WPS7285

Policy Research Working Paper 7285

Smallholders' Land Ownership and Access in Sub-Saharan Africa

A New Landscape?

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WORLD BANK GROUP
Development Research Group
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June 2015

Policy Research Working Paper 7285

Abstract

While scholars agree on the importance of land rental markets for structural transformation in rural areas, evidence on the extent and nature of their operation, including potential obstacles to their improved functioning, remains limited. This study uses household-level data from six countries to start filling this gap and derive substantive as well as methodological lessons. The paper finds that rental markets transfer land to land-poor, labor-rich, and more productive producers throughout. But vast cross-country variation in transfers and the fact that female managers could possibly improve their income by leasing out land point towards barriers to participation that policy might address. Methodological and substantive conclusions are derived.

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Smallholders' Land Ownership and Access in Sub-Saharan Africa: A New Landscape?

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JEL Classification: O13, Q12, Q15, Q18

Keywords: Land Markets, Land Ownership, Productivity, Gender, Sub-Saharan Africa

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1. Introduction

A popular view of Africa, in contrast to, say Asia, is that land on the continent is plentiful, so that everybody can access it. Yet, while this may hold true at a continental level, there are enormous differences across countries with some, most notably Rwanda with 384 inhabitants/km^2 overall and 526/km^2 of agricultural land, approaching or even surpassing levels of population density that are normally thought of to be more common in Asia. In fact, while there is land available for expansion in Africa, most of it is concentrated in few countries (Deininger and Byerlee 2012), often with poor access to infrastructure and low levels of profitability (Chamberlin *et al.* 2014). Together with technology-induced limits on farmers' ability to expand cultivated area and increased demand for African land from outsiders (Arezki *et al.* 2013; Schoneveld 2014), this implies that in many African countries, farm households have to adjust to higher levels of land scarcity, either through investment and intensification of production or by greater reliance on off-farm income, possibly alongside greater land rental market participation (Headey and Jayne 2014). While studies highlight broad trends and response options, a description of such trends from a micro-perspective and the policy issues underpinning them has thus far been missing.

To fill this gap, this paper draws on unique household-level data from six countries (Ethiopia, Malawi, Niger, Nigeria, Tanzania, and Uganda). We aim to explore three issues, namely (i) the distribution of land ownership and associated inequality as well as landlessness; (ii) the extent of land rental market activity (including potential gender bias in such activity); and (iii) the factors associated with land market participation interpreted in light of the structural transformation of Africa's economies. While they may miss out some large holdings, our data, collected under the LMS-ISA project, are representative of each country's smallholder sector, have land area measured using GPS as compared to farmers' estimates to reduce measurement error, include information on plot managers' and often owners' gender, and are geo-referenced to allow links to infrastructure.

If land is scarce and part of the population will be better off moving out of agriculture, markets will have an important role in helping to bring land to its most productive use. This has often been taken to imply that land markets will be less important if land is relatively abundant, equally distributed, and the economy's level of diversification remains low. Instead, markets will gradually assume greater importance with specialization and the emergence of a sizeable non-agricultural sector in the course of economic development. In such an evolutionary scenario, land rental is likely to predominate to enable households or individuals to take up employment outside the agricultural sector. Land transfers through sales will become important only as the economy develops and entrepreneurs need to raise capital by selling land directly or by using it as collateral in credit markets and mortgage-based financing.

From a policy perspective, empirical evidence on market functioning based on household- or farm-level data is important in two respects. First, with evidence of factor market imperfections (Dillon and Barrett 2014), it is of

interest to see if land markets equalize factors and transfer land to more productive and relatively land scarce producers. Second, land markets will operate more smoothly if clear information on land ownership is available at low cost and social norms ensure that a landlord who temporarily transfers land through rental does not risk the loss of this asset. This has historically provided the justification for public registries. Ill-defined or insecure property rights, including a failure of public institutions to respect and compensate existing rights in case of expropriation for public purpose, may put productivity-enhancing transactions out of reach for all or part of the population. Even if rights are clear and respected, inefficient institutions that make registering transactions costly and cumbersome will reduce the scope for land market transactions. This will either undermine the ability to reap associated gains in terms of productivity and financial market development or drive such transactions into informality.

The paper is structured as follows. Section two discusses conceptual background and evidence from the literature regarding the role of land markets, their evolution over time, institutional pre-conditions for effective functioning, and welfare- and productivity impacts. Section three uses LSMS-ISA data to descriptively explore determinants and impacts of land market operation, their contribution to productivity, and potential barriers to their functioning in the six countries. Section four explores determinants of land use efficiency as well as land market participation econometrically showing that, given their lower efficiency, female managers/owners might face tenure-related barriers to land rental market participation that may merit policy-makers' attention. Section five concludes.

2. Background and justification

While Africa has traditionally been described as land abundant, high levels of population growth imply that land is becoming more scarce in many countries, as documented for example in Mali (Guirkinger and Platteau 2014) and Ethiopia (Headey *et al.* 2014). Economic development and structural transformation involve specialization and a move of part of the labor force out of the agricultural sector that create heterogeneity in the population that increases the scope for efficiency-enhancing land transfers. Institutions to allow conduct of such transactions at low cost and in a way that, at least in the case of rental, does not involve a significant risk of land loss, can increase productivity of land use and help diversify the economy and foster economic development (Badiane *et al.* 2012). Land markets are thus largely absent in subsistence economies where land is relatively equally distributed, the skill-intensity of agricultural cultivation low, and the availability of non-farm opportunities limited. But, as the economy starts to diversity, the scope for efficiency-enhancing land transfers beyond immediate kin and for periods that may be longer than for just one season assumes considerable importance.

As leasing does not require any change in land ownership, land owners, even if they give up self-cultivation, will not have to forsake the benefits from owning land, including the ability to use land as collateral for loans to start non-agricultural enterprises (Deininger and Feder 2001, Swinnen *et al.* 2006). To the contrary, it provides access to regular income streams in the form of rents (Deininger 2003) which, if land is transferred to more productive producers and markets are competitive, will be higher than what owners could obtain from self-cultivation (Deininger *et al.*

2011). Households who participate actively in off-farm markets may be more likely to supply land to the rental market (Kung 2002) and restrictions on land rental may limit the scope for off-farm development as in Ethiopia (Deininger *et al.* 2003a). Equalization of land access through rental markets is also observed in Kenya (Jin and Jayne 2013), Uganda (Baland *et al.* 2003), Ethiopia (Deininger and Jin 2006; Teklu and Lemi 2004), and Eastern Europe (Swinnen and Rozelle 2009).

Secure property rights are a precondition for effective market functioning in a number of respects (Besley and Ghatak 2010). In India, improving producers' access to information by computerizing land records helped to increase the number of registered transactions and credit access in urban but not rural areas (Deininger and Goyal 2012). In Mexico, reforms to clarify land ownership,[2] in particular inheritance, and allow leasing out, are estimated to have increased eligible households' likelihood of having one or more members abroad by 12%, explaining 26% of the 1994–1997 increase in the number of migrants from the entire *ejido* sector (Valsecchi 2014). In China, where sales are not allowed, issuance of certificates helped reduce the risk of leased out land being taken back and redistributed (Mullan *et al.* 2011), and created institutional preconditions for households to take on non-agricultural activities (Deininger *et al.* 2014) and increase efficiency (Deininger and Jin 2009).

With land being a key asset throughout the world (Deininger 2003; Doss *et al.* 2012), land ownership by women is a key determinant of their bargaining power in the household, their ability to take advantage of economic opportunities and cope with risks (Deere *et al.* 2013), and overall household welfare. The literature highlights the impact of female property rights to land and other assets on girls' survival rates (Qian 2008), their anthropometric status (Duflo 2003), schooling (Luke and Munshi 2011), and broader empowerment (Deininger *et al.* 2013b). Yet, social conventions governing land access[3] and land conflicts that disproportionately affect women may reduce their security of property rights and is likely one of the factors contributing to significantly lower productivity on female-managed plots in Malawi (Kilic *et al.* 2013a), Nigeria (Oseni *et al.* 2014), and Ethiopia (Aguilar *et al.* 2014).

Land sales may allow households who want to move into the non-agricultural economy to mobilize the equity that will help them to exploit profitable economic opportunities but they are less liquid and may be affected by credit and other factor market imperfections. Indeed, asymmetric information and risk have long been shown to lead to credit rationing in equilibrium and the use of collateral as one way of reducing such credit rationing (Stiglitz and Weiss 1981). Its immobility and relative indestructibility make land ideal collateral. However, banks will use it for this purpose on a large scale only if they have access to low-cost means to make reliable inferences on ownership and the absence of other encumbrances for any given plot of land. Such information is normally provided by land registries. Compared to rental, land purchases will require more resources and purchase decisions will also be

[2] The program, PROCEDE, provided a total of more than 3 million households in participating communities with certificates for their housing plot, their individual agricultural plots, and their right to use the common land.
[3] In 15 Sub-Saharan African countries, less than half of widows inherited land (Peterman 2012) and their ability to hold on to their husband's land is highly unpredictable (Chapoto *et al.* 2011). Provisions to make their inheritance rights more secure are thus important (Cooper and Bird 2012).

affected not only by returns from productive use of land but also by expected future movements of land prices compared to those of other assets. Moreover, lack of insurance and highly covariate risk can cause price fluctuations whereby agricultural land is cheap in times of crisis (e.g. drought) when farmers have to resort to distress sales to cover their subsistence and very expensive in years with good harvests so that land sales markets may be less equity-enhancing than those for rental and can even increase inequality (Zimmerman and Carter 2003).

3. Data and descriptive statistics

Data from multi-purpose household surveys can allow us to explore determinants and impacts of the operation of land markets, the extent to which such markets contribute to greater productivity, and barriers to their functioning. We briefly characterize the coverage of the available surveys and use these to describe the nature of the rural economy overall, estimated levels of participation on both sides of land rental and sales markets, and characteristics of participants in both types of transactions.

3.1 Data and sample description

We use data from LSMS-ISA surveys in Ethiopia, Malawi, Niger, Nigeria, Tanzania, and Uganda. These are large multi-purpose household surveys with detailed information on agricultural production that are representative either for the entire country or for rural areas within a country. In addition to having been designed as panels so as to allow controlling for household-fixed effects, these data have three advantages. First, they aim to consistently use GPS to measure plot size, to reduce the measurement error inherent to farmers' estimates (Kilic *et al.* 2013b) that can have far-reaching impacts for estimates of outcome variables such as yield (Carletto *et al.* 2013). Second, while the phrasing of questions differs somewhat across surveys, all of them allow us to retrieve information on the gender of either the plot manager and in many cases also the owner.[4] This allows a much better appreciation of gender-disaggregated asset ownership and control and potential implications for efficiency of resource use (Aguilar *et al.*). Finally, all surveys provide GPS coordinates of at least the homestead so as to be able to link to infrastructure access and other physio-geographic data including agro-ecological potential (Fischer *et al.* 2002) that may have an important impact on production, prices for input and output, and the ease with which non-farm opportunities can be accessed.

[4] In Ethiopia, the relevant information used is the plot holder's ID, in Malawi it is the response (one person) to the question "who in the household makes the decisions concerning crops to be planted, input use and the timing of cropping activities on this plot" for one person in Malawi, in Niger it is the response to the question "what is the ID number of the person who currently works the parcel" for one person, and we identify the manager is joint if the whole household was reported rather than a personal ID, in Nigeria there are two questions on "who in the household manages this plot" (one person) and "write the ID codes of other household members who are decision makers on this plot" (up to four persons), and in Tanzania and Uganda, the manager is identified by the question of "who decided what to plant on this plot" (one person) or "who usually works on this parcel" (up to two persons), respectively. The extent to which information on the plot owner is provided is more limited. In different countries, the relevant person is identified in response to the following questions: "under whose name(s) is the certificate issued for this parcel" (up to two persons) in Ethiopia; "who in this household owns this plot" (up to two persons) in Malawi; "what is the ID number of the owner of this parcel" for one person with 'the whole household' as one of the codes in Niger; "who is the owner of this plot" (one person) in Nigeria; "who in the household owns this plot" (up to two persons) in Tanzania; and "who has the ownership/ use rights to this parcel" (up to two persons) in Uganda.

One disadvantage of our data is that the samples are household-based rather than area-based and in some cases limited to rural areas. Land held by legal entities or corporations, or by urban dwellers in cases of rural samples, will thus not be captured. This may affect estimates of the farm size distribution in relatively land-abundant countries where these groups can account for sizeable land holdings. For example in Zambia, farms operating between 5 and 100 ha of land, most of them owned by urban dwellers or companies, control more land than the country's entire smallholder sector (Sitko and Jayne 2014). Unfortunately, for all countries except Ethiopia, lack of data on land owned or operated by large farms makes it impossible to assess the extent of area not covered by our surveys. In this case, the country's regular commercial farm survey puts the total area held by operational commercial farms at 1.55 million hectares (Ali *et al.* 2015), compared to 9.2 million hectares cultivated by smallholders, implying that our data would account for some 85% of the agriculturally held area in the country.[5]

3.2 Descriptive evidence on country contexts

In addition to highlighting that smallholders' livelihood strategies are diverse and evolving as described elsewhere (Davis *et al.* 2014), descriptive statistics for the surveys in our sample provide a number of insights (table 1). They suggest that (i) sizes of land used for crop cultivation remain small, with a land distribution that is skewed to the right in virtually all of the countries, (ii) gendered patterns of land access are diverse; and (iii) the level of land market activity varies across countries, partly in response to land scarcity, and land sales are much less frequent than land rentals.

The surveys reveal marked differences in the shares of illiterate heads (from 66% in Ethiopia to 16% in Uganda), and mean household income (from USD 664 in Malawi to USD 1,396 in Niger). Although they are engaged in agriculture, the majority of households complement income from agriculture with resources from other areas. In fact, except for Nigeria where 70% of household income is from crops, the mean contribution of crops and income from crop production is less than 50%, with agricultural wages (from 1% in Nigeria to 15% in Malawi), self-employment (from 6% in Malawi to 24% in Niger), and transfers (from 1% in Nigeria to 8% in Malawi) making up the rest.

While the countries in our sample differ widely from each other in terms of relative land scarcity (Jayne *et al.* 2010), operated area per adult in smallholder farming is often limited by technology (Binswanger 1986) and thus less variable across countries. Indeed, for all of the countries except Niger, operated area per adult is less than one ha. With 3.02 plots per household, the level of fragmentation is highest in Ethiopia and lowest in Malawi with 1.74 with a large part of those with little or no land engaging in wage labor.

[5] In Tanzania, the total area cultivated by smallholders, using the weights from our survey, amounts to 6.026 million hectares, compared to 9.2 million hectares that are cultivated according to FAO statistics (Deininger and Byerlee 2011).

With the exception of Ethiopia where production in Ethiopia is estimated on the basis of crop-cutting of randomly selected crops/fields in each EA, thus making analysis of productivity at farm or household level impossible, we can compute the value of output as well as profits per ha. Doing so points towards considerable variation in levels of land and labor productivity. With gross per-hectare income from crops between USD 267 in Malawi and USD 545 in Uganda,[6] net income per hectare ranges from some USD 164 in Malawi to USD 289 in Tanzania. Combining this with cultivated area and labor days spent by family workers allows us to obtain net income per day of family labor as ranging between USD 2.21for Malawi and USD 1.19 for Uganda. As this figure includes returns to land and other fixed assets, it should provide an upper bound estimate of the reservation price, i.e. the wage rate at which the average individual would likely be indifferent between working in own agriculture and taking on non-agricultural wage work (or engaging in non-agricultural self-employment).

Throughout our sample, levels of formal and informal documentation of land ownership remain low. Except for Ethiopia where, as a result of a recent participatory low-cost land certification program (Deininger *et al.* 2008), some 38% of households indicate to have any type of document,[7] the share of households with any type of document (formal or informal) is below 20% in all of the other countries. Ethiopia's effort was found to have had positive impacts on investment (Holden *et al.* 2009) and land market participation (Deininger *et al.* 2011a). From a substantive point of view this suggests that in countries such as Uganda, Tanzania, and Nigeria where legislation to allow issuance of documents to customary land exists and households' demand for formal documentation may be high, high costs may have prevented more widespread access to formal documents and an ability to clearly distinguish between formal and informal documents will allow to contribute to the debate on the usefulness of different types of documentation.

The distribution of plot managers' gender varies markedly across countries; male managers are in charge of some 80% of area in Ethiopia and Nigeria, 70% in Malawi, and 54% in Niger but only 27% and 9% in Tanzania and Uganda where some 48% and 64%, respectively, are under joint management and 22% of 27% managed by females on their own. While only 7% or 30% of households report the owner's gender in Nigeria and Ethiopia, almost all do so in Uganda and about 80% in the remainder of the countries. Female ownership is most widespread in Malawi with 45%, followed by Uganda (24%), Tanzania (22%), and Ethiopia (17%) of reporting households.

Information on land rental and land sale is tabulated in table 2. With 21% and 19%, respectively, the share of households renting in land is highest in Ethiopia and Uganda and, with 6% or 7%, lowest in Tanzania and Niger. Malawi and Nigeria are in between with a market participation of 10% or 11%. By comparison, the share of households who, in the survey, report to rent out land is much lower, being highest in Ethiopia with 5%, followed

[6] We exclude Nigeria where there are some data issues with the level of gross income (Oseni *et al.* 2014).

[7] As coverage with first-level certificates was near-universal, the figure of 38% seems low. In addition to training enumerators in a way that would allow them to recognize and classify different forms of documentation, it may be useful to explore ways to improve the accuracy with which such information is gathered.

by Niger (1.6%), Tanzania (1.2%), and less than 1% in Uganda, Malawi, and Nigeria. To explore whether, as theoretically possible, this discrepancy may be due to landlords leasing out large tracts of land to multiple tenants, we also present the total area which, according to the survey has been leased in or out using survey weights (which are of course available only for population). Part of the under-estimation of leased out land may be due to the fact that, at least in some countries, landlords may move to urban areas and thus either not be included in the sample or not respond to questions on leasing out land that may be included in the agricultural section of the survey (Deininger and Jin 2008). Still, differences in the share of leased in area that is not accounted for on the other side are pronounced; while in Tanzania and Niger about 50% and 30% of the area leased in is also reported to have been leased out by a landlord, this figure is only 14% for Ethiopia and 6%, 4%, and 1%, respectively for Uganda, Malawi, and Nigeria.[8] To the extent that inferences on the functioning of land markets are desired, greater attention to balancing both sides of the market may be warranted.[9]

Information on land acquisition by the current household to provide information on land purchases is available for Uganda and Niger where 10% and 4% of households, respectively, indicated that they bought land during the past 5 years. While high levels of land rental as well as sales market activity in Uganda have long been noted (Baland *et al.* 2007), though sales market activity is still below what is observed in Rwanda (Ali *et al.*), detailed analysis is possible only for Uganda and Niger. Comparing welfare of the landless and the landed suggests that, except for Ethiopia, the landless are located much closer to infrastructure than the landed. They also have higher levels of education and income than those with land in Malawi, Niger, and, to some extent, in Uganda. Plots of the density of owned or operated land point towards a skewed distribution virtually everywhere, with a vast number of very small plots but a long tail of some larger ones. To illustrate distributional aspects, table 3 tabulates mean owned and operated area by quartile of the land ownership distribution. Mean owned areas for the top quartile of 1.48 ha in Malawi, 1.88 ha in Nigeria, 2.53 ha in Ethiopia, 3.54 ah in Uganda, 6.97 ha in Tanzania, and 11.6 ha in Niger clearly highlight differences in relative land scarcity. Also, the redistributive effect of land rental is evident from the fact that in many countries operated area is double what is owned whereas everywhere the area operated by the largest land owners is less or equal what they own.

3.3 Characteristics of land rental market participants

To motivate the potential impacts of land rental market functioning, table 4 displays descriptive statistics separately for households who did or did not participate. [10] Key insights are that (i) land markets allow households who are either landless or relatively land-poor but well-endowed with family labor or other fixed assets to access productive resources; (ii) they facilitate land access by younger operators; (iii) female heads are much less likely to lease in

[8] For the analysis of land rental markets to be conducted here, this implies that use of a maximum likelihood friction model that accounts for both sides of the market (Deininger *et al.* 2007; Deininger *et al.* 2012) will be infeasible.
[9] While in theory land could be rented in from the community, this is unlikely to be relevant in practice in the countries concerned. Obtaining landlord details from households leasing in as for example in Ethiopia (Deininger *et al.* 2013a), would be one way of addressing both concerns.
[10] AS there is likely to be considerable measurement error in the 'leasing out' variable, se are forced to focus only on those who either do or do not rent in.

land; and (iv) land rental markets are more active in areas with higher levels of economic activity as proxied by either infrastructure access, light intensity, or urban gravity.

With 54% of those renting in land in Malawi (74% in Nigeria, 35% in Tanzania, and 25 and 24% in Niger and Uganda) being landless, land rental allows households who are either landless or have significantly less land per adult than the rest to gain land access. Households with higher endowments of effective labor (including human capital) are more likely to rent in and make productive use of available resources including available family labor. Beyond improving equity, land rental is thus also likely to allow better overall land utilization.

Relatively younger household heads are more likely to use land renal markets and expand their agriculture production, although with an average age of the head of well beyond 40 - from 43 in Malawi to 51 in Nigeria. While the share of illiteracy is lower among those renting in than the rest everywhere, pointing towards a minimum level of educational attainment, participation in rental markets does not seem to be associated with high levels of formal education except in Malawi where educated households seem to access land through rental markets. Households headed by females are less likely to rent in land in Ethiopia, Malawi and Niger, something that may partly be a result of their lower overall labor endowment. To the extent that information on the value of assets is available, we note that lessees in Niger and Nigeria but not in Uganda hold more agricultural assets. Interestingly, land is transferred to wealthier households ($2,741 vs. $1,604 value of durable goods but not agricultural assets) in Malawi.

Non-farm diversification appears to drive some of the observed land rental activity as illustrated by the fact that in Malawi, Nigeria, and Uganda, land markets are more active in EAs with greater non-agricultural employment. This may suggest that land markets contribute to structural transformation by allowing interested individuals to take up non-agricultural employment without losing the safety net function implied by land ownership and making effective use of their land (Deininger et al. 2011b).

3.4 Evidence on land sales market participation

The fact that data on land sales are available only for two countries -Uganda and Niger- illustrates that, to obtain good information on land sales, issues of questionnaire design and sampling need to be considered. While including questions on land acquisition in samples of agricultural cultivators is important, land may increasingly also be acquired by firms that may not be visible in household surveys (Headey and Jayne 2014; Schoneveld 2014). Analysis of such transactions can be of great policy relevance (Sitko and Jayne 2014) and will be important especially in land-abundant countries where, in the context of the post-2008 food price spike (Deininger and Byerlee 2011), magnitudes involved are likely to be large and thus will affect the agricultural sector more broadly (Jayne *et*

al. 2014). Use of data on land transfers from registries as a frame is one option to cross-check and complement data from household samples that would also allow obtaining 'objective' land prices.[11]

Descriptive statistics for households who did or did not purchase land over the last 5 years in table 5 for Uganda and Nigeria suggest that sales markets had a mildly redistributive effect and transferred land to those with lower endowments.[12] At the same time, those who purchased land expanded existing holdings, are better educated, have significantly higher income and assets, and apply slightly more inputs than those in autarky. Infrastructure access seems to matter less for land purchases than for rentals, something that could be due to a number of reasons (e.g. buyers having access to transport).

4. Econometric approach and results

Subject to the limitations of data availability, econometric analysis suggests that, while land rental markets fail to fully equalize factor ratios, they contribute to structural transformation by helping to transfer land to productive but land-poor and relatively labor-rich households. Yet, the fact that female plot managers or owners, especially unmarried ones, almost universally attain much lower levels of productivity than the rest and could increase their income by leasing out land points towards significant barriers to land market participation at least for this group.

4.1 Gendered determinants of productivity

To assess levels and determinants of productive performance, we estimate country-specific stochastic frontier production (Coelli 1998) at household level using a Cobb-Douglas functional form:

$$ln(Y_i) = \beta\, ln(X_i) + \gamma M_i + v_i - u_i \qquad (1)$$

where, i indexes households, Y_i is the value of crop output, X_i is a vector of inputs including operated land area, number of days of family labor, expenses on hired labor and fertilizer, and value of agricultural assets, M_i is a vector that includes the share of household land managed either jointly or by a female, β and γ are vectors of parameters to be estimated, u_i proxies for technical inefficiency and v_i is an error term. [13] Each producer's distance from the frontier can then be used as a measure of inefficiency in subsequent regressions of land market participation to assess whether it is the more productive who are able to access land through rental or sales markets as expected if other factor markets function well or whether imperfections in other markets (e.g. those for credit) imply that land is acquired for reasons not directly related to agricultural production.

[11] In many countries, a desire to avoid taxes, together with an outdated valuation system, implies that prices for registered sales may be systematically under-declared, something that is often associated with weak governance. Documenting such differences could be a valuable contribution to the policy dialogue.
[12] Figures for land ownership are 2.72 ha vs. 4.43 ha for owned area, and 1.09 ha vs. 1.94 ha for owner area per adult in Niger and 0.70 ha vs. 1.38 ha for owned area, and 0.30 ha vs. 0.65 ha for owned area per adult in Uganda.
[13] Formally u_i is a ne-sided non-negative error term assumed to be half-normally distributed with unknown mean μ_u and variance σ_u^2 to v_i is a two-sided white noise error term assumed to be normally distributed with mean 0 and variance σ_v^2.

With few exceptions, all conventional factors are highly significant (table 6, panel A). Land and labor are most important with coefficients (which can be interpreted as elasticities) on land between 0.34 to 0.47 in Malawi, Nigeria and Tanzania and those for family labor between 0.22 and 0.37 in Niger and Uganda, respectively. Agricultural assets, fertilizer, and expenses on hired labor have lower elasticities between 0.13 and 0.02, 0.05 and 0.15, and quantitatively very small coefficients, respectively.

Dummies for female management (panels A and C for the entire sample and only married couples) or ownership (panels B and D, respectively) point towards considerable productivity differences: For all countries except Uganda, having a higher share of household plots managed jointly or solely by a female is estimated to be associated with lower levels of output, estimated coefficients range from a low of 4% for Malawi and 11% for Tanzania to 29% and 34% for Nigeria and Niger. While the estimated relationship weakens if only married couples are considered in most cases (except Nigeria and Tanzania), the magnitude of the implied productivity difference between females and males remains large, suggesting that in many cases females might be better off by leasing out land than by cultivating it themselves. Information on ownership in Nigeria and Tanzania lead to qualitatively similar conclusions. To the extent that other land quality differences are controlled for, these results suggest that female owners or managers everywhere except in Uganda and Malawi could increase output between 11% and 37% by leasing their land to an average producer instead of cultivating it themselves even if they had equal access to equivalent amounts of other inputs. The fact that they fail to do could point towards the existence of obstacles to greater female land market participation. Tenure security is likely to be an important factor: women in female-headed households are already at considerable risk of their land being taken over by relatives and leasing out land would likely further increase this risk and make it difficult for them to recover their land. If this interpretation is correct, it would mean that stronger female land tenure security could be critical to facilitate participation in lease markets and associated improvements in productivity and welfare especially by female-headed households. This interpretation is consistent with the finding that a program to increase tenure security in Rwanda had particularly strong positive impacts on female headed households' levels of investment (Ali *et al.* 2014a) and their land market participation (Ali *et al.* 2014b).

4.2 Determinants of land rental and sales market participation

As information on leasing out in our data is too thin to allow meaningful estimates,[14] we focus on assessing determinants of land rental market participation, estimating a probit equation of the form:

$$R_{ij} = \alpha + \beta X_{ij} + \gamma Z_j + \varepsilon_{ij} \qquad (2)$$

[14] Ethiopia is the only country where the underlying household survey points to a share of lessors of more than 5%. As in 62% of cases, information on plot size for plots rented out is missing we can only run very basic regressions to assess determinants of market participation on both sides.

where i and j index households and enumeration areas, respectively, R_{ij} is an indicator variable for households renting in land, X_{ij} is a vector of household characteristics, Z_j is a vector of location-specific variables,[15] and β and γ are vectors of parameters of interest. Results for all countries, reported in table 7 for specifications that include the distance to the nearest road or the EA-level share of self-employment income, suggest land markets have an important role to (i) help equalize land endowments and land/labor ratios; (ii) allow access to land by more efficient producers; and (iii) contribute to diversification and movement of labor out of agriculture in areas with good infrastructure access.

Evidence of endowment equalization through land markets with lower land endowments increasing the propensity of land market participation is found everywhere except in Ethiopia. Estimated effects are largest in Malawi, Uganda, and Nigeria where overall land pressure is high and rather modest in Tanzania and Niger. Labor-rich and young households are more likely to participate in land markets everywhere except possibly in Niger where the coefficient is significant only at 10%.

Second, the negative and significant coefficient on inefficiency as estimated by the stochastic production function in Malawi, Niger, Uganda, and Tanzania implies that more productive (less inefficient) producers are more likely to rent in land, implying that operation of rental markets will enhance allocative efficiency. Female headship is negative (though not always statistically significant) everywhere except in Uganda. Together with the coefficient on total non-land wealth is insignificantly different from zero for all cases except Malawi, this supports the notion that land rental markets contribute to redistribution of assets to the productive poor.

Finally, better access to non-agricultural opportunities is estimated to increase land rental market activity throughout. The coefficient on the share of non-agricultural wage employment is positive (though small) everywhere except in Tanzania and very significant in Uganda, where it has a point estimate of 0.14. Proximity to infrastructure is an important determinant of rental market participation in Niger, Malawi, and Tanzania where point estimates on the distance variable are 0.33, 0.48 and 0.95, respectively.

Regression results for land sale markets participation in Uganda and Niger using equation (2) but letting R_{ij} be an indicator for land purchase during the last 5 years are reported in table 8. Interestingly, in these two countries, the (marginally) more efficient and land but not asset-poor purchased land and little systematic impact of geographic variables.

5. Conclusion and policy implications

The above analysis documents that micro-data can help better understand the forces shaping structural change in Africa's rural areas. Although factor markets do not function perfectly, land rental markets perform an important

[15] We run separate regressions with one geographic variable each time due to high correlations. Regression results on light intensity and urban gravity as well as separately for North and South Nigeria as suggested by Oseni *et al.* (2014)are available on request.

function in the process of structural transformation by offering opportunities to those with better non-farm opportunities to move out while allowing land-poor but labor-rich and more productive households to increase the amount of land they cultivate. Although data on land sales market participation is too scant to allow generalization, this seems also true for land sales markets in Uganda, in line with earlier evidence.

Our analysis also points towards a number of areas where improvements in household questionnaire design and associated data collection protocols on land could make the data even more useful. Key areas in this respect are (i) a more consistent recording of the history of land acquisition to proxy for purchases; (ii) identifying rights held by individuals, including rights to identify plot manager and owner, possibly linking to land acquisition or inheritance history; (iii) matching renting in and renting out; (iii) training enumerators to distinguish different types of formal and informal documents (including maps) that may have been obtained to document ownership; (iv) including proxy variables for tenure insecurity; and (v) cross-checking actual or hypothetical land prices to ensure their realism.

Improving the capacity of African land institutions implies considerable scope for complementing household surveys with administrative data to exploit complementarities and cross-check, (e.g. to explore the extent of informal transactions and potential reasons for them), to cross-check information (e.g. on sales prices), and to follow up in more detail on rare events such as disputes. Exploring these opportunities, together with links to remotely sensed imagery, is likely to further expand the usefulness of household data to understand structural transformation in Africa and beyond.

Table1 : Descriptive statistics

	Ethiopia	Malawi	Niger	Nigeria	Tanzania	Uganda
Basic household characteristics						
Share owning land	0.98	0.95	0.98	0.92	0.98	0.95
Share agric. cultivators	0.99	1.00	0.99	1.00	0.94	0.98
Household size	5.15	4.75	6.82	6.02	5.69	6.04
adults	2.57	2.36	3.06	3.09	2.96	3.18
children	1.52	2.15	3.52	2.58	2.35	2.86
old people	0.24	0.24	0.24	0.35	0.37	0.33
Head's age	44.58	43.04	44.90	50.60	48.88	47.35
Head female	0.21	0.25	0.08	0.12	0.23	0.30
Head is illiterate	0.66	0.23	0.50	0.40	0.29	0.16
Head has primary	0.27	0.57	0.44	0.29	0.61	0.57
Head has more than primary	0.04	0.19	0.06	0.30	0.10	0.22
Assets						
Value of agricultural assets (USD)		323.61	483.73	340.46	415.95	24.49
Value of animals (USD)	499.70	85.98	489.79	185.67	266.45	369.41
Value of durable goods (USD)		1718.56	4402.32	1301.66		2948.10
Income and its sources						
Gross household income (USD)		663.50	1395.64	1307.00	1159.81	1201.75
share from crops		0.51	0.44	0.70	0.51	0.46
share from livestock		0.10	0.17	0.09	0.10	0.19
share from ag wage		0.15	0.02	0.01	0.05	0.06
share from non-age wage		0.09	0.06	0.08	0.11	0.10
share from self employment		0.06	0.24	0.11	0.17	0.13
share from transfer		0.08	0.07	0.01	0.07	0.06
Details of agricultural production						
Gross inc.from crops (USD/ha)		515.57	267.09	2233.80	509.88	545.39
Net inc.from crops (USD/ha)		164.11	226.13	1196.67	289.16	279.06
Gross inc.from crops (USD)		266.48	517.01	543.06	434.02	406.27
# of days by family members	126.82	74.28	151.07	108.76	183.03	234.95
Imputed return to family labor/day		2.21	1.50	11.00	1.58	1.19
Value of hired labor (USD)	20.47	3.56	41.93	27.05	17.79	30.35
Value of fertilizer (USD)		71.85	45.61	53.90	21.85	8.57
Land						
No. of plots owned	3.02	1.74	2.74	1.75	2.22	1.88
Owned area ha	1.05	0.68	5.17	0.73	2.50	1.44
Operated area ha	1.16	0.72	5.17	0.79	2.12	1.40
Owned area/adult (14-60)	0.44	0.32	1.93	0.28	0.90	0.53
Operated area/adult (14-60)	0.49	0.33	1.92	0.30	0.78	0.51
Has any type of document	0.38	0.01	0.11		0.14	0.19
Gender of manager reported	0.98	0.99	0.96	0.97	0.93	0.96
male manager	0.80	0.71	0.53	0.81	0.27	0.09
joint manager			0.36	0.01	0.45	0.52
female manager	0.19	0.29	0.10	0.18	0.24	0.38
Gender of owner reported	0.30	0.77	0.79	0.07	0.81	0.98
male owner	0.44	0.35	0.58	0.75	0.40	0.25
joint owner	0.25	0.17	0.26		0.31	0.46
female owner	0.18	0.45	0.09	0.05	0.22	0.28
Geo variables						
Distance to the nearest major road (km)	17.38	9.46	12.92	17.20	22.09	8.06
No. of households	3,099	10,123	2,263	3,029	2,625	2,129
Exploded	10,527,872	2,563,476	1,938,052	15,540,444	6,620,836	4,468,866

Source: Own computation from LSMS-ISA household surveys.

Table 2: Details on land market participation at household level

	Ethiopia	Malawi	Niger	Nigeria	Tanzania	Uganda
Autarkic (%)	73.99	89.65	91.12	89.04	92.69	80.55
Rent in (%)	20.81	10.06	7.29	10.80	6.17	18.65
if yes, mean area rented in	0.63	0.49	1.87	0.71	0.82	0.52
if yes, area of cultivated area (%)		74.69	48.14	87.54	72.64	57.11
Rent out (%)	5.20	0.30	1.59	0.17	1.14	0.80
Total area rented in (with weights)	1,516,979	130,155	262,079	1,069,316	400,091	492,903
Total area rented out (with weights)	206,339	5,092	80,486	15,404	197,619	27,824
Gini of owned area	0.50	0.40	0.45	0.53	0.59	0.49
Gini of operated area	0.50	0.39	0.45	0.53	0.59	0.48
Purchased any during last 5 years (%)			3.58			9.63
if yes size of area purchased			2.13			0.57

Source: Own computation from LSMS-ISA household surveys.

Table 3: Descriptive statistics by quartile of land area owned

		Quartile			
		Bottom	**2nd**	**3rd**	**Top**
Ethiopia	Owned area	0.12	0.51	1.05	2.53
	Operated area	0.24	0.63	1.14	2.62
Malawi	Owned area	0.15	0.42	0.69	1.48
	Operated area	0.29	0.44	0.71	1.45
Niger	Owned area	0.93	2.81	5.35	11.60
	Operated area	1.12	2.91	5.32	11.34
Nigeria	Owned area	0.03	0.25	0.74	1.88
	Operated area	0.29	0.26	0.75	1.88
Tanzania	Owned area	0.28	0.87	1.88	6.97
	Operated area	0.35	0.77	1.62	5.74
Uganda	Owned area	0.20	0.68	1.36	3.54
	Operated area	0.44	0.70	1.28	3.19

Source: Own computation from LSMS-ISA household surveys.

Table 4: Descriptive statistics by nature of land rental markets participation

	Ethiopia			Malawi			Niger		
		Rent in			Rent in			Rent in	
	No	Yes		No	Yes		No	Yes	
Basic household characteristics									
Share owning land	1.00	0.91	***	1.00	0.46	***	1.00	0.75	***
Share agric. Cultivators	0.99	1.00	**	1.00	1.00		0.99	1.00	
Household size	5.11	5.30	**	4.70	5.22	***	6.76	7.55	***
adults	2.54	2.69	**	2.31	2.79	***	3.05	3.28	*
children	1.50	1.59		2.14	2.31	***	3.48	4.04	***
old people	0.26	0.15	***	0.25	0.12	***	0.24	0.23	
Female head	0.24	0.10	***	0.26	0.15	***	0.08	0.04	**
Age of head	45.62	40.68	***	43.41	39.70	***	45.09	42.39	**
Head is illiterate	0.68	0.61	***	0.24	0.16	***	0.51	0.46	
Head has primary	0.26	0.32	***	0.58	0.49	***	0.44	0.47	
Head has more than primary	0.04	0.06	**	0.18	0.35	***	0.05	0.07	
Income and its sources									
Mean household gross income (USD)				614.03	1106.0	***	1381.78	1571.8	*
share from crops				0.52	0.42	***	0.43	0.45	
share from livestock				0.10	0.09	***	0.17	0.16	
share from ag wage				0.16	0.12	***	0.02	0.02	
share from non-age wage				0.08	0.22	***	0.06	0.05	
share from self employment				0.06	0.11	***	0.24	0.26	
share from transfer				0.08	0.04	***	0.07	0.05	**
Gross inc.from crops (USD/ha)				519.77	478.00		268.86	244.78	
Net inc.from crops (USD/ha)				168.63	123.71	***	229.33	185.78	
Land endowments									
Owned area/adult (14-60)	0.45	0.40	**	0.34	0.11	***	2.00	1.06	***
No. of plots owned	2.98	3.18	*	1.85	0.71	***	2.78	2.25	***
Owned area ha	1.06	1.02		0.73	0.26	***	5.32	3.28	***
Operated area ha	1.03	1.63	***	0.72	0.75		5.17	5.13	
Operated area/adult (14-60)	0.44	0.66	***	0.34	0.31	**	1.94	1.72	
Has any type of document	0.36	0.48		0.01	0.03	***	0.11	0.13	
Share of plots with gender of manager	0.98	0.97		0.99	0.99		0.96	0.98	
male manager	0.77	0.90		0.70	0.79	***	0.53	0.58	
joint manager							0.36	0.32	
female manager	0.22	0.09		0.30	0.21	***	0.10	0.08	
Share of plots with gender of owner	0.31	0.24		0.83	0.21		0.82	0.38	
male owner	0.48	0.31		0.36	0.23	***	0.59	0.42	***
joint owner	0.25	0.26		0.17	0.13	*	0.26	0.15	***
female owner	0.22	0.08		0.47	0.20	***	0.09	0.07	
Production									
Gross inc.from crops (USD)				265.87	272.09		511.91	581.14	
# of days by family members	113.73	175.32	***	74.79	69.73	**	149.63	169.30	
Value of days by hired labor (USD)	20.23	21.36		3.21	6.70	***	41.55	46.67	
Value of used fertilizer (USD)				69.52	93.00	***	42.92	79.45	*
Assets									
Value of agricultural assets (USD)				322.89	330.03		479.98	531.51	**
Value of animals (USD)	510.00	460.54	*	86.90	77.77	*	490.27	483.62	
Value of durable goods (USD)				1604.27	2740.8	***	4344.84	5133.3	**
Geo variables									
Share of non-ag wage income (EA level)				0.09	0.16	***	0.06	0.07	*
Distance to the nearest major road	17.35	17.52		9.72	7.15	***	13.25	8.67	***
No. of households	2,454	645		9,105	1,018		2,098	165	

Note: Production in Ethiopia is estimated on the basis of crop-cutting of randomly selected crops/fields in each EA. It does not allow for holder specific production analysis. The original design intent for the ERSS was to ask holder's to report the total amount of crops harvested from each field. However, in practice, the ERSS manual incorrectly instructed field staff to only collect self-reported harvest for the crops/fields which were selected for crop-cutting. Therefore we are unable to calculate income from crops, gross income and shares of income from other sources.

Table 4 (cont'd): Descriptive statistics by land rental markets participation

	Nigeria			Tanzania			Uganda		
	Rent in			Rent in			Rent in		
	No	Yes		No	Yes		No	Yes	
Basic household characteristics									
Share owning land	1.00	0.26	***	1.00	0.65	***	1.00	0.76	***
Share agric. Cultivators	1.00	1.00		0.93	0.99	***	0.98	1.00	***
Household size	6.02	6.09		5.68	5.75		6.08	5.82	
adults	3.09	3.10		2.96	3.00		3.21	3.03	*
children	2.57	2.71		2.34	2.59		2.87	2.80	
old people	0.36	0.27	**	0.39	0.15	***	0.36	0.21	***
Female head	0.12	0.14		0.24	0.21		0.30	0.31	
Age of head	50.79	49.11	*	49.25	43.20	***	48.04	44.33	***
Head is illiterate	0.41	0.36	*	0.29	0.21	**	0.17	0.12	***
Head has primary	0.29	0.30		0.60	0.69	**	0.57	0.60	
Head has more than primary	0.29	0.33		0.10	0.09		0.22	0.22	
Income and its sources									
Mean household gross income (USD)	1301.77	1350.2		1149.79	1312.1		1147.17	1439.9	***
share from crops	0.70	0.69		0.51	0.49		0.45	0.48	*
share from livestock	0.10	0.07	**	0.10	0.08		0.20	0.14	***
share from ag wage	0.01	0.01		0.05	0.05		0.06	0.07	
share from non-age wage	0.08	0.11	**	0.11	0.09		0.09	0.14	***
share from self employment	0.11	0.12		0.17	0.25	***	0.14	0.12	
share from transfer	0.01	0.00		0.07	0.04	**	0.06	0.06	
Gross inc.from crops (USD/ha)	2286.78	1796.6	*	494.09	735.14	*	503.20	725.39	***
Net inc.from crops (USD/ha)	1204.24	1134.20		284.43	356.55		256.67	374.62	***
Land endowments									
Owned area/adult (14-60)	0.30	0.05	***	0.94	0.35	***	0.61	0.20	***
No. of plots owned	1.90	0.49	***	2.28	1.27	***	2.04	1.15	***
Owned area ha	0.79	0.19	***	2.60	0.98	***	1.64	0.57	***
Operated area ha	0.78	0.89	**	2.15	1.59	*	1.48	1.07	***
Operated area/adult (14-60)	0.30	0.34	**	0.79	0.59	*	0.54	0.38	***
Has any type of document				0.15	0.09	**	0.17	0.26	***
Share of plots with gender of manager	0.97	0.96		0.93	0.93		0.95	0.96	
male manager	0.82	0.73	***	0.27	0.32		0.09	0.10	
joint manager	0.01	0.00		0.45	0.42		0.54	0.45	***
female manager	0.17	0.26	***	0.24	0.21		0.37	0.44	***
Share of plots with gender of owner	0.07	0.05		0.85	0.31		0.98	0.98	
male owner	0.77	0.62	*	0.40	0.27	***	0.26	0.20	***
joint owner				0.32	0.15	***	0.46	0.47	
female owner	0.05	0.05		0.23	0.12	**	0.28	0.32	*
Production									
Gross inc.from crops (USD)	542.02	552.21		428.99	506.18	**	387.61	485.66	***
# of days by family members	106.76	125.31		185.16	152.63	**	232.96	243.43	
Value of days by hired labor (USD)	26.94	28.03		17.25	25.45	*	32.53	21.10	***
Value of used fertilizer (USD)	56.44	31.73	**	21.24	30.58		8.10	10.59	
Assets									
Value of agricultural assets (USD)	145.45	1951.8	***	409.93	507.48		26.40	16.14	
Value of animals (USD)	194.94	109.10	***	268.50	235.34		403.90	218.93	
Value of durable goods (USD)	1295.57	1351.9					2839.35	3422.6	
Geo variables									
Share of non-ag wage income (EA level)	0.08	0.10	**	0.11	0.09		0.10	0.12	***
Distance to the nearest major road	17.30	16.36		22.33	18.35	**	8.20	7.41	*
No. of households	2,702	327		2,463	162		1,732	397	

Note: Tests of differences of means between lessees and non lessees are reported with * notifying significant at 10%, ** notifying significant at 5%, and *** notifying significant at 1%.

Table 5: Descriptive statistics by land sale market participation

	Niger			Uganda		
	Autarky or Sold	**Purchased**		**Autarky or Sold**	**Purchased**	
Basic household characteristics						
Share owning land	0.98	1.00		0.95	1.00	***
Share agric. Cultivators	0.99	1.00		0.98	1.00	**
Household size	6.79	7.80	***	6.00	6.39	*
adults five years ago	2.48	2.73	*	2.34	2.24	
adults	3.05	3.41	*	3.19	3.04	
children	3.49	4.25	***	2.81	3.35	***
old people	0.24	0.15	*	0.35	0.13	***
Female head	0.08	0.02	*	0.31	0.19	***
Age of head	44.98	42.65		48.04	40.86	***
Head is illiterate	0.51	0.38	**	0.17	0.11	**
Head has primary	0.44	0.54	*	0.58	0.52	*
Head has more than primary	0.05	0.07		0.21	0.29	***
Income and its sources						
Mean household gross income (USD)	1381.66	1772.24	***	1155.10	1639.64	***
share from crops	0.44	0.44		0.46	0.44	
share from livestock	0.17	0.21	*	0.19	0.17	
share from ag wage	0.02	0.00	**	0.06	0.06	
share from non-age wage	0.06	0.05		0.10	0.14	**
share from self employment	0.24	0.24		0.13	0.17	**
share from transfer	0.07	0.06		0.06	0.03	***
Gross inc.from crops (USD/ha)	269.25	209.32		528.80	697.97	*
Net inc.from crops (USD/ha)	230.11	119.68		268.19	379.12	***
Land endowments						
Owned area/adult (14-60) five years ago	1.94	1.09	***	0.65	0.30	***
Owned area/adult (14-60)	1.93	1.96		0.54	0.47	
No. of plots owned five years ago	2.20	1.68	**	1.69	1.26	***
No. of plots owned	2.70	3.75	***	1.80	2.58	***
Owned area ha five years ago	4.43	2.72	***	1.38	0.70	***
Owned area ha	5.15	5.62		1.46	1.31	
Operated area ha	5.16	5.33		1.41	1.35	
Operated area/adult (14-60)	1.93	1.81		0.51	0.49	
Has any type of document	0.09	0.46	***	0.16	0.43	***
Share of plots with gender of manager	0.96	0.97		0.95	0.97	
male manager	0.53	0.68	***	0.10	0.06	
joint manager	0.36	0.24	**	0.51	0.58	*
female manager	0.10	0.08		0.39	0.35	
Share of plots with gender of owner	0.78	0.90		0.98	0.99	
male owner	0.58	0.73	***	0.25	0.31	**
joint owner	0.26	0.11	***	0.45	0.52	**
female owner	0.09	0.07		0.30	0.16	***
Production						
Gross inc.from crops (USD)	513.49	611.57		394.94	510.19	***
# of days by family members	148.73	213.67	***	233.37	249.44	
Value of days by hired labor (USD)	39.17	116.05	***	28.65	45.97	***
Value of used fertilizer (USD)	44.90	64.66		6.89	24.03	***
Assets						
Value of agricultural assets (USD)	481.79	536.08	*	24.64	23.03	
Value of animals (USD)	482.48	686.53	**	366.97	392.27	
Value of durable goods (USD)	4348.33	5856.95	***	2607.45	6145.21	
Geo variables						
Share of non-ag wage income (EA level)	0.06	0.07		0.10	0.10	
Distance to the nearest major road	12.92	12.90		8.08	7.87	
No. of households	2,182	81		1,924	205	

Note: Tests of differences of means between lessees and non lessees are reported with * notifying significant at 10%, ** notifying significant at 5%, and *** notifying significant at 1%.

Table 6: Estimates of stochastic frontier production function

	MWI	NER	NGA	TZA	UGA
	Panel A: Coefficients for manager (entire sample)				
Operated area (log)	0.467***	0.153***	0.349***	0.333***	0.135**
	(0.043)	(0.040)	(0.038)	(0.035)	(0.054)
Number of days worked by family labor (log)	0.129***	0.215***	0.074***	0.184***	0.364***
	(0.011)	(0.026)	(0.008)	(0.017)	(0.031)
Value of days worked by hired labor (log)	0.022**	0.061***	0.034***	0.082***	0.055***
	(0.009)	(0.012)	(0.008)	(0.011)	(0.012)
Value of used fertilizer (log)	0.090***	0.089***	-0.001	0.050***	0.149***
	(0.005)	(0.013)	(0.006)	(0.010)	(0.019)
Value of agricultural assets (log)	0.128***	0.099***	0.020**	0.063***	0.084***
	(0.008)	(0.027)	(0.008)	(0.011)	(0.022)
Joint manager		-0.116**	-0.225	0.050	0.145*
		(0.054)	(0.151)	(0.042)	(0.078)
Female manager	-0.039*	-0.323***	-0.277***	-0.126***	0.072
	(0.021)	(0.106)	(0.040)	(0.049)	(0.080)
Constant	4.816***	5.035***	6.534***	5.328***	4.313***
	(0.056)	(0.174)	(0.051)	(0.095)	(0.183)
lnsig2v	-2.607***	-1.116***	-2.385***	-2.231***	-1.611***
	(0.069)	(0.083)	(0.104)	(0.115)	(0.125)
lnsig2u	1.676***	1.268***	0.726***	1.161***	1.146***
	(0.016)	(0.045)	(0.037)	(0.038)	(0.050)
Observations	9,891	2,171	2,723	2,354	2,004
Log likelihood	-16316.677	-3490.879	-3416.922	-3409.797	-3011.470
	Panel B: Coefficients for owner (entire sample)				
Joint owner	0.169***	-0.077		-0.036	0.131**
	(0.030)	(0.057)		(0.043)	(0.055)
Female owner	-0.037	-0.413***	-0.266	-0.154***	-0.052
	(0.023)	(0.107)	(0.261)	(0.048)	(0.060)
Observations	7,927	1,934	249	2,095	2,052
Log likelihood	-12688.820	-3012.830	-315.977	-2932.613	-3083.917
	Panel C: Coefficients for manager (married couples only)				
Joint manager		-0.103*	-0.239	0.032	0.111
		(0.054)	(0.146)	(0.043)	(0.092)
Female manager	0.044	-0.017	-0.229***	-0.190*	0.071
	(0.036)	(0.148)	(0.061)	(0.099)	(0.100)
Observations	7,312	2,077	2,317	1,761	1,506
Log likelihood	-11801.985	-3313.100	-2815.082	-2500.516	-2156.795
	Panel D: Coefficients for owner (married couples only)				
Joint owner	0.146***	-0.070		-0.046	0.126**
	(0.029)	(0.057)		(0.042)	(0.054)
Female owner	-0.052*	-0.196	-0.006	-0.129	-0.210**
	(0.027)	(0.162)	(0.713)	(0.118)	(0.095)
Observations	5,885	1,843	232	1,571	1,517
Log likelihood	-9185.318	-2845.716	-280.104	-2146.969	-2164.665

Note: As other coefficients are similar to those in panel A, panels B through D report only coefficients on female owner or manager. Standard errors are in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 7: Determinants of land rental markets participation

	MWI		NER		NGA		TZA		UGA		ETH
	Rent in	Rent in	Rent in	Rent in	Rent in	Rent in	Rent in	Rent in	Rent in	Rent in	Rent in
Land owned	-0.156***	-0.155***	-0.009***	-0.009***	-0.109***	-0.110***	-0.018***	-0.018***	-0.122***	-0.125***	-0.008
	(0.006)	(0.006)	(0.002)	(0.002)	(0.012)	(0.012)	(0.003)	(0.003)	(0.011)	(0.011)	(0.007)
Number of adults	0.015***	0.015***	0.010***	0.010***	0.004	0.004*	0.007***	0.006***	0.014***	0.016***	0.006
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.005)	(0.005)	(0.006)
Age of head/10	-0.004***	-0.004***	-0.007*	-0.007*	-0.008**	-0.008**	-0.008***	-0.009***	-0.013**	-0.014**	-0.029***
	(0.001)	(0.001)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.006)	(0.006)	(0.006)
Head is illiterate	-0.004	-0.002	0.014	0.016	-0.006	-0.009	0.005	0.011	-0.055**	-0.058***	-0.025
	(0.007)	(0.007)	(0.023)	(0.022)	(0.012)	(0.012)	(0.015)	(0.015)	(0.023)	(0.022)	(0.035)
Head has primary	-0.008	-0.007	0.012	0.013	-0.010	-0.010	0.013	0.016	-0.014	-0.013	-0.020
	(0.005)	(0.005)	(0.023)	(0.022)	(0.011)	(0.011)	(0.012)	(0.012)	(0.019)	(0.019)	(0.034)
Female head	-0.022***	-0.023***	-0.035**	-0.035**	-0.008	-0.007	-0.002	-0.002	0.017	0.019	-0.126***
	(0.004)	(0.004)	(0.015)	(0.014)	(0.014)	(0.014)	(0.009)	(0.009)	(0.019)	(0.019)	(0.017)
Value of durable	0.011***	0.011***	0.002	0.002	0.002	0.002			0.000	0.000	
goods/1000	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)			(0.000)	(0.000)	
Inefficiency from	-0.005***	-0.005***	-0.012**	-0.011**	0.002	0.003	-0.010***	-0.011***	-0.034***	-0.030***	
frontier with manager	(0.002)	(0.002)	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.008)	(0.007)	
Share of non-ag wage	0.004		0.048		0.015		-0.044		0.143**		
income (EA level)	(0.014)		(0.055)		(0.033)		(0.033)		(0.061)		
Distance to the nearest		-0.479**		-0.952***		0.263		-0.334**		-0.498	0.074
major road/1000		(0.196)		(0.310)		(0.239)		(0.150)		(1.050)	(0.299)
Observations	9,889	9,889	2,171	2,171	2,721	2,721	2,354	2,354	2,004	1,962	2,812
Pseudo R-squared	0.209	0.210	0.056	0.062	0.115	0.116	0.078	0.080	0.147	0.144	0.032

Note: We report rent out for Ethiopia because it is the only country where the share of lessors exceeds 5%. However, we do not include owned area in the regression because 62% of plots rented out have missing values for the area and therefore we do not know exact land endowment for 64% of lessors. Robust standard errors are in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 8: Determinants of land sale markets participation during last five years

	NER		UGA	
	Purchased	**Purchased**	**Purchased**	**Purchased**
Land owned five years ago	-0.004***	-0.004***	-0.036***	-0.035***
	(0.001)	(0.001)	(0.007)	(0.007)
Number of adults five years ago	0.005*	0.005*	0.006	0.005
	(0.003)	(0.003)	(0.006)	(0.006)
Age of head/10	-0.001	-0.001	-0.022***	-0.023***
	(0.003)	(0.003)	(0.004)	(0.004)
Head is illiterate	0.000	0.000	-0.015	-0.012
	(0.016)	(0.016)	(0.020)	(0.020)
Head has primary	0.011	0.012	-0.038***	-0.038**
	(0.016)	(0.016)	(0.015)	(0.015)
Female head	-0.019*	-0.019*	-0.038***	-0.039***
	(0.010)	(0.010)	(0.012)	(0.012)
Value of durable goods/1000	0.002**	0.002***	0.000	0.000
	(0.001)	(0.001)	(0.000)	(0.000)
Inefficiency from frontier with manager	-0.009**	-0.009**	-0.013**	-0.015**
	(0.004)	(0.004)	(0.006)	(0.006)
Share of non-ag wage income (EA level)	0.000		-0.036	
	(0.043)		(0.050)	
Distance to the nearest major road/1000		-0.034		-0.205
		(0.219)		(0.742)
Observations	2,171	2,171	2,004	1,962
Pseudo R-squared	0.056	0.056	0.082	0.083

Note: Robust standard errors are in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%.

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