Land Lease Markets and Agricultural Efficiency: Theory and Evidence from Ethiopia

John Pender* and Marcel Fafchamps**

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Abstract

In this paper, we develop a theoretical model of land leasing that includes transaction costs, risk pooling motives and non-tradable productive inputs, and investigate the empirical implications of land contracts using data collected from four villages in Ethiopia. We show that sharecropping is the dominant contract if transaction costs are negligible, but that a rental contract may arise if transaction costs decrease with increasing the tenant's share of output. When this is the case, the theory predicts that area operated by tenants will be an increasing function of their land endowment and that fixed rental contracts will be more likely in situations where transaction costs are higher. We find empirical support for these predictions in the villages studied. We also find that input of labor per hectare is about 25% lower on sharecropped than on other land tenure types, but that the differences in total value of inputs, outputs and profits per hectare are statistically insignificant and relatively small in magnitude. These results support the Marshallian argument that sharecropping reduces labor effort, but also support the "New School" perspective since the magnitude of the inefficiency is relatively small. A bigger source of inefficiency (and inequity) in the study villages appears to be the limited lease market for oxen services, together with credit constraints that limit the ability of land and oxen poor households to purchase oxen.

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

* Research Fellow (corresponding author)
International Food Policy Research Institute
2033 K St., N.W.
Washington, D.C. 20006 USA
j.pender@cgiar.org

** Professor
Center for the Study of African Economies
Oxford University
United Kingdom

1. Introduction

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 limited development of credit markets. 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 the fall of the Derg regime and leasing is again common in many parts of Ethiopia, though restrictions have been imposed on lease arrangements in some regions of the country. Now is thus an opportune time to assess the efficiency of the lease markets developing in Ethiopia, and implications for land tenure policies.

There is an old and large literature on land tenure contracts and their implications for agricultural efficiency.[1] Adam Smith (1776), John Stuart Mill (1848), Alfred Marshall (1890), and numerous authors since have argued that share tenancy causes inefficient resource allocation because the share tenant receives as marginal revenue only a fraction of the value of his marginal product of labor, thus reducing the tenant's incentive to supply labor or other inputs below the efficient level. 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, 1950; Cheung, 1969).[2] Whether monitoring and enforcement of contracts are sufficiently costless to allow for efficient sharecropping is of course an empirical question.

The available empirical evidence on the efficiency of alternative land tenure contracts is mixed. The majority of studies do not find significant inefficiency of share tenancy, and

[1] For excellent reviews, see Otsuka, Chuma and Hayami (1992); Singh (1989); Otsuka amd Hayami (1988); and Binswanger and Rosenzweig (1984).
[2] Marshall himself noted noted this possibility even while arguing for the inefficiency of sharecropping.

the distribution of case study results shows no significant evidence of Marshallian inefficiency of sharecropping (Otsuka and Hayami, 1988). However, many of the studies that have been completed 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, 1987). Several studies that did control for such characteristics have found evidence supporting the Marshallian perspective (Bell, 1977; Shaban, 1987; Sadoulet, Fukui and de Janvry, 1994; Laffont and Matoussi, 1995; Chunrong Al, Arcand and Ethier, 1996), although inefficiency was not always found for all groups of farmers (Sadoulet, et al.), nor did it always mean lower input use or output per hectare on sharecropped land (Chunrong Al, et al.).

The existing empirical literature on the effects of alternative land tenure contracts is dominated by studies conducted in south and southeast Asia, with very little information available from sub-Saharan Africa.[3] In this paper, we investigate the efficiency of land lease markets using data collected by the International Livestock Research Institute in four villages of Ethiopia. In a recent paper, Gavian and Ehui (1999) found that total factor productivity was somewhat lower on informally contracted land (whether by cash rental, sharecropping, gift or borrowing) than on owner-cultivated land in these villages, while use of inputs was similar. However, Gavian and Ehui did not provide statistical tests of their results or control for household or plot-level factors that may have caused differences in total factor productivity or masked differences in factor intensity.

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 show that

sharecropping is the dominant contract if transaction costs are negligible, but that a rental contract may arise if transaction costs decrease with increasing the tenant's share of output. When this is the case, the theory predicts that area operated by tenants will be an increasing function of their land endowment and that fixed rental contracts will be more likely in situations where transaction costs are higher, such as for tenants that are recent immigrants to a village or who are not related to landlords. We find empirical support for these predictions in the villages studied. We also find that input of labor per hectare is about 25% lower on sharecropped than on other land tenure types (also consistent with transaction costs of monitoring tenants' labor input in share contracts), but that the differences in total value of inputs, outputs and profits per hectare are statistically insignificant and relatively small in magnitude. These results support the Marshallian argument that sharecropping reduces labor effort, but also suggest that the magnitude of the inefficiency is relatively small in the study villages. A bigger source of inefficiency (and inequity) appears to be the limited lease market for oxen services, together with credit constraints that limit the ability of land and oxen poor households to purchase oxen.

2. Theory of Land Tenancy Contracts

Restrictions on land sales, as in Ethiopia, need not be a source of inefficiency in agricultural production, 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 by landowners until all factors of production earn equal marginal products by all landowners, resulting in productive efficiency (Binswanger and Rosenzweig, 1984). Tenancy is thus not necessary unless there is some other market imperfection in addition to a missing or poorly functioning sales market.

[3] There is a substantial and growing literature investigating the impacts of land rights and land titles on

Several kinds of market imperfections have been considered in the literature on land tenure contracts in developing countries to explain the existence and types of tenure contracts that arise. Among these are missing insurance markets, unobservable or costly monitoring of labor effort, asymmetrical information about labor quality, transaction costs of monitoring treatment of leased land or other capital goods, indivisibilities and non-tradability of other productive inputs, and capital market imperfections (Johnson, 1950; Cheung, 1969; Stiglitz, 1974; Newbery, 1975, 1977; Newbery and Stiglitz, 1979; Binswanger and Rosenzweig, 1984; Eswaran and Kotwal, 1985; Otsuka and Hayami, 1988; Shetty, 1988; Otsuka, Chuma and Hayami, 1992; Laffont and Matoussi, 1995).

In the presence of production risk, 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, 1950; Cheung, 1969). Cheung thus takes risk pooling as an argument for the existence of sharecropping. Newbery (1975 and 1977) 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 productive efficiency can be achieved by a combination of fixed rental and wage contracts, and that therefore some additional market imperfection is necessary to explain the choice of sharecropping.

One of the most commonly cited arguments for sharecropping to exist is the difficulty of monitoring labor effort. If labor effort is unobservable or costly to monitor, sharecropping may dominate labor hiring because of its incentive advantages and dominate fixed rental because of its risk pooling advantages (Stiglitz, 1974). Although this argument is persuasive, it is not clear how it could lead to multiple contract forms coexisting in the same communities, as is often observed in Ethiopia and in many other countries, unless, as seems unlikely in the context of smallholders in Ethiopia, some tenants are risk neutral while others

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agricultural productivity in Africa (Platteau, 1996), but little of it addresses the impacts of land lease contracts.

are risk averse (Binswanger and Rosenzweig, 1984).[4] Furthermore, since most of the literature on land tenure contracts assumes constant returns to scale, the level of land operated by any tenant is not determined by these theories. Indeed, agents are usually assumed to be either tenants or landlords, without any explanation of what determines whether they will be one or the other (or neither).

In this paper, we consider a model in which there are diminishing returns to scale because at least one factor of production is not marketed. Specific human capital of the farmer, such as managerial experience, may be limited to use in farming and subject to serious asymmetric information problems preventing the development of a market. Other productive capital, such as oxen, may also be subject to problems arising from covariate peak demand, asymmetric information and/or moral hazard problems that limit the development of lease markets in such assets. We also assume that all agents are risk averse, whether they are landlords, tenants, or solely owner-operators.

Whether a household is a landlord or tenant is determined by its demand to use farmland relative to the amount of land it owns.[5] If there are no transaction costs or indivisibility of land, all households would be expected to be either landlords or tenants, since the case of sole owner-operators would be a knife-edge solution that results only if the household's demand for land happened to exactly equal its land endowment. In this case, our model reduces to the perfect markets model, and efficient production and perfect risk pooling are achieved, as in Cheung's model.

[4] In his seminal treatment of the topic, Stiglitz (1974) proved that fixed rental would only occur if the tenant is risk neutral. However, he assumed that landlords are risk neutral in his model with unenforceable labor effort. We are not aware of any paper that has proved whether fixed rental is possible with risk averse tenants and landlords and costly monitoring of labor. We show this to be possible in our model below.

[5] In the Ethiopian context, households do not formally "own" land, since the 1995 Constitution proclaims all land to be the property of the people. However, land allocated by the Peasant Association has many characteristics of usufruct ownership, though land may not be sold or mortgaged and future redistributions have not been ruled out in the region under study.

If the landlord must bear transaction costs of monitoring the tenant's use of labor (to avoid shirking) or of the land (to avoid overexploitation of the land), there may be a gap between the landlord's and tenant's returns to land that can lead to "non-tradable" outcomes; i.e., cases in which landowning households neither lease in nor lease out land (sole owner-operators). Households with sufficiently large land endowments relative to their demand will be landlords, those with small endowments will be tenants, and those in between will be owner-operators.

We show that sharecropping is the dominant contract if transaction costs are zero, or more generally, do not vary with the tenant's share of output. Although Newbery (1975 and 1977) and others have argued that a sharecropping contract is equivalent to a combination of fixed rental and wage contracts, this argument hinges on the assumption of constant returns to scale. If there are fixed inputs such as managerial skills, achieving the same marginal products of land and labor with a combination of wage and rental contracts requires that the tenant use the same amount of land and labor as under a share contract, in order to keep the same ratio of these inputs to the fixed input.[6] But if the tenant does this, he will be bearing greater risk under fixed rental than under the share contract (Newbery and Stiglitz, 1979). Although Allen (1984) argues that an equivalence result holds without constant returns to scale, he does not provide a formal proof and appears to ignore risk pooling in his argument.[7]

If transaction costs depend on the terms of the contract, we show that perfect risk pooling no longer occurs and that a fixed rental or fixed wage contract may be preferred. If

[6] Note that Newbery's argument assumes that the tenant leases in a smaller amount of land under fixed rental than under the equivalent share contract (by the amount of the tenant's share), and that this does not affect the result due to constant returns to scale.

[7] Specifically, Allen states that "if there are decreasing returns to scale which for example occurs in the case . . . where tenants have a non-tradeable factor which is imperfectly divisible, it would be necessary for the contract to specify the ratio of land to nontradeable should be the same under the rent contract as in the equivalent share contract" (Allen; 1984, p. 315). Since the non-tradable factor is fixed, this is equivalent to saying that the amount of land operated (and labor used) by the tenant must be the same whether fixed rental or sharecropping is used. But since sharecropping an acre of land is less risky than renting one acre (Newbery and Stiglitz; 1979, p. 330), this implies that perfect risk pooling is not attained if the same amount of land is leased in the "equivalent" rental contract.

transaction costs decrease with an increase in the tenant's share (due to labor monitoring costs), this creates a tradeoff between risk pooling and the tenant's work incentive, which leads to a higher equilibrium share and the possibility that fixed rental is optimal. Conversely, if transaction costs increase with increasing tenant's share (due to land monitoring costs), this leads to a lower equilibrium share and the possibility that a wage contract is optimal. Since these transaction cost relationships may vary across different prospective tenants and landlords (and the tradeoffs also depend on household endowments), several different contract forms can coexist in the same community, even if no agents are risk neutral.

Model

Suppose production is determined by three factors of production: land (H), labor (L) and capital services (K). We assume that land and labor can be exchanged and are therefore variable factors of production, but that capital is non-tradable and therefore fixed. We may think of the services of human capital as an example of non-tradable capital, but services of other forms of capital, such as oxen, may also be non-tradable. Production by household i (Y_i) is a constant returns to scale function of all three factors, and hence a decreasing returns to scale function of the variable factors:

1) $Y_i = qF^i(H_i, L_i, \underline{K}_i)$

F^i is a concave function, 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. The underscore for $\underline{K}_i$ indicates that this is household i's fixed endowment of K.

Households are also endowed with land ($\underline{H}_i$) and labor ($\underline{L}_i$). They seek to maximize the expected utility ($Eu_i(\ )$) of income in each period, where u_i is a strictly concave function. If a household leases in land, it pays to the landlord:

2) $Lease\ payment = (1-a)(1-(\underline{H}_i / H_i))qF(H_i, L_i, \underline{K}_i) - b(H_i - \underline{H}_i)$

where α is the share of the harvest from the leased land that the tenant keeps, with $0 \leq \alpha \leq 1$; $(1-(\underline{H}_i/H_i))$ is the share of the tenant's total operated land that is leased in, and β is a fixed rental payment. If $0<\alpha<1$ and $\beta=0$, then the contract is a pure share contract. If $\alpha=1$ and $\beta>0$, then the contract is a fixed rental contract. We assume that β is unrestricted; i.e., a mixture of share and rental in a contract is possible. Households may also hire labor in or out at price p_L.

We assume that labor effort by workers and tenants can be enforced by employers and landlords, but that there is a transaction cost for this. As a simplification, we assume that tenants have sufficient labor such that they do not hire labor in. This assumption is not crucial to the results below.[8] The transaction cost of monitoring land lease contracts (ch) may depend upon the amount of land operated by the tenant, the amount of labor used by the tenant to operate this land, and the tenant's share of the crop. The transaction cost of monitoring wage contracts (cl) may depend on the amount of labor hired by the landlord. Thus the total transaction costs are given by:

3) $\textit{Total transaction costs} = ch(H_t, L_t, a) + cl(L_l - \underline{L}_l)$

The subscripts "t" and "l" refer to tenant and landlord households, respectively. We postulate that ch( ) is nondecreasing in H_t and L_t, and that cl( ) is nondecreasing in L_l-$\underline{L}_l$. The effect of α is ambiguous; labor monitoring costs may decrease with α while land monitoring costs (to prevent overexploitation of land by tenants) may inrease with α.

For simplicity, we assume that each tenant leases land from only one landlord, and vice versa. This may be optimal if there are fixed transaction costs of land lease contracts; e.g., if landlords must pay some costs to screen potential tenants. This assumption implies that $H_l = \underline{H}_l + \underline{H}_t - H_t$. Since labor effort is enforceable (at some cost) by the landlord, the

[8] As with a tax, it does not matter who initially "pays" a transaction cost, since such a cost affects both parties to a contract.

landlord chooses his own and the tenant's level of land and labor use, and the contract terms, to maximize his expected utility subject to the tenant receiving at least his reservation utility and to the land equilibrium condition above[9]:

4) $$Max_{L_l,H_t,L_t,a,b}\ Eu_l\{qF^l(\underline{H}_l+\underline{H}_t-H_t,L_l,\underline{K}_l)+(1-a)(1-\underline{H}_t/H_t)qF^t(H_t,L_t,\underline{K}_t) + b(H_t-\underline{H}_t)-p_L(L_l-\underline{L}_l)-ch(H_t,L_t,a)-cl(L_l-\underline{L}_l)\}$$

subject to:

5) $$Eu_t\{qF^t(H_t,L_t,\underline{K}_t)(1-(1-a)(1-\underline{H}_t/H_t))-b(H_t-\underline{H}_t)+p_L(\underline{L}_t-L_t)\}=\underline{U}_t$$

Note that if $\underline{H}_t > 0$, it is not possible for the tenant to eliminate risk through a tenancy contract, even if $\alpha=0$. Similarly, the landlord's risk cannot be eliminated through the tenancy contract if $H_l > 0$, even if $\alpha=1$.

The first order conditions for an interior solution reduce to the reservation utility constraint (5) and the following four equations[10]:

6) $$F_L^l=\frac{Eu_l'}{Eu_l'q}(p_L+cl_L)$$

7) $$\frac{Eu_t'q}{Eu_t'}-\frac{Eu_l'q}{Eu_l'}=\frac{ch_a}{F^t(1-\underline{H}_t/H_t)}$$

8) $$(\frac{-ch_a(1-a)}{F^t}+\frac{Eu_t'q}{Eu_t'})F_L^t=ch_L+p_L$$

9) $$-ch_a(1-a)(\frac{F_H^t}{F^t}+\frac{\underline{H}_t}{(H_t-\underline{H}_t)H_t})+\frac{Eu_t'q}{Eu_t'}F_H^t-\frac{Eu_l'q}{Eu_l'}F_H^l=ch_H$$

Equations 5) – 9) determine L_l, H_t, L_t, α and β as functions of the exogenous variables ($\underline{H}_t$, $\underline{L}_t$, $\underline{K}_t$, $\underline{U}_t$, $\underline{H}_l$, $\underline{L}_l$, $\underline{K}_l$, p_L, cl_L, ch_α, ch_L, ch_H).[11]

[9] We incorporate the equilibrium condition into the landlord's objective function by replacing H_l by $\underline{H}_l+\underline{H}_t-H_t$.
[10] The first equation results from differentiating the lagrangian with respect to L_l; the second from differentiating with respect to α and β; the third from differentiating with respect to L and the fourth with respect to H (combined with the other results). Partial derivatives are represented by subscripts (e.g., $ch_L = \partial ch/\partial L$).
[11] cl_l, ch_α, ch_L, ch_H are exogenous only if they are constant; otherwise they are determined in equilibrium by L_l, H_t, L_t, and α. p_L may be endogenous or exogenous at the level of the village.

Note that if transaction costs are constant, cl_L, ch_α, ch_L, and ch_H are zero and equations 6)-9) imply that

10) $$\frac{Eu_t'q}{Eu_t'} = \frac{Eu_l'q}{Eu_l'}$$

11) $$F_L^t = F_L^l = \frac{Eu_l'}{Eu_l'q}\, p_L$$

12) $$F_H^t = F_H^l$$

Thus, with constant transaction costs, landlords and tenants pool risks and equate the marginal productivity of variable inputs. This does not imply that all households will have the same marginal products and marginal rate of substitution between risky and riskless income. These equalities are only between each landlord-tenant pair, and unless landlords contract with more than one tenant or vice versa (which may be prevented by positive transaction costs), there is no reason that marginal products and rates of substitution will equalize across different landlord-tenant pairs. Furthermore, some households may be neither landlords nor tenants if there are positive transaction costs. Thus the first-best pareto optimum may not be achieved with positive transaction costs.

To show that some households may be sole owner-operators, assume that transaction costs of monitoring a lease contract (ch) are positive but constant, and that transaction costs of monitoring wage contracts are prohibitively large, so that no wage contracts occur. Consider a tenant whose land endowment is infinitesimally below his land demand. By equation (5), his expected utility will be $Eu\{\theta F^t(\underline{H}_t,\underline{L}_t,\underline{K}_t)\}$. If the same person has a slightly larger endowment of land (infinitesimally above his demand) and decides to lease out the infinitesimal amount greater than his demand, his expected utility will be $Eu\{\theta F^t(\underline{H}_t,\underline{L}_t,\underline{K}_t)$-ch$\}$. Clearly, if ch>0, this person would not choose to lease land out since his utility would

fall. Holding $\underline{L}_t$ and $\underline{K}_t$ constant, the minimum endowment of land that this person would have to own to become a landlord (H_{lmin}) is determined by the following relation:

13) $$Eu\{qF^t(\underline{H}_{l\min}, \underline{L}_t, \underline{K}_t) - ch\} = Eu\{qF^t(H_t, \underline{L}_t, \underline{K}_t)\}$$

If ch>0, then $H_{lmin} > H_t$. If $H_t \leq \underline{H}_i \leq H_{lmin}$ for a household, then that household will be a sole owner-operator. H_{lmin} will be determined by ch, the shape of the utility function and the same factors that determine H_t.

The model thus predicts whether a household will be a tenant, landlord, or neither. It also predicts that fixed rental or wage contracts may occur. Figure 1 illustrates this using equation (7). Suppose first that $\underline{H}_t = 0$ and $H_l = 0$. If $\alpha=0$, then the tenant bears no risk and therefore $Eu_t'\theta/Eu_t' = 1$, while the landlord bears all the risk and therefore $Eu_l'\theta/Eu_l' < 1$, by the strict concavity of u_l. If $\alpha=1$, then the tenant bears all the risk and therefore $Eu_t'\theta/Eu_t'<1$ while $Eu_l'\theta/Eu_l' = 1$. By continuity of the functions $Eu_t'\theta/Eu_t'$ and $Eu_l'\theta/Eu_l'$ in α, there exists a value of α between 0 and 1 where $Eu_t'\theta/Eu_t' = Eu_l'\theta/Eu_l'$ and perfect risk pooling occurs. If $ch_\alpha = 0$, this is the optimum choice of α (call this α^*). However, if $ch_\alpha < 0$ (i.e., labor monitoring costs decrease with increase in tenant's share), then the optimal choice of α will be greater than α^* (and conversely less than α^* if $ch_\alpha < 0$). There is a tradeoff between risk pooling and minimizing transaction costs of monitoring, and this may lead the landlord to choose a fixed rental contract if this has a large enough impact on reducing transaction costs. The smaller and less responsive are transaction costs to the contract terms, the more likely sharecropping is to be adopted. Thus we may expect to see sharecropping more commonly among family members or neighbors, while fixed rental may be more common among strangers.

If the tenant owns land ($\underline{H}_t > 0$), then he bears some risk even if $\alpha = 0$, so that the $Eu_t'\theta/Eu_t'$ function rotates downward (note that $Eu_t'\theta/Eu_t'$ is unaffected by $\underline{H}_t$ when $\alpha=1$). This function is still downward sloping in α, since the tenant's risk is increasing in α. Thus increasing $\underline{H}_t$ reduces α^*. However, if $ch_\alpha < 0$, the impact of increasing $\underline{H}_t$ on α is ambiguous, since the magnitude of the difference between $Eu_t'\theta/Eu_t'$ and $Eu_l'\theta/Eu_l'$ increases with $\underline{H}_t/H_t$, tending to increase α-α^*. The intuition for this result is that more land that the tenant owns, the more risk he bears for a given share, and therefore he wants to reduce the share he receives (compensated by a lower fixed payment $\beta(H_t-\underline{H}_t)$). On the other hand, the more land the tenant owns, the less share of output the landlord receives from sharecropping (by the factor $(1-\underline{H}_t/H_t)$) for a given transaction cost, so the landlord seeks to reduce transaction costs by increasing α (when $ch_\alpha<0$). If $ch_\alpha>0$, then increasing $\underline{H}_t$ likely reduces α (though impacts on H_t, F^t, and ch_α also influence the outcome). Thus there is no general presumption that increasing tenant's ownership of land will lead to greater use of fixed rental rather than sharecropping.

If the landlord farms some of his own land ($H_l > 0$), then he will bear some risk regardless of the share contract terms, though his risk will still be a decreasing function of α (hence $Eu_l'\theta/Eu_l'$ is an increasing function of α). Thus increasing the landlord's endowment of land will tend to shift the $Eu_l'\theta/Eu_l'$ downward, increasing α^* and likely α. The intuition for this result is that increasing the area farmed by the landlord increases his risk, and thus his preference for fixed rental over sharecropping as a way of reducing his risk. Conversely, the smaller are landholdings, the more landowners may prefer to sharecrop out rather than rent out land.

The tenant's marginal product of labor will be greater under fixed rental than under the sharecropping contract that involves perfect risk pooling ($\alpha=\alpha^*$). If $\alpha = 1$, then equation (8) implies:

$$14)\quad F_L^t = \frac{Eu_t'}{Eu_t'q}(ch_L + p_L)$$

Since $Eu_t'\theta/Eu_t'$ is a declining function of α, as shown in Figure 1, F^t_L is larger when $\alpha=1$ than when $\alpha=\alpha^*$ (assuming ch_L is constant). Equations (6) and (14) also establish that F^t_L will be larger than F^l_L in this case if ch_L and cl_L are zero (or more generally if $cl_L \leq ch_L$), since $Eu_t'\theta/Eu_t' < Eu_l'\theta/Eu_l'$ when $\alpha=1$. It can also be shown that increasing ch_α when $\alpha=1$ (which will increase ch_α towards zero and reduce α since $ch_\alpha < 0$ at this point) will reduce F^t_L.[12] This establishes the hypotheses that the tenant's marginal (and hence average) productivity of labor will be higher for fixed rental contracts than for some (though not necessarily all) share contracts, and under fixed rental, the tenant's labor productivity will be higher than the landlord's labor productivity.

There is also a tendency for the tenant's land productivity to be higher under fixed rental contracts, though some of the comparative statics results are more ambiguous. Rewriting equation (9) when $\alpha=1$ we obtain:

$$\mathbf{15)}\quad F_H^t = \frac{ch_H + \frac{Eu_l'q}{Eu_l'}F_H^l}{\frac{Eu_t'q}{Eu_t'}}$$

Since $Eu_t'\theta/Eu_t' < Eu_l'\theta/Eu_l'$ when $\alpha=1$, $F^t_H > F^l_H$ as long as $ch_H \geq 0$. This same equation holds when $ch_\alpha = 0$ (i.e., $\alpha=\alpha^*$), but there is tendency for F^t_H to be larger when $\alpha=1$, since $(Eu_l'\theta/Eu_l')/(Eu_t'\theta/Eu_t')$ is larger in this case. However, the comparison also depends upon

the difference in F^l_H between the two cases; if F^l_H is at least as large under fixed rental as when $ch_\alpha = 0$, then F^t_H is unambiguously larger under the case of fixed rental. Similarly, one can show that if a small increase in ch_α (leading to a reduction in α) does not increase the landlord's marginal product of land, then increasing ch_α marginally when α=1 will reduce the tenant's marginal product of land. Subject to these assumptions, we have the hypotheses that the tenant's land productivity will be higher than the landlord's land productivity under a fixed rental contract, and that there is a tendency for the tenant's land productivity to be higher under fixed rental than under some range of sharecropping contracts.

The comparative statics of the model are ambiguous in general. However, we can illustrate a few expected outcomes using simple partial equilibrium diagrams. Consider equation (9), and suppose that $ch_\alpha < 0$, $ch_{\alpha H} \geq 0$ and $ch_{HH} \geq 0$. Then increasing H_t (holding other factors constant) will not decrease the right side of equation (9) and will decrease the left side (since as H_t increases, $-ch_\alpha$ doesn't increase, F^t_H decreases, F^t increases, F^l_H increases (as H_l decreases), $Eu_t'\theta/Eu_t'$ decreases (since risk to tenant increases as H_t increases), and $Eu_l'\theta/Eu_l'$ increases (since risk to landlord decreases)). Figure 2 shows these functions of H_t, with the optimum achieved at H_t^*. Now increasing $\underline{H}_t$ shifts the left side of equation (9) up but doesn't directly affect the right side (ch_H). This leads to an increase in H_t^*. Thus we have the hypothesis that the area operated by the tenant will be an increasing function of his land endowment if $ch_\alpha < 0$ (and our assumptions on the second derivatives of ch hold). If $ch_\alpha = 0$, equations (6)-(9) are independent of the tenant's land endowment, while equation (5) can be satisfied by adjusting β so that $\beta(H_t^* - \underline{H}_t)$ is unaffected by variations in $\underline{H}_t$. Thus area operated (and labor supplied) by the tenant will be unaffected by his land endowment if $ch_\alpha = 0$.

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[12] This follows from totally differentiating equation (8) with respect to ch_α (assuming ch_α to be an exogenously determined constant), noting that α falls and $Eu_t'\theta/Eu_t'$ rises with a rise in ch_α (as shown in Figure 1), and

A similar argument establishes that the tenant's labor endowment does not affect his labor or land use, as long as he is participating in the labor market (so that equations (5)-(9) hold), irrespective of transaction costs. The tenant's labor endowment enters in equations (5)-(9) only as a component of the tenant's riskless income, and this can be maintained constant by adjusting β so that $-\beta(H_t^*-\underline{H}_t)+p_L(\underline{L}_t-L_t^*)$ is unaffected by variations in $\underline{H}_t$ or $\underline{L}_t$.

If some exogenous factor increases ch_H for each level of H_t (i.e., $ch_{Hz} > 0$ and z increases), this shifts up the ch_H curve and reduces H_t^*. In other words, increasing the marginal cost of monitoring land reduces land operated by tenants. Similarly, increasing the marginal cost of monitoring labor (ch_L) or the price of labor (p_L) will reduce labor used by tenants on their operated land.

Our arguments that land and labor use by the tenant are unaffected by his endowments of land (if $ch_\alpha = 0$) or labor (more generally) may not hold if credit constraints are binding. For example, if rental payments must be paid in advance of earning labor income and the tenant faces a credit constraint, this will constrain the amount of rental payment:

16) $b(H_t - \underline{H}_t) \leq B_t$

where B_t is the sum of the liquid assets the tenant owns and the amount he can borrow. If the borrowing constraint is binding, this will force the landlord to change other terms of the contract besides β to satisfy the tenant's reservation utility constraint (5). How much adjustment is required will depend upon the tenant's endowment of labor since, if relation (14) holds as an equality, the tenant's riskless income ($-\beta(H_t-\underline{H}_t)+p_L(\underline{L}_t-L_t)$) cannot be held constant by adjusting β. Thus labor and land use by the tenant, as well as the tenant's share, are expected to be different for different levels of the tenant's labor endowment if a credit constraint is binding. Similarly, changes in the tenant's land endowment may lead to changes in contract terms, even if $ch_\alpha = 0$, since this changes the mix of risky income between the

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setting α=1. The proof is available from the authors upon request.

landlord and tenant, and perfect risk pooling is no longer achieved in this case, due to the credit constraint. Furthermore, land ownership may affect the tenant's access to credit and hence affect contract terms.

If rental payments are paid after labor income is earned, but before the harvest, the left side of equation (14) includes also $p_L(L_t-\underline{L}_t)$. In this case, the tenant's labor endowment will not affect contract terms (since $\beta(H_t-\underline{H}_t)-p_L(\underline{L}_t-L_t) = B_t$, so that changes in $\underline{L}_t$ do not affect riskless income) as long as credit is constrained, unless access to credit is affected by the tenant's labor endowment. However, the labor endowment will affect the likelihood that the credit constraint is binding. The tenant's land endowment may affect contract terms in this case for the same reasons as discussed in the preceding paragraph.

To summarize the key predictions of the theory, we have argued that if there are no transaction costs of enforcing contracts, then all agents will equate their marginal products of land and labor and achieve perfect risk pooling, leading to the first best pareto optimum. Sharecropping is the dominant contract, as long as all agents are risk averse and there are non-marketed production inputs. If there are positive but constant transaction costs, the first best optimum is no longer assured, though each landlord-tenant pair will equate their marginal products and pool risks. Sharecropping is still the dominant lease contract in this case, though some households may be sole owner-operators. Among those that do lease land in, the area operated is independent of their land or labor endowments. All of the above results for the constant transaction costs case continue to hold if transaction costs are not constant, but are independent of the tenant's share of output.

If transaction costs decrease with the tenant's share of output, then a fixed rental contract may be preferred to a sharecropping contract, and tenants' land and labor productivity are likely to be higher under fixed rental than sharecropping (and higher than the landlord's productivity under fixed rental). Tenants with larger land endowments are

expected to operate more land if transaction costs decrease with the tenant's share. The tenant's labor endowment will not affect input use or production as long as he is participating in the labor market and there is no credit constraint. However, if the tenant faces a binding credit constraint, both labor endowment and land endowment may affect the tenant's land and labor use, even if transaction costs are independent of the tenant's share. An increase in the marginal transaction cost of monitoring land will reduce the area operated by the tenant, while an increase in the marginal transaction costs of monitoring labor or in the price of labor will reduce the amount of labor used by tenants.

Many of these hypotheses are tested using data from four villages in Ethiopia.

3. Land Tenure and Land Markets in Ethiopia

Prior to 1975, there were two dominant land tenure systems in Ethiopia—the traditional *rist* system in the north, and the *gebbar* freehold system in the south. In the *rist* system, land rights were claimed based on establishing ancestral links to the original holders of land, which led over time to small and fragmented land holdings. Landowners had rights to use land, but not to specific parcels, and land was periodically redistributed to address inequities that arose. Land sales or mortgage were not allowed, but leasing (especially sharecropping) was common.

The *gebbar* system developed after the southern parts of the country came under the control of the Emperial government, which granted land to officials and elites loyal to the crown. The owners of this land were given freehold tenure, with full rights to sell, mortgage and lease. Landlessness and absentee land ownership were common, as were sharecropping and cash rental arrangements.

After the fall of Emperor Haileselassie in 1974, the Derg government nationalized all land and instituted a far-reaching land reform. Land was distributed relatively equally, based

on land quality and family size. Land sales, leasing, mortgaging and bequests were prohibited, as was wage labor. Land was periodically redistributed by village Peasant Associations (PAs) to accommodate the growing number of landless households. The prohibitions appear to have been generally well enforced, although small amounts of land transfers did occur (Amare Teklu and Ehui, 1999).

Since the fall of the Derg, land policies have again changed. The new Constitution continues the prohibition on private ownership, sales and bequests of land, but allows for temporary land transfers by lease. Policies with regard to land distribution and land leasing are left up to the regional governments to decide. In the Oromia region, where the villages in this study are located, there has been no general land redistribution since 1991, though future redistributions have not been ruled out. In 1995, restrictions on leasing were enacted that allow peasants to lease out no more than half of their land for up to three years. Cash rental and sharecropping have again become common in the region.

4. Land Markets in the Study Villages

The study was conducted in four Peasant Associations (PAs or villages) in the Tiyo *woreda* (district), Arsi zone, Oromia region of Ethiopia. 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. A household survey conducted in 1994 collected information about household assets, management practices, etc., and a field level survey collected information on crop inputs and outputs and tenure status of the fields operated by the sample households.[13]

[13] If a household only operated PA-allocated fields, the field survey was conducted only for one randomly selected field. In all other cases, the survey included all fields operated by the household. More information on the study villages and the sample is available in Gavian and Ehui (1999) and Gavian and Teklu (1996).

Farmers are mainly semi-subsistence mixed crop-livestock producers in the study villages. Wheat and barley are the dominant crops. The villages are in a high potential cereal producing area of the Ethiopian highlands, with relatively assured rainfall, good soils and access to markets. As a result, use of purchased inputs such as fertilizer and improved seeds is greater in the study villages than in many other parts of Ethiopia, or elsewhere in sub-Saharan Africa.

Farms are small in size in the study villages (as in all of the Ethiopian highlands), averaging less than 3 ha. operated (including cropland and pasture) per landowning household and less than 1 ha. operated per landless household. (Gavian and Amare Teklu, 1996). All non-PA allocated households, and many PA-allocated households, acquired ("imported") land through various means from other households in 1993/94. In the sample, 85 households imported cropland (all of the landless households and 39 of the PA-allocated households) while 76 of the PA-allocated households did not import cropland (Table 1). Many households also owned and/or imported private pasture land, though we focus only on cropland transactions and their implications in this paper. The survey did not collect reliable data on exports of land in the study villages.[14] Thus we do not attempt to analyze land exports.

Cropland owners who imported cropland owned slightly less cropland than those who did not import. Interestingly, however, cropland owner-importers imported sufficiently large amounts of land such that they operated more land and more land per worker than non-importers. This appears to be because cropland owner-importers own more oxen. After importing land, the value of oxen owned per area operated is similar between non-importers and owner-importers. Thus, land imports help to equalize the land/oxen ratio, especially among landowners.

Landless households did not operate as much land as landowning households, though they did import 0.8 ha. on average. Nevertheless, they did operate as much land per worker as landowners who did not import land. Landless households are younger and have acquired fewer assets, especially livestock (though they tend to be more educated than landowners). The value of oxen that they own per ha operated is less than half that of landowners. Thus acquiring oxen may be a greater constraint to these households than acquiring land. Although the land market is capable of equalizing land/labor ratios for these households, it is not able to also completely equalize oxen land ratios, though it helps.

The means of acquiring access to non-allocated land are land borrowing or gifts, fixed-rental and sharecropping (in order from most to least common). 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. On the other hand, the rights of tenants to fallow or invest in the land are more restricted for gift and borrowed land than on owned or rented land (but similar to sharecropped land). Gift and borrowed land are usually provided by relatives, often parents providing land to newly married children. Although there are not explicit charges, many tenants contribute labor to the landowner. Because their characteristics are similar, these two categories are combined in the analysis below. There are 71 gift and borrowed crop fields in the sample (Table 2).

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 for cash rental arrangements. The contract is almost always for only one year, and a written contract is used in most cases. The average

[14] Only a very small percentage of sample households reported exporting land. Furthermore, in the census of all

rental cost was 352 EB (US $56) per ha. for the rented sample fields in 1993/94 (*Ibid.*). There are 64 rented crop fields in the sample.

Sharecropping agreements provide a share of the harvest to the landowner, usually one-half or one-third (Table 3). The landowner is usually not a relative of the share tenant. The contract is usually for only one year, but is three or more years in about one-third of cases. Written contracts are not common. 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 labor and purchased inputs such as fertilizer or pesticides, though the terms vary significantly across contracts. It is rare for the landowner to provide oxen, however. Direct credit linkages between landlords and tenants are also relatively rare, with the tenant borrowing from the landlord in only two cases and the landlord borrowing from the tenant in three cases. After deducting the landowner's share of inputs from his share of the outputs, the average cost of a sharecrop contract was 935 EB (US $148) per ha. (*Ibid.*). This high cost, relative to the cost of cash rental, suggests that tenants choose sharecropping because of its risk pooling advantages or because they are unable to rent due to lack of access to cash or credit. Consistent with this, the most common reasons reported for sharecropping were to share risk and lack of cash. There are 31 sharecropped fields in the sample.

The characteristics of households operating cropland differ across the different land tenure types (Table 2). Households farming owner-operated fields tend to own more cropland, have more labor, and tend to be older, more likely to be female-headed and less educated than the households operating imported fields. Recipients of gift/borrowed plots tend to have fewer workers in the household and to be poorer in general (less land owned, less livestock), slightly younger, more likely to report credit constraints as a terrible problem, and more likely to be related to the landowner than operators of land acquired under other

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households conducted prior to the survey, the total area of land reported to be imported was much higher than

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 fields 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 (including hired, exchanged, gift, and landlord labor as well as the tenant household's labor) is lower on sharecropped fields than on other fields. However, the value of other inputs such as seeds and fertilizer are similar on sharecropped as on other tenure types, and the total value of inputs (including purchased inputs as well) is not statistically significantly lower on sharecropped fields. The value of output and profit per hectare are highest on owner-operated fields, and somewhat higher on cash rental and sharecropped fields than on gift/borrowed fields. Output and profit per labor hour are also lower on gift/borrowed plots, but fairly similar across other tenure categories. These differences in productivity may be due to other factors than tenure status however, such as the differences in tenant household characteristics or plot quality characteristics mentioned above.

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the area exported.

These results are generally similar to those of Gavian and Ehui (1999), who found similar factor intensity but lower total factor productivity on informally contracted fields than on owner-cultivated fields in the study villages. Below we investigate whether these results are robust after controlling for differences in village and household characteristics and plot quality.

5. Econometric Approach and Empirical Hypotheses

The theory presented in section 2 predicts that land use, lease contract choice, use of labor, oxen and other inputs, and output and profitability may depend on many factors, including the price of labor and other marketed inputs and outputs, households' endowments of land, labor, physical and human capital, their access to credit and the transaction costs of monitoring labor effort and land use. 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 nor the coexistence of sharecropping and fixed rental contracts if transaction costs are negligible, so we have *a priori* reason to believe that transaction costs are important in the villages studied. The empirical implications of this are to be determined.

We have data on three types of dependent variables: 1) cropland imports; 2) choice of land tenure contract when land is imported; and 3) input use, output and profit per unit of land or per unit of labor. Cropland imports are a censored continuous variable; we use a tobit censored regression model for this. Choice of land tenure contracts is a polychotomous choice variable; we use a multinomial logit model for this. Input use, output and profit per hectare or worker are continuous uncensored variables; we use least squares regressions for these variables.

Cropland Imports

We focus on cropland imports rather than total cropland area operated because area operated is completely determined by area owned for owner-operators (i.e., no statistical model is necessary to predict area operated for such households), and because of unreliability of the cropland export data, which would contaminate estimates of area operated. For cropland importers, the area imported is just area operated minus the exogenously determined (by PA land allocation) area owned. Thus the coefficients of all explanatory variables except area owned would be the same whether area operated or area imported is the dependent variable, while the coefficient of area owned in an imports regression will be the coefficient in an area operated regression minus one. In symbols, if

17) $H_t = a_{\underline{H}} \underline{H}_t + bx_t + u_t$

Then cropland imports (I_t) are equal to:

18) $I_t = H_t - \underline{H}_t = (a_{\underline{H}} - 1)\underline{H}_t + bx_t + u_t = b_{\underline{H}} \underline{H}_t + bx_t + u_t$

Thus a test of $a_{\underline{H}} = 0$ is equivalent to a test that $b_{\underline{H}} = -1$. This is in turn a test of the joint hypothesis that $ch_\alpha = 0$ and that there is not a binding credit constraint, since otherwise, as shown in section 2, H_t will depend in general on $\underline{H}_t$.

Other factors that may affect land area operated by a tenant household include the labor endowment of the household ($\underline{L}_t$), the supply of non-tradable productive assets ($\underline{K}_t$), access to credit (B_t), the landlord's transaction costs of monitoring the lease contract (ch), the tenant's reservation utility (U_t), and prices in the village (p_L). If labor and capital markets function perfectly, then the labor endowment should have no impact on area operated, as argued in section 2. However, if labor is non-tradable for a household (e.g., due to transaction costs of monitoring wage contracts), then the labor endowment can obviously affect demand for land if land and labor are complements or substitutes. If a tenant

household faces a binding credit constraint, labor endowment may also affect area operated, as argued in section 2.

Increasing the supply of non-tradable productive assets will increase the demand for land if such assets are complementary to land (i.e., they increase the marginal product of land) if a perfect land market exists. This expectation still holds in the case of an imperfect land market, since increasing the tenant's marginal product of land shifts up the land "demand" curve in Figure 2. Increasing the marginal transaction costs of monitoring land (ch_H) will tend to reduce area operated as shown in Figure 2.

Increasing the tenant's access to credit will have no effect if a credit constraint is not binding, but if one is binding, relaxing the constraint may increase area operated (assuming $\beta > 0$ in equation (14)), though we haven't proved that this result follows from the theory. Increasing the tenant's reservation utility will not necessarily have any impact on area operated, unless a credit constraint is binding, since the fixed payment (β) may simply be adjusted to satisfy the tenant's reservation utility constraint. If a credit constraint is binding, area operated may adjust to a change in reservation utility, though the direction of adjustment is difficult to predict.

We measure the tenant's endowment of labor by the total number of workers in the household. The endowment of non-tradable productive assets may include oxen ownership (if oxen services are tradable, then the endowment of oxen will not affect area operated) and human capital. We measure human capital by the age, gender and education of the head of household. The financial capacity of the household may be affected by its ownership of land and productive capital and its human capital, but also by its ownership of other assets not used in crop production (such as ownership of small ruminants) and access to off-farm income (measured by whether farming is the primary income source). Other potential indicators of credit constraints are whether the household has received a cash loan in the past,

and whether it reports lack of access to credit as a major problem. It is difficult to identify good predictors of transaction costs, since these will depend upon the relationship between the tenant and potential landlords. Two potential indicators are the length of time the tenant household has resided in the village and the tenant's ethnicity (possibly affecting availability of information about the tenant and participation in social networks that may reduce transaction costs). Village dummy variables are used to reflect prices of marketed inputs and outputs, agroclimatic factors that cause differences in productivity across villages, village equilibrium risk pooling and factor productivity (in the perfect markets case), and other factors that may be constant within a village.

Contract Choice

For imported fields, we model the choice of tenure arrangement using a multinomial logit model. We use the same explanatory variables as included in the regression for land imports. Since the data are for specific tenancy contracts (as opposed to the land import regression), we can include explanatory variables specific to the particular landlord as well. One variable that we believe 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, the transaction costs may be lower, thus tending to favor a sharecropping over fixed rental arrangement. A close relationship with the landowner may also favor a gift or borrowing arrangement, which does not involve an explicit payment but may involve implicit obligations among family members (or which may be provided by family members for altruistic reasons). In addition to transaction costs, the tenant's endowment of land may affect the choice between sharecropping and fixed rental, as discussed in section 2, though the direction of impact is ambiguous.

Input Use, Output and Profit

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

19) $y_{hf} = b_h x_h + b_f x_f + b_c D_{cf} + v_{hf}$

where y_{hf} is a vector of dependent variables (input use per ha., value of output per ha., profit per ha., output per labor hour, profit per labor hour) for household h and field f, x_h and x_f are vectors of household and field characteristics affecting the dependent variables, D_{cf} is a vector of dummy variables for different land tenancy contracts (cash rent, sharecropped, or gift/borrowed relative to owner-operated), v_{hf} are unobserved factors affecting the dependent variables, and b_h, b_f and b_c are coefficient vectors to be estimated. We estimated two versions of the model. In one, x_h includes specific measured household characteristics expected to possibly affect input use intensity, output and profit, including the same variables used to predict area operated. In the second version of the model, we used household level fixed effects to account for all possible household level factors (measured or unmeasured) affecting the dependent variables.

The measured field level characteristics assumed to possibly affect input use, output and profit include the type of soil (red soil expected to be less productive than black soil), the slope of the field (flat or gently sloping fields expected to receive more inputs and produce greater output), whether there had been erosion problems on the field (ambiguous impact on inputs but expected to reduce productivity and profits), the use of irrigation on the field (expected to increase input use and production), and the distance of the field from the household compound (expected to reduce input use and output).

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 (19) using instrumental variables as well as ordinary least squares, taking as instruments the predicted

probabilities of each import contract from the multinomial logit regression, multiplied by the probability that the household imports cropland (from a probit model using the same explanatory variables as the tobit regression for cropland imports).[15] We conducted Hausman tests of the null hypothesis that the coefficients of the (inefficient but consistent) instrumental variables model are equivalent to the coefficients of the (efficient but possibly inconsistent ordinary least squares model, and failed to reject the null hypothesis in all regressions (Hausman, 1978). We therefore report only the results of the ordinary least squares regressions.

In all 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 possible non-independence of multiple observations from the same household. We tested for multicollinearity and found it not be a serious concern in any regression.[16]

6. Econometric Results

Cropland Imports

The determinants of cropland imports are shown in Table 4. We find that cropland imports are lower for households that own more land (each additional hectare owned reduces imports by 0.33 hectare), but this coefficient is statistically significantly greater than -1. Thus we reject the joint hypothesis that $ch_\alpha = 0$ and credit constraints are not binding. This finding implies that the area operated by tenants increases with area owned, consistent with the assumption that $ch_\alpha < 0$. The coexistence of fixed rental contracts with sharecropping also supports this conclusion (maintaining the assumption that all agents are risk averse). Thus,

[15] Regression results available from the authors upon request.
[16] The maximum variance inflation factor in any regression was below 4, indicating multicollinearity was not a serious problem (Chatterjee and Price, 1991).

transaction costs of monitoring labor effort in tenancy contracts (or credit constraints) appear to be an important element determining land use, and we do not expect fully efficient (though possibly second best) outcomes.

The value of oxen owned is a strong determinant of cropland imports, with an increase in oxen ownership of 1000 EB increasing predicted land imports by 0.4 ha. This is consistent with the argument that lease markets in oxen services do not function well, while oxen ownership may be constrained by the indivisibility of this investment together with financial constraints. Thus, as suggested in reviewing the descriptive data, the land market is helping to equalize oxen availability per unit of land operated.

Human capital characteristics, including the age, gender and education of the household head also affect cropland import decisions. Older household heads and female-headed households import less cropland, possibly because they face difficulties in farming. More educated household heads import more land. This may appear somewhat surprising, given the low level of technology of farming in Ethiopia in general (assuming education helps farmers to understand and adopt newer technologies). However, the study villages are in a high potential cereals producing region and are relatively commercialized and technified, using a substantial amount of improved seeds and purchased inputs (especially fertilizer). Greater education may increase farmers' awareness and ability to use such modern inputs, and/or increase their likelihood of contact with extension agents.

A possible alternative explanation for some of these effects is that credit constraints inhibit land imports and such physical and human capital assets increase access to credit. This explanation is consistent with the result in Table 4 that households with substantial off-farm income import more land (1.4 ha. more for households for whom farming is not the primary source of income), assuming that off-farm income increases farmer's liquidity. However, we also expect that if a credit constraint is binding, the household's labor

endowment and ownership of livestock besides oxen would tend to relax the credit constraint and affect land imports; but we do not find this to be the case. Furthermore, when we included as explanatory variables past access to loans and whether access to credit was reported as a terrible problem, the coefficients of neither of these variables was statistically significant (either individually or jointly). Thus we do not have strong support for the hypothesis of binding credit constraints.

The effect of off-farm income on area operated may be due instead to the risk reducing effects of this, if off-farm income is less risky, or at least not covariate with, crop income. Reducing the risk faced by tenants will tend to increase $Eu_t'\theta/Eu_t'$, thus shifting up the land "demand" curve in Figure 2. This explanation is consistent with the absence of an impact of labor endowment or other livestock assets on area operated.

Contract Choice

The determinants of import contract choice are reported in Table 5. The factor having the strongest influence on fixed rental vs. sharecropping is the length of time the farmer has been in the village; farmers who have immigrated to the village are much less likely to use sharecropping. This is consistent with the argument that transaction costs are critical in determining contract choice, and that social capital in the village helps to reduce these costs. The tenant's endowment of land does not have a statistically significant effect on choice of sharecropping vs. fixed rental. This may be due to the offsetting effects of the tenant's endowment discussed in section 2.

Other variables that do have a significant impact on the choice of sharecropping vs. fixed rental include the gender of the household head (female-headed households more likely to sharecrop) and the primary source of income (non-farmers less likely to sharecrop). Both of these findings are consistent with a credit constraint explanation for sharecropping (assuming female-headed households have less access to credit and non-farmers more access

to credit). The effect of non-farm income could also be due to lower risk being faced by farmers with substantial non-farm income, which would tend to shift up the $Eu_t'\theta/Eu_t$ curve in Figure 1, leading to greater likelihood of fixed rental.[17] It is not clear how a risk-based explanation would explain the greater propensity of female-headed households to sharecrop (controlling for other factors), however, unless women happen to be more risk averse than men. Thus the contract choice regressions provide a little more credibility to the credit constraint explanation for sharecropping, though this explanation is still not supported by other statistically insignificant variables.

The factors significantly associated (at the 5% level) with use of gift or borrowed land relative to fixed rental are the relationship between the tenant and landlord (gift/borrowed much more likely if the landlord is a relative), the availability of off-farm income (non-farmers less likely to receive land through gift/borrowing), and the household labor supply (households with more labor less likely to use gift/borrowing). The effect of family relationship between the tenant and landlord is as we expected. The effect of the other two variables may be because landowners prefer to target gifts or loans of land to households that are more dependent on farming with less alternative sources of income.

Input Use, Output and Profit

Labor input averages 47 hours per hectare per year less on sharecropped fields than on owner-operated fields (Table 6), a reduction of about 25% compared to the mean labor input on owner-operated fields. Oxen use is also lower on sharecropped fields, though the difference is less significant quantitatively (a 15% reduction) and statistically (significant at the 10% level). We do not find large or statistically significant differences between labor or oxen input on other tenure types. These results are consistent with the Marshallian argument concerning the disincentive effects of sharecropping. We do not find statistically significant

[17] On the other hand, Newbery's (1977) argument about the effect of non-covariate risk to labor income argues

differences between sharecropping and other tenure categories in the amount of other inputs (regressions not shown) or in total inputs, though the coefficient for sharecropping in the total input regression predicts (with low confidence) that sharecropped fields receive about 8% less total inputs than owner-operated plots. Sharing of other input costs by landlords may reduce the incentive problems associated with these inputs.

Other factors that influence input use include characteristics of the villages, household labor supply (favors greater labor and oxen input), age of the household head (less labor and total input), education of the household head (less labor and total input), the length of time the tenant family has been in the village (reduces oxen input), irrigation (reduces total input use), and distance to the field (reduces labor input). The effects of labor supply, age and education on labor input suggest that labor markets do not function perfectly, so that households with different endowments of labor and human capital have different opportunity costs of labor. Nevertheless, labor and/or oxen markets do help equalize labor/oxen availability, since the endowment of oxen does not affect labor or oxen use per hectare. The effect of distance to the field is consistent with the higher labor costs of operating more distant fields. The effects of length of time in the village and irrigation were not expected. The results provide some, but only weak, support for the hypothesis of credit constraints: households with more livestock wealth (other than oxen) or more off-farm income tend to use more of some inputs, though these differences are not statistically significant at the 5% level.

We do not find any statistically significant impact of land tenure status on output or profits per hectare or per labor hour (Table 7). The predicted values of output and profit per hectare are about 8% lower on sharecropped fields than on owner-operated fields, but this result is not statistically significant, so we are not confident of the prediction. The most important factors influencing productivity and profitability are differences in villages, oxen

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that such risk will lead farmers to favor sharecropping.

ownership (increasing average land productivity and profits per hectare, but no significant impact on labor productivity or profits per labor hour), and irrigation (surprisingly, a negative impact on land productivity and profits per hectare).

The very strong effect of village differences on productivity, compared to relatively small effects of most household level factors, implies that factor markets work fairly well in general in these villages to limit differences in marginal products of land, labor, and other factors across households, even if they do not function perfectly, as the results in earlier regressions suggest. The one major exception to this is the market for oxen, since households with greater endowments of oxen have a clear advantage in land productivity and profitability. This effect is quantitatively large, with a 1,000 EB investment in oxen increasing the value of both output and profits by about 235 EB per hectare. The return to such investment is likely to be greater for households who are able to acquire sufficient land to be able to use additional oxen at full capacity, given the apparent failure of oxen lease markets.

Interestingly, oxen ownership does not have a statistically significant effect on labor productivity or profit per labor hour. Apparently labor markets are able to equalize oxen/labor ratios sufficiently that labor productivity is relatively equal across households, even though the oxen market does not function well enough to equalize land/oxen ratios and land productivity. This is consistent with what we observed in Table 1, where we saw that landless households own fewer oxen per unit of land operated than landowners. This problem cannot be solved by improvements in the land market; landless household presumably could acquire less land and equalize land oxen ratios. The problem is more likely due to the indivisibility of oxen and difficulty of landless households to acquire sufficient savings or credit to finance acquisition of both oxen and land at a sufficient scale to be

economic. Thus, improvements in oxen lease markets and/or credit markets may be needed to increase productivity of land- and oxen-poor households in these villages.

The results of regressions including household level fixed effects (to control for all household level factors) are shown in Table 8. These regressions confirm the negative effect of sharecropping on labor input per hectare found earlier, which is also statistically and quantitatively significant in these regressions. They also predict that total input use, output and profit per hectare are lower under sharecropping than other tenure arrangements, though again these results are not statistically significant. Thus, although there is evidence to support the Marshallian argument of incentive problems reducing labor input under sharecropping—which is also consistent with evidence presented earlier confirming the importance of transaction costs in affecting land imports and choice of tenure arrangement—it appears that the land market works sufficiently well that large discernable impacts on productivity and profitability do not occur. However, improvements in oxen lease markets or credit markets may lead to increased productivity of land and oxen poor households.

7. Conclusions and Implications

Our theoretical results imply that sharecropping is the dominant contract where transaction costs of monitoring the tenant's effort are not prohibitive. Risk pooling, together with the presence of non-tradable (or imperfectly tradable) production inputs such as oxen services and human capital, make sharecropping a superior alternative to fixed rental when transaction costs are low, even though the marginal products of land and labor may be lower under sharecropping. The question is thus not why some farmers use sharecropping, but rather, why some farmers use fixed rental. Our theoretical and empirical results imply that transaction costs are an essential element of the explanation.

We have found evidence that land lease contracts are affected by transaction costs of monitoring tenant's labor input, causing land area operated by tenants to be an increasing function of the land that they own, making sharecropping less likely to be used by recent immigrants to the study villages, and resulting in tenants applying less labor input on sharecropped fields than land held under other tenure arrangements. Despite these results, we do not find strong evidence that total input use, productivity or profitability are significantly different under different tenure arrangements. Thus, although land lease markets are subject to transaction costs and are thus not perfect, they appear to function fairly well to equalize marginal products of land in the study villages.

These results provide support to both the Marshallian and "New School" perspectives on the efficiency of sharecropping. While we do find evidence of Marshallian incentive effects, the effects are limited in size and difficult to disentangle from other factors influencing agricultural productivity. As argued by Otsuka, et al. (1992), 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 may reduce the incentive problems by sharing some of the costs. As we have seen, landlords often do share costs in share tenancy contracts, including labor costs.

A bigger constraint to productive efficiency in the study villages appears to be the limited lease market for oxen services together with limitations on the ability of land and oxen poor households to purchase oxen, likely due to the indivisibility of such purchases together with credit constraints. Households with fewer oxen earn substantially lower returns per hectare than more well endowed households. Thus, efforts by the Ethiopian government

to address credit constraints and deficiencies in lease markets for animal traction may be more effective in increasing agricultural production and reducing poverty than any changes in land tenure arrangements.

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. Such restrictions may well have reduced the efficiency of lease markets in the region. Investigation of the impacts of these restrictions would be useful.

Another implication of our empirical results is that village level factors are very 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 1993/94, so too much should not be made of this result. However, if these village level differences persist over time, they suggest that factor markets do not function efficiently to equalize marginal returns to productive factors across villages. For example, the absence of a land sales market in Ethiopia may have a more important bearing upon the ability of people to migrate to villages where the returns to their labor and capital are higher, than upon the efficiency of factor allocation within any given village. More research on this issue at a broader scale, enabling identification of what village-level factors are leading to differences in input use and productivity, would be valuable.

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Table 1: Characteristics of cropland importers and non-importers, ownership status

Item	Landowners (PA-allocated)						All Households	
	Cropland Non-Importers		Cropland Importers		Land less Cropland Importers			
Number of sample households	76		39		46		161	
	---- means (standard errors in parentheses)[1]----							
Cropland owned (ha)	1.66	(0.08)	1.51	(0.20)	0	(0)	1.32	(0.06)
Cropland imported (ha)	0	(0)	0.86	(0.17)	0.78	(0.10)	0.36	(0.06)
Cropland operated (ha)	1.66	(0.08)	2.37	(0.31)	0.78	(0.10)	1.68	(0.09)
Household labor force (number of workers)	2.75	(0.21)	2.35	(0.25)	1.07	(0.06)	2.35	(0.14)
Value of oxen owned (EB)	1271	(112)	1583	(194)	439	(116)	1201	(83)
Cropland owned per worker (ha/worker)	0.79	(0.05)	0.74	(0.13)	0	(0)	0.63	(0.04)
Cropland operated per worker (ha/worker)	0.79	(0.05)	1.23	(0.22)	0.77	(0.10)	0.90	(0.06)
Value of oxen owned per ha. of cropland owned (EB/ha)	814	(92)	1202	(165)	NE	NE	925	(82)
Value of oxen owned per ha of cropland operated (EB/ha)	814	(92)	795	(105)	416	(104)	738	(62)

[1]Means and standard errors were corrected for stratification and sampling weights.
NE means “not estimable” due to zero denominator.

Table 2-characteristics of operator households and cultivated fields under different tenure arrangements

Item	Type of Tenure: PA-allocated		Fixed rent		Sharecrop		Gift/borrowed		All fields	
Number of sample fields	149		64		31		71		315	
	- 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)	0.65	(0.16)	1.50	(0.14)
- household labor force	2.69	(0.18)	1.95	(0.22)	2.05	(0.28)	1.44	(0.12)	2.28	(0.15)
- value of oxen owned (EB)	1666	(134)	1670	(232)	1688	(313)	910	(160)	1540	(146)
- age of household head (years)	41.1	(1.9)	30.0	(1.6)	31.0	(2.3)	28.7	(1.6)	36.2	(1.5)
- % with female head of household	7.14	(2.47)	0.85	(0.86)	2.72	(2.73)	2.11	(2.09)	4.7	(1.5)
- Education of household head										
-- % illiterate	38.4	(6.4)	14.1	(5.6)	15.3	(6.9)	9.6	(4.2)	27.3	(5.0)
-- % can read and write	20.3	(5.1)	7.1	(3.9)	7.6	(4.7)	9.7	(4.0)	14.7	(4.1)
-- % completed primary school	17.9	(5.9)	26.3	(7.9)	32.3	(12.5)	32.7	(7.2)	23.3	(5.1)
-- % completed secondary school	23.4	(5.9)	52.6	(9.5)	44.9	(12.5)	48.0	(7.8)	34.7	(6.0)
- Value of other livestock owned (EB)	1874	(203)	1669	(273)	1538	(336)	1064	(186)	1670	(187)
- % with farming as primary ssource of income	95.8	(4.1)	83.6	(8.0)	91.4	(6.3)	94.6	(2.8)	93.4	(4.0)
% that received a cash loan in the past	11.8	(4.6)	10.8	(5.4)	4.1	(4.0)	6.1	(3.4)	9.7	(3.9)
- % reporting lack of credit as a terrible problem	48.1	(6.7)	48.0	(9.7)	51.6	(12.7)	64.3	(7.3)	51.7	(6.1)
- Length of family residence in village										
-- % whose father was born in village	42.6	(6.5)	56.1	(9.8)	52.2	(12.6)	58.3	(7.6)	47.9	(6.0)
-- % whose father immigrated but were born in village	47.3	(6.9)	39.5	(9.9)	47.8	(12.6)	36.1	(7.5)	44.9	(6.2)
-- % who immigrated to village	10.0	(3.7)	4.4	(3.7)	0.0	(0.0)	5.5	(3.6)	7.2	(2.6)
- Ethnicity										
-- % Oromo	74.1	(5.8)	75.6	(8.6)	63.3	(12.8)	78.8	(6.0)	74.3	(5.2)
- Relationship to landowner										
-- % with landowner a relative	N/A		31.0	(6.0)	31.5	(11.1)	71.6	(6.6)	20.2	(2.8)
Characteristics of Fields										
- % having red soil	4.6	(1.3)	11.4	(4.2)	11.1	(4.7)	11.0	(3.3)	7.3	(1.3)
- % flat or gently sloped (not stony)	77.3	(4.0)	78.6	(5.7)	82.7	(7.2)	85.4	(4.1)	78.5	(2.7)
- % with no reported erosion problems	78.2	(3.9)	82.6	(5.0)	70.7	(8.9)	72.9	(6.5)	75.9	(3.1)
- % irrigated	23.1	(3.7)	14.9	(5.0)	15.3	(7.2)	14.7	(4.7)	19.1	(2.8)
- Distance from field to compound (meters)	1281	(100)	1816	(179)	1469	(311)	1293	(184)	1393	(86)
Input use and outputs – 1993/94										
- total labor hours per ha	190	(12)	188	(21)	139	(14)	200	(19)	186	(9)
- total oxen hours per ha	376	(16)	402	(38)	309	(28)	382	(28)	375	(14)
- value of fertilizer applied per ha (EB)	102.1	(4.1)	119.8	(9.5)	116.0	(13.2)	127.0	(8.6)	110.6	(4.0)
- value of seeds applied per ha (EB)	269.9	(10.9)	262.0	(15.7)	266.1	(23.1)	250.3	(15.4)	264.9	(8.2)
- total of value all inputs per ha (EB)	957	(21)	984	(49)	902	(61)	920	(32)	949	(16)
- total value of output per ha (EB)	2872	(112)	2623	(181)	2534	(294)	2228	(154)	2688	(85)
- profit per ha (EB)	1916	(100)	1639	(158)	1632	(248)	1308	(134)	1739	(76)
- total value of output per labor hour (EB)	21.5	(1.3)	21.7	(3.0)	23.3	(3.7)	15.3	(1.6)	20.7	(1.1)
- profit per labor hour (EB)	14.9	(1.0)	14.5	(2.4)	15.2	(2.7)	9.1	(1.2)	13.9	(0.9)

[1]Means and standard errors were corrected for stratification, sampling weights, and clustering (non-independence of observations within households.)

Table 3- Landlord's share of inputs and outputs under shareropping contracts

Item	Siso Contract (1/3 share)		Equl contract (½ share)		All contracts	
Number of Fields	12		19		31	
	mean percentage (standard errors in parentheses)					
Inputs						
- Land	100	(0)	100	(0)	100	(0)
- Oxen	4	(14.4)	0	(0)	2	(9.1)
- Fertilizer	14	(23.4)	42	(25.7)	31	(28.1)
- Seed	4	(14.4)	19	(25.1)	13	(22.5)
- Pesticide	0	(0)	25	(41.8)	21	(39.3)
- Herbicide	0	(0)	25	(28.9)	20	(27.4)
- Plowing labor	0	(0)	0	(0)	0	(0)
- Seeding labor	0	(0)	0	(0)	0	(0)
- Weeding labor	0	(0)	19.2	(26.9)	11	(0)
- Harvesting labor	0	(0)	33	(29.7)	20	(28.2)
- Hired Labour	0	(0)	20	(27.3)	8	(19.5)
Outputs						
- Crop	33	(4.9)	50	(0)	44	(8.3)
- Residue	27	(41.0)	40	(33.8)	35	(36.8)

Table 4 – Determinants of Cropland Imports - Tobit Regression[1]

Explanatory variable	Cropland Imported (ha.)
Village (cf. Abichiu Peasant Association)	
- Bilalo Peasant Association	-0.373
- Ketar Genet Peasant Association	-0.760***
- Mekro & Chebote Peasant Association	-0.351
Crop land owned (ha)	-0.326**
Household labor supply (number of workers)	-0.0454
Value of oxen owned (1000 EB)	0.398***
Age of household head (years)	-0.0150*
Household head female	-1.374***
Education of household head (cf. illiterate)	
- Read and write	-0.210
- Finished primary school	0.156
- Finished secondary school	0.513*
Value of livestock other than oxen (1000 EB)	0.0009
Farming primary source of income	-1.357**
Length of time in village (cf. father born in village)	
- Father immigrated to village, farmer born in village	0.270
- Farmer immigrated to village	0.335
Ethnicity of household Oromo	0.117
Number of uncensored/total observations	85/161

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

[1] Coefficients and standard errors were corrected for sample weights and stratification. Standard errors are robust to heteroskedasticity. Intercepts are not reported.

Table 5 – Determinants of Lease Contract Choice - Multinomial Logit Model[1]

Explanatory Variables[a]	Sharecropping Contract	Gift/Borrowed
Village (cf. Abichiu Peasant Association)		
- Bilalo Peasant Association	0.045	0.593
- Ketar Genet Peasant Association	-0.651	-0.527
- Mekro & Chebote Peasant Association	1.375	0.033
Crop land owned (ha)	0.506	0.462
Household labor supply (number of workers)	0.070	-0.805**
Value of oxen owned (1000 EB)	0.131	-0.583
Age of household head (years)	0.0650	0.0819*
Household head female	3.627**	1.187
Education of household head (cf. illiterate)		
- Read and write	0.419	1.954*
- Finished primary school	1.227	1.208
- Finished secondary school	0.499	1.028
Value of livestock other than oxen (1000 EB)	-0.404	-0.273
Farming primary source of income	2.337**	2.283**
Length of time in village (cf. father born in village)		
- Father immigrated to village, farmer born in village	-0.266	0.240
- Farmer immigrated to village	-37.4***	1.489
Ethnicity of household Oromo	-0.172	0.281
Landlord is a relative of tenant	0.309	2.477***
Mean predicted probabilities[2]		
- Fixed rent	0.37	0.24

[1] Coefficients and standard errors were corrected for sample weights, stratification and clustering. Standard errors are robust to heteroskedasticity. Intercepts are not reported.

[2] The mean predicted probabilities for fields under fixed rental are: fixed rent 0.51, sharecrop 0.23, gift/borrowed 0.26.

- Sharecrop	0.38	0.15
- Gift/borrowed	0.25	0.60

a. Number of observations is N=166.

b. *, **, *** indicate statistical significance at the 10%, 5% and 1% levels respectively.

Table 6 – Determinants of Input per Hectare– Least Squares Regressions [18]

Explanatory variable[a]	Total Labor Hours per Ha.	Total Oxen Hours per Ha.	Total Value of Inputs per Ha. (EB)
Tenure status (cf. PA-allocated field)			
- Fixed rental	3.4	7.7	-12.7
- Sharecropped	-46.9**	-54.6*	-72.4
- Gift/borrowed	20.2	7.6	-58.6
Village (cf. Abichiu Peasant Association)			
- Bilalo Peasant Association	-49.3*	-153.0***	-164.4***
- Ketar Genet Peasant Association	-57.8**	-93.3**	87.6
- Mekro & Chebote Peasant Association	-88.0***	-256.3***	8.0
Crop land owned (ha)	11.3	-17.5	-28.8
Household labor supply (number of workers)	15.3**	14.0**	11.7
Value of oxen owned (1000 EB)	-2.5	8.9	0.6
Age of household head (years)	-2.40***	-0.78	-5.32***
Household head female	-14.6	-19.9	-126.0*
Education of household head (cf. illiterate)			
- Read and write	-25.0	-12.0	-26.6
- Finished primary school	-36.8	-1.4	-125.0**
- Finished secondary school	-44.9**	-19.4	-87.7
Value of livestock other than oxen (1000 EB)	-0.3	6.6	28.2*
Farming primary source of income	-41.5*	-79.7*	-71.4
Length of time in village (cf. father born in village)			
- Father immigrated to village, farmer born in village	-12.2	-76.7***	-55.2
- Farmer immigrated to village	-34.2	-25.7	35.0
Ethnicity of household Oromo	-13.3	-12.6	-8.9
Landlord is a relative of the tenant (if field leased in)	-15.7	-42.5	27.0
Red soil on field	-7.8	3.4	-48.2
Flat or gently sloping field	1.4	-11.6	-43.4
No erosion problem on field	-15.6	-25.9	-8.9
Irrigated field	-26.0	-31.9	-108.5***
Distance from field to compound (km.)	-12.6**	1.1	-3.2
Intercept	396.9***	675.2***	1361.5***
R^2	0.183	0.318	0.149

a. Number of observations is 315 fields.
b. * , ** and *** indicate statistical significance at the 10%, 5% and 1% levels respectively.

[18] Coefficients and standard errors were corrected for sample weights, stratification and clustering. Standard errors are robust to heteroskedasticity. Intercepts are not reported.

Table 7 – Determinants of Total Output and Profit per Ha. and per Labor Hour – Least Squares Regressions[1]

Explanatory variable[a]	Value of Output per Ha. (EB)	Profit per Ha. (EB)	Value of Output per Labor Hour (EB)	Profit per Labor Hour (EB)
Tenure status (cf. PA-allocated field)				
- Fixed rental	-108.2	-95.5	3.22	2.38
- Sharecropped	-216.1	-143.7	4.27	2.68
- Gift/borrowed	-224.4	-165.9	-0.69	-0.74
Village (cf. Abichiu Peasant Association)				
- Bilalo Peasant Association	-578.1***	-413.7**	-1.61	-1.29
- Ketar Genet Peasant Association	1576.0***	1488.3***	20.81***	17.29***
- Mekro & Chebote Peasant Association	657.7***	649.7***	12.52***	9.43***
Crop land owned (ha)	-111.9	-83.0	-0.98	-0.79
Household labor supply (number of workers)	5.0	-6.7	-0.40	-0.22
Value of oxen owned (1000 EB)	234.7***	234.0***	0.86	1.00
Age of household head (years)	-7.56	-2.24	0.125	0.094
Household head female	-186.0	-60.0	-1.94	-0.99
Education of household head (cf. illiterate)				
- Read and write	113.1	139.7	3.75	2.90
- Finished primary school	-277.5	-152.5	-1.35	-1.46
- Finished secondary school	-31.4	56.3	3.46	2.49
Value of livestock other than oxen (1000 EB)	-67.3	-95.4	0.28	-0.006
Farming primary source of income	-235.0	-163.6	-0.58	-0.70
Length of time in village (cf. father born in village)				
- Father immigrated to village, farmer born in village	-285.3*	-230.1	-2.63	-2.12
- Farmer immigrated to village	-51.9	-86.9	-1.93	-2.12
Ethnicity of household Oromo	-268.3	-259.3	-2.38	-2.12
Landlord is a relative of the tenant (if field leased in)	-118.0	-145.0	-0.37	-0.67
Red soil on field	105.8	154.0	0.80	0.87
Flat or gently sloping field	-250.2	-206.8	-0.90	-0.92
No erosion problem on field	62.2	71.1	-0.93	-0.58
Irrigated field	-471.1**	-362.6*	-0.59	-0.60
Distance from field to compound (km.)	-85.9	-82.7	0.15	0.03
Intercept	3474.7***	2113.2***	11.2	7.30
R^2	0.333	0.347	0.334	0.349

c. Number of observations is 315 fields.

* , ** and *** indicate statistical significance at the 10%, 5% and 1% levels respectively.

[1] Coefficients and standard errors were corrected for sample weights, stratification and clustering. Standard errors are robust to heteroskedasticity. Intercepts are not reported.

Table 8 – Determinants of Inputs per Ha. and Total Output and Profit per Ha. and per Labor Hour – Least Squares Fixed Effects Regressions[1]

Explanatory variable[a]	Labor Hours per Ha.	Oxen Hours per Ha.	Value of Inputs per Ha. (EB)	Value of Output per Ha. (EB)	Profit per Ha. (EB)	Value of Output per Labor Hour (EB)	Profit per Labor Hour (EB)
Tenure status (cf. PA-allocated field)							
- Fixed rental	-4.3	10.7	-4.2	-93.4	-89.1	4.11	3.08
- Sharecropped	-67.3**	-34.4	-66.1	-302.5	-236.4	3.43	2.08
- Gift/borrowed	10.5	-27.4	-45.4	-81.9	-36.5	1.51	0.91
Red soil on field	6.3	5.1	-46.1	-113.0	-66.9	-3.06	-2.13
Flat or gently sloping field	-7.5	-11.5	-18.3	-32.7	-14.5	1.51	1.25
No erosion problem on field	6.5	13.3	50.5	-137.0	-187.5	-3.95	-3.19
Irrigated field	-43.4	-3.6	-110.8	-531.7	-420.9	-0.85	-0.50
Distance from field to compound (km.)	-15.4*	1.7	10.3	-166.0	-176.3*	0.28	-0.56
R^2	0.567	0.669	0.510	0.655	0.666	0.722	0.741

d. Number of observations is 315 fields.

* , ** and *** indicate statistical significance at the 10%, 5% and 1% levels respectively.

[1] Coefficients and standard errors were corrected for sample weights, stratification and clustering. Standard errors are robust to heteroskedasticity. Intercepts are not reported.

Figure 1- Determination of the Tenant's Share

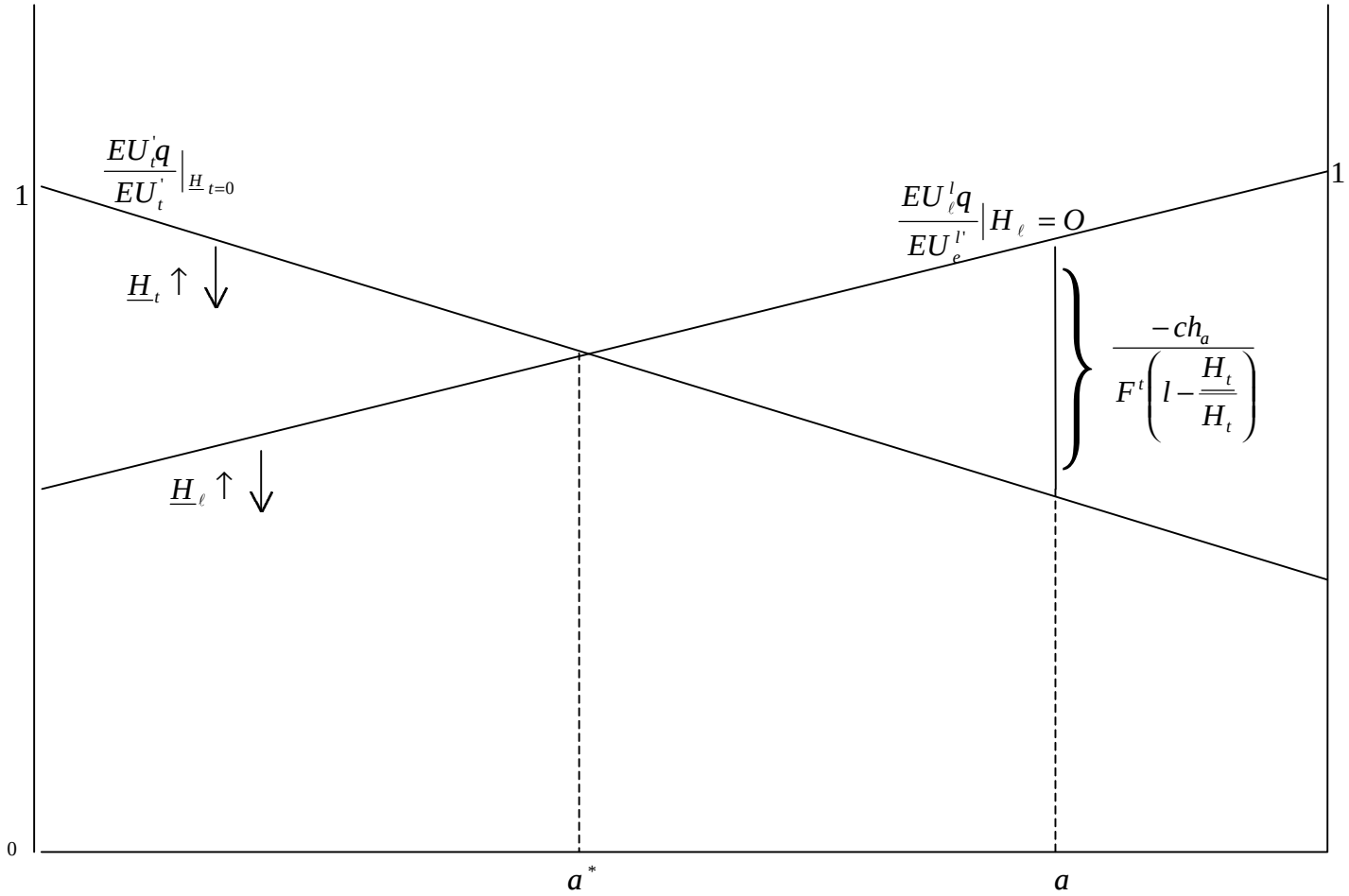

Figure 2 – Determination of Area Cultivated by Tenant