Productivity Effects of Land Rental Market Operation in
Ethiopia : Evidence from a Matched Tenant-Landlord Sample

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Productivity effects of land rental markets in Ethiopia:
Evidence from a matched tenant-landlord sample

Abstract: As countries increasingly strive to transform their economies from agriculture-based into a diversified one, land rental will become of greater importance. It will thus be critical to complement research on the efficiency of specific land rental arrangements such as sharecropping with an inquiry into the broader productivity impacts of the land rental market. Plot-level data for a matched landlord-tenant sample in an environment where sharecropping dominates allow us to explore both issues. We find that pure output sharing leads to significantly lower levels of efficiency that can be attenuated by monitoring while the inefficiency disappears if inputs are shared as well. Rentals transfer land to more productive producers but realization of this productivity advantage is prevented by the inefficiency of contractual arrangements, suggesting changes that would prompt adoption of different contractual arrangements could have significant benefits.

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1. Introduction

It is well recognized that there is considerable potential for the agricultural sector to help improve labor productivity in rural areas through technology, integration into supply chains, and better functioning of factor markets including those for land and labor to facilitate off-farm employment (World Bank 2007). In the context of economic growth, low-cost and flexible mechanisms to bring land to its most productive use can help in the transformation of rural economies by allowing those with little comparative advantage in agriculture to take up non-agricultural employment and thus lay the basis for a more diversified growth (de Janvry *et al.* 2001). Given their greater flexibility and limited upfront capital requirements, rental markets allow greater flexibility than sales and allow owners working off-farm to continue enjoying the benefits of land ownership (Otsuka and Hayami 1988) while at the same time drawing on non-agricultural income (Deininger and Jin 2006). There is, however, concern that, especially if other markets do not work well, contractual arrangements adopted in such markets may fail to fully realize their potential. However, few empirical studies have explored productivity impacts of different forms of land rental, making it difficult to assess the scope and possible nature of policies to help realize such potential more fully. Doing so for the case of Ethiopia's highlands, where rental markets are quite active, is the goal of this paper.

We use a sample of some 1,700 households and their 800 rental partners to address two questions that are critically important for productivity and welfare. First, the extent to which 'Marshallian inefficiency' affects productive efficiency of sharecropping and whether parties can alter associated impacts. Second, whether landlords' choice of partners with greater agricultural ability affects the productivity impact of land rental market and the extent to which policy can help to encourage productivity-enhancing outcomes.

Use of within-household fixed effects estimates for owner-cum-tenants to answer the first question suggests that output on sharecropped plots is significantly lower, by between 16% and 25%, than on owned plots cultivated by the same household. If landlords share in provision of inputs, the inefficiency will disappear. Landlords' monitoring capacity, i.e., being a farmer or having off-spring live in the village, attenuates but fails to eliminate the inefficiency arising from sharecropping contract.

While earlier analyses provided estimates of the magnitude of the 'Marshallian inefficiency' comparable in magnitude to those obtained here, lack of information on partners in rental markets made it impossible to ascertain whether this is due not to the contractual form or tenants' inherent productivity. Analysis of pair fixed effects for properly chosen plot samples, i.e., plots owned and cultivated by either the landlord or the partnering tenant, shows that tenants' productivity is higher than that of landlords by between 17 and 26 percentage points suggesting that land rental could significantly enhance productivity. Still, this is counteracted by contractual arrangements; in fact we cannot reject the hypothesis that, despite tenants' productivity advantage, productivity on leased plots is no different from those self-cultivated by the landlord. As this result is unlikely to be driven by unobserved land quality, use of sharecropping rather than fixed rental arrangements implies that rental markets fail to realize their productive potential. Predominantly female landlords will draw little, if any benefits from having their land sharecropped as compared to cultivating it themselves. Policies such as insurance that would allow adoption of fixed rent contracts could thus increase welfare by both tenants and landlords.

The paper is structured as follows. Section two introduces the topic and uses descriptive statistics from household- and plot-level data to illustrate the setting and highlight evidence on working of rental markets from data on transaction partners. Section three discusses literature on the efficiency of sharecropping and introduces our analytical framework that extends the standard approach to allow for arrangements that might allow partners to reduce inefficiency of certain contractual arrangements and to assess potential and actual productivity differential between tenants and landlords. Section four presents results from the econometric analysis. Section five concludes by discussing potential policy implications.

2. Background and descriptive statistics

Our data come from a rural environment with limited non-agricultural labor markets and high levels of land rental market activity. High risk, social norms regarding females' roles, and large differences in wealth and endowments with critical factors, in particular oxen, implied that land is mainly transferred from poor and often female headed landlords to relatively more affluent tenants with draught power. Contrary to what is observed elsewhere, rentals thus lead to greater concentration of operational holdings. Virtually all rentals involve sharecropping rather than fixed rental contracts. Descriptive results suggest that intensity of input use is lower on sharecropped than on owned plots.

2.1 Household characteristics

Our data used are from the fourth round of a longitudinal survey in the Amhara region of Ethiopia's highlands conducted by the Ethiopian Development Research Institute jointly with the World Bank and Gothenburg University. Details of earlier rounds are described elsewhere (Deininger *et al.* 2008). A unique feature of the data is that, for participants on either side of the land market, rental partners from the same village were included in the sample and were administered essentially the same questionnaire.[1] In light of high levels of rental activity, this yields a sample of 1,700 randomly selected households plus their 787 rental partners (either landlords or tenants) from 14 villages (*kebeles*) in 6 districts (*woredas*) in South Wollo and East Gojam zones. The survey includes plot level data on production for the 2007 main season (*meher*, i.e. September-February), household characteristics including resource endowments, and participation in land, labor and credit markets.

Table 1 presents household level information for the whole sample and separately for those leasing out, leasing in, and remaining in autarky on the entire sample.[2] With 69% of the households participating on either side (33% leasing out and 36% in), [3] rental markets are fairly active but localized, with more than 85% of transactions involving households from the same village and virtually no cases of simultaneous renting in and renting out.[4] With 63% of landlords still cultivating some own land and only 2% of tenants being landless, mixed tenancy predominates.

Differences in gender and resource endowments appear to be key drivers of land market participation. Almost half (47%) of those renting out are female headed, compared to 17% and 3% of female headed households in autarky and renting in, respectively. Landlords have significantly less access to livestock and draught animals (0.4 oxen and bulls compared to an average of 1.3), supporting the notion of ill-functioning markets for oxen rental as a driver of rental market activity. With some 70% of female headed households renting out land, land markets seem to transfer land from resource poor, female-headed, and slightly older households to wealthier ones with better access to family labor. This is in contrast to what is observed in many other settings where skilled, wealthy households rent out land to pursue non-agricultural options,[5] possibly because barriers to entry into non-farm activities in Ethiopia remain high. Rental markets contribute to a concentration of operational land holdings compared to land ownership; the Gini coefficient increases form 0.37 for owned to 0.48 for operated holdings, different from other countries, e.g., China where rental markets help equalize the operational land distribution, [6]

To illustrate the extent to which land rental markets helped equalize factor ratios across households, table 2 presents labor-to-land and oxen-to-land ratios for different types of land rental market participants

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[1] In the case of multiple partners, all partners within the village were to be interviewed. In East Gojjam, an unexpectedly large number of rental transactions implied that the partner questionnaire was administered to a randomly selected partner while a shorter questionnaire (without plot level production) was administered to the remaining partners within the village.

[2] Equivalent information for the sub-sample with availability of matched partner information can be found in appendix table 1.

[3] The participants in the rental markets include transaction partners of the original sample. If the partners are excluded from the analysis, the share of market participants drops to 57% which still indicates the existence of active rental markets in the study areas.

[4] Less then 1% of households are reported to simultaneously lease out and lease in land.

[5] A similarly counter-intuitive pattern of 'reverse' tenancy is observed in Madagascar where insecurity of tenure that poses asset risk on leased out plots is hypothesized to be one of the key underlying factors (Bellemare 2009).

[6] In China, a Gini of 0.36 for land use rights (comparable to ownership) was further reduced through transfers (Deininger and Jin 2005).

before and after they entered the market.[7] While land markets almost fully equalize the oxen to land ratio to about 1.2 and reduced the labor to land ratio from 4.3 to 2.3 for tenants, they led to a large increase in labor to land ratios, from 2.96 to 11.16 (or a median of 1.91 and 5.26) for landlords.[8] This is in line with the importance of oxen as a key factor of crop production (Holden et al. 2011, Pender and Fachamps 2006).

2.2 Plot characteristics

Table 3 summarizes details on inputs and outputs at plot level, overall and by land market participation, for the entire owner-cum-tenant sub-sample (see appendix table 2 for corresponding information on the restricted sample where partner information is available). More than 95% of the 2,083 (1,135 for the restricted sample) leased plots are sharecropped (12% under input sharing and 88% using a simple output sharing) and less than 5% use fixed rent.[9] To avoid biases from underreporting of output for continuously harvested crops or non-availability of price information, we exclude the few plots with vegetables, fruits or trees.[10] This can be justified as the survey villages are located predominantly in cereal producing areas.

The top panel of table 3 suggests that mot plot transfers involved close kin: 66% between relatives or in-laws, 11% among friends or neighbors, and only 23% among unrelated individuals (possibly members of informal associations). Almost half of transferred plots are owned by female headed households. While most rental contracts (70%) are open-ended, the mean rented plot in the sample had been in the current tenant's possession for more than 4 years. As this is about three times the mean contract duration of those who reported a fixed term, contract renewal seems frequent.

While descriptive data point to few differences in terms of observable soil fertility characteristics between tenure regimes, they *prima facie* suggest Marshallian inefficiency.[11] With a difference of 18 percentage points (significant at 5% if one outlier is excluded), owner-cum-sharecroppers produce less on their sharecropped than their owned (or fixed rented) plots. This is mirrored by large differences in application of inputs between plots held under different rental arrangements. Use of family labor is, with 191 vs. 129 days/ha, more than 30% higher on owner-operated as compared to sharecropped plots. Although hired labor is, with some 8 days/ha, used less intensely than family labor, its use is higher on owned than on leased plots as well. Differences extend to manure application; while 26% of owned plots receive manure only 6% of leased plots do so and even for this group, the quantity applied is four times higher on owned

[7] Note that we have to exclude 53 landless tenants in the 'before' and 289 pure landlords in the 'after' panel of the table.
[8] It is important to note that possible participation in off-farm or self employment activities are not considered in the analysis. Landlords may be more likely to get involved in such activities compared to tenants. Therefore, interpretation of the results requires some caution.
[9] Summary statistics are not affected by the small number input sharing and fixed rental contracts. Therefore, most of the discussion focuses on leased-in plots irrespective of the type of the contract.
[10] A total of 371 plots (29 rented-in and 342 owned plots operated by owner-cum-tenants planted to vegetables, fruits or tree crops) are dropped from the analysis due to the difficulty of computing output values.
[11] Note that the figures reported below are for owner-cum-tenants within the same household in all cases thus excluding non-contractible factors or (labor) market imperfections that could reduce productive efficiency across households.

plots (393 vs. 93 kg/ha). Chemical fertilizers are applied more equally on owned and leased plots with about 40% of each types of plots receiving an average of 50 kg/ha. In line with factor equalization as presented in table 2, use of oxen for land preparation is less unequal although, with a difference of 4 oxen-pair days/ha, it is still higher on owned than leased plots.

Although one might expect that, to reduce the scope for shirking, landlords might require tenants to grow less labor intensive crops on leased plots descriptive statistics suggest otherwise; *teff*, the traditional labor intensive staple is grown on 36% of leased vs. 29% of own plots. Multivariate analysis will be required to assess which of these effects can be attributed to share tenancy. Before conducting such analysis, we report descriptive statistics for matched tenant-landlord pairs that can give an indication of whether rental markets transfer land from less to more able and productive farmers, thus providing some initial evidence on potential productivity impacts of land rental contracts.[12]

Comparing input and output quantities, plot characteristics, and crop choice by operator-cum-landlords and their rental partners who also cultivate their own land (i.e., owner-cum-tenants) in table 4 points to some interesting observations. The value of crop output per hectare differs markedly between the two categories with average productivity on plots operated by owner-cum-tenants 20% higher than on those cultivated by landlord farmers. The top panel suggests that this difference could be partly explained by observed input applications: with the exception of manure and use (but not the amount) of hired labor, the intensity with which family labor, oxen power, and chemical fertilizer are used is higher on plots cultivated by operator-cum-tenants compared to their rental partners. This could imply higher productivity by tenants compared to their partners who cultivate some of their land but econometric analysis is needed to confirm this and explore sources that could underlie such differences.

3. Conceptual framework and empirical strategy

Use of partner data allows us to take a three-pronged approach to assess productivity implications of land rental, each with different samples. To assess existence and magnitude of Marshallian inefficiency, we compare productivity on owner-cum-tenants' owned and sharecropped plots. If such inefficiency were outweighed by differences in farming ability, rental transactions could still contribute to higher levels of productive efficiency. The tenant and landlord sample is thus used to compare productivity on owner-operated plots by tenants and their landlords to estimate differences in ability differences or equivalently the maximum potential productivity gain from land rental. Comparing productivity between landlords' owned and cultivated and leased out plots provides an estimate of the actual productivity impact of land rental, i.e., the extent to which potential productivity gains are realized in practice.

[12] In line with what emerged at the household level, comparing plots in our two samples (table 3 for the entire sample and appendix table 2 for plots with matching partner information), points towards very few significant differences, suggesting that the latter are representative of the overall population.

3.1 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 market transactions allow everybody to operate at an optimum farm size (Feder 1985). In addition to non-agricultural options which will affect potential tenants' reservation utility, labor (which needs to be supervised), credit and insurance market imperfections as well as transaction costs due to search and contract enforcement will, however, affect the outcomes from land rental markets. The efficiency outcome might not always prevail and heavily depends on the choice of contractual arrangements.

By varying the share and the fixed payment to the tenant, land owners who wish to rent out can achieve any combination of contractual forms from a wage labor over a share to a fixed rental contract. While all contracts will lead to equivalent outcomes if output is certain and tenants' effort can be monitored and enforced (Cheung 1969), relaxation of this assumption gives way to a number of scenarios. If effort cannot be monitored and agents are risk neutral, fixed rental contracts are optimal. This is because in a pure sharecropping contract tenants will equalize the marginal disutility of effort to their marginal benefit, thus exerting less than the socially optimal amount of effort and obtaining lower levels of production. For risk-averse agents, 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 rental contract, which would result in optimal effort supply but no insurance against bad events. Second, 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 rental 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). Finally, a dynamic setting opens up a number of additional perspectives besides the scope for using the repeated game context and the threat of eviction to reduce the efficiency losses of sharecropping. On the other hand, 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, with often mixed results (Otsuka and Hayami 1988). Within-household data suggest that, in India, share tenancy is associated with an average productivity loss of 16% (Shaban 1987). Part of the losses might have been policy-induced as fixed rental contracts were outlawed in the study area. Recent studies using household fixed effects suggest that, in light the constraints faced agents' choice of contractual arrangements is rational

(Arcand *et al.* 2007, Jacoby and Mansuri 2009) so that the scope for policy to bring more efficient outcomes is limited (Otsuka *et al.* 1992, Otsuka and Hayami 1988, Pender and Fafchamps 2006, Shaban 1987). We use the same methodology but add elements to explore how other factors affect the size of inefficiencies. For example, if landlord and tenant are close kin, monitoring sharecropping disincentives can be reduced (Sadoulet *et al.* 1997). In Ethiopia, lower efficiency of tenants renting in from female landlords is attributed to females' inferior ability to monitor or enforce sanctions (Holden and Bezabih 2009).[13]

To test whether sharecropping contracts are (in)efficient, we follow the literature in restricting the sample to owner-cum-tenants and use within-household variation under the assumption of constant returns to scale to identify the impact of contractual arrangements, controlling for household-specific characteristics that do not differ between owned and sharecropped plots (Bell 1977, Shaban 1987). Formally, the base equation to be estimated is:

$$y_{hi} = \gamma^s S_{hi} + \gamma^f F_{hi} + \alpha' Z_{hi} + u_h + \nu_{hi} \qquad (1)$$

where y_{hi} is the log of crop output per hectare on plot i by household h; S_{hi} is a dummy that is one if the plot is sharecropped and zero otherwise; F_{hi} is fixed rental dummy; and Z_{hi} is a vector including a set of dummy variables relating to a plot's soil quality, topography, and access to irrigation, as well as the number of years it has been possessed by the current user. The first element of the error term, u_h, captures observed and unobserved household-level heterogeneity arising from managerial ability, credit access, or risk aversion that affect production on all household plots equally while v_{hi} is a plot specific error term assumed to be identically and independently distributed with mean zero and finite variance. Including household fixed effects (u_h) also eliminates scope for sample selection bias that may result from the use of a sub-sample of households who simultaneously cultivate their own and rented in land. This is because of the fact that sample selection bias in panel data estimation arises only if unobservables that determine selection vary across different observations for the same unit of analysis (Verbeek and Nijman 1992). Also, the assumption of constant returns to scale is critical and we report results from testing for it at holding level in appendix table 3. The null hypothesis of constant returns to scale, i.e., the sum of coefficients for land, labor, draft power, chemical fertilizer and manure equaling one, cannot be rejected at conventional levels.[14] The coefficients on sharecropping and fixed rental dummies, γ^s and γ^f, can then be interpreted as the estimated percentage differences in yield for leased compared to owned plots by the same household.

[13] Note that Kassie and Holden (2007) find higher productivity on sharecropped than owned plots which they attribute to eviction threats, the effectiveness of which is reduced for close kin.

[14] OLS estimation of the Cobb-Douglas production function parameters might be affected by endogeneity of some variable inputs. The potential for this is small, though, because in Ethiopian subsistence agriculture the levels of most major inputs such as land, draft power and family labor are determined in the early stages of the crop production cycle conditional on "anticipated" output before realization of stochastic shocks that are predominately weather related. It has been shown that if producers make input decision based on "expected" rather than actual output, single equation estimation of Cobb-Douglas production function is likely to provide unbiased and consistent parameters (Zellner *et al.* 1966).

We conduct several robustness tests on this specification. First, yield differences could be due to crop choice and associated differences in input intensity. We include dummies on the right-hand side variables, implicitly treating crop choice as exogenous, to accommodate this possibility, thus providing us with a measure of sharecropping-induced inefficiency attributable purely to intensity of variable input use.[15] Second, we split the sharecropping dummy into two—one for sharing of output only and one for output plus input sharing—to test whether input sharing arrangements will affect efficiency. We also expand the specification to control for tenant-landlord relationships and kinship that may reduce the inefficiency of sharecropping contracts (Kassie and Holden 2007). Levels of observed inputs are then controlled for to check whether, beyond affecting intensity of inputs use, sharecropping has other effects on productivity. Finally, to address concerns about possible underreporting of output on sharecropped plots, we repeat similar analysis for the intensity of family labor, draft power and chemical fertilizer use.[16]

The fact that optimum contract choice depends on substitutability between observable and unobservable inputs when tenant's actions are not observed may make contract choice on leased plots endogenous and thus bias estimates (Arcand *et al.* 2007). In practice, lack of identifying instruments has made it difficult to address this concern. While household fixed effects remove bias that may be due to partner choice on the basis of unobserved factors, access to information on rental partners allows us to instrument using landlord characteristics, in particular distance of the plot from the landlord's homestead, age, sex, and literacy status of the landlord's head, demographic composition, primary activity, and resource or asset endowments (land, oxen, other livestock, iron roof).

3.2 Ability differences between landlords and tenants

Ideally, study of productivity impacts of land rental transactions would require information on contracting parties and production on the same plot before and after it had been transferred. No study using the full set of such information is known to us. One alternative that has been used in the literature is to draw on the fact that household fixed effects allow recovery of parties' ability (Lanjouw 1999) to assess potential productivity impacts of rental market operation (DeSilva 2000, Deininger 2003, Deininger and Jin 2005). Recall data on productivity by rental partners have been used as an alternative method to assess productivity impacts of rentals (Deininger and Jin 2007).

To address this specific issue, we exploit the fact that detailed information was collected on matching rental partners, we use pair- rather than household-fixed effects to recover the difference in productivity between landlord and tenant in the pairs that are actually realized. To avoid confounding productivity-

[15] In fact, household fixed effects at least partially purge any potential bias that may arise from crop choice decisions in response to unobserved household specific factors and plot level characteristics that are likely to affect crop choice decisions are already included.

[16] While household fixed effects models are feasible for family labor and draft power, a random effects model is estimated to account for the presence of nontrivial proportion of zero observations in the case of chemical fertilizer.

effects with those related to incentives due to contractual arrangements, the comparison is limited to only plots owned by either the landlord or the tenant.[17] Considering once again a linearly homogeneous Cobb-Douglas production function as in equation (1), the econometric model to be estimated is:

$$y_{phi} = \gamma T_{ph} + \alpha' Z_{phi} + u_p + \nu_{phi} \quad (2)$$

where y_{phi} denotes the log value of crop output per hectare on plot *i* by household *h* of rental partner pair *p*; T_{ph} is a dummy that equals one for tenants, and Z_{phi} is a vector of exogenous plot characteristics such as soil quality and topography (measured by several dummy variables), irrigation access, and the number of years the plot has been cultivated by the current operator. Again, u_p captures observed and unobserved rental pair-specific variables; v_{phi} is a plot specific error term assumed to be identically and independently distributed with mean zero and finite variance; γ and α are parameters to be estimated. To the extent that unobserved land attributes are controlled for, γ, the coefficient of the tenant dummy, will provide an unbiased estimate of the mean productivity differential between the rental partners in each pair that can be interpreted as the potential gain from land rental market operation. Potential reasons for such differences (e.g., farming ability or access to credit or insurance) can then be further explored. As the pair-fixed effect captures only factors common to the partners, the operator's holding size is included as an additional right hand side variable to control for any potential scale effect.

Unlike in equation (1), unobservable characteristics that may determine partner choice will not be fully absorbed by the partner fixed effect so that selectivity bias may be an issue that has to be corrected for. As there are four mutually exclusive groups of households, i.e., owner cultivators, owner-cum-tenants, landlord cultivators and pure landlords, we address this using a multinomial logit selection model based on Lee (1983).[18] This involves estimation of a first stage multinomial logit model for selection into the different rental market participation regimes. Right hand side variables include farm and household assets (owned area, proportion of good soil quality land, number of bulls and oxen that are used as draft power, value of other livestock, and corrugated iron roof); household composition (number of dependents, male adults and female adults); and head characteristics (age, sex, literacy level, and whether farming is the primary activity). All of these had earlier been identified as key determinants of rental market participation in the study areas (Deininger *et al.* 2008). In the second stage, equation *(2)* is estimated by

[17] Due to the disincentive effects of sharecropping contracts, owner-cum-tenants are likely to reallocate effort and physical inputs to their owned plots more than it would have been the case if all their cultivated land were self owned. This likely leads to higher yield in owned plots which will, in turn, be transmitted into overestimation of the yield differential between owned plots cultivated by tenants and that of their rental partners. To check the robustness of our results, we also estimate equation (2) by including all owned and rented in plots cultivated by the tenant. The results (not reported, but available upon request from the authors) are not different from those reported in table 8.

[18] Alternatively, the modified Dubin and McFadden (1984) procedure, as proposed by Bourguignon et al. (2007), is also used, but the results are the same and hence are not reported for the sake of brevity.

including selection correction terms (i.e., conditional probability of being owner-cum-tenant or landlord cultivator) from the first stage regression.[19]

To assess the extent to which potential productivity gains are realized, we estimate equation (2) on all plots owned by the landlords in the sample with T_{ph} a dummy equaling 1 if the plot is cultivated by a tenant and 0 otherwise. If unobserved plot characteristics do not vary systematically between plots kept by landlords and those rented out to tenants, the coefficient γ in this regression provides an estimate of the productivity gain actually realized by transacting land in the market. As landlord fixed effects fully absorb the choice of being a landlord cultivator there is no need to correct for selection bias in this case.

4. Estimation results

Results point towards Marshallian inefficiency that is reduced or vanishes if landlords' ability to monitor and their participation in managerial decisions through input sharing is accounted for. Tenants' farming ability is estimated to exceed landlords' by about 20%, suggesting that rental markets indeed transfer land to inherently more productive farmers. Productivity on plots cultivated by tenants is, however, statistically indistinguishable from that on self-cultivated plots by their landlords. To the extent that Marshallian inefficiency of sharecropping underlies this phenomenon, changes such as making insurance available to allow adoption of different contractual arrangements could thus help realize a larger share of the potential productivity gains from land rental and, in the setting concerned, also have positive equity impacts.

4.1 Efficiency of sharecropping arrangements and contract choice

Results from different specifications of the household fixed effects regression of equation (1) for the entire sample of owner-cum-tenant households are reported in table 5 with own plots as omitted category throughout.[20] Initially we control only for observable plot characteristics (col. 1), successively adding dummies for crop choice, input sharing, and kinship. The basic specification suggests that productivity on sharecropped plots is 8% lower than on owned plots by the same household, similar to what was obtained in other studies (Deininger *et al.* 2008). No inefficiency is found for fixed rental contracts. Once crop choice is controlled for (col. 2), the coefficient on the sharecropping dummy is more precisely estimated and of larger magnitude (13%), supporting the notion that Marshallian inefficiency exists irrespective of the type of crop grown and, in fact, increases if crop choice is controlled for.

Splitting the sharecropping dummy into two, one for pure output sharing and one for joint output and input sharing allows us to explore the impact of contractual arrangements (col. 3). We note that, if outputs

[19] Conditional probabilities are included separately for owner-cum-tenants and landlord cultivators interacted with *T* and (1-*T*), respectively. This is similar to a two-step estimation of the switching regression model.
[20] We use data on owner-cum-tenants from both the randomly selected original sample of households and their rental partners. To check whether pooling the two data has affected our results, we run similar regressions on plots operated by owner-cum-tenants from the original sample only. The results, not reported here, are similar to those presented in table 5.

and inputs are shared, productivity is no longer significantly different from that on owned plots by the same household, suggesting that this arrangement provides tenants with an incentive to use optimal levels of inputs, thus making the inefficiency disappear.[21] By contrast, the coefficient on output sharing is of comparable magnitude to what was observed earlier, suggesting limited if any impact of this modality on productivity. Adding information on the landlord such as gender (col. 4) or relationship to the tenant (col. 5) does not support the notion that Marshallian inefficiency is particularly large for female landlords as was found to be the case in Tigray (Holden and Ghebru 2011). Similarly, landlords who are relatives of the tenant are not automatically better positioned to prevent shirking. At the same time, the difference in output per ha due to sharecropping disappears once input use is controlled for (appendix table 4), suggesting that higher productivity on sharecroppers' owned plots can largely be attributed to more intensive use of observed labor and non-labor inputs.

To complement these results and address potential concerns about cultivator households underreporting output from sharecropped plots, appendix table 5 presents the estimate of the difference in the intensity of input application between owned and sharecropped plots while accounting for operator household specific effects. We find statistically significant differences in the intensity of family labor, draft power and chemical fertilizer use between owned and sharecropped plots. For male adult family labor and total labor (including female family labor and hired labor) intensity is estimated to be some 15 percentage points lower on sharecropped plots as compared to owned plots (cols. 1 and 2), a figure that increases to about 20 percentage points for oxen (col. 3). Results from a random effects regression for fertilizer application in col. 4 indicate that, conditional on use of any fertilizer, sharecropped plots receive about 28% less fertilizer than owned plots. Overall, and consistent with findings for yields, results point toward shirking in tenants' supply of labor or effort that is not compensated by more intensive use of purchased inputs.

Table 6 reports results from using only the matched sample which, after dropping 1678 plots,[22] allows us to include landlord characteristics such as whether the landlord is a farmer and the number of adult children who live in the same village and can thus help in monitoring the actions of the tenant. Doing so provides a few new insights:[23] First, the point estimate of the coefficient on sharecropping is, with -0.18, more than double the original estimate (table 5, col. 1). Second, having the landlord involved in farming is estimated to significantly reduce, but not eliminate Marshallian inefficiency as illustrated by results from the F-tests in the bottom of table 6 which consistently reject the hypothesis of no inefficiency ($\gamma+\beta=$

[21] It is worth mentioning that one should be cautious in interpreting the results because the numbers of plots with fixed rental and a combination of output and input sharing arrangements are very small, and hence the parameters may not be precisely estimated.
[22] As output and input intensities on fixed rent plots cannot be distinguished from owner operated ones, we drop the separate fixed rent dummy. In practice this implies that the few observations (39 plots in the matched sample) under fixed rent arrangements are treated as equivalent to owner operated plots. Inclusion of a separate fixed rental dummy yields qualitatively similar results that are available from the authors on request
[23] To test that the results are not affected by the difference in sample, we also rerun the earlier regressions for the restricted sample. We find that in all cases the coefficients on the sharecrop dummy are indeed not significantly different from those reported in table 5.

0). The number of adult children in the same village is estimated to reduce the inefficiency of sharecropping (col. 2 and 4), though the coefficient is much smaller. As almost two thirds (63%) of landlords engage in farming and 46% have it as their main activity (table 1), monitoring thus seems to be important to reduce negative impacts of sharecropping on productivity. Third, consistent with what was found earlier the inefficiency vanishes on plots cultivated under contracts that involve sharing of output as well as input (col. 3 and 4).

To control for endogeneity of contract choice, landlord characteristics are used as identifying instruments as discussed above. First stage regressions for linear probability models of output and input sharing as presented in appendix table 6 suggest that wealthy landlords who are farmers themselves are more likely to engage in input sharing and that this arrangement is less likely on plots more distant from the landlord's homestead. The corresponding IV estimates for the impact of sharecropping on productivity are presented in table 7. All identifying instruments are jointly highly significant, supporting our choice of instruments. Across a wide range of methodologies, i.e., irrespectively of whether 2SLS, GMM, limited information maximum likelihood (LIML) or the Fuller method (Fuller 1977), overidentification tests (Sargan-Hansen J or Anderson-Rubin statistics) fail to reject the statistical validity of the instruments. The Anderson correlations likelihood ratio tests also reject the null hypothesis that the models are underidentified. While 2SLS and GMM point to somewhat weak instruments, the other estimators (LIML and Fuller) reveal no sign of weak instruments being a problem.

Substantively, these results point towards a significant negative effect of output sharing (that disappears if inputs are also shared) even after adjusting for endogeneity of contract choice. Coefficients on output and input sharing dummies and the variables proxying for landlords' monitoring capacity are more precisely estimated and of higher magnitude than earlier. Most importantly, our point estimate of the Marshallian inefficiency increases to 0.25 with farmer-landlords having the potential to reduce it by half.

4.2 Productivity differential among rental partners and gains from trade

Table 8 reports results from partner fixed effects estimates of equation (2) where our main interest is on the coefficient of the tenant dummy which takes the value of 1 if a plot is owned and cultivated by the tenant and 0 if it is owned and cultivated by the landlord. All estimates point towards a statistically significant and quantitatively large productivity differential between landlords and tenants. Tenants' productivity is estimated to be 17% and 26% higher than that of landlords' depending on whether or not holding size of the cultivator household is controlled for (cols. 1-3).[24] Coefficients on other variables, in particular observed land quality characteristics, have the expected signs with levels of output estimated to

[24] Omitting holding size appears to underestimate the yield differential between tenants and their partner by some 10 percentage points.

be higher by 26%, 16%, and 35% on plots with good and medium land quality as well as irrigation, respectively and crop choice estimated to have a significant impact on the intensity of output as well.

Results so far are based on a sample of tenants and landlord cultivators, raising potential concern about possible self-selection into the different rental market participation regimes. To correct for potential bias along these lines, we us Lee's (1983) multinomial logit approach as described earlier.[25] Results with selectivity correction are reported in columns 4 to 6 of table 6. A first point to note is that the selection correction variables are jointly significantly different from zero, implying a need to adjust for selection into rental market participation regimes to more precisely estimate the productivity differential between tenants and landlord cultivators. Although findings are generally consistent with the results discussed above, the magnitude of the point estimate of the tenant dummy almost doubles once selection bias is controlled for. A related issue is the way in which the use of a sub-sample of tenants with (only) matching landlord cultivators affects the estimated parameters. While there is limited scope to address this concern in a cross section, the fact that our panel includes information on landlords or tenants who cultivated land earlier allows us to recover fixed effects for pure landlords and tenants (with no matching partner data) that can be compared to that of those included in our sample. For all possible comparisons, we can never reject the null hypothesis that differences are not significantly different from zero, suggesting that it is highly unlikely for selection bias to drive our results.[26]

To probe for potential systematic disadvantages faced by female landlords—possibly due to lower social status or discrimination—in Tigray (Holden and Ghebru 2011), we include a female dummy. The results in cols. 2 and 5 show that the coefficient on this variable is statistically insignificant, and that neither the significance nor the magnitude of the coefficient on the tenant dummy is affected. We thus reject the hypothesis that rental markets in our study area are biased against women; possibly that differences in policy, e.g., restrictions on land rental in Tigray, might explain the difference to what was found elsewhere. A general conclusion is that policies that facilitate land rental, by increasing security of tenure or reducing conflict, for example, could significantly benefit women landlords.

A broader puzzle is why, as suggested by the regression with landlord fixed effects (table 9), tenants' higher levels of farming ability ascertained earlier do not translate into productivity gains through land rental markets. Unobserved differences in land quality, whereby landlords will keep the best plots for themselves and rent out the lower quality ones (Jacoby and Mansuri 2008), might partially explain this

[25] For the sake of brevity the first stage multinomial selection regression is not reported, but the results are available upon request from the authors. Overall, the results show that land is transferred from resource poor (in terms of family labor, ownership of oxen and other livestock, and farming experience) female headed households to relatively resource rich male headed households.

[26] Our estimated measure of ability does not significantly vary across types of landlords, i.e., pure landlords (82 households cultivating 452 plots), landlords with no matching partner data (90 households cultivating 749 plots) and operator landlords with matching partner data (151 households cultivating 1237 plots). Similar results emerge for the different types of tenants, i.e., tenants with pure landlord partners (128 households), with no partner data (180 households) and with partner data (158 households) cultivating 1744, 2088 and 2171 plots, respectively.

observed outcome. However, although we cannot test for this explicitly, landlords would have a strong incentive to behave in this way under fixed rental rather than under sharecropping contracts. A second possible reason may be that, in a high-risk environment with insurance market imperfections, sharecropping involves less risk than fixed rental contracts and may thus be preferred by the parties involved. This is remarkable because, contrary to the standard argument, in our context of 'reverse tenancy', this implies that small landlords provide insurance to land-rich tenants and transition to fixed rental arrangements could improve efficiency and equity. This is of relevance for policy in light of the fact that incentive-compatible and economically viable mechanisms to insure against risk, e.g., through indexed rainfall insurance, have been implemented successfully in other contexts. As fixed rental contracts were earlier shown to be being fully efficient, the size of the Marshallian inefficiency documented above, net of land quality differences, provides an estimate of the potential benefits from making this transition.

5. Conclusion and policy implications

As more and more developing countries, including Ethiopia, aspire to rapid economic transformation and structural change, the importance of rental markets to labor movement out of agriculture and help transfer land to more productive users is likely to increase dramatically. Ensuring efficient operation of such markets is thus of great importance. Our results suggest that, in the case of Ethiopia, efficiency losses due to land rental are large with estimates of up to 24%. By using a comprehensive set of partner data, we can show that such inefficiency is not due to lower tenant productivity but to the choice of sharecropping as the dominant form of contractual arrangements. Within these arrangements, resident landlords can take measures to share inputs or supervise more closely, the scope for such measures is limited and likely to further decrease in the future.

Our findings are relevance for research as well as policy. From a research perspective, failure to separate the impact of ability from that of contractual choice, together with variation in these parameters over time and space, could explain the divergence and lack of consistency in empirical estimates of productivity-effects of sharecropping in the literature (Otsuka and Hayami 1988). From a methodological perspective, a slight modification of the approach taken here to compare ability effects of rental arrangements across jurisdictions with different regulatory frameworks, could help to estimate productivity effects of policy-induced restrictions on certain forms of rental transactions—or on rental altogether. Exploring these in more detail is left for future research.

From a policy perspective, the magnitude of the Marshallian inefficiency obtained here, and its adverse distributional effect, are striking. To the extent that lack of insurance motivates adoption of sharecropping as the predominant contractual form, interventions to make other forms of insurance available could have high productivity and equity benefits while at the same time contributing to the broader goal of economic transformation in rural areas.

Table 1: Descriptive Statistics at Household Level

		By land market participation		
	Total	**Lease-out**	**Autarkic**	**Lease-in**
Household characteristics				
Household size	5.81	4.55	6.47	6.38
Number of dependents	2.51	2.05	2.62	2.82
Number of male adults	1.61	1.06	1.91	1.86
Number of female adults	1.62	1.37	1.86	1.64
Female head dummy	0.22	0.47	0.17	0.03
Head literate	0.33	0.25	0.30	0.43
Farming is head's primary activity	0.76	0.46	0.87	0.95
Dwelling has corrugated iron roof	0.74	0.69	0.68	0.83
Number of rooms in dwellings	2.14	1.91	2.20	2.29
Agricultural endowments				
Total value of livestock owned (birr)	5712.10	2442.70	6081.68	8337.60
Value of bulls and oxen (birr)	2495.61	771.34	2661.17	3905.30
Value of other livestock (birr)	3216.49	1671.36	3420.52	4432.30
Number of bulls and oxen owned	1.29	0.42	1.40	1.98
Value of farm assets (birr)	160.35	78.79	152.68	240.13
Total owned area (ha)	1.27	1.35	1.31	1.18
Share of good quality land	0.64	0.63	0.76	0.54
Agricultural production				
Cultivates any land	0.88	0.63	1.00	1.00
Owned cultivated area (ha)	0.98	0.45	1.30	1.18
Area of sharecropped out land (ha)	0.28	0.85	0.00	0.00
Area of fixed rented out land (ha)	0.02	0.04	0.00	0.00
Area of sharecropped in land (ha)	0.29	0.00	0.00	0.78
Area of fixed rented in land (ha)	0.03	0.00	0.00	0.07
Area of leased out land (ha)	0.29	0.89	0.00	0.00
Area of leased in land (ha)	0.31	0.00	0.00	0.85
Assets and social capital				
Value of household assets (birr)	300.32	264.51	274.26	354.72
House value (birr)	7382.48	6560.25	8901.85	6827.77
No. of male adult children living in the village	0.41	0.61	0.41	0.22
No. of female adult children living in the village	0.33	0.48	0.32	0.20
No. of head's brothers living in the village	1.03	0.80	1.02	1.24
No. of spouse's brothers living in the village	0.65	0.54	0.69	0.72
No. head's sisters living in the village	0.69	0.56	0.68	0.81
No. spouse's sisters living in the village	0.51	0.41	0.54	0.57
No. of adult children living in the village	0.74	1.09	0.73	0.42
No. of brothers and sisters living in the village	2.88	2.31	2.94	3.33
Number observations	2487	813	770	904

Source: Own computation from AU/WB/UG land tenure survey.

Table 2: Factor Ratios before and after Land Market Participation

		By type or rental market participation				
	Total	Lease-out		Autarkic		Lease-in
Before land market participation						
Household size per ha of owned land	7.01	5.46	***	7.38		8.16
No. of adult labor per ha of owned land	3.88	2.96	***	4.34		4.34
No. of male adult labor per ha of owned land	1.89	1.23	***	2.13		2.30
Number of oxen per ha of owned land	1.35	0.28	***	1.32	***	2.41
No. of observations	2,434	813		770		851
After land market participation						
Household size per ha of operated land	9.22	20.61	***	7.38	***	4.30
No. of adult labor per ha of operated land	5.11	11.16	***	4.34	***	2.34
No. of male adult labor per ha of operated land	2.26	4.27	***	2.13	***	1.23
Number of oxen per ha of operated land	1.22	1.09		1.32	*	1.20
No. of observations	2,188	514		770		904

Source: Own computation from AU/WB/UG land tenure survey.

Note: Asterisks indicate the difference in significance between means for landlord and autarky groups as compared to tenants with *, **, and *** denoting significance at 10%; 5%; and 1%. The top panel excludes 53 landless tenants while 299 pure landlords had to be dropped in the bottom panel.

Table 3: Plot Characteristics for Entire Sample

	All plots	All owner-cum-tenants				
		Own plots	Leased plots	Output sharing	Out-& input sharing	Fixed Rent
Relation with partner						
TP relative	0.25		0.66	0.68	0.64	0.39
TP in-law	0.05		0.13	0.14	0.10	0.10
TP friend or neighbor	0.04		0.11	0.11	0.10	0.19
TP unrelated	0.09		0.23	0.21	0.26	0.42
Female rental partner	0.47		0.47	0.49	0.42	0.28
Output and input use:						
Crop output/ha (birr)	3476.47	3693.07	3127.07	3125.90	2952.21	3561.46
Plot size (ha)	0.30	0.28	0.33	0.32	0.39	0.36
Used fertilizer	0.40	0.38	0.43	0.41	0.52	0.59
Fertilized used per ha (kg)	54.91	55.40	54.12	51.26	61.69	86.02
Manure used	0.19	0.26	0.06	0.06	0.08	0.07
Manure used per ha (kg)	278.00	393.03	92.68	84.30	90.59	246.10
Used pesticides	0.08	0.07	0.08	0.07	0.10	0.07
Pesticides used per ha (kg)	0.40	0.35	0.47	0.55	0.09	0.08
Pair of oxen days per ha	24.99	26.71	22.22	22.13	21.17	24.44
Male family labor/ha (days)	111.94	127.32	87.11	87.82	84.11	82.76
Female family labor/ha (days)	56.56	65.54	42.06	42.80	39.41	37.31
Total family labor/ha (days)	167.28	190.89	129.17	130.61	123.52	120.07
Used hired labor	0.84	0.86	0.81	0.81	0.81	0.71
Hired labor/ha (days)	8.08	9.85	5.24	5.36	4.23	6.10
Plot characteristics:						
Years of possession	13.97	19.75	4.66	4.81	4.28	3.16
Good soil quality	0.46	0.46	0.45	0.45	0.50	0.37
Medium soil quality	0.36	0.36	0.37	0.37	0.34	0.41
Flat land	0.71	0.70	0.72	0.73	0.69	0.73
Gently sloped land	0.24	0.24	0.23	0.23	0.23	0.25
Irrigated land	0.05	0.05	0.04	0.04	0.03	0.01
Crop choice:						
Teff	0.32	0.29	0.36	0.35	0.48	0.29
Wheat/barely	0.21	0.20	0.22	0.21	0.24	0.26
Sorghum/maize	0.30	0.34	0.23	0.23	0.20	0.31
Pulses	0.13	0.12	0.14	0.16	0.04	0.10
Oilseeds	0.05	0.05	0.04	0.04	0.04	0.03
Number of observations	5443	3360	2083	1728	238	102

Source: Own computation from AU/WB/UG land tenure survey.
Note: Only plots with cereals, pulses and oilseeds included.

Table 4: Plot Characteristics for Pairs of Operator-cum-Landlords and Owner-cum-Tenants

	Total	Only owned plots	
	Sample	Landlords	Tenants
Output and input use:			
Crop output/ha (birr)	3060.91	2709.98	3268.03
Plot size (ha)	0.33	0.35	0.32
Used fertilizer	0.37	0.30	0.41
Fertilized used per ha (kg)	50.75	41.28	56.34
Manure used	0.28	0.34	0.25
Manure used per ha (kg)	371.55	421.17	342.22
Used pesticides	0.07	0.04	0.09
Pesticides used per ha (kg)	0.22	0.09	0.30
Pair of oxen days per ha	25.50	24.75	25.95
Male family labor/ha (days)	113.54	109.00	116.23
Female family labor/ha (days)	66.18	76.72	59.94
Total family labor/ha (days)	153.66	145.65	158.38
Used hired labor	0.84	0.86	0.83
Hired labor/ha (days)	14.22	7.53	18.17
Plot characteristics:			
Years of possession	20.48	23.62	18.63
Good soil quality	0.51	0.56	0.47
Medium soil quality	0.34	0.32	0.35
Flat land	0.73	0.74	0.73
Gently sloped land	0.22	0.21	0.23
Irrigated land	0.08	0.06	0.08
Crop choice:			
Teff	0.29	0.24	0.32
Wheat/barely	0.20	0.19	0.21
Sorghum/maize	0.42	0.51	0.37
Pulses	0.12	0.12	0.13
Oilseeds	0.05	0.04	0.06
Number of observations	2213	822	1391

Source: Own computation from AU/WB/UG land tenure survey.

Table 5: Impact of Sharecropping on Output per Hectare

	Specification				
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Sharecrop dummy	-0.082**	-0.132***			
	(2.15)	(3.66)			
Fixed rental dummy	-0.023	-0.043	-0.040	-0.041	-0.048
	(0.24)	(0.47)	(0.44)	(0.44)	(0.53)
Only output sharing			-0.142***	-0.143***	
			(3.88)	(3.42)	
Output and input sharing			-0.024	-0.024	
			(0.33)	(0.33)	
Landlord is a relative by blood					-0.111**
					(2.47)
Landlord is an in-law					-0.168**
					(2.56)
Landlord is a friend/neighbor					-0.159**
					(2.26)
No other relationship					-0.172***
					(3.04)
Female landlord (if sharecropped)				0.002	-0.001
				(0.04)	(0.04)
Number of years possessed	-0.002	-0.002	-0.001	-0.001	-0.002
	(1.10)	(0.78)	(0.63)	(0.63)	(0.93)
Good soil quality	0.214***	0.249***	0.247***	0.247***	0.249***
	(5.31)	(6.50)	(6.44)	(6.44)	(6.48)
Medium soil quality	0.180***	0.159***	0.158***	0.158***	0.159***
	(4.56)	(4.25)	(4.22)	(4.22)	(4.25)
Flat land	0.035	0.045	0.047	0.047	0.047
	(0.55)	(0.75)	(0.79)	(0.79)	(0.79)
Gently sloped land	0.009	0.019	0.020	0.020	0.020
	(0.14)	(0.30)	(0.32)	(0.32)	(0.31)
Irrigated land	0.040	0.077	0.080	0.080	0.074
	(0.56)	(1.14)	(1.19)	(1.19)	(1.10)
Teff		0.551***	0.550***	0.550***	0.551***
		(10.20)	(10.18)	(10.18)	(10.19)
Wheat		0.415***	0.414***	0.414***	0.415***
		(7.50)	(7.49)	(7.49)	(7.49)
Sorghum		-0.075	-0.073	-0.073	-0.077
		(1.36)	(1.33)	(1.33)	(1.39)
Pulses		0.133**	0.134**	0.134**	0.133**
		(2.20)	(2.23)	(2.22)	(2.21)
Constant	7.561***	7.294***	7.287***	7.287***	7.300***
	(99.99)	(84.56)	(84.41)	(84.39)	(84.59)
Number of observations	5443	5443	5443	5443	5443
Number of households	826	826	826	826	826
R^2	0.009	0.114	0.114	0.114	0.114

Note: Absolute value of t statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 6: Impact of Sharecropping on Yield: Within Household Fixed Effects Estimates with Landlord Characteristics

	Specification			
	(1)	**(2)**	**(3)**	**(4)**
Sharecrop dummy (γ)	-0.172***	-0.185***		
	(3.40)	(3.63)		
Only output sharing (γ)			-0.182***	-0.195***
			(3.57)	(3.79)
Output and input sharing (θ)			-0.050	-0.064
			(0.52)	(0.67)
Farming is landlord's main activity (β)	0.101*	0.100*	0.095	0.094
(if sharecropped)	(1.72)	(1.71)	(1.63)	(1.61)
No. of landlord's adult children/ha of rented land		0.008**		0.008*
		(1.97)		(1.95)
Number of years possessed	-0.003	-0.003	-0.003	-0.002
	(1.06)	(0.96)	(0.98)	(0.88)
Good soil quality	0.292***	0.289***	0.289***	0.287***
	(6.19)	(6.13)	(6.13)	(6.07)
Medium soil quality	0.175***	0.173***	0.174***	0.172***
	(3.84)	(3.79)	(3.81)	(3.77)
Flat land	0.031	0.036	0.035	0.039
	(0.42)	(0.48)	(0.47)	(0.53)
Gently sloped land	0.041	0.044	0.043	0.046
	(0.53)	(0.56)	(0.55)	(0.59)
Irrigated land	0.041	0.038	0.045	0.042
	(0.51)	(0.48)	(0.57)	(0.53)
Teff	0.558***	0.558***	0.557***	0.557***
	(8.70)	(8.71)	(8.68)	(8.70)
Wheat	0.463***	0.464***	0.462***	0.463***
	(7.08)	(7.09)	(7.06)	(7.07)
Sorghum	-0.075	-0.076	-0.074	-0.074
	(1.15)	(1.16)	(1.13)	(1.14)
Pulses	0.217***	0.216***	0.218***	0.216***
	(3.00)	(2.99)	(3.01)	(2.99)
Constant	7.258***	7.251***	7.252***	7.245***
	(68.75)	(68.67)	(68.66)	(68.59)
Number of observations	3765	3765	3765	3765
Number of households	637	637	637	637
R^2	0.114	0.115	0.115	0.116
Coefficient tests				
γ +β= 0	8.64***	9.39***	8.95***	9.70***
θ +β= 0			1.34	1.59

Note: Absolute value of t statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 7: Impact of Sharecropping on Productivity (IV Estimates): Household Fixed Effects with Landlord Characteristics

	Methodology used			
	2SLS	**GMM**	**LIML**	**Fuller**
Only output sharing (γ)	-0.247***	-0.229***	-0.245***	-0.245***
	(3.70)	(3.66)	(3.58)	(3.59)
Output and input sharing (θ)	-0.305	-0.336	-0.333	-0.331
	(0.70)	(0.79)	(0.71)	(0.71)
Farming is landlord's main activity (β)	0.137**	0.136**	0.138**	0.138**
(if sharecropped only)	(2.19)	(2.19)	(2.19)	(2.19)
No. of adult children per ha of rented out land	0.008**	0.008**	0.008**	0.008**
	(2.16)	(2.01)	(2.16)	(2.16)
Number of years possessed	-0.005*	-0.005*	-0.005*	-0.005*
	(1.72)	(1.86)	(1.74)	(1.73)
Good soil quality	0.291***	0.287***	0.292***	0.292***
	(6.03)	(5.70)	(6.03)	(6.03)
Medium soil quality	0.170***	0.167***	0.170***	0.170***
	(3.70)	(3.46)	(3.70)	(3.70)
Flat land	0.045	0.033	0.044	0.044
	(0.60)	(0.45)	(0.59)	(0.59)
Gently sloped land	0.054	0.033	0.053	0.053
	(0.69)	(0.43)	(0.68)	(0.68)
Irrigated land	0.034	0.017	0.033	0.033
	(0.42)	(0.21)	(0.40)	(0.40)
Teff	0.561***	0.575***	0.561***	0.561***
	(8.69)	(9.11)	(8.69)	(8.69)
Wheat	0.464***	0.481***	0.464***	0.464***
	(7.04)	(7.41)	(7.04)	(7.04)
Sorghum	-0.076	-0.060	-0.076	-0.076
	(1.15)	(0.90)	(1.16)	(1.16)
Pulses	0.215***	0.239***	0.215***	0.215***
	(2.96)	(2.98)	(2.96)	(2.96)
Number of observations	3743	3743	3743	3743
Number of households	635	635	635	635
R^2	0.113	0.113	0.113	0.113
Sargan/Hansen J Statistic	14.599	14.948	14.596	14.596
Sargan/Hansen J Chi2	0.147	0.134	0.148	0.148
Anderson-Rubin Statistic			14.630	14.630
Anderson-Rubin Chi2			0.146	0.146
Anderson/Kleibergen-Paap Statistic	107.203	46.157	107.203	107.203
Anderson/Kleibergen-Paap Chi2	0.000	0.000	0.000	0.000
Cragg-Donald/Kleibergen-Paap Statistic	9.181	4.127	9.181	9.181
Coefficient tests				
γ +β= 0	14.58***	14.29***	14.45***	14.46***
θ +β= 0	0.90	1.08	0.90	0.90

Note: Absolute value of t statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%.
Contract choice (sharecropping only, output, or input sharing) is instrumented using landlord characteristics, in particular plot distance from homestead, land ownership, household composition (number of dependents, number of male adults, number of female adults), assets (no. of oxen, value of other livestock, iron roof), and characteristics of the head (age, sex, literacy level, and farming as a primary activity). First-stage regressions are reported in appendix table 6.

Table 8: Productivity Differential between Rental Partners: Pair Fixed Effects with Owned Plots Only

				With selectivity correction		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Cultivated by tenant	0.174***	0.178***	0.262***	0.475***	0.490***	0.598***
	(3.894)	(2.842)	(3.808)	(3.085)	(2.839)	(3.298)
Tenant with female partner		-0.007	0.067		-0.025	0.051
		(0.091)	(0.782)		(0.240)	(0.428)
Holding size in hectares (log)			-0.106***			-0.109*
			(2.896)			(1.914)
Number of years possessed	-0.006**	-0.006**	-0.005**	-0.005	-0.005	-0.004
	(2.380)	(2.372)	(1.982)	(1.524)	(1.520)	(1.134)
Good soil quality	0.265***	0.264***	0.253***	0.281***	0.281***	0.269***
	(3.884)	(3.878)	(3.706)	(3.770)	(3.758)	(3.570)
Medium soil quality	0.160**	0.160**	0.160**	0.159**	0.159**	0.159**
	(2.383)	(2.380)	(2.383)	(2.115)	(2.109)	(2.098)
Flat land	0.131	0.131	0.113	0.141	0.141	0.123
	(1.314)	(1.314)	(1.132)	(1.327)	(1.334)	(1.151)
Gently sloped land	0.105	0.105	0.091	0.120	0.121	0.106
	(0.995)	(0.996)	(0.863)	(1.065)	(1.071)	(0.928)
Irrigated land	0.349***	0.349***	0.351***	0.354***	0.355***	0.355***
	(3.733)	(3.732)	(3.757)	(2.837)	(2.839)	(2.857)
Teff	0.521***	0.521***	0.540***	0.518***	0.518***	0.536***
	(9.222)	(9.217)	(9.502)	(7.765)	(7.781)	(7.860)
Wheat	0.435***	0.435***	0.449***	0.431***	0.431***	0.445***
	(7.288)	(7.286)	(7.509)	(7.042)	(7.045)	(7.136)
Sorghum	-0.164***	-0.164***	-0.161***	-0.156***	-0.156***	-0.153**
	(2.926)	(2.927)	(2.874)	(2.613)	(2.622)	(2.563)
Pulses	-0.100	-0.100	-0.081	-0.099	-0.098	-0.078
	(1.458)	(1.454)	(1.175)	(1.111)	(1.097)	(0.892)
Constant	7.080***	7.080***	7.028***	6.945***	6.943***	6.864***
	(54.679)	(54.664)	(53.876)	(35.611)	(35.595)	(34.478)
Selection variables						
Landlord cultivators				-0.076	-0.077	-0.098
				(0.687)	(0.692)	(0.886)
Tenants				0.325***	0.327***	0.322***
				(2.764)	(2.755)	(2.737)
Number of observations	2224	2224	2224	2224	2224	2224
Number of households	366	366	366	366	366	366
R^2	0.144	0.144	0.148	0.150	0.150	0.154

Note: Absolute value of t statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. Household level variables are for cultivator households.

[a] In order to describe selection into rental market participation regimes, we use a multinomial selection method proposed by Lee (1983). The reported t statistics are robust to any general form of heteroscedasticity. The method suggested by Dubin and McFadden (1984), and generalized by Bourguignon *et al.* (2007), is used alternatively, but the results are not reported as they are similar to those obtained using the Lee 91983) approach.

Table 9: Productivity Differential between Rental Partners: Within Landlord Fixed Effects

	Specification	
	(1)	**(2)**
Cultivated by the tenant household	-0.054	0.005
	(-0.728)	(0.052)
Tenant with female partner		-0.097
		(-1.105)
Number of years possessed	-0.008***	-0.008***
	(-2.691)	(-2.634)
Good soil quality	0.329***	0.325***
	(4.291)	(4.227)
Medium soil quality	0.285***	0.284***
	(3.829)	(3.805)
Flat land	0.173	0.172
	(1.525)	(1.508)
Gently sloped land	0.143	0.140
	(1.178)	(1.158)
Irrigated land	0.346***	0.353***
	(3.050)	(3.108)
Teff	0.589***	0.590***
	(9.082)	(9.104)
Wheat	0.343***	0.346***
	(5.217)	(5.258)
Sorghum	-0.239***	-0.242***
	(-3.690)	(-3.724)
Pulses	-0.101	-0.099
	(-1.315)	(-1.291)
Constant	7.038***	7.043***
	(47.314)	(47.330)
Number of observations	1,717	1,717
Number of households	357	357
R^2	0.182	0.182

Note: Absolute value of t statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%.

Appendix table 1: Descriptive Statistics at Household Level for Pairs of Rental Partners

	Total	Landlord	Tenant
Household characteristics			
Household size	5.37	4.49	6.24
Number of dependents	2.44	2.05	2.83
Number of male adults	1.41	1.03	1.79
Number of female adults	1.46	1.35	1.57
Female head dummy	0.25	0.48	0.02
Head literate	0.35	0.24	0.46
Farming is head's primary activity	0.70	0.45	0.95
Dwelling has corrugated iron roof	0.77	0.70	0.84
Number of rooms in dwellings	2.08	1.89	2.26
Age of head (years)	48.79	55.34	42.30
Agricultural endowments			
Total value of livestock owned (birr)	5511.98	2397.64	8602.83
Value of bulls and oxen (birr)	2356.21	720.91	3979.16
Value of other livestock (birr)	3155.78	1676.73	4623.67
Number of bulls and oxen owned	1.22	0.40	2.03
Value of farm assets (birr)	159.81	72.79	246.07
Total owned area (ha)	1.30	1.41	1.18
Share of good quality land	0.60	0.67	0.52
Agricultural production			
Cultivates any land	0.81	0.62	1.00
Owned cultivated area (ha)	0.81	0.44	1.18
Area of sharecropped out land (ha)	0.46	0.93	0.00
Area of fixed rented out land (ha)	0.02	0.05	0.00
Area of sharecropped in land (ha)	0.44	0.00	0.87
Area of fixed rented in land (ha)	0.03	0.00	0.07
Area of leased out land (ha)	0.49	0.97	0.01
Area of leased in land (ha)	0.47	0.00	0.93
Assets and social capital			
Value of household assets (birr)	351.40	248.27	453.76
House value (birr)	6494.70	6108.19	6878.30
No. of male adult children living in the village	0.43	0.64	0.21
No. of female adult children living in the village	0.35	0.50	0.19
No. of head's brothers living in the village	1.04	0.81	1.27
No. of spouse’s brothers living in the village	0.65	0.54	0.77
No. head's sisters living in the village	0.67	0.54	0.81
No. spouse's sisters living in the village	0.50	0.41	0.59
No. of adult children living in the village	0.77	1.14	0.40
No. of brothers and sisters living in the village	2.87	2.29	3.44
Number of observations	1584	789	795

Appendix table 2: Plot Characteristics for Owner-cum-Tenants with Partner Information Only

	Type of arrangement				
	Own plots	**Leased plots**	**Output sharing**	**Out-& input sharing**	**Fixed Rent**
Relation with partner					
TP relative		0.72	0.73	0.76	0.38
TP in-law		0.13	0.13	0.11	0.15
TP friend or neighbor		0.10	0.10	0.08	0.23
TP unrelated		0.18	0.17	0.16	0.38
Female rental partner		0.49	0.52	0.39	0.31
Output and input use:					
Crop output/ha (birr)	3413.91	3090.97	3115.83	3100.04	2522.06
Plot size (ha)	0.28	0.33	0.32	0.39	0.37
Used fertilizer	0.41	0.43	0.39	0.64	0.64
Fertilized used per ha (kg)	58.67	53.20	49.50	74.81	74.60
Manure used	0.23	0.07	0.07	0.07	0.03
Manure used per ha (kg)	313.97	80.64	85.62	70.57	6.29
Used pesticides	0.08	0.07	0.07	0.13	0.03
Pesticides used per ha (kg)	0.33	0.19	0.20	0.12	0.02
Pair of oxen days per ha	26.08	20.97	20.65	21.22	25.34
Male family labor/ha (days)	123.52	90.22	92.94	75.50	75.19
Female family labor/ha (days)	61.22	44.62	46.28	36.60	35.17
Total family labor/ha (days)	184.74	134.84	139.22	112.11	110.37
Used hired labor	0.84	0.83	0.83	0.83	0.72
Hired labor/ha (days)	11.93	5.63	5.92	4.31	3.74
Plot characteristics:					
Years of possession	19.05	4.94	5.06	4.67	3.21
Good soil quality	0.45	0.46	0.48	0.44	0.33
Medium soil quality	0.37	0.37	0.37	0.38	0.41
Flat land	0.72	0.71	0.72	0.64	0.74
Gently sloped land	0.24	0.24	0.24	0.25	0.26
Irrigated land	0.06	0.05	0.05	0.02	0.00
Crop choice:					
Teff	0.29	0.35	0.34	0.44	0.38
Wheat/barely	0.21	0.22	0.22	0.24	0.28
Sorghum/maize	0.33	0.25	0.25	0.21	0.28
Pulses	0.12	0.14	0.15	0.05	0.05
Oilseeds	0.05	0.04	0.04	0.05	0.00
Number of observations	2630	1135	955	135	39

Source: Own computation from AU/WB/UG land tenure survey.
Note: Only plots with cereals, pulses and oilseeds included.

Appendix table 3: Test of Constant Returns to Scale at the Holding Level

	(1)	(2)
Holding size in hectares (log)	0.409***	0.421***
	(15.794)	(15.952)
Male family labor days (log)	0.347***	
	(14.447)	
Female family labor days (log)	-0.051**	
	(-2.391)	
Hired labor days (log)	0.082***	
	(2.903)	
Family and hired labor days (log)		0.343***
		(13.740)
Pair of oxen days (log)	0.073***	0.092***
	(3.041)	(3.762)
Chemical fertilizer in kg (log)	0.166***	0.166***
	(7.086)	(6.970)
Manure in kg (log)	0.017	0.021
	(1.126)	(1.427)
Dummy female family labor[a]	-0.299***	
	(-2.756)	
Dummy hired labor[a]	0.028	
	(0.362)	
Dummy chemical fertilizer[a]	0.323***	0.311***
	(3.041)	(2.878)
Dummy manure[a]	0.137	0.190**
	(1.608)	(2.192)
Number of years possessed	-0.007***	-0.006***
	(-4.081)	(-3.814)
Good soil quality	0.475***	0.510***
	(6.724)	(7.099)
Medium soil quality	0.317***	0.357***
	(4.314)	(4.771)
Flat land	-0.037	-0.066
	(-0.392)	(-0.681)
Gently sloped land	-0.086	-0.077
	(-0.861)	(-0.757)
Irrigated land	0.165**	0.209***
	(2.403)	(2.997)
Constant	5.369***	5.013***
	(28.202)	(26.662)
Number of observations	1572	1572
Adjusted R^2	0.694	0.681
F-test of constant returns to scale	1.200	2.320
p-value for the test of constant returns to scale	0.273	0.128

Note: Absolute value of t statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%.
[a]The value of the dummy is 1 if the input is not used, and the value is 0 if the input is used (see Battese (1997) for the formalization of this method). All inputs are in logs.

Appendix Table 4: Productivity Impact of Sharecropping Controlling for Observed Inputs

		Restricted sample	
	(1)	**(2)**	**(3)**
Fixed rental dummy	-0.018		
	(0.23)		
Only output sharing	-0.021	-0.017	-0.055
	(0.66)	(0.42)	(1.26)
Output and input sharing	0.092	0.095	0.047
	(1.52)	(1.22)	(0.58)
Farming is landlord's main activity (if sharecropped)			0.086*
			(1.74)
No. of adult children per ha of rented out land			0.004
			(1.08)
Number of years possessed	-0.000	-0.001	-0.000
	(0.01)	(0.23)	(0.18)
Good soil quality	0.157***	0.195***	0.194***
	(4.76)	(4.80)	(4.78)
Medium soil quality	0.098***	0.124***	0.123***
	(3.09)	(3.19)	(3.18)
Flat land	0.032	0.026	0.030
	(0.64)	(0.42)	(0.48)
Gently sloped land	0.005	0.046	0.049
	(0.09)	(0.70)	(0.75)
Irrigated land	-0.016	-0.047	-0.049
	(0.28)	(0.71)	(0.72)
Teff	0.045	0.006	0.006
	(0.86)	(0.09)	(0.10)
Wheat	-0.034	-0.019	-0.019
	(0.66)	(0.31)	(0.30)
Sorghum	-0.289***	-0.323***	-0.325***
	(5.94)	(5.61)	(5.63)
Pulses	0.111**	0.128**	0.128**
	(2.14)	(2.06)	(2.06)
Male adult labor (days per hectare)	0.251***	0.255***	0.255***
	(9.62)	(8.20)	(8.18)
Female adult labor (days per hectare)	0.086***	0.107***	0.106***
	(4.33)	(4.42)	(4.38)
Hired labor (days per hectare)	0.015	0.036	0.037
	(0.55)	(1.10)	(1.12)
Oxen (days per hectare)	0.286***	0.266***	0.266***
	(13.35)	(10.03)	(10.05)
Chemical fertilizer (kg per hectare)	0.133***	0.121***	0.122***
	(6.18)	(4.83)	(4.84)
Manure (kg per hectare)	0.049**	0.056**	0.055**
	(2.47)	(2.27)	(2.25)
Dummy female family labor[a]	0.331***	0.566***	0.566***
	(4.69)	(6.31)	(6.32)
Dummy hired labor[a]	-0.152*	-0.153	-0.149
	(1.92)	(1.60)	(1.56)
Dummy chemical fertilizer[a]	0.346***	0.275**	0.274**
	(3.38)	(2.29)	(2.29)
Dummy manure[a]	0.245*	0.280*	0.277*
	(1.80)	(1.68)	(1.67)
Constant	4.885***	4.853***	4.852***
	(25.07)	(20.59)	(20.59)
Number of observations	5443	3765	3765
Number of households	826	637	637
R^2	0.367	0.370	0.371

Note: Absolute value of t statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%.
[a]The value of the dummy is 1 if the input is not used, and the value is 0 if the input is used. All inputs are in logs.

Appendix table 5: Impact of Sharecropping on Input Intensity per Hectare

	Household Fixed Effects			RE Tobit (Marginal Effects)[a]
	Male adult labor days per ha (log)	**Total labor days per ha (log)**	**Pair of oxen days per ha (log)**	**Quantity of fertilizer in Kg/Ha**
Sharecrop dummy	-0.150***	-0.156***	-0.194***	-0.283***
	(-4.870)	(-4.990)	(-6.382)	(-4.448)
Fixed rental dummy	0.011	-0.017	-0.032	-0.143
	(0.142)	(-0.218)	(-0.414)	(-0.948)
Number of years possessed	-0.002	-0.002	-0.004**	-0.008**
	(-1.220)	(-1.400)	(-2.170)	(-2.193)
Good soil quality	0.107***	0.147***	0.117***	-0.055
	(3.270)	(4.429)	(3.624)	(-0.829)
Medium soil quality	0.073**	0.097***	0.062**	0.071
	(2.288)	(2.985)	(1.979)	(1.108)
Flat land	0.065	0.068	0.009	-0.102
	(1.281)	(1.313)	(0.189)	(-0.998)
Gently sloped land	0.068	0.071	0.034	-0.236**
	(1.269)	(1.294)	(0.647)	(-2.174)
Irrigated land	0.101*	0.120**	0.155***	-0.210
	(1.755)	(2.057)	(2.736)	(-1.615)
Teff	0.442***	0.530***	0.356***	2.503***
	(9.606)	(11.313)	(7.830)	(18.301)
Wheat	0.337***	0.382***	0.343***	2.573***
	(7.157)	(7.969)	(7.370)	(18.471)
Sorghum	0.126***	0.234***	0.140***	0.962***
	(2.692)	(4.878)	(3.023)	(7.518)
Pulses	-0.113**	-0.109**	-0.094*	0.290*
	(-2.204)	(-2.084)	(-1.861)	(1.934)
Constant	3.895***	4.219***	2.634***	
	(53.077)	(56.391)	(36.320)	
Number of observations	5443	5443	5443	5443
Number of households	826	826	826	826
R^2	0.095	0.111	0.077	
Log-Likelihood				-15041.72
Chi-squared				1443.746

Note: Absolute value of t statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%.

[a] 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 tenancy dummy similarly to that of the labor and draft power intensity regressions as the percentage deviations of input intensities on sharecropped plots relative to owner-cultivated plots.

Appendix Table 6: First-Stage Regressions of Contract Choice: Household Fixed Effects Linear Probability Models

	Type of arrangement	
	Output sharing only	**Output and input sharing**
Identifying instruments (landlord's characteristics)		
Distance of the plot from homestead (walking minutes)	0.001***	-0.000***
	(2.88)	(2.84)
Farming head's primary activity	-0.723***	-0.068***
	(39.93)	(4.45)
Total owned land by the landlord	0.005	0.013**
	(0.79)	(2.29)
Number of oxen owned	-0.044***	0.020***
	(7.28)	(3.92)
Value of other animals x 10^{-3} (Birr)	-0.002	-0.002
	(1.02)	(1.37)
Roof corrugated iron sheet	-0.036***	0.046***
	(2.78)	(4.22)
Number of dependents	0.006*	-0.013***
	(1.65)	(4.29)
Number of male adults	0.001	-0.009**
	(0.12)	(2.21)
Number of female adults	-0.011**	0.013***
	(2.22)	(3.04)
Age of household head (years)	0.000	0.001***
	(0.97)	(3.83)
Female headed household	0.033**	-0.014
	(2.12)	(1.07)
Household head can read and write	0.045***	-0.015
	(3.93)	(1.59)
Farming is landlord's main activity (if sharecropped)	0.769***	0.111***
	(44.44)	(7.57)
No. of adult children per ha of rented out land	0.002*	-0.000
	(1.71)	(0.31)
Number of years possessed	-0.002**	-0.003***
	(2.45)	(5.62)
Good soil quality	-0.014	0.015
	(1.24)	(1.59)
Medium soil quality	-0.004	0.007
	(0.38)	(0.72)
Flat land	0.017	-0.029*
	(0.98)	(1.95)
Gently sloped land	0.009	-0.024
	(0.48)	(1.51)
Irrigated land	0.042**	-0.036**
	(2.19)	(2.22)
Teff	-0.012	0.011
	(0.75)	(0.82)
Wheat	-0.011	0.011
	(0.67)	(0.84)
Sorghum	0.008	-0.015
	(0.49)	(1.09)
Pulses	0.001	-0.001
	(0.07)	(0.06)
Constant	0.812***	0.056*
	(23.61)	(1.92)
Number of observations	3745	3745
Number of households	637	637
R^2	0.834	0.150
Shea Partial R^2	0.600	0.048
Partial R^2	0.611	0.049
F-test of excluded instruments F(12, 3084)	403.50	13.15

Note: Absolute value of t statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%.

Reference List

Arcand, J. L., C. Ai and F. Ethier. 2007. "Moral Hazard and Marshallian Inefficiency: Evidence from Tunisia." *Journal of Development Economics 83* (2): 411-45.

Battese, G. E. 1997. "A Note on the Estimation of Cobb-Douglas Production Functions When Some Explanatory Variables Have Zero Values." *Journal of Agricultural Economics 48* (2): 250-2.

Bell, C. 1977. "Alternative Theories of Sharecropping: Some Tests Using Evidence from Northeast India." *Journal of Development Studies 13* (4): 317-46.

Bellemare, M. 2009. "Sharecropping, insecure land rights and land titling policies: A case study of Lac Alotra, Madagascar." *Development Policy Review 27* (1): 87-106.

Bourguignon, F., M. Fournier and M. Gurgand. 2007. Selection Bias Corrections Based on the Multinomial Logit Model: Monte Carlo comparisons." *Journal of Economic Survey 21* (1): 174-205.

Cheung, S. N. S. 1969. "Transaction Costs, Risk Aversion, and the Choice of Contractual Arrangements." *Journal of Law and Economics 12* (1): 23-42.

de Janvry, A., G. Gordillo, J. P. Platteau and E. Sadoulet. 2001. *Access to Land, Rural Poverty, and Public Action*. Oxford: Oxford University Press.

Deininger, K. 2003. *Land Policies for Growth and Poverty Reduction. A World Bank Policy Research Report*. Oxford and New York: World Bank and Oxford University Press.

Deininger, K., D. A. Ali and T. Alemu. 2008. "Assessing the Functioning of Land Rental Markets in Ethiopia." *Economic Development and Cultural Change 57*(1): 67-101.

Deininger, K. and S. Jin. 2005. "The potential of land markets in the process of economic development: Evidence from China." *Journal of Development Economics 78* (1): 241-70.

Deininger, K. and S. Jin. 2006. "Productivity and equity effects of rental markets: Evidence from China." The World Bank, Policy Research Working Paper Series.

Deininger, K. and S. Jin. 2007. "Land rental markets in the process of rural structural transformation: Productivity and equity impacts in China." Policy Research Working Paper 4454. Washington: The World Bank.

DeSilva, S. 2000. "Skills, Partnerships and Tenancy in Sri Lankan Rice Farms." *Yale Economic Growth Center Discussion Paper: 819*.

Dubin, J. A. and D. L. McFadden. 1984. An Econometric Analysis of Residential Electric Appliance Holdings and Consumption." *Econometrica 52* (2): 345-362.

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

Fuller, W. A. 1977. "Some properties of a modification of the limited information estimator." *Econometrica 45* (4): 939-54.

Holden, S. T.and M. Bezabih. 2009. "Gender and Land Productivity on Rented Land in Ethiopia." In Holden, S. T., K. Otsuka and F. M. Place, eds., *The Emergence of Land Rental Markets in Africa: Impact on Poverty, Equity, and Efficiency*. Washington, DC, USA: Resources for the Future.

Holden, S. T., K. Deininger and H. Ghebru. 2011. "Tenure Insecurity, Gender, Low-cost Land Certification and Land Rental Market Participation." *Journal of Development Studies* 47(1): 31-47.

Holden, S. T. and H. Ghebru. 2011. Household Welfare Effects of Low-cost Land Certification in Ethiopia. Ås, Norway: Norwegian University of Life Sciences. Mimeo.

Jacoby, H. G. and G. Mansuri. 2008. "Land tenancy and non-contractible investment in rural Pakistan." *Review of Economic Studies 75* (3): 763-88.

Jacoby, H. G. and G. Mansuri. 2009. "Incentives, supervision, and sharecropper productivity." *Journal of Development Economics 88* (2): 232-41.

Kassie, M. and S. Holden. 2007. "Sharecropping Efficiency in Ethiopia: Threats of Eviction and Kinship." *Agricultural Economics 37* (1-2): 179-88.

Lanjouw, J. O. 1999. "Information and the Operation of Markets: Tests Based on a General Equilibrium Model of Land Leasing in India." *Journal of Development Economics 60* (2): 497-527.

Lee, L. F. 1983. "Generalized Econometric Models with Selectivity." *Econometrica 51* (2): 507-512.

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

Otsuka, K. and Y. Hayami. 1988. "Theories of Share Tenancy: A Critical Survey." *Economic Development and Cultural Change 37* (1): 31-68.

Pender, J. and M. Fafchamps. 2006. "Land Lease Markets and Agricultural Efficiency in Ethiopia." *Journal of African Economies 15* (2): 251-84.

Ray, T. 2005. "Sharecropping, Land Exploitation and Land-Improving Investments." *Japanese Economic Review 56* (2): 127-43.

Sadoulet, E., A. de Janvry and S. Fukui. 1997. "The Meaning of Kinship in Sharcropping Contracts." *American Journal of Agricultural Economics 79* (2): 394-406.

Shaban, R. A. 1987. "Testing between Competing Models of Sharecropping." *Journal of Political Economy 95* (5): 893-920.

Shetty, S. 1988. "Limited Liability, Wealth Differences and Tenancy Contracts in Agrarian Economies." *Journal of Development Economics 29* (1): 1-22.

Verbeek, M. and T. Nijman. 1992. "Testing for Selectivity Bias in Panel Data Models." *International Economic Review 33* (3): 681-703.

World Bank. 2007. *Agriculture for Development: World Development Report 2008*. Washington, D.C.: World Bank and Oxford University Press.

Zellner, A., J. Kmenta and J. Dreze. 1966. "Specification and Estimation of Cobb-Douglas Production Function Models." *Econometrica 34* (4): 784-795.