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Assessing the Functioning of Land Rental Markets in Ethiopia

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Abstract

Although a large theoretical literature discusses the possible inefficiency of sharecropping contracts, the empirical evidence on this phenomenon has been ambiguous at best. Household-level fixed-effect estimates from about 8,500 plots operated by households that own and sharecrop land in the Ethiopian highlands provide support for the hypothesis of Marshallian inefficiency. At the same time, a factor adjustment model suggests that the extent to which rental markets allow households to attain their desired operational holding size is extremely limited. Our analysis points towards factor market imperfections (no rental for oxen), lack of alternative employment opportunities, and tenure insecurity as possible reasons underlying such behavior, suggesting that, rather than worrying almost exclusively about Marshallian inefficiency, it is equally warranted to give due attention to the policy framework within which land rental markets operate.

This paper—a product of the Sustainable Rural and Urban Development Team, Development Research Group—is part of a larger effort in the group to assess the impact of land policies. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The author may be contacted at kdeininger@worldbank.org.

Assessing the Functioning of Land Rental Markets in Ethiopia

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I. Introduction

In situations where the distribution of land ownership is different from the optimal operational structure, mechanisms—in many cases rental markets—that transfer this factor to its most productive use have a key role in increasing total production and ensuring economic efficiency. Historically, when most of the land was cultivated with traditional technology and nonagricultural labor markets were virtually nonexistent, the majority of such land transactions occurred between large landlords, often absentees, and small tenants with few alternative opportunities, essentially compensating for a skewed distribution of land ownership. The increasing complexity of the agricultural production process implies that imperfections in other markets that are frequent in the rural areas of developing countries will affect the nature and direction of rental contracts. However, with economic development, a number of other disequilibrating factors such as changes in the demographic structure, nonagricultural demand for land, and an array of other reasons for land transactions—from producers' desire to take advantage of opportunities for off-farm employment and temporary migration to differential agricultural ability—have started to complement, and in many cases substitute for, the "traditional" model of land leasing from large to small landlords (Sadoulet, Murgai, and de Janvry 2001). As a result, land lease markets have become quite active, even in countries such as China and Vietnam where, with a highly egalitarian distribution of land ownership, the traditional model of land leasing would otherwise lead one to expect limited levels of land rental activity and the nature, purpose, and potential effects of such transactions may change significantly in ways that have not yet been fully explored in the literature.

In developing countries, where land is a key productive asset and source of income, it is not only the level of land rental activity but also the level of productive efficiency on the land thus transferred that is of relevance. In fact, economists have long been concerned about the efficiency implications of rental markets with a view towards identifying policy options that, by improving the efficiency of land use, have the potential to make everybody better off. A key motivation for doing so has been that, in addition to the limited investment incentives conveyed by short-term rental contracts, share tenants will, in any given season, receive only part of their marginal product and thus have limited incentives to supply effort. Many theoretical and empirical studies have identified conditions, mainly in terms of other market imperfections, for sharecropping to be a rational strategy and quantified its productivity as compared to owner-cultivation.

While such analysis can provide useful insights and has led to a number of policy interventions, it takes the renting decision as given and makes few predictions about the extent to which rental markets' response to exogenous changes is optimal in the sense of fully utilizing available opportunities. Exploring this issue is of policy relevance because with economic development in a modern economy, the incidence of exogenous changes to which land markets need to respond increases disproportionately. The transaction costs associated with renting out land may well affect land owners' decisions on whether to, e.g., adopt new technology or take up off-farm employment, thus having implications for nonfarm growth.

Given its limited land endowment that is under increasing threat from degradation, making the most productive use of available land resources is important for Ethiopia to escape the threat of starvation and dependence on food aid. Similarly, the population's continued high level of dependence on agriculture implies that well-functioning land rental markets that would allow those with little comparative advantage in agriculture to take up nonagricultural employment will be critical to lay the basis for overall development and a more diversified rural economy. If the experience of other countries that followed similar strategies is anything to go by, land rental markets will have to assume a major role in allowing movement of labor out of agriculture, and transferring land to more productive producers. However, past studies of the extent efficiency of rental markets in Ethiopia yield contradictory results; while some are unable to reject the hypothesis of frictionless adjustment through rental markets (Pender and Fafchamps 2006), others provide strong evidence for land markets allowing at best partial adjustment (Teklu and Lemi 2004, Ghebru and Holden 2006, Holden and Ghebru 2006).

In this paper, we use a large panel data set from Ethiopia that contains a substantial share of cultivating households owned and sharecropped land simultaneously, in addition to being more detailed and larger than what had been available in other studies. To assess the efficiency of sharecropping as a key contractual arrangement in land markets, we estimate a production function and input demand functions using household fixed effects. To explore the extent to which land markets help farmers capitalize on existing opportunities, we use a friction model (Rosett 1959, Skoufias 1995) to identify whether rental markets allow producers to attain their desired level of land holding irrespectively of their endowment, and also to provide an empirical estimate of the magnitude of friction in land rental markets.

Our results suggest that input and output intensities are indeed statistically significantly lower on sharecropped as compared to owned plots, thus leading us to reject the hypothesis that tenure status does not affect producers' decisions and that sharecropping contracts are not affected by Marshallian inefficiency, though the level of inefficiency is much lower than that found elsewhere in the literature. At the same time, we find evidence not only for large amounts of friction that prevents land owners to use rental markets to adjust to their optimum size but also to support the hypothesis that such friction reduces productivity by preventing productive producers from gaining access to additional land.

The paper is organized as follows. Section II discusses features of the rural economy in Ethiopia to motivate the study and provide the background for some of the analytical hypothesis. It also introduces the conceptual framework for testing the efficiency of sharecropping and the extent to which rental markets facilitate optimum adjustment. Section III describes the sample and uses descriptive statistics from our data to generate summary statistics at household and plot levels. Section IV presents results from the econometric analysis and discuses potential implications. Section V concludes by relating our results to the literature and highlighting areas for future research.

II. Background and Conceptual Framework

To motivate our analysis, we highlight key features of land tenure in Ethiopia, in particular the relative scarcity of land and the high risk associated with agricultural production and the fact that land is state owned and relatively equally distributed. Despite recent efforts to increase tenure security by demarcating land holdings, policy ambiguities may limit tenure security and market participation and we discuss the conceptual framework for exploring these quantitatively.

A. Distinguishing Features of Ethiopian Land Tenure

Prior to 1975, land in large parts of Ethiopia was concentrated in the hands of absentee landlords, tenure was highly insecure, arbitrary evictions posed a serious threat, and much land was severely underutilized. The land tenure system then prevailing was characterized by great inequality which, through its negative impact on production and investment, not only affected productivity but was also considered to have been the most important cause of political grievances that eventually led to the overthrow of the imperial regime. The Marxist government, soon after ousting the imperial regime, transferred ownership of all rural land to the state for distribution of use rights to cultivators through local peasant associations (PAs) and then embarked on large scale collectivization efforts. However, contrary to the case of China (Dong 1996), collectivization was not accompanied by large investments, so that most of the agricultural land remained rainfed and subject to degradation and soil erosion (Kebede 2002). Tenure security was undermined by the PAs' and other authorities' ability to redistribute land, an ability that was in some cases used for political ends (Ege 1997). Transferability of land through lease, sale, exchange or mortgage and the use of hired labor were prohibited and inheritance was possible only among immediate family members. Anybody involved in land rental ran the risk of losing his or her land and the fact that land use rights were contingent on proof of permanent physical residence prevented migration from rural areas.

Although it committed itself to a free-market philosophy and enacted a number of new pieces of legislation, the government that took power in 1991 failed to fundamentally alter the ambiguity of many aspects of land policy. For example, the right of every Ethiopian who wants to engage in agriculture to receive a piece of land for free is anchored in the 1995 Constitution. While it is recognized that this may conflict with other goals such as the desire for greater tenure security and well-functioning land markets, a 1997 federal proclamation essentially transferred responsibility for enacting laws regarding the nature of land rights, their transferability, and matters of land taxation to regional governments (FDRE 1997).[1] As tenure insecurity will be an important determinant of rental decisions, a brief review of regional policies on land redistribution and land rental is in order.

Despite repeated public announcements against land redistribution, regional positions are ambiguous. Proclamations in Amhara and SNNPR explicitly provide for other types of redistribution but make them the responsibility of local communities and require that they be supported by research that it will not lead to land fragmentation and does not adversely affect land productivity. Proclamations everywhere maintain that land rights of those obtaining non-agricultural jobs or otherwise being absent from the village for more than a certain period will fall back to the village.[2]

Even with rental now officially allowed (Pender and Fafchamps 2006), regions impose restrictions on the extent of land that can be leased or the duration of rental contracts (Nega, Adenew, and Gebre-Sellasie 2003, Beyene 2004). Oromia and SNNPR allow farmers to rent out up to 50% of their holding and stipulate maximum contract terms of 3 years for traditional and 15 years for modern technology (ONRS 2002; SNNPR 2003). In Amhara where our data was collected, a recent proclamation allows leasing of land for up to 25 years irrespective of the technology used (ANRS 2006) but still leaves large amounts of uncertainty.[3] For example, a clause that would have allowed mortgaging was removed from the draft proclamation before its enactment. More importantly, regulation is silent on whether long-term rental contracts entered into by a person who subsequently finds a non-farm job will have to be honored or not.

The notion that legal provisions lack clarity is supported by survey data. We note that, while the share of households who expect their land holding to be affected by administrative land redistribution or reallocation over the next five years has declined, on average it is still high with 47% over the three rounds. Such fears could reduce investment incentives (Deininger and Jin 2006b) as well as the propensity to rent out land which could be perceived as a signal that the land is no longer needed. Without judicial institutions to interpret regulations or adjudicate in case of dispute, it also implies that land conflicts are frequent and bureaucratic discretion in solving them pervasive (Rahmato 2003).

Partly to reduce such conflicts and respond to widespread tenure insecurity, the government recently launched an ambitious program of land certification that has made considerable progress, covering more than 6 million households by late 2005 in a participatory low-cost process to delineate borders and issue land use certificates (Deininger *et al.* 2007). Evidence on high levels of willingness to pay for land certification (Solomon 2004) suggests that this indeed responds to a farmers' demand. However, unless

[1] A new federal rural land administration and use proclamation was enacted in 2005, partly to re-establish consistency. As our data was collected before its enactment, its relevance for or analysis is limited and there is no need for us to analyze its provisions in detail.
[2] Most regions allow for eminent domain with compensation for land and improvements to establish irrigation. See the Southern Nation, Nationalities and Peoples Region (SNNPR) Amhara, and Oromia (ANRS 2000; ONRS 2002; SNNPR 2003). No clear statement on redistribution is included in Tigray (TNRS 1997).
[3] Recall that, as all of our data is from before 2005, it will not reflect changes brought about by this new development.

the meaning of land ownership and the ways it can be exercised, e.g. through land transfers, is clearly defined and limits are placed on the scope for interference from above , such initiatives may have limited impact and may actually give rise to disillusionment as users' high expectations are disappointed.

B. Testing the Efficiency of Sharecropping

In a world of perfect information, complete markets and zero transaction costs, the distribution of land ownership will affect welfare but will not matter for efficiency as everybody will operate their optimum farm size (Feder 1985). However, agricultural production is risky and outcomes depend on the level of technology and producers' ability. In addition to non-agricultural options which will affect potential tenants' reservation utility, labor and credit market imperfections as well as the transaction costs associated with transferring land will affect the outcomes that can be achieved in land rental markets. A key question is thus whether, taking the land ownership distribution as given, rental markets will achieve socially optimal outcomes, and to identify factors that will affect their ability to do so.

The literature has long shown that, by varying the share and a fixed payment to the tenant, land owners who wish to rent can achieve any combination of contractual forms from a wage labor over a share to a fixed rent contract. While, in a one-period setting, all contracts will lead to equivalent outcomes if output is certain and tenants' effort can be enforced (Cheung 1969), relaxation of this assumption gives way to a number of scenarios. If effort cannot be monitored perfectly[4] and agents are risk neutral, only the fixed rent contract is optimal and all other contracts will result in lower overall production because the tenants will supply effort only to the point where the marginal disutility of effort equals the tenant's marginal benefit. The optimum outcome will require a trade-off between the risk-reducing properties of the fixed-wage contract, under which the tenant's residual risk is zero, and the incentive effects of the fixed-rent contract, which would result in optimal effort supply but no insurance. Limited tenant wealth has a similar effect because in case of a negative shock tenants with insufficient wealth are likely to default on rent payments. This implies that landlords will tend to enter into fixed-rent contracts only with tenants who are wealthy enough to pay the rent under all possible output realizations, implying that poorer tenants will be offered only a share contract (Shetty 1988). If multiple periods are considered, there is scope for using the repeated game context and the threat of eviction to reduce the efficiency losses of sharecropping. At the same time, the fact that the tenant's behavior may affect not only output but also the stock of soil quality introduces additional decision variables that will need to be taken into account.[5]

[4] Systematic differences in landlords' ability to monitor effort can lead to endogenous matching between parties (Ackerberg and Botticini 2002), implying that contract parameters and type of partner will be jointly determined. Although exploring this issue would be of interest, our data do not include sufficient detail on the other party in the contract to allow meaningful analysis which would also be beyond the scope of this paper.

[5] A rental contract that provides tenants with adequate incentives to maximize production in any given time period may lead to overexploitation of the land if (dis)investment is considered, implying that a share contract with lower-powered incentives and possibly compensation may be more appropriate (Ray 2005).

A large literature has focused on testing the extent of inefficiency involved in sharecropping contracts, although with often mixed results (Otsuka and Hayami 1988). One of the key problems of cross-sectional estimates is that the estimated 'inefficiency' of sharecropping is due to unobserved household characteristics that affect contract choice rather than the contractual structure *per se* (Binswanger, Deininger, and Feder 1995).[6] Use of within-household variation suggests that, in India, share tenancy is associated with a reduction in input use of 32% and an average loss of productivity of 16% (Shaban 1987) although part of the losses may have been due to administrative measures outlawing fixed rent contracts. More recent studies using household fixed effects cast doubt on the inefficiency of sharecropping (Jacoby and Mansuri 2006), suggesting that agents' choice of contractual arrangements is rational given the constraints faced and that the scope for government to bring about more efficient outcomes may be limited.

Although possibly limited by a rather small number of observations, studies from Ethiopia fail to lend strong support to the hypothesis of Marshallian inefficiency either but instead suggest that farmers apply the same amount of inputs on land under informal and less secure contracts (rented, sharecropped and borrowed) and on lands formally allocated by PAs (Gavian and Ehui 1999, Pender and Fafchamps 2006). In fact, possibly due to eviction threats, sharecropped plots may be more productive than owner operated ones (Kassie and Holden 2006). To control for household-specific characteristics that vary systematically across owned and sharecropped plots (Bell 1977, Shaban 1987), we use the presence of a large number of households who own and sharecrop land at the same time to apply a methodology that compares yields and input intensities on owned and sharecropped plots for the same household. Formally, we estimate

$$y_{hi} = \gamma s_{hi} + \beta' x_{hi} + V_{vt} + u_h + \nu_{hi} \tag{1}$$

where y_{hi} denotes either the value of crop output[7] or physical quantities of key variable inputs (family labor, oxen days, or chemical fertilizer) used per hectare on plot i by household h, s_{hi} is a dummy variable that equals one if the plot is owner-cultivated and 0 if the plot is sharecropped, and x_{hi} is a vector of exogenous plot characteristics such as soil quality and topography (measured by several dummy variables), a dummy variable whether the plot is irrigated or not, and the number of years the plot has been possessed by the current user. V_{vt} is a vector of time-varying district (woreda) dummies that capture season and community specific effects, u_h captures the impact of all observed and unobserved household specific variables such as managerial ability, credit market access, or risk aversion that affect production decisions on all plots cultivated by the household equally, and ν_{hi} is plot specific unobserved error term assumed to be identically and independently distributed with mean zero and finite variance.

In addition to output, our empirical analysis focuses on use of family labor, draft power, and chemical fertilizer as the most important inputs. As all households use family labor and draft power we can

[6] If households entering into sharecropping contracts are poorer or have less access to capital than own-cultivators or fixed renters, what shows up in a cross sectional regression as an "impact" of sharecropping may well be the result of these factors rather than the specific form of the contract.
[7] Problems in recovering fertilizer prices make it impossible for us to compute a measure of profits or net revenues.

estimate a fixed effects model for these whereas presence of a non-trivial fraction of zero observations for fertilizer leads us to choose a random effects tobit model. Throughout, the key variable of interest is γ, the estimated difference in output or input intensity between owned and sharecropped plots not accounted for by other factors. A positive and significant value of this variable would indicate Marshallian inefficiency.

C. Optimality of Adjustment through Rental Markets

Irrespectively of whether the principal's inability to enforce the optimum level of effort by the agent will lead to sharecropping being inefficient, it is important to explore whether land rental allows households to attain their desired or 'optimum' cultivated land size. A number of factors including the transaction costs (e.g. for search of partners and contract enforcement) associated with land rental or imperfections in other markets, e.g. those for labor and draught animals (Bliss and Stern 1982, Bell and Sussangkarn 1988), may prevent attainment of desired holding sizes. Ethiopian studies take *prima facie* evidence on the failure of rental markets to equalize factor ratios as an indicator for rental markets allowing only partial adjustment (Teklu and Lemi 2004). Together with large rates of non-participation, this is often interpreted as an indication for presence of friction in land rental markets (Ghebru and Holden 2006, Holden and Bezabih 2006) although the methodology does not allow quantification of magnitudes involved. At the same time, the only study that formally tests factor adjustment, albeit for a small sample of households renting out land only, is unable to reject the hypothesis of land markets facilitating full and frictionless adjustment to the desired land size (Pender and Fafchamps 2006). Other empirical evidence suggests that imperfections in land rental markets lead to large productivity differentials that are not gender neutral: not only is female-headed households' land used much less productively than that cultivated by male-headed ones (Holden, Shiferaw, and Pender 2001), female headed households also tend to rent-out their land to tenants with much lower productivity (Bezabih and Holden 2006, Holden and Bezabih 2006).

To formally test for such friction in land rental markets, let k be the amount of net land leased which is itself a function of the difference between desired cultivated area (DCA), defined as the amount of land that matches the household's resource endowment in the absence of friction in the tenancy market, and total owned area (K).[8] Letting h be an the adjustment function which depends on the size and type of transaction costs in the rental market (Skoufias 1995), this relationship can be written as

$$k = h(DCA - K) = h(f(O, L) - K), \tag{2}$$

where, by assumption, DCA is a function of the household's endowment with oxen power O and family labor L. With the adjustment function h being non-decreasing in ($DCA - K$) and $h(0)=0$, i.e., a household that owns its desired cultivated area will not participate in the tenancy market, and f non-decreasing in both of its arguments, a first-order Taylor series expansion of equation (2) yields

[8] See Bliss and Stern (1982) and Skoufias (1985) for graphical exposition of some of the possible forms of the adjustment function, *h*.

$$k = (h' f_O)O + (h' f_L)L - h'K + C, \tag{3}$$

where h' is the slope the adjustment function, i.e. the first derivative with respect to ($DCA - K$), f_O and f_L are partial derivatives of the desired cultivated area function with respect to oxen and family labor endowments of the household, respectively, and C is a constant term.[9] Distinguishing observations with positive, zero, and negative amounts of net land leasing, an econometric model that accounts for these three observations, and that allows for asymmetry is given by

$$k_i = \begin{cases} -\alpha_n + \beta_n' Z_i + \varepsilon_i & if\ \varepsilon_i < \alpha_n - \beta_n' Z_i \\ 0 & if\ \alpha_n - \beta_n' Z_i \le \varepsilon_i \le \alpha_p - \beta_p' Z_i \\ -\alpha_p + \beta_p' Z_i + \varepsilon_i & if\ \varepsilon_i > \alpha_p - \beta_p' Z_i \end{cases} \tag{4}$$

where subscripts n and p denote the rental market participation status of household i with negative net leased-in area and positive net leased-in area, respectively; the parameters α_n and α_p include the constant term in (3) and the unobserved transaction costs that relate the latent to the observed variable; Z_i is a vector of household level variables; β is a vector of coefficients that combine the slope the adjustment function and the marginal responses of desired cultivated area to the underlying input endowment; and ε_i is the unobserved household specific error term. District dummies and a time trend capture differences in social and infrastructure endowments as well as prices, market access, and other time-varying factors that affect market functioning and thus agricultural productivity.

Household level variables which we expect to determine participation in tenancy markets and desired amounts of net area leased are included in Z_i. They include the demographic structure of the household (number of male adults, number of female adults, number of children, and age and sex of the head of the household), key assets (number of bulls and oxen and other livestock owned, number of rooms in dwellings), the area of land and its quality, and the literacy level of the head of the household as a proxy for human capital. It assumes that households' endowments with land, labor and oxen are exogenously determined, a reasonable assumption in our setting where land cannot be sold and endowments have been assigned by the village some time ago, oxen markets are very imperfect, and instantaneous adjustments of family size impossible.[10] We also estimate a version of this equation that includes measures of households' social capital and their agricultural ability, two variables the construction of which is explained below.

[9] Using this basic model, Bliss and Stern (1982) applied ordinary least-squares to a pooled sample of participants and non-participants. This has been criticized as it ignores the non-linear nature of the participation decision in the tenancy market due to the presence of transaction costs and the possibility of asymmetries across the two sides of the market (Bell and Sussangkarn 1988, Skoufias 1995). Such asymmetries may arise from differences in the slope of the adjustment function and/or from differences in the marginal responses of desired cultivated area to the household's endowment of draft power and family labor as can be seen from equation (3).

[10] Although in an environment of perfect markets and complete information, the solution to households' utility maximization problem over an infinite horizon would fully determine their asset stock and land rental decisions at any point in time, the presence of frequent exogenous shocks implies that such a model would not be a realistic approximation of the Ethiopian situation.

Parameters of the model are estimated using maximum likelihood (ML) under the assumption of an identically, independently, and normally distributed error term with mean zero and constant variance σ^2 (Skoufias 1995). The ML estimator is consistent and asymptotically efficient. However, as the model to be estimated is based on the first-order Taylor expansion, it is not possible to distinguish the threshold values related to transaction costs from the intercept terms and less weight should be given to the magnitude of the estimated intercept terms in interpreting results.

The econometric model in (4) can be used to test a range of hypotheses concerning the role of transaction costs and market imperfections in explaining the performance of the land rental market. First, full adjustment to the desired level of cultivated area through land rental markets would translate into the coefficients of own area equaling -1; rejection of this hypothesis would point towards friction (Skoufias 1995) of a magnitude proportional to the deviation of the coefficient from -1. Second, symmetry of the adjustment function for households who rent land in or out can be assessed by testing for equality of the coefficients of land area owned—or the symmetry of all or some of the estimated coefficients—on the two sides of the rental market. Finally, inferences regarding non-tradability of other inputs can be made by testing whether the estimated coefficients on these inputs are statistically different from zero.

Assuming that soil quality differences can be controlled and that other time invariant aspects such as infrastructure and market access are subsumed under district dummies, household fixed effects from a panel production function regression can be taken as a measure of producers' farming or management skills (Lanjouw 1999, Deininger and Jin 2005). Including these in the adjustment cost regression allows a *prima facie* test of whether, by transferring land from less to more productive producers, land rental helps improve efficiency. To do so, we exploit availability of detailed information on inputs and outputs for 3 years that differ from each other in terms exogenous factors (e.g. rainfall, prices, and non-farm opportunities) to recover household fixed effects from a Cobb-Douglas crop production function see appendix table 2 for results. Estimated ability follows a normal distribution and varies with the nature of households' land market participation as one would expect. It is positive and significantly different from zero for households leasing in (0.083) but negative for autarkic (-0.032) and landlord households (-0.096).

The literature on institutional economics has long highlighted that social capital and associated networks can have an important role in reducing the cost associated with economically beneficial transactions. For example, the size of a person's network will make it easier to identify potential transaction partners[11] and being part of a network is likely to reduce the cost of enforcing contracts or monitoring other parties' performance (Sadoulet, de Janvry, and Fukui 1997). Although this could be of great relevance in our case, the measure in our data that is closest to such a network variable is whether or

[11] Social capital can be economically beneficial, e.g. by improving the scope for co-insurance if agents are subject to random but uncorrelated shocks (Fafchamps and Lund 2003), if there are economies of scale in utilizing fixed investment as in marketing (Fafchamps and Minten 2002) or if, as in labor markets, the surplus from a particular transaction depends on the quality of the match between the two partners.

not the household participated and had a relation in a village burial association *('iddir')*. Inclusion of this variable in the respective regression could provide a first opportunity to test for network effects.

III. Data and Descriptive Statistics

Our panel data point to a high level of land rental activity, almost exclusive reliance on sharecropping, and a prevalence of rental transactions between close kin. Supply of land to rental markets is concentrated among female-headed households who lack draught power. Thus, contrary to other countries, rentals lead to operational holdings being more concentration than owned area. Data also point towards lower rates of input application and output per area cultivated on sharecropped as compared to own land.

A. Data and Household Level Evidence

We use data from three rounds of a longitudinal survey of rural households in the Amhara region of the Ethiopian highlands that comprise production information during the main agricultural season (*meher,* i.e. September-February) of the 1999, 2001, and 2004 agricultural years. In each period the survey, which was implemented by the Department of Economics of Addis Ababa University collaboration with the Department of Economics of Gothenburg University, covers about 1520 randomly selected households from 12 villages (*kebeles*) in 6 districts (*woredas*) in South Wollo and East Gojam zones of the Amhara region. Among others, data for every year include detailed information on household resource endowments, crop production inputs and outputs at the plot level, demographic characteristics of households and their participation in land, labor and credit markets.

Table 1 provides household level information for the whole sample and separately for those leasing out, leasing in, and remaining in autarky.[12] An first interesting observation is that land markets are very active with almost half the households (46%) participating in rental markets either on the demand or the supply side and only 54% remaining in autarky. The fact that participation rates in our sample are rather balanced between the two sides of the market (20% leasing out; 26% leasing in) highlights that the vast majority of transactions is between households in the same village. A second observation of interest is that, with 40%, a significant share of those renting out (compared to 12% among those in autarky and 3% among those renting in) are female headed. With more than 70% of all female headed households renting out land, rental seems to assume a key function in transferring land from resource poor female-headed households to resource rich male-headed ones and the equity impact of such transfers may be of interest.[13] Third, with few differences in area owned between the different groups (1.08, 1.08, and 1.12 hectares, respectively), operation of land markets leads to a slight concentration of operational land

[12] Almost all the households involved in the land rental market participated in either renting-out or -in land with less then 1% of households reporting to simultaneously leasing out and leasing in of land.

[13] The gender dimension and possible cultural factors attached to it is only one of the many facets of land rental market operation; in fact even if female headed households are excluded from the analysis , those who rent in are significantly more wealthy than those renting out.

holdings compared to land ownership, different to what is observed in most other countries. The Gini coefficient is 0.40 for land ownership compared to 0.47 for operational holdings. While this is low compared to the high levels of land inequality encountered in Latin America, it is higher than in China where, contrary to Ethiopia, rental markets also equalize the operational land distribution.[14] Finally, while one would expect those renting in to have better access to family labor, the fact that—contrary to what is observed in most other settings where the skilled and relatively wealthy rent out to pursue non-agricultural options—tenants' human and physical capital endowments are higher than that of landlords points towards barriers to entry into non-farm activities in the Ethiopian context.

B. Plot Level Characteristics

Table 2 presents information on output and input as well as source of traction and, for rented ones, the type of transaction partner for the 19,249 relevant plots under cereals, pulses, and oilseeds in the pooled sample. Plots cultivated with vegetables, fruits and other trees are excluded because of the nature of the survey villages all of which are predominantly cereal-producing areas in the highlands, in addition to a number of technical reasons, e.g. significant underreporting of output for continuously harvested fruits and vegetables and non-availability of price information for some tree crops such as eucalyptus.[15] Out of these, slightly more than one third (7,569 plots) belong to owner-cum-sharecroppers who own and lease in land at the same time and who will be of main interest for the household fixed-effect regressions.[16]

Comparison of the columns 1-4 and 5-7 corresponding to the whole sample and the sub-sample of owner-cum-sharecroppers, respectively, points towards few significant differences, suggesting that the latter are broadly representative of the overall population. With less than 10% of rented plots transferred on fixed rent, sharecropping is the predominant contractual arrangement. As per panel 1, most transfers were limited to close kin: 60% of plots were exchanged between relatives or in-laws, 30% among neighbors or VA members,[17] and only 10% between unrelated individuals. With 21%, the share of plots transacted in rental markets is lower than that of households involved in rental transactions as rental transactions normally involve only part of a household's endowment. Also the share of output accruing to landlords, close to 50%, is high. Although detailed data was not collected on the nature and formality of contracts, the mean leased-in plot in the sample had been in the possession of the current tenant for about 4 years, consistent with mean contract duration of 3 years based on the 3rd round data.

[14] The Gini coefficient for the ownership distribution of land is 0.92 for Venezuela and 0.87 for Brazil (Deininger and Squire 1998) compared to a Gini of 0.36 for the distribution of use rights, which was further reduced through transfers, in three provinces of China (Deininger and Jin 2005).

[15] A total of 3966 plots in the pooled sample from the analysis (112 of them under sharecropping and a total of 993 operated by owner-cum-sharecroppers planted to vegetables, fruits or tree crops are dropped due to the difficulty of computing output values.

[16] As plots transferred under fixed rent are not included in our plot-level analysis, and in view of their small number, we do not separately report descriptive statistics for them.

[17] Village associations (VAs) are self-help groups and informal networks such as agricultural mutual aid groups, rotating savings and credit associations, rotating feast groups, burial associations, etc. that are formed among persons of common kin, neighborhood or faith.

Noting that stars in column 8 indicate statistical significance of the difference in means between owned and sharecropped plots, we can compare differences in output and input use for plots operated by owner-cum-sharecroppers. We note that output per hectare is significantly lower on sharecropped plots compared to the ones under owner-cultivation. For owner-cum-sharecroppers, the difference amounts to 15 percentage points, statistically significant at 1%. Although multivariate analysis will be needed to test for it once other factors (e.g. lower soil quality of sharecropped plots) are controlled for and quantify its magnitude this, together with marked differences in application of almost all inputs between owned and sharecropped plots, provides *prima facie* evidence of Marshallian inefficiency. While 43% of own plots receive an average of 102 kg/ha of fertilizer, only 36% of sharecropped plots receive fertilizer at all and if so, at a much lower quantity (77 kg/ha). Differences in manure application are even more pronounced, compared to 29% of owned plots only 6% apply of sharecropped ones receive manure and differences in quantity applied are dramatic.[18] Use of family labor is more than 25% less on shared in than on own plots ((191 vs. 257 days/ha) and although hired labor is applied on a slightly higher share of sharecropped than owned plots (23% vs. 17%), amounts applied do not differ significantly from each other.[19] Recall that these are differences within the same household for owner-cum sharecroppers only, thereby excluding many non-contractual factors that could lead to inefficiency. At the same time, the considerably higher share of shared-in plots cultivated with own oxen suggests that oxen shortage may be a key reason for households to engage in land rental activities.[20] The main source of traction power for about 30 percent of cultivated plots was thus either oxen-sharing (*mekenajo*) or exchange of labor for oxen services.

[18] Checking back with field supervisors confirmed correctness of the large values for manure application. High values for this variable are attributed to the fact that (i) manure is applied infrequently (every 3-4 years at most) and (ii) the figures in the table refer to plots with non-zero manure application. If rented plots have been sharecropped for a long time, and to the extent that subjective assessments of soil fertility and other right hand side variables in our regressions do not capture them, the productivity differentials emerging from our regression could partly reflect the cumulative effect of low investment in maintaining soil fertility. As this would just be a different channel for Marshallian inefficiency to manifest itself, it would not alter our substantive conclusions.

[19] While one could imagine that landlords would require tenants to grow less labor intensive crops on sharecropped plots to reduce the scope for shirking (or the need for supervision), this is inconsistent with descriptive statistics highlighting that the incidence of *teff*, the traditional staple which is relatively labor intensive is about one third higher on sharecropped than on owned plots.

[20] Non-existence of rental markets for oxen can be explained to synchronic timing of activities and moral hazard that could lead renters to over-use and under-feed animals (Binswanger and Rosenzweig 1986).

IV. Econometric Results

Results from econometric estimation demonstrate that, even in an environment where there are little observed outcomes from operation of rental markets that are fully efficient, significant barriers to entry or friction in their operation could imply that whatever adjustment is brought about through the operation of such markets falls short of the potential. The hypothesis of sharecropping leading to inefficient use of resources is not rejected. This adds to the magnitude of friction that would, according to our estimates, prevent rental markets from attaining a first best allocation of resources.

A. Evidence on the Inefficiency of Sharecropping

Table 3 reports results from the household fixed effect estimates of yield and input intensity equations at the plot level for the most common crops. As discussed earlier, we use semilog equations conditional on plot characteristics (soil quality, topography, years of possession and availability of irrigation) to allow interpretation of the coefficients on the ownership dummy as percentage deviations of output and input intensities of owner-cultivated relative to sharecropped plots. After controlling for the effects of soil and other plot level characteristics, the results in column 1 of table 3 show a statistically significant difference in yields between owned and sharecropped plots that can be attributed to the rental arrangement. The point estimate suggests that, after adjusting for other factors, yields are 7% higher on owned as compared to sharecropped plots for the same household, about half the yield differential in semiarid India (Shaban 1987). This supports our hypothesis of ‘Marshallian inefficiency’, i.e. lower output on sharecropped as compared to owned plots.

To complement the above results, columns 2-6 of table 3 report results of fixed effect regressions for intensity of input application on owned and sharecropped plots by the same household. Except for oxen power where descriptive statistics also showed few differences, we find statistically significant gaps in input use between owned and sharecropped plots throughout. For example, intensity of family labor and total labor (including hired labor) are estimated to be 17 and 16 percentage points lower on sharecropped as compared to owned plots (columns 2 and 3). Similar conclusions emerge from random effect tobit regressions for intensity of fertilizer application (columns 5 and 6); conditional on fertilizer use, owned plots receive about 38% more fertilizer than sharecropped ones. Overall, and consistent with findings for yields, results point towards moral hazard in tenants’ supply of labor or effort that is not compensated by more intensive use of purchased inputs. Thus, despite generally close social relationships, principals are unable to induce tenants to apply optimum effort levels. The fact that parties enter into contracts that are less efficient than fixed rental can be explained by capital market imperfections or social norms.

Although the number of fixed rent contracts in the sample is limited, repeating the above analysis on them provides an independent check of our hypotheses.[21] Results fail to indicate significant differences in either output or input intensity between the two types of plots. The exception to this is family labor which is 13% higher on owned than on fixed-rented plots, possibly as a form of long-term investment, e.g. by removing stones or more intensive weeding to prevent accumulation of a stock of weed seed.

Studies show that omission of land quality can significantly bias empirical findings (Frisvold 1994, Benjamin 1995, Lamb 2003). It is thus important to check that our results are not due to omitted variable bias whereby, for example, land of unobservably worse quality is allocated to sharecropping. Three observations increase our confidence in the reliability of our estimates. First, all our regressions include a subjective measure of land quality obtained from the cultivator rather than the owner. This is important because landlords, especially if they are not involved in cultivation, may either be unaware of their plots' true soil quality or have an incentive to systematically overstate it, two factors that do not apply to cultivators, therefore suggesting less presence of measurement error. Second, as soil quality has often been found to be negatively correlated to plot area, we test whether including parcel size as an additional right hand side variable alters conclusions.[22] Results for the two variables of interest are reported in the top panel of appendix table 1. The negative and significant coefficient on parcel size suggests that larger parcels indeed have lower (unobserved) soil quality but that inclusion of this variable affects neither magnitude nor significance of the estimated coefficient on ownership. Finally, although crop choice is endogenous and the hypothesis of full efficiency would imply that there be no difference in crop choice between owned and sharecropped plots, we repeat our analysis only for plots with the most common crop (*teff*) as a robustness check.[23] The bottom panel of appendix table 1 shows that the coefficient on the ownership dummy is highly significant and larger—rather than smaller as would be expected—than in the base regression, making crop choice an unlikely source of Marshallian inefficiency. Estimating the model using household-year fixed effects to control for time-varying shocks (not reported) reduces the explanatory power but does not alter the basic results either. The robustness of the results increases our confidence in the results and allays fears about potential bias.

[21] There are 128 owner-cum-fixed renter households in the sample who operated a total of 1565 plots over the three periods. Results are not reported due to space reasons but available from the authors upon request.

[22] In our survey, parcels were defined as contiguous pieces of land with no variation in physical characteristics and tenure status whereas plots are contiguous pieces of land cultivated with a specific crop or mixture of crops. Under this terminology, a parcel can be sub-divided into more than one plot in any given season. As any such subdivisions will be endogenous, the correct unit of analysis is the parcel.

[23] Note that, according to descriptive statistics, labor intensive high-value crops are equally or more likely to be cultivated on sharecropped than on owned land.

B. Evidence on Friction in Land Rental Markets

Independently of whether existing contracts are fully efficient or not, it is important to check whether rental markets allow producers to attain their optimum holding size. To explore whether this is the case, the parameters for intensity of participation in tenancy market (table 4) allow a number of insights.[24]

Most importantly, noting that the coefficient of owned land area corresponds to the slope of the adjustment function in (2), the positive (negative) and significant coefficients of owned area in the leasing out (in) equations suggest that, once households' endowments with fixed factors are accounted for, land markets facilitate an adjustment towards households' desired level of cultivated area. However, figures in table 4 illustrate that both the hypotheses of the symmetry of the coefficients on both sides of the market and, more importantly, full adjustment, i.e. the equality of these coefficients to 1 or -1 is strongly rejected. While suppliers appear to be slightly less constrained than those demanding land through the market, estimated coefficients suggest that, on average, farmers realize only about 25% of the desired amount of land leased, pointing towards large amounts of friction in the land lease market. This is in marked contrast to results by the only other study on this issue in Ethiopia which—albeit based on somewhat imperfect data[25]—was unable to reject the hypothesis of perfect adjustment (Pender and Fafchamps 2006).

To put this figure into perspective, note that in India where a large number of policies impose multiple *de jure* restrictions on land rental (Deininger, Jin, and Nagarajan 2007), the corresponding coefficient was 78% (Skoufias 1995). Despite manifold rental restrictions, rental markets thus allowed producers in India to come much closer to their desired operational land endowment than in Ethiopia. A second finding of interest relates to the signs and significance levels of the coefficients on other factors, all of which should equal zero under the assumption of perfect markets. The coefficient on ownership of draft animals is highly significant and positive (negative) on the demand (supply) side of the market, suggesting that households with more (less) animals are likely to lease-in (out) more (less) land in line with the hypothesis that land leasing decisions help to improve utilization of households' imperfectly tradable endowment with oxen. The extent of land transactions is also significantly affected by female headship and the number of male adult members and dependents in the expected way, due in part to the fact that—even if females participate in other activities such as weeding and harvesting—ox plowing is a male task and it will be difficult for females to obtain the necessary male labor (plus oxen) through markets. The value of other livestock and number of rooms in the house, a proxy for wealth and access to credit and

[24] Recall that the dependent variable is the amount of net land leased-in (i.e. leased in minus leased out) in hectares. To facilitate interpretation, estimated coefficients in the lease-out equation (except for the district dummies, the time trend and the intercept term) are multiplied by -1. A positive (negative) coefficient in the leasing-out column can thus be interpreted as an increase (decrease) in the amount of land leased-out in response to a positive change in a given explanatory variable.

[25] Their data contains only information on leasing in for a much smaller sample of 161 observations.

working capital, is positive (negative) in the lease in (out) equation, suggesting that credit market imperfections may be another factor preventing households from leasing in the desired amount of land.

While the regressions suggest that land markets transfer land from older to younger households and thus substitute for administrative redistribution of land, households' literacy level is not significant, in contrast to what is found in other countries where off-farm labor markets are often found to be a driving factor underlying land market activity (Deininger and Jin 2006a). The fact that higher levels of education do not increase the propensity of renting out land points towards limited opportunities in non-agricultural labor markets. Finally, intercept terms and the district dummies are significantly different from zero (table 5), suggesting differences in the extent of land rental market functioning across villages. The coefficient on our social capital variable (participation in a village burial association) is highly significant in the rent-out but not in the rent-in equation (not reported). While this is consistent with the notion that higher levels of social capital reduce the barriers to renting out land, the high correlation with woreda dummies implies that its significance disappears once these are included and we conclude that the quality of either of the variables is poor and that better data will be needed to support more far-reaching inferences.

Results for the equation with farming ability are reported in the last two columns of table 4.[26] Our failure to find a statistically significant effect of ability on leasing-out decisions is consistent with the descriptive evidence according to which imperfections in input markets, rather than ability, are a key factor prompting households to supply land to the rental market. At the same time, we note that, according to our results, households with higher levels of ability are likely to rent-in more land (significant at 10%), implying that by providing greater land access to those with higher levels of ability, rental markets make some contribution to enhancing productive efficiency.

V. Conclusion and Implications for Future Research

Study of land rental markets in Ethiopia is of interest not only because of the relevance of such markets for nonagricultural development but also because the country is characterized by a relatively equal allocation of land but high levels of production risk that lead to sharecropping as the most prevalent contractual form. Our results suggest that rental markets are doubly inefficient. On the one hand, high transaction costs, partly policy-induced, imply that many households are either completely rationed out of rental market participation or unable to use land rental to attain their optimum operational holding size. On the other hand, high levels of risk and imperfections in other factor markets, especially those for credit, imply that even those able to overcome barriers to participation are unable to use contractual forms—or other mechanisms to supervise tenants—that would allow to attain efficient outcomes. These results are in contrast to what has been found in other contributions to the literature on Ethiopia. Still, the

[26] Note that the mean of this variable varies with the land market participation status of households in expected ways, being positive and significantly different from zero for tenants (0.083) and negative for landlords (-0.096) and households in autarky (-0.032).

level of inefficiency associated with sharecropping found here is comparatively modest and, from a policy point of view, anything that will reduce producers' exposure to uninsured risk will result in higher levels of efficiency.

By comparison, the magnitude of friction estimated here is not only much larger than what has been found in other countries but also likely to be associated with considerable efficiency losses. Moreover, the ability to respond to changes brought about by new technology, greater integration with marketing and processing, and better off-farm opportunities will be of even greater importance for rural growth and development in the future. In view of this, follow-up research to identify factors that prevent households from attaining their desired level of operated land will be of great relevance.

Although our data do not allow unambiguous identification of the source of such friction, they are not inconsistent with the notion that policy constraints are a major factor.[27] While policy dialogue to explore the extent to which existing policies are appropriate, and to revise them where needed, will be critical to allow rural producers to take advantage of these new opportunities, the fact that policies are formulated at the regional level and have, at least on paper, changed considerably over time, could help separate the effects of policy from those of other factors. Combining "objective" legislative provisions with households' subjective perceptions of their land rights in a national data set could also allow identification of the various effects at play, in addition to providing insights on the extent to which producers are aware of new legislation and the way in which such awareness links to and interacts with other factors and affects socioeconomic outcomes. Such analysis is left for future research.

[27] Lack of clarity as to whether land will be lost if the owner takes up non-agricultural employment as a possible impediment to out-migration of labor from rural areas (Rahmato 2003). The fact that Tigray has very recently launched attempts to recover lands by households who had their primary source of livelihood outside of the village for two seasons illustrates that such constraints are of continuing relevance.

Table 1: Household level descriptive statistics

Variable	Total	By land market participation status				
		Leased-out		Autarky	Leased-in	
Household characteristics						
Female head dummy (%)	15.37	39.95	***	11.82	3.29	***
Head literate (%)	41.31	29.05	***	41.27	51.14	***
Age of head in years	48.38	51.61	***	48.71	45.11	***
No. of rooms in dwellings	1.95	1.74	***	1.95	2.13	***
Owned area in ha	1.10	1.08		1.12	1.08	
Number of adult males	1.49	1.04	***	1.57	1.70	***
Number of adult females	1.46	1.33	***	1.52	1.46	*
No. of dependents (<15 or >60)	2.72	2.26	***	2.74	3.05	***
Agricultural production						
Net land leased-in	0.01	-0.71	***	0.00	0.61	***
Cultivates any land (%)		63.2				
Owned cultivated area in ha	0.95	0.37	***	1.12	1.07	
Total cultivated area in ha	1.11	0.37	***	1.12	1.69	***
Share of good quality land (%)	38.42	36.68	*	39.42	37.70	
Owns bulls or oxen (%)	67.31	23.65	***	72.42	91.32	***
No. of bulls/oxen (for owners)	1.19	0.39	***	1.21	1.79	***
Value of other livestock in (‘000) Birr	1.20	0.57	***	1.20	1.69	***
Distribution over districts (*Woredas*)						
Woreda1 (Machakel), East Gojam (%)	15.44	13.09		12.55	23.38	
Woreda2 (Gozamin), East Gojam (%)	15.91	16.88		16.64	13.61	
Woreda3 (Enemay), East Gojam (%)	15.98	21.35		12.25	19.54	
Woreda4 (Tehuledere), South Wollo (%)	20.57	18.94		23.20	16.35	
Woreda5 (Tenta), South Wollo (%)	15.96	13.55		20.03	9.32	
Woreda6 (Habu), South Wollo (%)	16.14	16.19		15.33	17.81	
Number of observations	4268	871		2302	1095	

Source. Own computation from AAU/UG Amhara Panel Survey

Note. Unit of observation is a household in a given year. Except for negligible attrition (less than 3% between rounds), this implies that the same household contributes three observations. Stars indicate that means for the lease-out and lease in group, respectively, are significantly different from those for the group remaining in autarky. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 2: Plot characteristics for different samples (only cereals, oilseeds and pulses plots)

	Total sample				Owner-cum-sharecroppers			
	All	**Own cult.**	**Shared in**	**Shared out**	**All**	**Own cult.**	**Shared in**	
Relation w. partner (TP)								
TP relative (%)	48.16		48.55	49.83	48.95		48.95	
TP in-law (%)	10.68		11.13	11.22	10.61		10.61	
TP neighbor (%)	17.53		15.62	18.52	15.34		15.34	
TP member of VA (%)	12.74		13.83	10.79	14.38		14.38	
TP unrelated (%)	10.90		10.87	9.64	10.72		10.72	
Harvest share received (%)	51.08		53.10	49.18	53.39		53.39	
Output & plot characteristics								
Crop output/ha (Birr)[a]	2753.71	2788.92	2579.31		2868.60	2973.47	2480.64	
Crop output/ha (Birr)	2087.78	2086.07	2147.79		2043.36	2106.22	1827.98	***
Plot size in ha	0.26	0.26	0.29	0.28	0.26	0.26	0.28	***
Years of possession	15.99	17.43	3.91	17.85	13.79	16.70	3.81	***
Good soil quality (%)	36.94	37.81	34.92	33.27	36.08	36.43	34.88	
Medium soil quality (%)	41.76	41.72	40.59	43.31	40.93	41.22	39.93	
Poor soil quality (%)	21.16	20.33	24.49	23.28	22.88	22.21	25.19	***
Flat land (%)	3.84	3.83	2.98	4.74	68.48	67.09	73.21	***
Gently sloped (%)	3.45	3.41	2.80	4.42	27.51	28.58	23.86	***
Steeply sloped (%)	0.42	0.45	0.20	0.36	4.00	4.32	2.92	***
Irrigated (%)	2.47	2.67	1.39	2.26	2.42	2.75	1.29	***
Variable input use								
Used fertilizer (%)	36.95	36.99	34.33		41.88	43.45	36.49	***
Fertilizer used per ha (kg)	90.05	91.54	78.22		96.29	102.30	76.76	***
Used manure (%)	25.84	28.91	6.31		23.65	28.84	5.85	***
Manure used per ha (kg)	2953.28	3284.99	414.29		3079.62	3803.08	294.78	***
Used improved seed (%)	3.83	4.08	2.14		3.88	4.45	1.93	***
Male family labor/ha (d)	178.11	185.15	136.30		162.86	171.84	132.09	***
Fem. family labor/ha (d)	92.03	97.20	60.51		79.57	85.64	58.74	***
Total family labor/ha (d)	270.15	282.35	196.81		242.43	257.49	190.83	***
Used hired labor (%)	17.13	16.16	21.91		18.43	17.24	22.51	***
Hired labor/ha (d)	72.96	79.81	45.39		46.97	48.90	41.90	
Source of traction								
Own pair of oxen (%)	58.47	56.46	70.30		67.00	66.22	69.65	***
Oxen exchange for labor (%)	15.87	17.17	7.34		11.12	12.37	6.84	***
Oxen sharing (%)	19.28	19.39	19.80		19.39	18.98	20.82	*
Gift/support (oxen party) (%)	5.03	5.49	2.06		1.96	1.88	2.22	
Oxen rental (%)[b]	1.12	1.20	0.50		0.54	0.56	0.47	
Hoe and other (%)	0.40	0.48	0.00					
Pair of oxen days per ha	50.38	49.74	54.36		52.27	51.83	53.79	
Crop choice								
Teff plot	32.44	31.39	40.24		34.97	32.79	42.46	***
Wheat/barely plot	21.13	22.05	18.08		22.06	23.16	18.30	***
Sorghum/maize plot	20.44	22.33	14.06		19.22	21.04	12.98	***
Pulses plot	14.52	14.40	16.44		14.16	13.82	15.32	
Oilseeds or other crops plot	12.02	10.43	11.57		10.20	9.85	11.40	*
Number of observations	19249	14668	2013	2217	7569	5859	1710	

Source. Own computation from AAU/UG Amhara Panel Survey
Note. Unit of observation is a plot in a given year. Thus the same plot could provide multiple observations.

Significance levels reported for t-tests of the equality of the means between owned and shared-in plots for the sub-sample of owner-cum-sharecroppers. * significant at 10%; ** significant at 5%; *** significant at 1%
[a] The standard error for the share rule varies between 10.87 and 11.79.
[b] Value of crop output per ha (Birr) using all the plots (including plots covered by vegetables and perennial crops).
[c] Rental includes provision of animals by the sharecropping partner or other arrangements.

Table 3: Determinants of output and input intensity per ha for owner-cum-sharecroppers (household fixed effects)

	Value of output per hectare (log)	Family labor per ha (log)	Total labor per ha (log)	Pair of oxen days per ha (log)	Quantity of fertilizer per ha – Random effect tobit	
					Coef.	Marginal effect (dlny/dx)
Ownership dummy	0.071**	0.171***	0.163***	0.014	59.804***	0.380***
	(2.48)	(6.55)	(6.25)	(0.49)	(6.17)	(6.16)
Number of years possessed	-0.002	-0.002*	-0.003**	-0.001	-0.752*	-0.005*
	(1.32)	(1.89)	(2.12)	(0.81)	(1.86)	(1.86)
Good soil quality	0.107***	0.034	0.030	-0.010	-20.215**	-0.129**
	(3.66)	(1.30)	(1.14)	(0.34)	(2.15)	(2.14)
Medium soil quality	0.091***	0.024	0.019	0.015	-12.818	-0.082
	(3.32)	(0.98)	(0.76)	(0.59)	(1.45)	(1.45)
Flat land	0.064	0.049	0.026	0.046	-8.880	-0.056
	(1.22)	(1.03)	(0.56)	(0.91)	(0.52)	(0.52)
Gently sloped land	0.085	0.035	0.021	0.058	-18.830	-0.120
	(1.61)	(0.73)	(0.44)	(1.15)	(1.09)	(1.09)
Irrigated land	-0.055	-0.040	-0.056	-0.046	-28.103	-0.179
	(0.83)	(0.66)	(0.93)	(0.72)	(1.09)	(1.09)
Constant	7.143***	4.663***	4.736***	3.480***	-81.877***	
	(124.51)	(89.34)	(90.85)	(63.18)	(4.20)	
Observations	7569	7569	7569	7569	7569	
Number of household	591	591	591	591	591	
R-squared	0.25	0.12	0.13	0.15		

Note. Absolute value of t statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%.
The reported marginal effects for the fertilizer regression are provided in the form of *dlny/dx* such that we can interpret the coefficient of the ownership dummy similar to that of the labor intensity regressions as the percentage deviations of input intensities on owner-cultivated plots relative to sharecropped plots. Time-varying district (*woreda*) dummies are included, but not reported.

Table 4: Determinants of net land leased-in: Maximum likelihood estimates

	Simple friction model		Ability included	
Variable	**Leased-out**	**Leased-in**	**Leased-out**	**Leased-in**
Owned area (ha)	0.305***	-0.208***	0.303***	-0.208***
	(5.14)	(3.84)	(4.95)	(3.75)
Proportion of good soil quality	-0.052	-0.007	-0.058	-0.011
	(0.83)	(0.11)	(0.83)	(0.18)
Number of dependents	-0.057***	0.067***	-0.044**	0.066***
	(2.79)	(3.56)	(2.03)	(3.40)
Number of adult male	-0.090***	0.071**	-0.091***	0.070**
	(2.76)	(2.40)	(2.59)	(2.32)
Number of adult female	-0.004	-0.039	0.009	-0.043
	(0.13)	(1.11)	(0.25)	(1.19)
Number of bulls and oxen	-0.641***	0.292***	-0.629***	0.286***
	(9.36)	(4.32)	(8.91)	(4.25)
Value of other livestock owned × 10^{-3} (Birr)	-0.096***	0.036**	-0.083**	0.035**
	(3.00)	(1.99)	(2.57)	(1.98)
Number of rooms of the household	-0.030	0.079***	-0.043	0.084***
	(1.03)	(2.79)	(1.30)	(2.90)
Age of household head (years)	0.011***	-0.011***	0.012***	-0.011***
	(5.93)	(5.26)	(5.52)	(5.04)
Female headed household	0.619***	-0.654***	0.611***	-0.634***
	(7.41)	(5.85)	(6.81)	(5.48)
Household head can read and write	0.021	-0.000	0.008	-0.000
	(0.35)	(0.01)	(0.12)	(0.01)
Farm ability			-0.058	0.111*
			(0.94)	(1.68)
Threshold effect and constant parameters				
Woreda2	-0.270**	0.222**	-0.294***	0.232**
	(2.50)	(2.41)	(2.62)	(2.44)
Woreda3	-0.265**	-0.186*	-0.253**	-0.139
	(2.53)	(1.89)	(2.16)	(1.29)
Woreda4	-0.762***	0.340***	-0.840***	0.334***
	(5.93)	(2.79)	(5.98)	(2.66)
Woreda5	-0.958***	0.333***	-1.026***	0.355***
	(7.30)	(2.87)	(7.19)	(2.98)
Woreda6	-0.439***	-0.053	-0.436***	-0.003
	(3.76)	(0.48)	(3.44)	(0.03)
Time trend	0.101***	0.138***	0.097***	0.142***
	(3.50)	(4.58)	(3.03)	(4.58)
Constant	-0.630***	0.369***	-0.735***	0.360**
	(3.60)	(2.58)	(3.81)	(2.43)
σ	1.025***		1.058***	
	(9.78)		(9.58)	
Log likelihood	-4680.15		-4466.07	
Wald chi2(23)	156.65***		140.08***	
Observations	4268		4106	

Note. Robust z statistics adjusted for clustering in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Coefficients for leasing-out (except constant and dummies) are multiplied by -1 for ease of interpretation. The discrepancy in the total number of observations is mainly because about 137 households leasing-out land were pure landlords over the three periods, and the rest is due to missing values in the value of crop output or its determinants. This leads to some missing values in the household fixed effects (a proxy variable for farming ability) obtained from the regression estimates given in appendix table 2.

Table 5: Wald tests of equality of coefficients on opposite sides of the land lease market

Hypothesis tested (using estimated coefficients given in the first two columns of table 5)	**Wald statistic chi2(r)**
Symmetry of all coefficients (except woreda dummies), number of restrictions (r)=11	37.20***
Symmetry of subset coefficients (resource endowment: labor, land, oxen, assets), r=8	36.60***
Owned area	11.2***
Owned area=-1, r=2	218.64***
Good soil quality	0.57
Dependants	0.16
Male adult	0.21
Female adult	0.99
Oxen	22.68***
Other livestock	3.08*
Rooms	1.94
Age	0.06
Female headship	0.1
Literacy	0.08
Equality of intercept terms	
Woreda1[a]	1.13
Woreda2	1.72
Woreda3	9.31***
Woreda4	6.32***
Woreda5	14.66***
Woreda6	9.49***

Note. * significant at 10%; ** significant at 5%; *** significant at 1%.

[a] Woreda1 is the district included in the constant term (the reference category). The intercept term for the other districts is, therefore, the sum of the coefficients of the respective district dummy and the constant term.

Appendix table 1: Determinants of output and input intensity for owner-cum-sharecroppers (household fixed effect estimates)

	Value of output per hectare (log)	Family labor per ha (log)	Total labor per ha (log)	Pair of oxen days per ha (log)	Quantity of fertilizer per ha – Random effect tobit	
					Coef.	Marginal effect (dlny/dx)
			All plots			
Ownership dummy	0.055**	0.149***	0.142***	-0.006	59.557***	0.379***
	(1.96)	(6.02)	(5.70)	(0.21)	(6.14)	(6.13)
Parcel size in hectares	-0.544***	-0.710***	-0.707***	-0.640***	-5.334	-0.034
	(18.16)	(26.73)	(26.63)	(22.53)	(0.55)	(0.55)
Observations	7569	7569	7569	7569	7569	
Number of household	591	591	591	591	591	
R-squared	0.28	0.21	0.21	0.21		
			Teff plots only			
Ownership dummy	0.096**	0.105***	0.107***	-0.078*	78.015***	0.530***
	(2.34)	(2.85)	(2.93)	(1.66)	(6.28)	(6.24)
Parcel size in hectares	-0.513***	-0.648***	-0.642***	-0.672***	-20.782	-0.141
	(9.40)	(13.23)	(13.30)	(10.88)	(1.43)	(1.43)
Observations	1998	1998	1998	1998	1998	
Number of household	369	369	369	369	369	
R-squared	0.35	0.16	0.17	0.24		

Note. Absolute value of t statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%.
The reported marginal effects for the fertilizer regression are provided in the form of *dlny/dx* such that we can interpret the coefficient of the ownership dummy similar to that of the labor intensity regressions as the percentage deviations of input intensities on owner-cultivated plots relative to sharecropped plots. Plot level characteristics and time-varying district (*woreda*) dummies are included, but not reported.

Appendix table 2: Determinants of value of crop output for all plots: Household fixed effects estimates

	Value of crop output (log)
Plot size (log)	0.219***
	(21.86)
Male family labor (log)	0.320***
	(24.35)
Female family labor (log)	0.010
	(0.96)
Hired labor (log)	0.039**
	(2.33)
Pair of oxen days (log)	0.158***
	(15.31)
Chemical fertilizer kg (log)	0.164***
	(13.73)
Manure in kg (log)	0.019
	(1.64)
Dummy female family labor[a]	-0.057*
	(1.82)
Dummy hired labor[a]	-0.116***
	(3.42)
Dummy oxen labor[a]	0.125**
	(2.51)
Dummy chemical fertilizer[a]	0.212***
	(5.28)
Dummy manure[a]	0.142**
	(2.09)
Number of years possessed	0.000
	(0.10)
Good soil quality	0.129***
	(6.52)
Medium soil quality	0.112***
	(6.10)
Flat land	0.016
	(0.47)
Gently sloped land	0.039
	(1.12)
Irrigated land	0.056
	(1.27)
Constant	4.192***
	(42.50)
No. of observations	15935
No of households	1504
R-squared	0.44

Note. Absolute value of t statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.
Time-varying district (woreda) dummies included throughout but not reported.
[a] The value of the dummy is 1 if the input is not used, and the value is 0 if the input is used.

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