Land Lease Markets and Agricultural Efficiency in Ethiopia

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August 2001

Abstract

This paper develops a theoretical model of land leasing that includes transaction costs of enforcing labor effort, risk pooling motives and non-tradable capital inputs. We test the implications of this model compared to those of the "Marshallian" (unenforceable labor effort) and "New School" (costlessly enforceable effort) perspectives using data collected from four villages in Ethiopia. We find that land lease markets operate relatively efficiently in the villages studied, supporting the New School perspective. Land contract choice is found to depend upon the social relationships between landlords and tenants, but differences in contracts are not associated with significant differences in input use or output value per hectare. We find that other household and village characteristics do affect input use and output value, suggesting imperfections in other factor markets.

Keywords: land lease markets, land tenure, sharecropping, agricultural efficiency, Ethiopia

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The efficiency of land lease markets is a critical issue in many developing countries, where land sales markets are often thin and inhibited by problems of asymmetric information and transaction costs. The issue is particularly important in Ethiopia, where land sales are officially prohibited by the new Constitution and where land leases were prohibited by the former Marxist government until 1991. Land leases have been permitted since 1991, and are again becoming common in many parts of Ethiopia. Now is thus an opportune time to assess the efficiency of the lease markets developing in Ethiopia.

There is an old and large literature on land tenure contracts and their implications for agricultural efficiency. Adam Smith, John Stuart Mill, Alfred Marshall, and many economists since have argued that share tenancy causes inefficient resource allocation because the share tenant receives only a fraction of the value of his marginal product of labor, thus reducing the incentive to supply labor or other inputs. More recently, others have argued that if the tenant's work effort can be costlessly monitored and enforced by the landlord, then resource allocation can be as efficient under sharecropping as under owner-cultivation or fixed-rent tenancy (Johnson; Cheung). Whether costs of monitoring and enforcing tenancy contracts are sufficiently low to allow for efficient sharecropping is of course an empirical question.

The available empirical evidence on the efficiency of land tenure contracts is mixed. The majority of studies do not find significant inefficiency of share tenancy (Otsuka and Hayami). However, many of these studies did not adequately distinguish sharecroppers from fixed-rent tenants or owner-operators and did not control for other factors that may affect input use and productivity, such as land quality or differences in farmers' endowments or abilities (Shaban). Several studies that did control for such characteristics have found evidence supporting the

"Marshallian" perspective of inefficient sharecropping (Bell; Shaban; Sadoulet, Fukui and de Janvry; Laffont and Matoussi; Chunrong Al, Arcand and Ethier).

The existing empirical literature on the efficiency of land lease markets is dominated by studies conducted in south and southeast Asia, with very little information available from sub-Saharan Africa. In this paper, we investigate this issue using data collected in four villages of Ethiopia. In a recent paper, Gavian and Ehui found that total factor productivity was somewhat lower on leased-in plots than on owner-cultivated plots in these villages, while use of inputs was similar. However, they did not provide statistical tests of their results or control for other factors that may have caused measured differences in total factor productivity.

In this paper, we develop a theoretical model of land use, land contract choice, and other input use that includes transaction costs, as well as allowing risk pooling motives and non-tradable productive inputs such as draft animal services or human capital. We test the implications of this model compared to those of the "Marshallian" (unenforceable labor effort) and "New School" (costlessly enforceable effort) perspectives. Our findings support the "New School" perspective of a well functioning lease market in the Ethiopian villages studied.

Land Markets in the Study Villages

The study was conducted in the Arsi zone of the Oromia region of Ethiopia. In this area, there was an active land market before the Marxist Derg regime nationalized land in 1975. Land redistribution by the Peasant Association (PA, usually consisting of a few villages) was the only means of accessing land during the Derg period, but there have been no redistributions in this region since the fall of the Derg in 1991. Since then, land leasing and informal transfers have again become common.

The means used to acquire access to land are gifts or borrowing, fixed-rental and sharecropping. Gift fields are given free of any explicit charge for an indefinite period, while borrowed fields are also free but provided for a specified period. In terms of contract duration, gift and borrowed land are most like PA-allocated land, since the duration is generally longer for this type of land than for rented or sharecropped land. Gift and borrowed land are usually provided by relatives, often parents providing land to newly married children. Because of their similarities, these two categories are combined in the analysis.

Fixed rental involves a cash payment paid in advance to the landlord. The tenant pays for all inputs, reaps all of the benefits and bears all of the risk from his production. The landowner is usually not related to the tenant, the contract is almost always for only one year, and a written contract is used in most cases.

Sharecropping agreements provide a share of the harvest to the landowner, usually one-half or one-third. The landowner is usually not a relative of the share tenant. The contract is usually for only one year. In contracts in which the landowner receives a one-half share, the landowner often provides a share of the inputs in production and harvesting, including purchased inputs and harvesting labor, though the terms vary significantly across contracts. It is rare for the landowner to provide oxen or pre-harvest labor, however. Direct credit linkages between landlords and tenants are also relatively rare.

This study is based upon a survey conducted by the International Livestock Research Institute in four PAs in the Arsi zone in 1994. A sample of 161 households was selected, stratified by whether the households "owned" (were allocated by the PA in a prior land distribution) any land. There were 115 PA-allocated ("landowning") households and 46 non-PA allocated ("landless") households in the sample. All of the landless households and many of the landowning households acquired ("imported") cropland through gift, borrowing or leasing arrangements. The surveys collected information about these households and their operated plots. No information was collected on the plots that households gave, loaned or leased out ("exported"), though information was collected on which households were land exporters.

Households farming owner-operated fields tend to own more cropland, have more labor, are older and less educated than the households operating imported fields (table 1). Recipients of gift/borrowed plots tend to have fewer workers in the household and to be poorer in general (less land owned, less livestock), younger, more educated, of longer residence in the village, and more likely to be related to the landowner than operators of land acquired under other tenure arrangements. There are few clear differences between characteristics of tenants who have acquired land under fixed rental and those using sharecropping, except that sharecropping is not used by recent immigrants to the villages and is less common among ethnic Oromo people. This suggests that the choice of sharecropping vs. fixed rental depends on social relationships that may determine the transaction costs of screening and monitoring tenants.

There are also some differences in the characteristics of the plots operated under different tenure arrangements. Owner-operated plots are less likely to have red soils and more likely to be irrigated than imported plots. Rented plots are least likely to have reported erosion problems, but are further from the operator household's residence than other tenure categories. Sharecropped plots also tend to be somewhat further from the residence than owner-operated or gift/borrowed plots. Overall, however, it is not clear that the average quality of land is superior or inferior in any tenure category.

Total labor and oxen use per hectare are lower on sharecropped fields than on other fields. The value of output per hectare is highest on owner-operated fields and lowest on gift/borrowed fields. These differences in input use and output per hectare may be due to other factors than tenure status however, such as the differences in tenant household characteristics or plot quality characteristics mentioned above. Below we investigate whether such differences are robust after controlling for differences in village and household characteristics and plot quality.

Theory of Land Tenancy Contracts

Restrictions on land sales need not be a source of inefficiency, and achieving efficiency may not even require land lease markets to function. If there are perfect markets for other factors of production, those factors can be hired in or out by landowners until landowners earn equal marginal products for all factors of production, resulting in productive efficiency (Binswanger and Rosenzweig). Tenancy is thus not necessary unless there is some other market imperfection.

In the presence of production risk and missing insurance markets, households can use share contracts to achieve perfect risk pooling and productive efficiency, provided that the intensity of labor effort can be costlessly monitored and enforced (Johnson; Cheung). Cheung thus takes risk pooling as an argument for the existence of sharecropping. Newbery has shown, however, that if the production technology is constant returns to scale and labor can be costlessly monitored then the same degree of risk pooling and efficiency can be achieved by a combination of fixed rental and wage contracts. Thus some additional market imperfection is necessary to explain the choice of sharecropping, even with a missing insurance market.

One of the most commonly cited rationales for sharecropping is the difficulty of monitoring labor effort. If labor effort is unobservable, sharecropping will dominate wage labor because of its incentive advantages and dominate fixed rental because of its risk pooling advantages (Stiglitz). Although this argument is persuasive, it is not clear how it could lead to multiple contract forms coexisting in the same communities, unless, as seems unlikely in the context of smallholders in Ethiopia, some tenants are risk neutral while others are risk averse.

Cash constraints could lead to multiple contract forms. Tenants who are cash constrained might be unable to pay a cash rent and thus be forced to use share tenancy. For similar reasons, cash constrained landlords may prefer to use cash rental. Whether such differences in contracts have any implications for agricultural efficiency, however, depends upon whether there are transaction costs of monitoring and enforcing contracts. If labor can be costlessly monitored, then any outcome achievable via a cash rental contract can also be achieved via a share rental contract, as in Cheung's model. Thus, transaction costs are essential to explain why productive inefficiency may result as a result of differences in lease contracts.

In this paper, we consider a model in which tenants' effort is observable but costly to monitor and enforce. In this case, coexistence of fixed rental and sharecropping contracts may occur as a result of differences in transaction costs. Below, we derive the empirical implications of this model and contrast those to the implications of the "New School" model with costless enforcement and the "Marshallian" model with unenforceable effort.

Model

Suppose that production is determined by three factors of production: land (H), labor (L) and capital services (K). Production by household i on plot p (Y^{ip}) is assumed to be a constant returns to scale function of the amount of each factor applied to the plot:

1) $Y^{ip} = \theta F^{ip}(H^p, L^p, K^p)$

θ is a random variable with an expected value of 1 and positive variance, and which is unknown to households at the time decisions about H and L are made. We assume that θ is the same for all households in a village, as may result from weather or price related risks, though the model could be readily extended to incorporate idiosyncratic risks.

Households are endowed with land ($\underline{H}^i$), labor ($\underline{L}^i$) and capital ($\underline{K}^i$). We assume that a local labor market and a lease market for land exist, but that there is no market for capital. Below, we consider the implications of relaxing the assumption that capital is not marketed. If labor is hired by a household, the household pays a wage (w) to the worker plus a transaction cost (cl^i) of monitoring the worker's effort. We assume that the transaction cost is a non-decreasing function of the amount of labor hired ($cl^i_L \geq 0$) (subscripts denote partial derivatives).

If a plot of land (s) is leased out, the landlord charges a lease payment, which is a linear combination of a share of output (1-α) and a fixed rent (β):

$$\textbf{2)}\ \ \textbf{\textit{Lease payment}} = (1-\alpha)qF(H^s, L^s, K^s) + \beta H^s$$

If 0<α<1 and β=0, then the contract is a pure share contract. If α=1 and β>0, then the contract is a fixed rent contract. We assume that a mixture of share and rental in a contract is possible.

The landlord can monitor and enforce the tenant's use of inputs on the plot, and hence can select the level of inputs, but pays a transaction cost for this (ch). We assume that this cost is a non-decreasing function of the size of the plot, and of the amount of labor and capital applied by the tenant ($ch_H \geq 0$, $ch_L \geq 0$, $ch_K \geq 0$). We also assume that the monitoring costs are a non-increasing function of the share of output received by the tenant, since the tenant has greater incentive to apply effort if he receives a higher share ($ch_\alpha \leq 0$).

For simplicity, we assume that each landlord household operates only one owned plot and leases out one plot, and that each tenant operates his own plot plus one leased in plot. Thus, each landlord deals with only one tenant, and vice versa.

Households seek to maximize the expected utility of income and leisure ($Eu^i(Q^i, M^i)$), where u^i is a strictly concave function. We assume that tenants select their level of leisure (M^t) and labor use on their own plot (L^t), considering the lease terms specified by the landlord (á, â, H^s, L^s, K^s). The tenant's maximization problem is thus:

3)
$$\begin{aligned} &Max_{L^t, M^t}\; Eu^t\{qF^t(\underline{H}^t, L^t, \underline{K}^t - K^s) + aqF^s(H^s, L^s, K^s) \\ &- bH^s - w*(L^t + L^s + M^t - \underline{L}^t) - cl^t(L^t + L^s + M^t - \underline{L}^t) + g(z^t), M^t\} \end{aligned}$$

where $g(z^t)$ is the tenant's income from other assets (z^t) and other variables are as defined above.

The first order conditions for this problem are (assuming an interior solution):

4) $$\frac{Eu_M^t}{Eu_Q^t} = w + cl_L^t$$

5) $$\frac{Eu_Q^t q}{Eu_Q^t} F_L^t = w + cl_L^t$$

Unenforceable Contracts

Before we consider the landlord's problem, it is useful to note that if the landlord can not enforce the tenant's labor or capital use on the leased in plot, the tenant will also choose L^s and K^s to maximize 3), resulting in two additional first order conditions:

6) $$F_L^t = aF_L^s$$

7) $$F_K^t = aF_K^s$$

These equations illustrate the "Marshallian" result that productive inefficiency results if the tenant's inputs are not enforceable. If the same production function applies to the tenant's own plot and leased in plot ($F^t(\,)=F^s(\,)$) and if L and K are normal inputs, then labor and capital use per hectare and yield will be lower on sharecropped than tenant's own plot if á<1 (Shaban).

Enforceable Contracts

Returning to the case of enforceable contracts, the landlord's problem is given by:

8)
$$\mathbf{Max}_{L^l, M^l, H^s, L^s, K^s, a, b}\ Eu^l\{qF^l(\underline{H}^l - H^s, L^l, \underline{K}^l) + (1-a)qF^s(H^s, L^s, K^s) + bH^s - w*(L^l + M^l - \underline{L}^l) - cl^l(L^l + M^l - \underline{L}^l) - ch(H^s, L^s, K^s, a) + g(z^l), M^l\}$$

subject to the tenant's participation constraint

9)
$$Eu^t\{qF^t(\underline{H}^t, L^t, \underline{K}^t - K^s) + aqF^s(H^s, L^s, K^s) - bH^s - w*(L^t + L^s + M^t - \underline{L}^t) - cl^t(L^t + L^s + M^t - \underline{L}^t) + g(z^t), M^t\} = \underline{U}^t$$

and the first order conditions of the tenant's problem (4) and 5)).

The first order conditions for this problem (assuming an interior solution) lead to the following conditions, in addition to equations 4), 5) and 9):[ii]

10) $$\frac{Eu^l_M}{Eu^l_Q} = w + cl^l_L$$

11) $$\frac{Eu^l_Q q}{Eu^l_Q} F^l_L = w + cl^l_L$$

12) $$\frac{Eu^t_Q q}{Eu^t_Q} - \frac{Eu^l_Q q}{Eu^l_Q} = \frac{ch_a}{F^s}$$

13) $$F^s_L = \frac{w + cl^t_L + ch_L}{\frac{Eu^l_Q q}{Eu^l_Q} + \frac{a ch_a}{F^s}}$$

14) $$F^s_K - F^t_K = \frac{Eu^t_Q}{Eu^t_Q q}[ch_K + ch_a(1-a)\frac{F^s_K}{F^s}]$$

15) $$F^s_H - F^l_H = \frac{Eu^l_Q}{Eu^l_Q q}[ch_H - ch_a a \frac{F^s_H}{F^s}]$$

Fixed Transaction Costs

If all transaction costs are fixed costs, these equations imply

16) $$\frac{Eu_M^t}{Eu_Q^t} = \frac{Eu_M^l}{Eu_Q^l} = w$$

17) $$\frac{Eu_Q^t \boldsymbol{q}}{Eu_Q^t} = \frac{Eu_Q^l \boldsymbol{q}}{Eu_Q^l}$$

18) $$F_L^s = F_L^t = F_L^l = \frac{Eu_Q^l}{Eu_Q^l \boldsymbol{q}} w$$

19) $$F_K^s = F_K^t$$

20) $$F_H^s = F_H^l$$

If the production functions for the tenant's own and sharecropped plots are the same ($F^t(\,)$ $= F^s(\,)$) and are constant returns to scale, then $F^s_H = F^t_H$.[iii] Similarly, $F^s_L = F^l_L$ and $F^s_H = F^l_H$ imply that $F^s_K = F^l_K$.. Thus, even though there is no capital market, equalization of all marginal rates of substitution and marginal products between each landlord and tenant occurs through the operation of the labor and land lease markets if transaction costs are constant. This does not guarantee unconstrained pareto optimality in the economy, since with positive fixed transaction costs there may be households that do not participate in these factor markets, or differences across landlord-tenant pairs in the marginal products and rates of substitution. If transaction costs are zero, the model reduces to Cheung's model, and pareto optimality is achieved.

In the efficient markets case with zero transaction costs, the total amount of land operated by any household will not depend upon its own endowment of land or labor, though it will depend upon the household's endowment of capital, due to the non-marketability of capital. Thus a simple test of the efficient land and labor markets hypothesis is whether the land area operated by households is affected by their endowments of land or labor. Under efficient land markets, these endowments should have no effect on area operated, factor intensities or yields.

A test of the assumption of non-marketable capital is whether the household's endowment of capital has any effect on area operated. If capital is marketable with no transactions costs, this endowment should also not affect area operated. If capital is not marketable, then households with greater capital endowments will operate more land if capital and land are complements (F_{KH}>0), and less land if capital and labor are substitutes (F_{KH}<0). The capital endowment will not affect factor ratios or yields in this case, however. If capital is marketable but subject to transaction costs, the effect of capital endowment would be analogous to the effect of labor endowment when labor is marketable but subject to transaction costs.

Variable Transaction Costs

In the case with variable transaction costs, the unconstrained pareto optimum is no longer achieved, since there will be differences in marginal rates of substitution and marginal products of factors across households. For example, if $ch_{á}$ < 0, equation 12) implies that the marginal rate of substitution between risky income and riskless income (Eu_Qè/Eu_Q) will be greater for the landlord than the tenant, and suggests that the tenant will bear more risk (and the landlord less risk) than if the transaction cost were constant. This is illustrated in Figure 1. If the utility functions exhibit constant or increasing absolute risk aversion, Eu^l_Qè/Eu^l_Q is an increasing function of á and Eu^t_Qè/Eu^t_Q is a decreasing function of á.[iv] The landlord seeks to increase á above the level at which perfect risk pooling occurs, sacrificing optimal risk pooling in order to reduce transaction costs. This suggests that a pure rental contract will be more likely in situations where the transaction costs of monitoring land leases are larger and more responsive to changes in á.[v] We expect this to be more likely if the tenant and landlord are unrelated than if they are relatives or long associates. Thus, we expect sharecropping to be more common among relatives or long associates, and rental contracts to be more common among unrelated individuals.

In general, this model predicts differences in marginal products, factor intensities and yields across different households and between different plots within households. The signs of these differences are generally ambiguous, and depend on the relative magnitudes of the marginal transaction cost terms.

Equation 15) provides the least ambiguous prediction of the model. If $ch_H>0$ or $ch_{\alpha}<0$, then $F^s_H>F^l_H$. A positive marginal cost of monitoring land use by the tenant will cause the landlord to restrict land availability to the tenant, even when the tenant has a higher marginal product of land. This effect is even stronger when the transaction cost depends on the tenant's share, since the tenant is forced to bear more risk, tending to reduce the optimal level of land use.

Equation 15) also has implications for differences in yields and factor intensities. If the production function is of the CES class, then yield is a positive function of the marginal product of land.[vi] Thus, if $ch_H>0$ or $ch_{\alpha}<0$, the tenant's yield on the leased in plot must be higher than the landlord's yield on his own plot. This implies that the landlord applies less labor or capital per hectare, or both (if K and L are normal). This contrasts with the Marshallian prediction that factor intensities and yields are higher on owner-operated than sharecropped plots. Note, however, that our prediction compares tenants' to landlords' factor intensities and yields.

If the marginal transaction costs of monitoring fixed rent contracts are zero, then our model predicts that factor intensities and yields will be the same on the tenant's plots under fixed rent as on the tenant's or landlord's own plots. However, the owner may also need to monitor the fixed rental tenant's use of the plot to ensure that the tenant is not depleting soil fertility or otherwise damaging the plot (Murrell). In this case, there would be differences in factor intensities and yields between owner-operated plots and plots leased in under fixed rental.

Econometric Approach and Results

The theory presented above predicts that land use, lease contract choice, use of labor, oxen and output may depend on many factors. If transaction costs are negligible, most of these factors are irrelevant and only endowments of non-marketed assets and prices should matter. Of course, we would not expect to observe sole owner-operators if transaction costs are negligible, so we have *a priori* reason to believe that (at least fixed) transaction costs are important in land markets in the villages studied. The empirical implications of this are to be determined.

We have data on three types of dependent variables: 1) cropland area operated; 2) choice of land tenure contract when land is imported; and 3) labor use, oxen use, and value of output per unit of land. The econometric model is different for each of these types of dependent variables.

Cropland Area Operated

Econometric Model

We do not observe actual cropland area operated, but rather the area "owned" (allocated by the Peasant Association) plus the area "imported" (acquired by fixed rental, sharecropping, gift or borrowing). We do not have reliable information on the amount of cropland "exported". Cropland area operated is thus observed for cropland importer/non-exporters, but left-censored for other households. We therefore use a censored regression model for area operated.

Define h_{op} as ln(area operated by a cropland importer), h as ln($\underline{H}$+$H_{imported}$) and $\underline{h}$ as ln($\underline{H}$). We assume that

21) $$h_{op} = b_h x_h + u_h$$

for cropland importers, where x_h is a vector of observed variables affecting desired area operated, and u_h is an unobserved error term. h_{op} is observed only for households that import but do not export cropland. For these households, we have that

22) $\boldsymbol{h} = \boldsymbol{h_{op}} = \boldsymbol{b_h x_h} + \boldsymbol{u_h}$

For all other households, we have that[vii]:

23) $\boldsymbol{h} \geq \boldsymbol{b_h x_h} + \boldsymbol{u_h}$

We estimate this model two ways: 1) maximum likelihood estimation, assuming that u_h is independently and identically normally distributed across households, and 2) censored least absolute deviation (CLAD) estimation using the method of Buchinsky, which avoids any distributional assumption concerning u_h.

According to the theory presented earlier, area operated may be affected by the household's endowments of land, labor, capital, other assets determining household income, factors associated with the household's reservation utility or preferences, factors affecting the household's agricultural productivity, factors affecting transaction costs, relative prices and wages, and the endowments, preferences and production functions of potential land tenancy partners. The household's physical endowments are represented by the logarithms of land owned, household labor supply, value of oxen owned, and value of other livestock owned.[viii] We also include dummy variables for households with no land, oxen, or other livestock, since these cases otherwise cause difficulties for the log-log specification used.[ix] Human capital endowments (potentially affecting both farm productivity and non-farm sources of income) are represented by the logarithm of age of the household head and the level of education of the household head. Transaction costs may be affected by many of these factors, as well as by social status and networks of the household. We represent these by indicators of the length of time the farm household has been settled in the village and the ethnicity of the household. Village level dummy variables reflect differences across villages in agroclimatic factors affecting farm productivity, relative prices, access to markets or off-farm sources of income.

Results

The censored regression results are presented in table 2. The maximum likelihood estimates support the transaction costs model, since area operated is found to be positively and statistically significantly associated with land ownership. The positive effect of oxen ownership also supports the transaction costs model, implying imperfections in oxen rental markets and that oxen and land are complementary inputs. Area operated also varies significantly across villages.

In the CLAD estimation, only village effects are statistically significant. The effect of oxen ownership is in the same direction and similar in magnitude as in the maximum likelihood (ML) model, but is no longer statistically significant due to the larger standard errors in the CLAD model. By contrast, the effect of land ownership is much smaller in magnitude and of the opposite sign in the CLAD model to that expected (for the coefficient of ln(area operated)).

The CLAD results reduce our confidence in the implication that imperfections in the land lease market exist, and suggest that those results hinge upon distributional assumptions of the ML model. On the other hand, the insignificant effect of oxen ownership in the CLAD model may simply be a result of the lower statistical power of that model (given the similar magnitude of the coefficients in both models). Next we examine the other evidence available concerning the efficiency of land markets in the study villages.

Contract Choice

Econometric Model

For imported fields, we model the choice of tenure arrangement using a multinomial logit model. We include the same explanatory variables as in the regression for land imports. Since the data are for specific tenancy contracts, we can include explanatory variables specific to the particular landlord as well. One factor that may be an additional important indicator of the transaction costs of the contract is the relationship between the landowner and tenant. If the landowner is a relative of the tenant or if the tenant and the landlord have established a long-term relationship, the transaction costs may be lower, thus tending to favor sharecropping or gift/borrowing over a fixed rental arrangement. Thus we include variables indicating whether the landlord is a relative of the tenant and the number of years the farmer has farmed the plot.

Results

As expected, the length of time the tenant has farmed the plot is positively associated with both sharecropping and gift or borrowing arrangements (table 3). Recent immigrants to the village are very unlikely to acquire plots by sharecropping, while gift and borrowed plots are much more common when the landowner is a relative of the tenant. These findings confirm our expectations about the importance of social relationships in determining land contract choice.

Other factors affecting contract choice include lack of ownership of livestock other than oxen (negative association of dummy variable with sharecropping), household labor supply (negative association with land gifts/borrowing), and literacy (literate households less likely to receive land through gifts/borrowing). The negative associations of household labor supply and literacy with land gifts/borrowing suggests that gifts and loans of land may be reserved for poor relatives who have few alternative income earning opportunities. Households with greater human capital endowments may be better able to afford to rent or sharecrop land, which may be of higher quality. We do not have a strong hypothesis to explain the negative association between lack of other livestock and sharecropping. Given that sharecropping can be a way for tenants who lack access to liquidity to lease land, we expected if anything a positive relationship between lack of livestock and sharecropping.[x]

Input Use and Output Value per Hectare

Econometric Model

The econometric model estimated for these dependent variables can be summarized as follows:

24)

$$y_{hp} = a + b_i D_{ih} + b_x D_{xh} + b_r D_{rp} + b_s D_{sp} + b_g D_{gp} + b_{ir} D_{ih} D_{rp} + b_{is} D_{ih} D_{sp} + b_{ig} D_{ih} D_{gp} + b_h x_h + b_p x_p + v_{hp}$$

where y_{hp} is ln(labor use per ha.), ln(oxen use per ha.), or ln(value of output per ha.) for household h and plot p; D_{ih} and D_{xh} are dummy variables equal to 1 if household h is a land importer or exporter, respectively; D_{rp}, D_{sp} and D_{gp} are dummy variables equal to 1 if plot p is rented, sharecropped or gift/borrowed, respectively; x_h and x_p are vectors of household and plot characteristics affecting the dependent variables; v_{hp} are unobserved factors affecting the dependent variables, and a, b_i, b_x, b_r, b_s, b_g, b_{ir}, b_{is}, b_{ig}, b_h, b_p are coefficients to be estimated.

We include interactions between households' land trade status and the tenure status of the plot to be able to test the specific hypotheses following from the theory presented above. For example, to test the implication of the transaction costs model that yields will be higher on sharecroppers' leased-in plots than landlords' owner-operated plots, we cannot determine this from the average effect of either the land trade status of the household or the tenancy status of the plot. We need interaction terms for this.

The following hypotheses are tested:

Hypothesis	Test
1) y(rented|importer) - y(owned|importer) = 0	$b_r + b_{ir} = 0$
2) y(shared|importer) - y(owned|importer) = 0	$b_s + b_{is} = 0$
3) y(gift/borrowed|importer) - y(owned|importer) = 0	$b_g + b_{ig} = 0$

4) y(rented|importer) – y(owned|exporter) = 0	$b_r + b_{ir} + b_i – b_x = 0$
5) y(shared|importer) – y(owned|exporter) = 0	$b_s + b_{is} + b_i – b_x = 0$
6) y(gift/borrowed|importer) – y(owned|exporter) = 0	$b_g + b_{ig} + b_i – b_x = 0$

Tests 1) – 3) compare inputs and outputs on a tenant's imported plots and his own plots. These tests are comparable to the tests for Marshallian inefficiency in studies such as Bell and Shaban. Marshallian inefficiency implies that $b_s + b_{is} < 0$. Tests 4)-6) test the predictions of the transactions costs theory that inputs and outputs should be greater on tenants' imported plots than on landlords' own plots.

We estimated two versions of the model. In one, x_h includes the same explanatory variables used to predict area operated. In the second version, we included household level fixed effects to account for all possible household level factors (measured or unmeasured) affecting the dependent variables. The fixed effects model was estimated for the subsample of households who were cropland importers and also operated PA-allocated land. This is similar to the approach devised by Shaban to test for Marshallian inefficiency. In the fixed effects regressions, we could not include household level factors (x_h, D_{ih}, D_{xh}). Thus, we could not test hypotheses 4)-6) using fixed effects regressions.

The measured plot level characteristics assumed to affect input use and output include the type of soil, the slope of the field, whether there had been erosion problems on the field, the use of irrigation on the field, and the distance of the field from the household compound.

The endogeneity of the contract choice for imported fields could lead to biased estimates in the model above. To address this issue, we estimated equation (24) using instrumental variables, taking as instruments for contract choice the predicted probabilities of each import contract from a multinomial logit regression.[xi]

In all of the above regressions, coefficients and standard errors are adjusted to account for sample stratification and sample weights. The estimated standard errors are robust to heteroskedasticity and to non-independence of multiple observations from the same household.

Results

In the regressions without household fixed effects, we find statistically significant effects of the plot tenure variables and the interaction terms between land trade status of the household and plot tenure (table 4). To interpret these coefficients, we need to consider the hypothesis tests discussed above. In the hypothesis tests based on the no-fixed effects regressions, we find that labor use is more than 30% lower on importers' sharecropped plots than on their owner-operated plots, and that this difference is statistically significant at the 5% level (table 5). However, we find no statistically significant differences in oxen use or yield on importers' sharecropped vs. owner-operated plots, and the estimated yield difference is only 3%.[xii] Furthermore, in the fixed-effects regressions, there are no statistically significant differences in input use or yields between importers' sharecropped and owner-operated plots, and the magnitude of the differences are relatively small. The results thus provide little support for the hypothesis of Marshallian inefficiency of sharecropping.

We also find no statistically significant difference between input use and yields on importers' cash rented plots and their owner-operated plots, and that the estimated differences are relatively small (especially in the fixed-effects regressions). This is consistent with the assumption that the transactions costs of monitoring fixed rental contracts are low, leading to relatively efficient use of rented plots as well.

We find that estimated input use and yields are substantially lower on importers' gift/borrowed plots than on their owner-operated plots, though the difference is statistically significant only for oxen use. Perhaps this is because operators of gift/borrowed plots own fewer oxen on average than owner-operators, or to unobserved differences in land quality.

We do not find statistically significant differences in output value per hectare on importers' leased-in plots and exporters' owner-operated plots, as predicted by the transaction costs theory. The estimated differences are in the direction predicted by the theory (higher for importers' rented or sharecropped plots than exporters owner-operated plots) but are relatively small in magnitude, particularly for sharecropping (about 5% higher on importers' sharecropped plots). Furthermore, predicted differences in input use are in the opposite direction to that predicted by the theory (though not statistically significant). We thus find little support for the transaction costs theory from the input and output regressions, consistent with the findings from the CLAD regression for area operated. The results are more consistent with the "New School" model of efficient land lease markets.

These results provide little evidence to support the Marshallian view of the inefficiency of sharecropping. This may partly be due to the fact that landlords share some inputs in production, which can help to reduce or offset the incentive effects. However, landlords share very little of the inputs of pre-harvest labor or oxen, so one would still expect less of these inputs to be applied on sharecropped fields, if the Marshallian assumption of no monitoring and enforcement of labor effort were correct. Some form of monitoring and enforcement appears to take place with sharecropping contracts in these Ethiopian villages.

Several household-level factors significantly affect input use and output per hectare, indicating that other factor market imperfections may be important. Labor use per hectare is greater for households having a larger labor endowment, and less where the head of household is older. Oxen ownership has a positive impact on output value (significant at the 10% level). More educated household heads apply less labor (10% level). We also find a positive effect of household labor supply on oxen use (10% level), supporting the hypothesis that capital and labor are complementary. Households that have not been long established in the village use less oxen input per hectare and achieve lower yields. This suggests that farmers' options for leasing or borrowing oxen depend upon social relationships as developed through long presence in the community. Household level fixed effects are highly jointly significant (at the 0.01% level) in all regressions. These household level effects imply that factor markets do not perfectly equalize factor ratios and yields, and suggest that imperfections in labor or oxen markets are responsible.

Conclusions and Implications

Our empirical findings are most consistent with the "New School" perspective, indicating that land lease markets were operating relatively efficiently in the villages studied in 1994. We do not find empirical support for the "Marshallian" prediction of inefficient sharecropping, since factor intensity and output value are not significantly different on tenants' own vs. sharecropped fields. Nor do we find that factor intensity or output value differs significantly between cropland importers and exporters, or that cropland area operated is a function of area owned, as predicted by the transaction costs theory.

As argued by Otsuka, Chuma and Hayami, it is likely that in the absence of institutional restrictions on contract choice, the selection of tenancy contracts will tend to minimize inefficiency. Thus, landlords who do not know prospective tenants well or for whom monitoring the tenant may be costly will tend to prefer a cash rental contract to a sharecropping contract. Where sharecropping is preferred, transaction costs are lower and hence the inefficiency is limited. Furthermore, landlords who do participate in sharecropping contracts reduce the incentive problems by sharing some of the costs.

Although we find that land lease markets function relatively efficiently in the study villages, our data were collected prior to adoption of restrictions on land leasing by the Oromia Regional Government in 1995. These restrictions allow farmers to lease out no more than half of their land for a maximum of three years. Such restrictions may well have reduced the efficiency of lease markets in the region. Investigation of the impacts of these restrictions would be useful.

We do find evidence of imperfections in labor or oxen lease markets. Efforts to improve the functioning of these markets are thus more likely to improve agricultural efficiency than efforts focused on improving land lease markets.

Another implication of our results is that village level factors are important determinants of input use and productivity. It may be that differences in productivity across the study villages resulted from local variations in rainfall or other idiosyncratic factors in 1994, so too much should not be made of this result. However, if such village level differences persist over time, they suggest that factor markets do not function efficiently to equalize marginal returns to productive factors across villages. More research on this issue at a broader scale would enable identification of which village-level factors are causing differences in input use and productivity.

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Table 1 – Characteristics of Households and Cultivated Plots under Different Tenure Arrangements

Item	Type of Tenure: PA-allocated		Fixed rent		Sharecrop		Gift/borrowed		All fields	
Number of sample fields	149		64		31		56		300	
	- means (standard errors in parentheses)[1]									
Characteristics of operator households										
- Cropland owned (ha)	1.93	(0.12)	1.00	(0.25)	1.20	(0.31)	0.16	(0.09)	1.46	(0.14)
- Household labor force	2.69	(0.18)	1.95	(0.22)	2.05	(0.28)	1.28	(0.10)	2.31	(0.15)
- Value of oxen owned (EB)	1666	(134)	1670	(232)	1688	(313)	676	(137)	1537	(139)
- Value of other livestock owned (EB)	1874	(202)	1669	(274)	1538	(336)	687	(130)	1646	(181)
- Age of household head (years)	41.1	(1.9)	30.0	(1.6)	31.0	(2.3)	24.3	(1.1)	35.9	(1.5)
- Education of household head										
-- % illiterate	38.4	(6.4)	14.1	(5.6)	15.3	(6.9)	4.1	(2.7)	27.3	(5.0)
-- % can read and write	20.3	(5.1)	7.1	(3.9)	7.6	(4.7)	0.0	(0.0)	14.1	(4.0)
-- % completed primary school	17.9	(5.9)	26.3	(7.9)	32.3	(12.5)	39.7	(8.9)	23. 7	(5.3)
-- % completed secondary school	23.4	(5.9)	52.6	(9.5)	44.9	(12.5)	56.2	(9.0)	34.9	(6.0)
- Length of family residence in village										
-- % whose father was born in village	42.6	(6.5)	56.1	(9.8)	52.2	(12.6)	67.3	(8.4)	49.2	(6.1)
-- % whose father immigrated but were born in village	47.4	(6.9)	39.5	(9.9)	47.8	(12.6)	29.5	(8.2)	43.7	(6.3)
-- % who immigrated to village	10.0	(3.7)	4.4	(3.7)	0.0	(0.0)	3.2	(2.8)	7.1	(2.8)
- Ethnicity - % Oromo	74.1	(5.8)	75.6	(8.6)	63.3	(12.8)	71.5	(7.7)	72.9	(5.4)
- Relationship to landowner - % with landowner a relative	N/A		31.0	(6.0)	31.5	(11.1)	89.3	(5.5)	45.2	(5.4)
- Number of years household has farmed the plot	8.31	(0.93)	0.59	(0.12)	1.80	(0.49)	1.62	(0.28)	5.45	(0.60)
Characteristics of Fields										
- % having red soil	4.6	(1.3)	11.4	(4.2)	11.1	(4.7)	12.1	(4.1)	7.4	(1.3)
- % flat or gently sloped (not stony)	77.3	(4.0)	78.6	(5.7)	82.7	(7.2)	86.3	(4.4)	79.3	(2.7)
- % with no reported erosion problems	78.2	(3.9)	82.6	(5.0)	70.7	(8.9)	71.8	(7.4)	77.3	(3.2)
- % irrigated	23.1	(3.7)	14.9	(5.0)	15.3	(7.2)	19.8	(6.0)	20.5	(3.0)
- Distance from field to compound (meters)	1281	(100)	1816	(179)	1469	(311)	1338	(225)	1398	(89)
Input use and outputs – 1993/94										
- total labor hours per ha	190	(12)	188	(21)	139	(14)	192	(22)	184	(9)
- total oxen hours per ha	376	(16)	402	(38)	309	(28)	359	(29)	371	(14)
- total value of output per ha (EB)	2872	(111)	2623	(181)	2534	(293)	2233	(183)	2710	(85)

[1]Means and standard errors were corrected for stratification, sampling weights, and clustering (non-independence of observations within households.) Difference in means among tenure categories statistically significant at 1% level for all variables.

Table 2 – Determinants of ln(Cropland Area Operated) – Censored Regressions

Explanatory variable	Maximum Likelihood Estimation	Censored Least Absolute Deviations Estimation
Village (cf. Abichiu Peasant Association)		
- Bilalo Peasant Association	-0.204	-0.285
- Ketar Genet Peasant Association	-0.414**	-0.910***
- Mekro & Chebote Peasant Association	-0.411**	-0.711**
ln(Crop land owned) (ha)	0.353**	-0.004
Landless (dummy variable=1 when cropland owned=0)	-0.363**	-0.031
ln (Household labor supply) (number of workers)	0.048	0.348
ln(Value of oxen owned) (EB)	0.338***	0.400
No oxen (dummy variable=1 when oxen owned=0)	1.842**	2.167
ln(Value of other livestock owned) (EB)	0.051	0.075
No other livestock (dummy variable=1 when other livestock owned=0)	0.158	0.273
ln(age of household head) (years)	-0.338	-0.035
Education of household head (cf. illiterate)		
- Read and write	-0.115	-0.119
- Finished primary school	0.130	0.166
- Finished secondary school	0.346	0.200
Length of time in village (cf. father born in village)		
- Father immigrated to village, farmer born in village	0.043	-0.173
- Farmer immigrated to village	0.049	0.044
Ethnicity of household Oromo	-0.016	-0.356
Intercept	-1.450	-2.653
Number of uncensored/total observations	78/161	77/161[b]
Pseudo R^2		0.479

a. *, **, *** indicate statistical significance at the 10%, 5% and 1% levels respectively. Coefficients and standard errors of maximum likelihood estimator were corrected for sample weights and stratification.
b. Number of predicted uncensored observations after convergence of algorithm.

Table 3 – Determinants of Lease Contract Choice - Multinomial Logit Model

Explanatory Variables[a]	Sharecropping Contract	Gift/Borrowed
Village (cf. Abichiu Peasant Association)		
- Bilalo Peasant Association	0.080	-0.173
- Ketar Genet Peasant Association	-0.737	-1.101
- Mekro & Chebote Peasant Association	0.386	-1.491*
ln(Crop land owned) (ha)	0.237	-1.165
Landless (dummy variable=1 when cropland owned=0)	-0.884	-0.456
ln(Household labor supply) (number of workers)	-0.171	-1.760***
ln(Value of oxen owned) (EB)	-0.520	-0.657
No oxen (dummy variable=1 when oxen owned=0)	-4.000	-2.957
ln(Value of other livestock owned) (EB)	-0.329	-0.322
No other livestock (dummy variable=1 when other livestock owned=0)	-43.866***	-1.391
ln(Age of household head) (years)	0.372	1.577
Education of household head (cf. illiterate)		
- Read and write	-0.954	-40.755***
- Finished primary school	-0.428	2.489
- Finished secondary school	-0.841	2.252
Length of time in village (cf. father born in village)		
- Father immigrated to village, farmer born in village	0.246	1.261
- Farmer immigrated to village	-44.759***	0.435
Ethnicity of household Oromo	-0.738	-0.332
Landlord is a relative of tenant	0.038	3.440***
Number of years farmer has farmed the plot	1.576***	1.939***
Mean predicted probabilities|actual contract[b]		
- Fixed rent	0.408	0.186
- Sharecrop	0.458	0.119
- Gift/borrowed	0.134	0.695

a. *, **, *** indicate statistical significance at the 10%, 5% and 1% levels respectively. Omitted category is cash rental. Coefficients and standard errors were corrected for sample weights, stratification and clustering. Standard errors are robust to heteroskedasticity. Intercepts are not reported. Number of observations is 151.

b. The mean predicted probabilities for fields under fixed rental are: fixed rent 0.597, sharecrop 0.244, gift/borrowed 0.159.

Table 4 – Determinants of Input and Output per Ha. – Instrumental Variables Regressions

Explanatory Variables[a]	Without Household Fixed Effects[c]			With Household Fixed Effects[d]		
	ln(labor/ ha)	ln(oxen time/ha)	ln(output value/ha)	ln(labor/ ha)	ln(oxen time/ha)	ln(output value/ha)
Cropland importer	0.182*	0.006	-0.003			
Cropland exporter	0.135	-0.030	-0.076			
Fixed rent plot[b]	0.029	0.163	0.029	0.006	-0.110	-0.059
Sharecropped plot[b]	-1.538***	-0.985***	-0.341**	-0.008	-0.034	-0.119
Borrowed/gift plot[b]	-0.797***	-0.627***	-0.170	-0.234	-0.879***	-0.393
Importer x fixed rent interaction[b]	-0.285	-0.294	0.046			
Importer x sharecropped interaction[b]	1.238***	0.817***	0.313			
Importer x borrowed/gift interaction[b]	0.578**	0.360*	-0.068			
Village (cf. Abichiu)						
- Bilalo	-0.225*	-0.309***	-0.320***			
- Ketar Genet	-0.388***	-0.226	0.578***			
- Mekro & Chebote	-0.430***	-0.644***	0.304***			
Ln(Crop land owned) (ha)	0.013	-0.007	-0.033			
Landless (dummy variable=1 when cropland owned=0)	0.055	0.156	0.096			
ln(Household labor supply) (number of workers)	0.188**	0.103*	0.119			
Ln(Value of oxen owned) (EB)	0.0569	0.0113	0.128*			
No oxen (dummy variable=1 when oxen owned=0)	0.480	0.115	0.865*			
Ln(Value of other livestock owned) (EB)	-0.0291	-0.0090	-0.0225			
No other livestock (dummy variable=1 when other livestock owned=0)	0.008	-0.017	-0.095			
ln(Age of household head) (years)	-0.423***	0.154	-0.162			
Education of household head (cf. illiterate)						
- Read and write	-0.147	0.006	0.109			
- Finished primary school	-0.168	0.107	-0.062			
- Finished secondary school	-0.198*	0.014	0.104			
Length of time in village (cf. father born)						
- Father immigrated to village, farmer born in village	-0.016	-0.203***	-0.124*			
- Farmer immigrated to village	-0.044	-0.077	0.058			
Ethnicity of household Oromo	0.002	-0.031	-0.083			
Number of years farmer has farmed the plot	-0.0095	-0.046	0.058	0.229	-0.021	0.016
Red soil on field	-0.007	0.064	0.069	0.300	0.280	0.030
Flat or gently sloping field	0.022	-0.012	-0.093	-0.144	-0.049	-0.028
Erosion problem on field	-0.039	-0.026	-0.003	0.014	0.0005	-0.047
Irrigated field	-0.106	-0.095	-0.136**	-0.306*	-0.082	-0.163
Distance from field to compound (km.)	-0.0476**	0.0133	-0.0149	-0.061	-0.001	-0.043
R^2	0.202	0.353	0.357	0.416	0.549	0.453

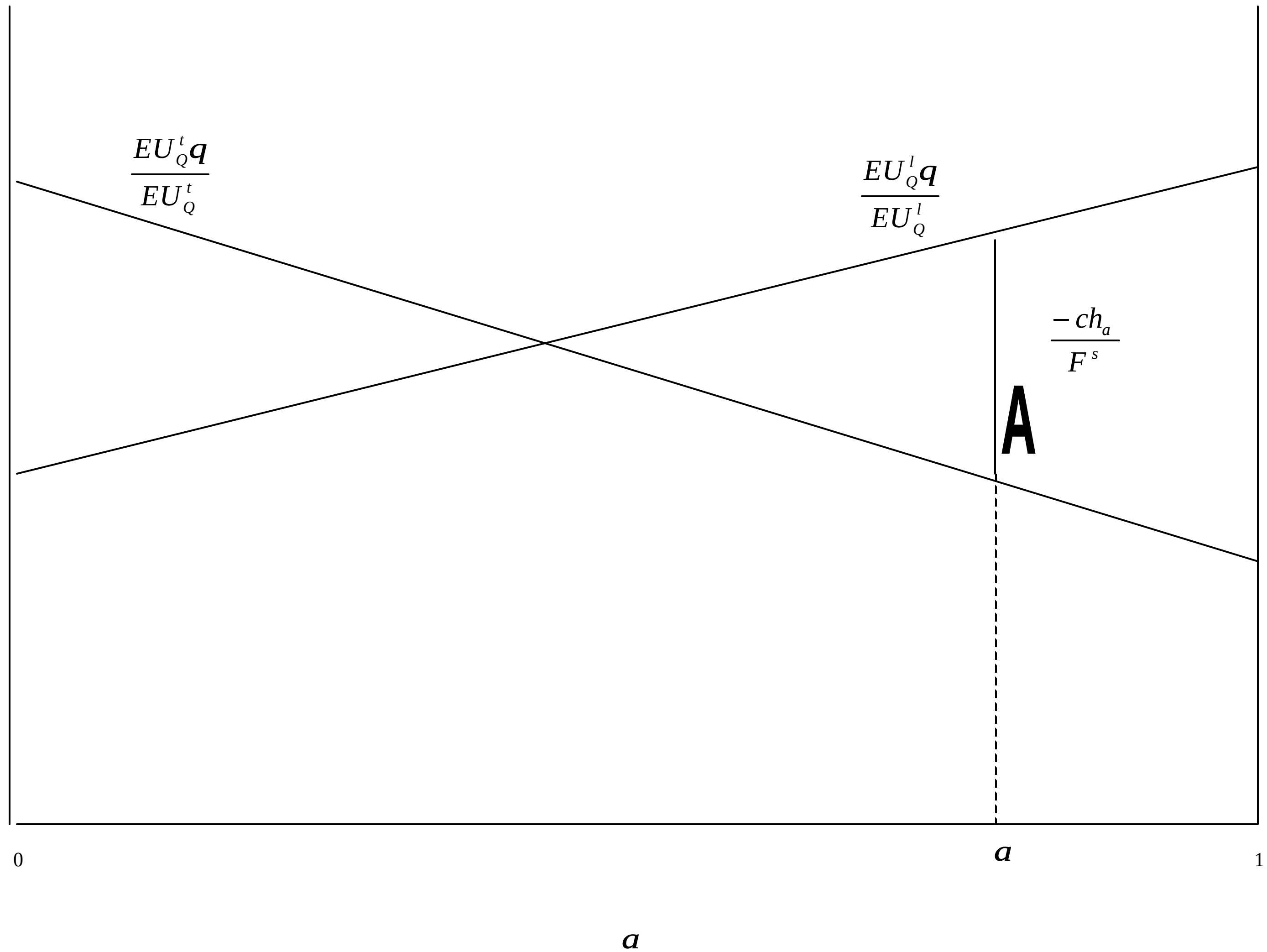
a. *, **, *** indicate statistical significance at the 10%, 5% and 1% levels respectively.
b. Instrumental variables used for tenure categories and interactions include predicted probabilities of each land lease type, predicted by a multinomial logit model including household fixed effects, and interactions between predicted probabilities of land lease types and cropland importer dummy.
c. Number of observations = 300.
d. Number of observations = 127.

Table 5 – Hypothesis Tests about Impacts of Land Tenure Variables

Hypothesis	Without Household Fixed Effects			With Household Fixed Effects		
	ln(labor/ ha)	ln(oxen time/ha)	ln(output value/ha)	ln(labor/ha)	ln(oxen time/ha)	ln(output value/ha)
All land tenure x land trade effects = 0	***	***	*		***	
	p=(0.000)	(0.000)	(0.089)	(0.785)	(0.001)	(0.578)
Importer rented plot – importer own plot = 0	-0.256	-0.131	0.075	0.006	-0.110	-0.059
	(0.168)	(0.362)	(0.565)	(0.979)	(0.554)	(0.743)
Importer sharecropped plot – importer own plot = 0	-0.300**	-0.168	-0.028	-0.008	-0.034	-0.119
	(0.035)	(0.154)	(0.845)	(0.975)	(0.819)	(0.582)
Importer gift/borrowed plot – importer own plot = 0	-0.219	-0.267*	-0.238	-0.234	-0.879***	-0.393
	(0.157)	(0.066)	(0.104)	(0.295)	(0.000)	(0.163)
Importer rented plot – exporter own plot = 0	-0.209	-0.095	0.148	NE	NE	NE
	(0.382)	(0.585)	(0.264)			
Importer sharecropped plot – exporter own plot = 0	-0.253	-0.132	0.045	NE	NE	NE
	(0.196)	(0.382)	(0.758)			
Importer gift/borrowed plot – exporter own plot = 0	-0.172	-0.231	-0.165	NE	NE	NE
	(0.416)	(0.191)	(0.277)			

a. *, **, *** indicate statistical significance at the 10%, 5% and 1% levels respectively. p values in parentheses.

Figure 1- Determination of the Tenant's Share



Appendix.

Derivation of First Order Conditions:

The tenant's optimization constraints (4) and 5)) are satisfied if the landlord solves the less-constrained maximization problem excluding these two equations, and taking L^t and M^t as choice variables. We can therefore solve this less-constrained problem, since the solution will be the same.

The lagrangian for maximization of 8) with respect to L^t, M^t, L^l, M^l, H^s, L^s, K^s, á, and â subject to 9) is given by:

A1)
$$\begin{aligned} V =\ & Eu^l\{\theta F^l(\underline{H}^l - H^s, L^l, \underline{K}^l) + (1-\alpha)\theta F^s(H^s, L^s, K^s) \\ & + \beta H^s - w*(L^l + M^l - \underline{L}^l) - cl^l(L^l + M^l - \underline{L}^l) - ch(H^s, L^s, K^s, \alpha) + g(z^l), M^l\} \\ & + \lambda[Eu^t\{\theta F^t(\underline{H}^t, L^t, \underline{K}^t - K^s) + \alpha\theta F^s(H^s, L^s, K^s) \\ & - \beta H^s - w*(L^t + L^s + M^t - \underline{L}^t) - cl^t(L^t + L^s + M^t - \underline{L}^t) + g(z^t), M^t\} - \underline{U}^t] \end{aligned}$$

Differentiating V with respect to L^t and M^t we obtain:

A2) $$\frac{\partial V}{\partial L^t} = \lambda[Eu^t_Q \theta F^t_L - Eu^t_Q(w + cl^t_L)] = 0$$

A3) $$\frac{\partial V}{\partial M^t} = \lambda[Eu^t_M - Eu^t_Q(w + cl^t_L)] = 0$$

Equations A2) and A3) simplify to equations 4) and 5) since the tenant's participation constraint is binding (ë > 0).

Differentiating with respect to â yields:

A4) $$\frac{\partial V}{\partial \beta} = Eu^l_Q H^s - \lambda Eu^t_Q H^s = 0$$

Equation A4) implies that

A5) $\boldsymbol{l} = \frac{Eu_Q^l}{Eu_Q^t}$

Differentiating with respect to á yields:

A6) $\frac{\partial V}{\partial \boldsymbol{a}} = -Eu_Q^l \boldsymbol{q} F^s - Eu_Q^l ch_a + \boldsymbol{l} Eu_Q^t \boldsymbol{q} F^s = 0$

Substituting A5) into A6) and simplifying, we obtain equation 12).

Differentiating with respect to L^l and M^l yields:

A7) $\frac{\partial V}{\partial L^l} = Eu_Q^l \boldsymbol{q} F_L^l - Eu_Q^l (w + cl_L^l) = 0$

A8) $\frac{\partial V}{\partial M^l} = Eu_M^l - Eu_Q^l (w + cl_L^l) = 0$

Equation A7) and A8) can be rewritten as equations 11) and 10).

Differentiating with respect to L^s, K^s, and H^s yields:

A9) $\frac{\partial \boldsymbol{V}}{\partial \boldsymbol{L^s}} = \boldsymbol{Eu_Q^l} (1 - \boldsymbol{a}) \boldsymbol{q} \boldsymbol{F_L^s} - \boldsymbol{Eu_Q^l ch_L^l} + \boldsymbol{l} [\boldsymbol{Eu_Q^t a q F_L^s} - \boldsymbol{Eu_Q^t} (\boldsymbol{w} + \boldsymbol{cl_L^t})] = 0$

A10) $\frac{\partial V}{\partial K^s} = Eu_Q^l (1 - \boldsymbol{a}) \boldsymbol{q} F_K^s - Eu_Q^l ch_K^l + \boldsymbol{l} [-Eu_Q^t \boldsymbol{q} F_K^t + Eu_Q^t \boldsymbol{a q} F_K^s] = 0$

A11) $\frac{\partial V}{\partial H^s} = -Eu_Q^l \boldsymbol{q} F_H^l + Eu_Q^l (1 - \boldsymbol{a}) \boldsymbol{q} F_H^s + Eu_Q^l (\boldsymbol{b} - ch_H^l) + \boldsymbol{l} [Eu_Q^t \boldsymbol{a q} F_H^s - Eu_Q^t \boldsymbol{b}] = 0$

Substituting A5) and 12) into A9), A10) and A11) and simplifying, we obtain equations 13)-15).

Proof that $d(Eu^t_Q\theta/Eu^t_Q)/d\alpha < 0$ if $u^t(\ )$ exhibits constant or increasing absolute risk aversion:

A12) $$\frac{\partial[\frac{Eu^t_Q\theta}{Eu^t_Q}]}{\partial\alpha} = F^s\,\frac{Eu^t_Q E(u^t_{QQ}\theta^2) - E(u^t_Q\theta)E(u^t_{QQ}\theta)}{(Eu^t_Q)^2}$$

Case 1. Constant absolute risk aversion

In this case, u^t_{QQ} = constant < 0. Thus

A13) $$sign\{\frac{\partial[\frac{Eu^t_Q\theta}{Eu^t_Q}]}{\partial\alpha}\} = sign\{E(u^t_Q\theta)E(\theta) - E(u^t_Q)E(\theta^2)\}$$

Since

A14) $$\frac{\partial u^t_Q}{\partial\theta} = (F^t + \alpha F^s)u^t_{QQ} < 0$$

Then

A15) $$Cov(u^t_Q, \theta) < 0$$

A15) implies that

A16) $$E(u^t_Q\theta) < E(u^t_Q)E(\theta) = E(u^t_Q)$$

since $E(\theta) = 1$.

Jensen's inequality implies that

A17) $$E(\theta^2) > (E\theta)^2 = 1$$

Using relations A16) and A17) in equation A13), we find that

A18) $sign\{\frac{\partial[\frac{Eu_Q^t q}{Eu_Q^t}]}{\partial a}\} < 0$

Case 2. Increasing absolute risk aversion

With increasing absolute risk aversion, $u^t_{QQQ} < 0$. Therefore

A19) $\frac{\partial u_{QQ}^t q}{\partial q} = u_{QQ}^t + q(F^t + aF^s)u_{QQQ}^t < 0$

This implies that

A20) $Cov(u_{QQ}^t q, q) < 0$

Thus

A21) $E(u_{QQ}^t q^2) < E(u_{QQ}^t q)E(q) = E(u_{QQ}^t q) < 0$

Using relations A21) and A16) (which holds also with increasing absolute risk aversion) in equation A12) proves the result.

Endnotes

[i] We are grateful to the World Bank for providing financial support to this research; to the International Livestock Policy Research Institute for providing access to the data; to Sarah Gavian, who led the field research; to Pamela Jagger and Amare Teklu for providing excellent research assistance; to Kei Otsuka, Elisabeth Sadoulet, Alain de Janvry, Peter Hazell, Simeon Ehui, Stein Holden, Nancy McCarthy, Gershon Feder, Hanan Jacoby, Chris Barrett and other participants at various seminars on this paper who provided valuable comments and suggestions; and to the many farmers who participated in the study. The authors bear sole responsibility for any errors or omissions.

[ii] These results are proved in the Appendix.

[iii] This can be shown by writing the production function as F(H,K,L)=Hf(k,l), where k=K/H, l=L/H, and f( ) is a strictly concave function. Since $F_K=f_k(k,l)$ and $F_L=f_l,(k,l)$ and f( ) is strictly concave, we can invert this system to determine $k=g(F_K,F_L)$ and $l=h(F_K,F_L)$. Since $F_K{}^s=F_K{}^t$ and $F_L{}^s=F_L{}^t$, this implies that $k^s=k^t$ and $l^s=l^t$, and thus that $f(k^s,l^s)= f(k^t,l^t)$. Since $F_H=f-f_kk-f_ll$, this implies that $F_H{}^s= F_H{}^t$.

[iv] The proof is given in the Appendix. The assumption of constant or increasing absolute risk aversion is a sufficient but not necessary condition. These results may also hold with decreasing absolute risk aversion.

[v] We say "suggests" since we do not offer a formal proof of this hypothesis. The proof is difficult due to the large number of endogenous variables in the system of equations 4), 5), and 9)-15). However, the intuition that the landlord would increase á if doing so would reduce transactions costs seems compelling to us.

[vi] Specifically, if $F(H,K,L)=(A_1H^{ñ}+ A_2K^{ñ}+ A_3L^{ñ})^{1/ñ}$, then $F/H=(F_H/A_1)^{1/(1-ñ)}$.

[vii] If a household does not import land (either autarkic or an exporter), then desired operated area (if it were to import) must be less than or equal to its endowment (<u>h</u>) plus some positive amount (Äh) necessary for an importer to overcome fixed transaction costs. Ideally, Äh should be included on the left side of relation 23) and estimated. However, this parameter is not identified, and excluding it biases only the intercept of $â_h$ (assuming that Äh is constant or randomly distributed and uncorrelated with x_h). If a household is both an exporter and importer, relation 23) holds because area operated is less than area owned plus imported (by the amount exported).

[viii] We used a logarithmic specification for these variables and the dependent variable to reduce problems of non-normality and sensitivity to outliers. Similar qualitative results were obtained using a linear specification.

[ix] The terms with ln(0) for such cases were set to zero and a separate coefficient computed for the dummy variable.

[x] Very similar results were obtained using a probit model to compare determinants of sharecropping vs. fixed rental.

[xi] To increase the efficiency of the instrumental variables estimator, we included household level fixed effects in the multinomial logit model used to predict the instruments for contract choice.

[xii] The efficiency of the estimators may be affected by the use of instrumental variables and problems of multicollinearity. Very similar results were found when ordinary least squares rather than instrumental variables estimation was used, indicating that the use of instrumental variables did not greatly reduce efficiency. Similar results were also found using a linear rather than a logarithmic specification. Multicollinearity is a problem mainly for the oxen endowment variables (the correlation between ln(oxen owned) and the no oxen dummy is -0.98), and for some of the tenure and land trade status variables in the regressions without fixed effects, due to the interaction terms (variance inflation factors greater than 10 for several of these). Dropping the ln(oxen owned) variable from the regressions has little impact on the regression results, except that the no oxen dummy no longer has a significant impact on output. Thus multicollinearity between the oxen endowment variables does not cause major problems for the other regression results. The multicollinearity among the tenure variables is unavoidable, since all of these must be included for the hypothesis tests.