51.5437	-51.6862	-50.2930	-50.2739	-56.0474	-53.7532	-115.7624	-114.3609	0.0156	0.0598
	(0.224)	(0.222)	(0.190)	(0.190)	(0.325)	(0.343)	(0.093)*	(0.095)*	(0.630)	(0.642)
Adult equivalents	15.4321	15.3085	14.0866	14.0850	28.3552	28.2344	37.8636	38.4156	0.0453	0.1745
	(0.003)***	(0.003)***	(0.004)***	(0.004)***	(0.002)***	(0.003)***	(0.002)***	(0.001)***	(0.000)***	(0.000)***
Landholding (ha)	6.8246	6.8769	5.7177	5.7598	-1.5339	-1.3621	4.5639	4.4926	-0.0032	-0.0123
	(0.028)**	(0.028)**	(0.036)**	(0.037)**	(0.492)	(0.547)	(0.564)	(0.573)	(0.070)*	(0.072)*
Assets (1000s USD)	57.7804	57.2234	53.1316	52.9511	9.3556	9.1641	104.3903	104.0182	-0.0349	-0.1348
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.455)	(0.463)	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Fertilizer (kg/ha)	0.4074	0.4052	-0.0989	-0.0995	0.2340	0.2489	-0.0870	-0.0780	-0.0001	-0.0004
	(0.001)***	(0.001)***	(0.324)	(0.319)	(0.258)	(0.224)	(0.816)	(0.832)	(0.136)	(0.104)
Mortality (=1)	-70.8669	-68.9210	-72.0529	-71.3481	-18.8001	-22.0078	-220.7698	-220.5125	-0.0096	-0.0382
	(0.111)	(0.119)	(0.086)*	(0.089)*	(0.747)	(0.704)	(0.025)**	(0.023)**	(0.844)	(0.835)
Rainfall (mm)	0.0372	0.0370	0.0403	0.0403	-0.0229	-0.0260	-0.0001	-0.0013	-0.0000	-0.0000
	(0.001)***	(0.001)***	(0.000)***	(0.000)***	(0.252)	(0.200)	(0.997)	(0.960)	(0.204)	(0.251)
2008	111.8441	110.7334	107.2832	107.0190	24.0234	20.8972	170.1506	169.7217	-0.0592	-0.2268
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.463)	(0.528)	(0.000)***	(0.000)***	(0.002)***	(0.002)***
N	7698	7698	7698	7698	7698	7698	7698	7698	7698	7698

Note: Models 1-8 are estimated using Fixed Effects; models 9-10 estimated via Probit using the Mundlak-Chamberlain device that includes time-averages of all time-varying covariates (not shown). Provincial and year dummies and time-averages not shown. Bootstrapped standard errors are robust to clustering at the community level. * p<0.10, ** p<0.05, *** p<0.01

Table 6: Rental rate as a proportion of gross value of crop production per hectare (Malawi)

	percentile				
	10th	25th	50th	75th	90th
tenants only	0.06	0.12	0.23	0.47	0.95
full sample	0.10	0.17	0.31	0.59	1.19

Table 7: Quantile regression estimates of factors affecting net crop income in Malawi (binary participation indicators)

	(1) 10th	(2) 25th	(3) 50th	(4) 75th	(5) 90th	(6) Mean¥
Tenant (=1)	-8.0530	-3.5264	10.9125	42.3609	95.8327	72.3953
	(0.091)*	(0.375)	(0.086)*	(0.001)***	(0.000)***	(0.001)***
Landlord (=1)	-1.4830	-5.3225	-7.2555	-19.2919	-44.0652	-95.0686
	(0.803)	(0.285)	(0.361)	(0.210)	(0.154)	(0.018)**
Female headed (=1)	-4.9729	-7.6149	-9.7951	-14.6455	-18.8929	-23.6926
	(0.044)**	(0.000)***	(0.003)***	(0.022)**	(0.141)	(0.204)
Adult equivalents	1.2944	2.1488	3.9169	6.5771	10.6056	9.5188
	(0.272)	(0.029)**	(0.013)**	(0.031)**	(0.083)*	(0.041)**
Landholding (ha)	2.3010	10.3593	26.9910	58.3624	105.5443	81.4699
	(0.161)	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.005)***
Assets (1000s USD)	-0.6025	0.7936	24.0857	58.5780	169.4052	17.3742
	(0.523)	(0.313)	(0.000)***	(0.000)***	(0.000)***	(0.225)
Fertilizer (kg/ha)	-0.1352	-0.0245	-0.0034	0.0175	-0.0223	-0.0169
	(0.000)***	(0.000)***	(0.593)	(0.156)	(0.370)	(0.465)
Mortality (=1)	2.1708	0.6503	6.1293	1.2223	1.5052	14.5764
	(0.612)	(0.855)	(0.282)	(0.912)	(0.946)	(0.255)
Education	-0.4592	-0.0350	0.4071	0.2285	-0.5772	
	(0.134)	(0.891)	(0.319)	(0.773)	(0.716)	
Age of head	0.0368	0.0470	0.0063	0.0040	-0.1574	
	(0.566)	(0.380)	(0.942)	(0.980)	(0.636)	
Immigrant (=1)	-13.7776	-11.1374	-7.0260	-7.3025	-19.0928	
	(0.000)***	(0.000)***	(0.098)*	(0.374)	(0.247)	
Matrilineal (=1)	5.4529	5.5514	1.7893	7.3936	-10.7194	
	(0.041)**	(0.013)**	(0.615)	(0.283)	(0.438)	
Rainfall (mm)	0.0114	0.0153	0.0249	0.0445	0.0433	0.0349
	(0.019)**	(0.000)***	(0.000)***	(0.000)***	(0.087)*	(0.314)
2002	-4.7907	-15.7986	-40.9892	-60.6248	-101.6346	-81.8054
	(0.237)	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
2003	1.3988	-6.0432	-30.6610	-50.9463	-75.0137	-56.4917
	(0.721)	(0.065)*	(0.000)***	(0.000)***	(0.000)***	(0.001)***
2007	-12.3363	-27.1032	-56.6243	-77.8662	-102.6816	-60.5746
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
N	6942	6942	6942	6942	6942	6942

Note: ¥ indicates that estimate are the same as in from Table 5a, column 3. Models 1-5 are estimated via quantile regression with the Mundlak-Chamberlain device that includes time-averages of all time-varying covariates (not shown). Provincial and year dummies and time-averages not shown. Bootstrapped p-values in parentheses, significance denoted as: *** p<0.01, ** p<0.05, * p<0.1.

[1] These barriers include the lack of formal institutional mechanisms for sales within customary tenure systems, as well as the greater flexibility of rental arrangements as compared with sales arrangements, particularly in environments characterized by missing or imperfect credit markets, and the greater risk of longer-term investments implied by sales.

[2] The population of Zambia is about 13 million, 61% of which reside in rural areas and earn their incomes primarily from agriculture. The population of Malawi is about 16 million, of which about 85% are rural farm households.

[3] Farm size distributions are also highly skewed *within* the smallholder sector. For example, in Zambia, 50% of smallholders farm less than 2 hectares and about a quarter have farms of one hectare or less. In Malawi, 55% of smallholders cultivate less than one hectare.

[4] There is also public tenure, which corresponds to land rights claimed by state entities.

[5] The Zambia Land Act of 1995 established mechanisms for the conversion of customary land to leasehold statues. Malawi has no such formal mechanism, as the Land Act has yet to be passed.

[6] About 10% of the land area under smallholdings in Zambia has now been converted to leasehold tenure. In MalawI, as of 2005, only 1.55% of all plots are in leasehold or were purchased with or without title.

[7] The nationally representative IHS3 dataset in Malawi indicates that in the 2008/09 and 2009/10 cropping seasons 96% of all rental contracts were upfront cash rent.

[8] When all factor markets are well functioning, and production has constant returns to scale, land endowments should not matter for either efficiency or equity, as household factor ratios would equilibrate via markets (even where land markets do not exist but non-land factor markets do). Given the highly imperfect factor markets in SSA, however, we would expect land endowments to have important implications for both efficiency and equity.

[9] Examples include the fixed costs of finding, negotiating and enforcing rental agreements, and the costs of monitoring land management by tenants. Additionally, variable costs may be imposed by, e.g. pressure not to rent out too much land lest a household be perceived as excessively wealthy (and thus possibly subject to losing land under reallocation by traditional authorities).

[10] Pre-rental farm size is the amount of land that a household has ownership rights to. This includes all cultivated area by the household (excluding rented in land) + rented out land.

[11] This panel survey has 3 waves in total: 2001, 2004, and 2008. In this study, we use data from the first and last waves only, due to limited information collected on rental participation in the 2004 wave.

[12] Other analysis was performed for Zambia using cross-sectional data on 8,716 households from the 2012 Rural Agricultural Livelihoods Survey. These results are largely consistent with the results presented here, but because cross-sectional data do not allow us to control for unobserved heterogeneity (as we can with panel data) we do not report these results here.

[13] Farm size, and land rented in and out are measured using farmer estimates of area in both Malawi and Zambia. Though this may lead to some measurement error compared to land estimates using GPS, if the measurement error is random, and is not mis-estimated by farmers for any systematic reason, then the farm size coefficient estimates will still be unbiased. The results from this study are generally consistent when the land rental variables are measured as binary indicators, and when they are measured as continuous variables. This lends robustness to the notion that measurement error is not biasing the results in our analysis.

[14] Results from the land rental market participation models estimated via tobit, where land renting is measured as a continuous variable based on hectares rented in or out, are very similar to the ordered probit estimates in tables 4a and 4b. As a result these alternative specifications are not presented for space considerations but are available from the authors upon request.

[15] All monetary values in this analysis are converted to real 2009 USD.

[16] This is about 70 Malawian kwacha in real 2009 terms. 89% of the households in our sample are below this threshold, which accords with recent poverty headcount estimates for the rural smallholder population.

[17] One note of caution in interpreting these results is in order: in the Zambia panel data, costs of production are only partially observed. Thus, net crop income accounts for fertilizer costs and the costs of renting, but not for labor, traction, seed or other input expenditures.

[18] The quantile regression results for the Zambian model generate no statistically significant results on the land rental coefficients. Therefore, results are not shown, but are available from the authors upon request.