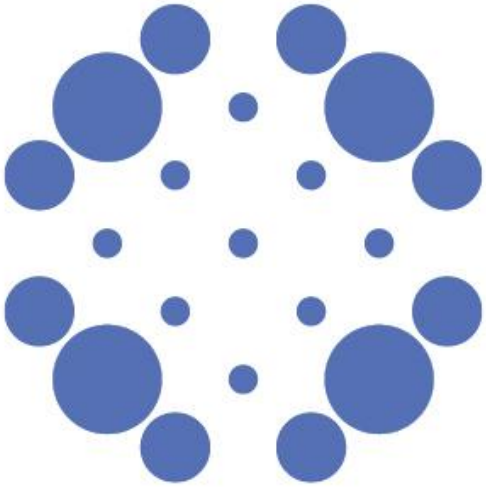
Norwegian University of Life Sciences (UMB)

Reverse Share-Tenancy and Marshallian Inefficiency: Bargaining Power of Landowners and the Sharecroppers' Productivity

By
Hosaena H. Ghebru and Stein T. Holden

CLTSUMB

Centre for Land Tenure Studies Working Paper 02/12



CLTSUMB

Centre for Land Tenure Studies

Centre for Land Tenure Studies
Norwegian University of Life Sciences
http://www.umb.no/clts/

September 2012

REVERSE SHARE-TENANCY AND MARSHALLIAN INEFFICIENCY: BARGAINING POWER OF LANDOWNERS AND THE SHARECROPPER'S PRODUCTIVITY

Hosaena H. Ghebru[1] and Stein T. Holden[2]

[1] International Food Policy Researc Institute (IFPRI), 2033 K. Street, Washington, DC, 20006, USA, Email: h.g.hagos@cgiar.org

[2]Department of Economics and Resource Management (IØR),Norwegian University of Life Sciences (UMB), P.O.Box 5003, N_1432, Aas, Norway, Email: stein.holden@umb.no

Abstract

Making use of a unique tenant-landlord matched data from the Tigray region of Ethiopia, we are able to show how strategic response of tenants - to varying economic and tenure security status of the landlords - is important in explaining productivity differentials of sharecroppers. The results show that sharecroppers' yield are significantly lower on plots leased from landlords who are non-kin; female; with lower income generating opportunity; and tenure insecure households, than on plots leased from landlords with contrasting characteristics. While, on aggregate, the result shows no significant efficiency loss on kin-operated sharecropped plots, a more decomposed analyses indicate strong evidences of Marshallian inefficiency on kin-operated plots leased from landlords with weaker bargaining power and higher tenure insecurity. This study, thus, shows how failure to control for such heterogeneity of landowners' characteristics can explain the lack of clarity in the existing empirical literature on the extent of moral hazard problems in sharecropping contracts.

JEL classification: D1, O13, O18, Q12, Q15

Keywords: Marshallian inefficiency; kinship; matching; Reverse-Share-Tenancy; Ethiopia

1. Introduction

Amid claims about the potential disincentive effects and efficiency losses of sharecropping, its prevalence and diffusion in much of the developing world makes share tenancy arguably one of the most controversial subjects in agricultural economics. In an attempt to better explain the contrasting evidences on the efficiency of sharecropping tenancy, Otsuka and Hayami (1988),

Singh (1989), Hayami and Otsuka (1993) and Otsuka (2007) have reviewed a large body of literature claiming that the evidence on the alleged systematic downward bias in input intensify and productivity are far from universal.

Only recently have case studies from Pakistan by Jacoby and Mansuri (2009); from Thailand by Sadoulet et al (1994; 1997); from India by Sharma and Dreze (1996); from Ethiopia by Gavian and Ehui (1999), Pender and Fafchamps (2006), and Kassie and Holden (2007); from Ghana by Otsuka and others (2003); and from Tunisia by Arcand and others (2007) started to establish alternative conditions under which particular circumstances share tenancy can be no less efficient than owner-operated or fixed rent contracts. For instance, Otsuka (2007) suggested that land-to-the-tiller policies in several Asian countries created tenure insecurity on the landlord side and this may explain the Marshallian inefficiency in these countries. The two notable studies by Sadoulet and others (1997) and Kassie and Holden (2007; 2008) stand out for the similarities in their approach to consider the role indigenous institutions play to internalize the disincentive effects of share tenancy. Both studies tried to explain sharecropping efficiency differentials in terms of the role kinship ties between tenant and landlord play in mitigating the problem of moral hazard that looms over share tenancy arrangements.

While the empirical evidence by Sadoulet et al (1997) from the Philippines shows the positive role of kinship tenancy arrangements, results by Kassie and Holden (2007;2008) in their study from the Amhara region of Ethiopia, on the other hand, reveal the contrary – showing that nonkin operated farms are more productive than kin-operated farms. And similarly, Holden and Bezabih (2008) find sharecropping inefficiency to be associated with female landlords renting out their lands to in-law tenants in the same region in Ethiopia. We believe such discrepancy can partly be

voided by considering the motives why farm households opt for kin-tied transactions and exchanges. Though it is a well documented fact that households tend to operate within their own social circle mainly to tackle problems associated with market imperfections (moral hazard, adverse selection) and high transaction costs (Arrow 1968; Sen 1975; Sadoulet et al. 1997; Fafchamps 2004), such arrangements may also be considered by poor households as a form of "insurance policy" against consumption risks during times of crop failure or tenure insecurity due to land-to-the-tiller policies as demonstrated by Aral and Holden (2012) in Nepal. In such a case, poor landowners are more likely to be economically dependent and highly reliant on kin-based tenancy arrangements (Macours 2004). There are claims that such economic dependence may degrade the bargaining power of landowners and undermine their ability and will to exercise eviction as a threat to induce the effort /performances of tenants (Holden and Bezabih 2008). We follow up on this and aim to show how, other than the expected higher degree of social concern between kin tenants and their landlords, the strategic response (opportunistic behavior) of tenants to varying economic and tenure security condition/status of the landlord can have an effect on the performance of sharecropped plots[1].

All these studies by Sadoulet et al (1997) and Kassie and Holden (2007; 2008), are made from the demand (tenant) side of the market, and they only consider the heterogeneity of agents from the supply side of the market (landlords) in their efficiency analysis. Failure to account for such heterogeneity of the characteristics of landlord households may conceal the opportunistic behavior of tenants. Making use of unique matched tenant-landlord plot level data from the Tigray region in the northern highlands of Ethiopia, our inclusion of such heterogeneous

[1] On the other hand, Holden and Bezabih (2008) approach this from the land lord side, comparing male and female landlord households while taking into account the tenant characteristics, including possible kinship relationships between landlords and tenants.

economic and property right conditions of landlords allows us to reconcile and bridge these contrasting findings. We used household fixed effects to control for unobservable tenant heterogeneity while non-parametric matching was applied to control for plot selection bias in rental and partner selection decisions. Our results confirm that, after controlling for plot selection bias, sharecroppers' yield on plots leased from landlords who are non-kin; female, with lower income generating capacity or those who are perceived to be tenure insecure (pure landlords) are significantly lower than plots leased from households with contrasting conditions. Failure to control for such heterogeneity of landowners' characteristics, thus, may cause the lack of clarity in the existing empirical literature on sharecropping productivity differentials. The empirical evidence implies that strengthening property rights of landholders may not only have a direct productivity-enhancing effect on owner-operated smallholder cultivation but also an indirect impact on the productivity of transacted plots.

This paper is organized as follows. Section 2 reviews the literature on the evolution of land tenure and the structure of the tenancy market in Ethiopia. The theoretical model adapted in this study together with testable hypotheses is discussed in section 3. Section 4 is devoted for econometric methods applied for the analysis while section 5 describes the data sources and variable definition. The last two sections are devoted for the discussion and summary of the findings.

2. The land tenure system and sharecropping in Ethiopia

In an attempt to examine the possible effects of the Ethiopian land tenure system on the dynamics of the tenancy market and its efficiency, three key issues stand out as key features of the land tenure system in Ethiopia: 1) tenure insecurity; 2) land fragmentation and landlessness; and 3) rural factor market imperfections and the "Reverse-Share-Tenancy" scenario.

Tenure Insecurity (supply-side-effects)

One of the major land-related problems in Ethiopia, mainly due to the frequent land distribution and redistribution in the past, has been insecurity of tenure (Alemu 1999; Hoben 2000). This calls up on the need for having land policies and a system of land administration that supports secure property rights, broadens access to land and supports incentives for improved land use management. It is with the desire to reap such benefits that the current Government of Ethiopia, through the Ministry of Agriculture and Rural Development (MOARD), has embarked on a land certification program in the country (Deininger et al. 2008)[2]. In addition to the well-documented investment effects of secured property rights (Feder et al. 1988; Besley and Coast 1995; Deininger and Feder 1998; Li et al. 1998; Holden et al. 2009), there are evidences that formalization of land rights - in the form of providing households with inheritable user certificates – lubricate the functioning of land rental markets and the factor ratio adjustment process (Holden et al. 2011; Deininger et al. 2011).

Key policy concerns, however, are whether the land reform in form of registration and certification has contributed to increased tenure security, especially for the poor, including women. From the supply side perspective, for instance, without clear and definite claims to the land, farmers (potential landlords) can be reluctant to rent/lease out to others for fear of losing the land through future administrative redistribution (Deininger et al. 2008; Ghebru and Holden 2008). In such circumstances, despite the possibility that the productivity of the land is better under different operator (potential tenant) - with better skill and complementary farm inputs, it is

[2] The Tigray region was the first to start a land certification process in 1998-99 and used simple traditional methods in the implementation. More than 80% of the population in the region had received land certificates when the process was interrupted by the war with Eritrea (Deininger et al. 2008; Holden et al. 2009)

possible that the landowner may decide to operate the land by himself or lease it out to a less-efficient kin tenant (Holden and Bezabih 2008).

Furthermore, the cultural rule against women cultivating their land cause single women to depend on assistance from men sharecropping out their land to a kin. This cultural taboo causes female-headed households in Tigray often to be (kin) landlords and among the poorest of the poor (MUT 2003; Holden et al. 2011). Anecdotal evidences from Tigray (Pender et al. 2002; MUT 2003) show that women think differently about their land certificates than men as their tenure rights have been less secure than that of men. This may imply that the certificates have a higher value to women than they have to men. Having a certificate may thus come to the rescue in strengthening the bargaining power of female-headed (poor) households and this may have a productivity-enhancing effect. Empirical evidence of a previous study by Holden et al (2011) and Holden and Ghebru (2011b) from the study area (using the same sample) shows that possession of land use certificate has increased participation in the tenancy market especially of female headed households who have become more willing to rent out land.

Land Fragmentation and Landlessness / demand side effect

Following the legal reforms in the country, the halt in the administrative redistributions of land accompanied by rapid population growth in the country means farm households rely on intra-household land distribution (inheritance) so as to accommodate descendants. This leads to a problem of dwindling farm sizes[3] creating an increase in demand for land through the land rental market. Such direct (landlessness) and indirect (dwindling farm sizes) effects of the population pressure accompanied by the recent land policy reforms make the tenancy market the main venue

[3] The landholding size for an average farm household in Ethiopia is only one hectare while the problem is more acute in the study area with an average landholding size of 0.5ha (Ghebru and Holden, 2009).

for land-constrained farm households for accessing additional land and providing access to land to the landless[4].

Non-Land Factor Market Imperfections and Reverse-Share-Tenancy

Despite the relatively egalitarian distribution of land holding across households in the country (Rahmato 1984; Adal 2002), heterogeneity in non-land resource endowment (such as labor and oxen) causes inequalities in relative factor ratios endowment across households (Ghebru and Holden 2008). On the other hand, due to problems of moral hazard, liquidity constraints and seasonality of farm production, labor and oxen rental markets does not function smoothly (Bliss and Stern 1982; Holden et al. 2001; Holden et al. 2008). This may cause the non-land factor markets (oxen and labor markets) to be a risky and more expensive option for farm households' factor-ratio adjustment process. Under such circumstances, despite the highly fragmented land holdings of households, there is a possibility that households may join the supply side of the tenancy market due to lack of one or more essential non-land factors of production.

Hence, the fact that non-land factor markets are imperfect coupled with the egalitarian land distribution in the country create a "Reverse-Share-Tenancy" scenario where landlords are poor in non-land resources (rather than land-rich households) while tenants can be best described as non-land asset-rich landowners rather than landless or near-landless poor households. Empirical evidence supports the persistence of such contracts in Ethiopia (Ghebru and Holden 2008; Ghebru 2009; Holden and Bezabih 2008); Eriteria (Tikabo and Holden 2003); and Madagaskar (Bellemare 2006; Bellemare 2008). Whether or not the "Reverse-Share-Tenancy" scenario in the

[4] We were not able to analyze the severity of landlessness in the region from our sampled data as it includes only those households with access to arable land, our matched partner data shows that 17% of the tenants were landless in 2006.

country has an impact on the performance (technical efficiency) of the tenancy market is an empirical issue this study strives to address.

3. Theoretical Model

Starting from the reverse share tenancy and the inherent tenure insecurity in the Ethiopian tenure system, we draw on a two-period utility maximization model developed by Kassie and Holden (2007; 2008) to show how the power of eviction by the landlord upon unsatisfactory performance increases the performances/incentives of an agent to work hard in the first period and thereby reduces the Marshallian disincentive effects on the output of sharecropped land.

We assume that the tenant is risk averse and maximizes expected utility, U, of income (Y) from farm production (Q) from PA allocated land (A^o) and leased land (A^r) with the probability (η) of carrying the rental contract through period two to produce Q^{r2}. We assume that the probability of contract renewal (η) in period two depends on the amount of output produced in period one (Q^{r1}) and kinship relations between landlord and tenant measured by (κ). In addition, we assume that economic and tenure security of the landlord (S) is a critical factor affecting the probability of contract renewal[5]. Hence, the probability of contract renewal is given by:

$$(1) \qquad \eta = \eta(Q^{r1}, \kappa, S), \text{ and } \partial\eta/\partial Q^{r1} > 0, \partial\eta/\partial\kappa > 0, \partial\eta/\partial S < 0, \partial^2\eta/\partial Q^{r1}\partial S > 0$$

Thus, we assume that good performance is more important to reduce the threat of eviction

[5] Bezahih and Holden (2009) shows that female landlords who are assumed to have a poor socioeconomic and property right status are less likely to exercise their power of eviction due to high search cost and insecurity of land ownership. In our study, gender income generating ability of the landlord, whether or not the landlord is a pure or cultivating landlord, and possession of land use certificate by the landlord households are the four key variables used as indicators to capture the economic and tenure security parameter (S).

(probability of contract renewal) when tenants deal with landlords with higher tenure security and strong socioeconomic status which ultimately decreases the search costs and thereby the cost of eviction of the tenant. We assume it could be harder to impose eviction threats by landlords with weak bargaining power and insecure property rights conditions due to their poor bargaining power and economic dependences. When landlords enjoy tenure security and stronger economic condition (better bargaining power), the threat of eviction upon unsatisfactory performance is real and high, forcing tenants to cultivate the leased-in land with greater care and intensity. On the other hand, when landlords are economically dependent and tenure insecure, this may undermine their power of eviction in which case the Marshallian disincentive effects are visible (Kassie and Holden 2007; 2008).

Following Kassie and Holden (2007) a two-period utility maximization model for a sharecropping owner-cum-tenant is developed and given by:

$$\begin{aligned} Max \underset{A_{it},x_{it},z_{it}}{\mathrm{EU(Y)}} = EU_1 & \left\{ \begin{aligned} & \left[p_{q1}\theta_1 Q^{o1}(A_{o1}, x_{o1}, z_{o1}, z_{h1}) - p_{x1}x_{o1} \right] \\ & + \left[p_{q1}\theta_1 Q^{r1}(A_{r1}, x_{r1}, z_{r1}, z_{h1})\beta - p_{x1}x_{r1} \right] \end{aligned} \right\} \\ & + \rho \mathrm{EU}_2 \left\{ \begin{aligned} & \left[\eta(Q^{r1}(.), \kappa, S).p_{q2}\theta_2 Q^{r2}(A_{r2}, x_{r2}, z_{r2}, z_{h2})\beta - p_{x2}x_{r2} \right] \\ & + \left[p_{q2}\theta_2 Q^{o2}(A_{o2}, x_{o2}, z_{o2}, z_{h2}) - p_{x2}x_{o2} \right] \end{aligned} \right\} \end{aligned} \tag{2}$$

Where β is the output share going to the tenant in a pure sharecropping arrangement, the subscripts *o*=PA allocated plots, *r*=leased plot, (1) and (2) indicate period one and two, respectively, ρ is the discount factor given by $\frac{1}{1+\delta}$ and δ is the discount rate, *x* is the conventional inputs (fertilizer, labor, oxen, seed), *z* observed and unobserved household and plot

characteristics, p_x is price of inputs, p_q is the price of output, θ is weather-related risk factor, which, following (Stiglitz, 1974) is treated as a multiplicative factor distributed with $E\theta = 1$ and positive finite variance. The first order conditions (FOCs) for maximization of this problem under pure sharecropping arrangement are:

$$\frac{EU_y \theta_i}{EU_y} \frac{\partial Q^{oi}}{\partial x_{oi}} . p_q = p_{xi} \tag{3}$$

and,

$$\beta \frac{EU_{1y} \theta_1}{EU_{1y}} \frac{\partial Q^{r1}}{\partial x_{r1}} . p_q + \rho \frac{EU_{2y} \theta_2}{EU_{1y}} \frac{\partial Q^{r1}}{\partial x_{r1}} \frac{\partial \eta}{\partial Q^{r1}} . p_q Q^{r2} \beta = p_{x1} \tag{4}$$

The FOC in equation (3) is with respect to input use on tenant's own plots while the FOC equation (4) is with respect to input use on sharecropped plots which both satisfy the equality of expected marginal utility of farm input use to the respective input prices. The problem of the sharecropper is therefore to optimally distribute (utilize) the non-land resources between the owned plots and sharecropped plots until:

$$\frac{EU_y \theta_i}{EU_y} \frac{\partial Q^{oi}}{\partial x_{oi}} . p_q = \beta \frac{EU_{1y} \theta_1}{EU_{1y}} \frac{\partial Q^{r1}}{\partial x_{r1}} . p_q + \rho \frac{EU_{2y} \theta_2}{EU_{1y}} \frac{\partial Q^{r1}}{\partial x_{r1}} \frac{\partial \eta}{\partial Q^{r1}} . p_q Q^{r2} \beta = p_{x1} \tag{5}$$

which tells us that non-land resources are utilized by the sharecropper until the expected marginal returns from such resources are equal on the owned and sharecropped plots. The standard Marshallian inefficiency hypothesis prevails when the tenant does not care about his future utility from the sharecropped land, i.e., ρ = 0 which is given by:

(6) $$\frac{EU_y \theta_i}{EU_y} \frac{\partial Q^{oi}}{\partial x_{oi}} \cdot p_q = \beta \frac{EU_{1y} \theta_1}{EU_{1y}} \frac{\partial Q^{r1}}{\partial x_{r1}} \cdot p_q$$

However, due to the scarcity of arable land in the study area and the resultant rationing in the supply side of the market, we expect a positive discount factor ($\rho > 0$). In such a case, the second term of the right hand side of equation (5) shows the value of the potential loss of future utility from the sharecropped land due to eviction (contract non-renewal). Therefore, the more the tenant is concerned about the threat of eviction or contract insecurity (the larger ρ gets), the more input and effort he/she puts on the sharecropped land so as to qualify for contract renewal which is shown by the term $\partial\eta / \partial Q^{r1}$ (implying the decrease in the probability of eviction by increasing effort/yield in period one). Using the implicit function theorem on equation (1.4), we are able to show that a sharecropper applies less input and effort if the land is leased from a landlord with poor economic and property right conditions (S=0).

Building upon the theoretical model and the structure of the tenancy market in the country (see section 2), we aim to show how the strategic response (opportunistic behavior) of tenants to varying economic and property right condition/status of the landlord can affect their performance on sharecropped plots. Based on this, we expect stronger bargaining power and tenure security of the landlord to increase the contract insecurity effect on sharecroppers and, thereby, induce their effort on sharecropped plots. To the best of our knowledge, this is the first study to account for the supply side (landlord side) information in the analysis of sharecroppers' level of effort and productivity. A recent exception is Jacoby and Mansuri (2009) that analyzed the effect of supervision on sharecroppers' productivity using data on monitoring frequency collected from

share tenants in rural Pakistan.

4. Estimation Strategy

Based on the theoretical discussion in section 3 of this paper, the reduced form regression model for producer *i* on parcel *p* is

(1.7) $$y_{ip} = \beta x_{ip} + \delta T_{ip} + \mu_i + \varepsilon_{ip}$$

where y_{ip} yield value per hectare is realized by tenant *i* on parcel *p*, x_{ip} includes observable plot characteristics, and T_{ip} is a vector of dummy variables representing kinship relationship between partners (kin and non-kin leased plots using tenant's own plots as counterfactual) that estimate the average yield differential between owner-cultivated and kin or non-kin transacted plots, respectively. The error component μ_i, captures the unobserved tenant household characteristics such as farming ability, tenant's social connections, and others that are not observable but affect input use and productivity, while ε_{ip} is a random variable that captures plot-specific unobservables that are not captured in the model such as soil quality variations, plot susceptibility to erosion, and weed infestations.

Had tenant's effort been fully observable where $E(\mu_i) = 0$, estimating the above regression model with OLS would have been free of any bias and inconsistency. However, the very fact that tenant's effort is not fully observable by the landlord $E(\mu_i) \neq 0$ makes households to internalize such unobservable characteristics in their contract and/or partner choice decisions (self-selection of contract and/or partner types). In such a case, OLS estimates of $\delta's$ are biased and inconsistent which may lead to an overstatement of the disincentive effects of sharecropping (Jacoby and Mansuri 2009).

Amid the mass of empirical contributions, two articles, by Bell (1977) and Shaban (1987) addressed the fundamental problem of assessing the productivity differential that may exist between plots under sharecropping and plots under owner-operation by considering only those households that farm more than one plot – effectively, are those households that are simultaneously owner-operators and sharecroppers. The use of household-specific fixed effects then allows one to compare the productivity of the two classes of plots while at least maintaining constant the identity of the household engaging in the farming activity. We adopt this strategy to correct selection bias as majority of tenants included in the study (91) are owner-cum-sharecropper households - owner-cultivators that also cultivate at least one sharecropped plot.

Note, finally, that our household fixed effects estimator may not be robust to correlation between T_{ip} and ε_{ip}, when there is adverse selection in the leasing market. Under adverse selection, sharecropped land tends to be of lower quality than owner-cultivated land (or, more importantly, non-kin sharecropped land may tend to be lower quality than kin sharecropped land). Thus, ignoring this form of selection bias when it is present would lead us to understate the productivity of share-tenancy vis á vis owner-cultivation (or more importantly understate the productivity of non-kin share-tenancy vis á vis kin share-tenancy. Two alternative approaches were used to deal with such plot selection bias caused by adverse selection: 1) A two-step non-parametric matching; and 2) A two-step control function (CF) approach.

We begin by applying a two-step non-parametric propensity score matching method on observable plot characteristics to identify: 1) those leased-in plots that are relatively comparable to owner-operated plots (see Appendix 11); and 2) using the sample of leased-in plots that

satisfied the balancing and common support requirement, we implement the non-parametric matching method to further identify plots leased-in from kin that are fairly comparable to plots leased-in from non-kin landlords using observable plot characteristics (see Appendix 12).The matched data of plots that were used in the productivity analysis included the owner-operated and leased-in plots planted with cereal crops that satisfied the balancing and common support requirement but excluding plots planted with perennial plants and plots leased-out by tenants. This caused the number of plot observations to be reduced from 1148 to 997 plots. This kind of data preprocessing reduces model dependence in the subsequent parametric analysis of the outcome equation (Ho et al. 2007).

As an alternative a Control Function (CF) approach (Wooldridge 2007) was also implemented to account for the possible endogeneity of plot-specific leasing-in decision of tenants using the already matched plots that satisfies the balancing and common support requirement. For an endogenous binary response variable T_{ip}^{*}, the Control Function (CF) approach based on equation (6) involves estimating

(1.8) $$E(y_{ip} \mid x_{ip}, T_{ip}) = x_{ip}\beta_1 + \gamma T_{ip} + E(\varepsilon_{ip} \mid x_{ip}, T_{ip}).$$

While making decisions regarding participation in the informal land lease market, we assume there is unobserved factor (utility index) T_{ip}^{*} that explain why farm households lease in. We postulate this variable T_{ip}^{*} (latent variable) is a function of vector of exogenous variables with the relationship specified as:

(1.9) $$T_{ip}^{*} = \beta_2 x_{ip} + u_{ip},$$

Where the observed binary response is given by:

$T_{ip} = 1 \quad \text{if} \quad T_{ip}^{*} = \beta_2 x_{ip} + u_{ip} > 0, \ \text{and}$
$T_{ip} = 1 \quad \text{if} \quad T_{ip}^{*} = \beta_2 x_{ip} + u_{ip} \leq 0$

Therefore, if $(\varepsilon_{ip}, u_{ip})$ is independent of x_{ip}, $E(\varepsilon_{ip} \mid u_{ip}) = \alpha_{ip} u_{ip}$, and $u_{ip} \sim Normal(0,1)$, then

(1.10) $$E(\varepsilon_{ip} \mid x_{ip}, T_{ip}) = \alpha_{ip}\left[T_{ip}\lambda(\beta_2 x_{ip}) - (1-T_{ip})\lambda(-\beta_2 x_{ip})\right],$$

where $\lambda(.) = \phi(.) \big/ \Phi(.)$ is the inverse Mills ratios (IMR) of plot *p* cultivated by tenant *i* (see Wooldridge, 2008). This leads to a simple Heckman two-step estimate (for endogeneity) where we obtain the probit estimate $\hat{\beta}_2$ and generate the "*generalized residual*" as:

$generalized\ residual \equiv T_{ip}\lambda(\hat{\beta} x_{ip}) - (1-T_{ip})\lambda(-\hat{\beta} x_{ip})$, and use it as an additional regressor in the "Shaban-type" regression (equation 1.8) together with the endogenous binary choice variable T_{ip}. Due to lack of suitable instruments that are required to be exogenous and uncorrelated with the error term in the outcome equation, we rely on non-linearities as an identification strategy.

5. Data and Descriptive statistics

Data

Data used for analysis of this study are derived from 400 randomly selected farm households from a stratified sample of 16 '*tabias'* (communities) in the Tigray region of Ethiopia. These communities were stratified to represent the major variation in agro-ecological factors, market access, population density, and access to irrigation. Out of the 400 sampled households, only

385 (among whom 103 landlord and 105 tenant) households were used in the analysis. Furthermore, as the main issue of interest in this study is to assess the productivity differentials of the kin-based share-tenancy, tenant farm households are the relevant sample for the productivity analysis. For this end, household and plot information was also collected from 128 tenant partners matched with the 103 landlords.

Thus, 1148 plots operated by the 105 sampled and 128 partner tenants during the 2005/06 production year were considered for analysis though this study uniquely utilized the supply side (landlord side) information as a possible factor affecting sharecroppers' level of effort and productivity. To control for plot specific heterogeneity of parcels operated under the various arrangements and identify comparable plots that satisfy common support and balancing properties, we applied non-parametric propensity score matching on observable plot characteristics which further reduced the number of plots used for analysis from 1148 to 997 plots. After excluding plots planted with perennial plants and plots leased-out by tenants[6], only 386 rented in plots[7] were found to be comparable with 611 owner-operated plots of 225 owner-cum-sharecroppers.

Descriptive Statistics

To be able to show how (kin/non-kin) sharecroppers' effort (productivity) is strategically responsive to variations in the bargaining power or economic independence and property right conditions (tenure security) of the landowner, we introduce four key indicator variables that we believe may capture the issues of economic and property rights status of landowners. Economic

[6]We found 18 of the sampled tenant households engage themselves not only in lease-in land but also leasing-out part of their own holding (24 plots). Similar practices are common in the study area as farms try to adjust distance to plots by renting out distant plots and renting in nearby plots.

[7] The number of transacted plots further diminishes due to incompleteness of matched data from landlord partners.

dependence and technical inability of landlord households may undermine their bargaining power and thereby their eviction power (Holden and Bezabih 2008). We use the gender of the household head and off-farm labor income-generating opportunity of landlords as alternative indicator variables to capture the economic status and bargaining power of landlords.

On the other hand, we use an indicator variable showing whether or not the sharecropped plot is included in the land use certificate of the landlord as a control variable to capture the potential role tenure security of the landholder might play in affecting the effort of kin and/or non-kin sharecroppers. A previous study from the study area (using the same sample) supports this argument (Holden et al. 2011) indicating that possession of land use certificate boosts the perception of tenure security status and confidence of landowners against losing the land. However, we feel this variable may not be effective enough to capture the tenure (in)security issues of landowners since majority of the rural households in the region possess land use certificates to their plots[8]. For this reason, we construct and use an indicator variable "pure landlords – landlord households who lease-out all their parcels" as an alternative indicator to capture tenure security status of landlords. Due to the frequent land redistribution reforms of the past (the 1970's and 1980's of Ethiopia), and the increasing number of landlessness in the country, we believe that those pure landlords belong to risk-group landlords that feel the pressure of tenure insecurity for-fear of future confiscations.[9] The recent land proclamation the Tigray region (TNRS 2006) that decrees leasing-out more than 50% of own-holding as an act of illegal and are subject to confiscation vindicates our approach.

[8] More than 80% of the rural farm households in the region and 86% of our sampled farm households possess land use certificates to their landholdings.

[9] Perception data (2001) from the study area shows more than 60% of those households who fear losing a land indicates future land redistribution (to address landlessness) as a reason for their fear of loss.

Table 2 compares summary statistics of these (four) indicator variables together with other plot-specific characteristics based on their tenure and kinship status. The paired mean comparison tests (see the bottom section Table 2) show a significant and systematic difference in these key landlord characteristics. Significantly larger proportion kin-transacted plots are plots originated from female land owners than it is for non-kin transacted plots. Stated otherwise, the likelihood for a kin-tenant having a female landlord is significantly higher (57%) than it is for non-kin tenant (48%). Supporting our earlier argument on the role of economic independence of the landowner, off-farm income generating opportunity is significantly lower (13%) for landowners who leased-out plots to kin partners than those who transact plots with non-kin partners (27%).

The summary result in Table 2 further indicates pure landlords with no operational holding (believed to be tenure insecure landowners) are more likely lease-out their plots to kin partners than to non-kin partners. Showing a potential rationing-out of young farmers, kin-sharecropped plots are mostly leased-in by younger tenants while the most established (more experienced) farmers get access to land through the less likely route of non-kin contracts. This leaves those younger tenants with relatively poorer endowment of such farm inputs to bask on access through kin-tied arrangements.

6. Results and Discussions

We begin our analysis by comparing the estimates of average yield differentials between sharecropped and owner-cultivated plots of owner-cum-sharecroppers. A summary of the estimated results is presented in Table 4 below[10]. In contrast with the Marshallian inefficiency

[10] Since model misspecifications and potential weaknesses of instruments used in the first stage estimation may cause inconsistency in estimates of the CF approach and make them too imprecise to be informative (Wooldridge 2007), we are thus less reliant on using the estimates of this approach (though results are reported) as a basis for

hypothesis, on average, we found no strong evidence to suggest productivity on sharecropped plots is lower than on owner operated plots of sharecroppers once we control for plot quality, crop selection and unobserved household heterogeneity. Similar results, however, could not be reached once we control for variations in characteristics of partners from the supply side of the market. Taking advantage of unique information on the kinship, bargaining power and tenure security status of matched-landlords, Models 2 – 6 reported in Table 4 estimate and compare how responsive sharecroppers' performance is to such variations in the characteristics of landowners.

Results reported under Model 2 show the positive role kinship ties play in influencing sharecroppers' productivity. The results show, on average, non-kin sharecropped plots are significantly less productive than owner-cultivated crops though the same cannot be stated about kin-sharecropped plots. This finding is in line with our hypothesis (H2) and supports the claim by Sadoulet et al. (1997) that there is a relatively higher moral hazard problem among non-kin contracts as compared to kin-tied tenancy arrangements.

In line with our hypothesis of the gender bias in sharecroppers' effort/productivity, results from Model 3 of Table 4 further indicate that there is a strong evidence of Marshallian inefficiency when tenancy arrangements are made with female landlords. While results from Table 4 confirm there is no significant productivity loss on plots leased in from kin landlord, a more decomposed analysis (with landlord's gender and kinship interaction effect) from Model 1 of Tables 5 shows there is rather a strong (statistically significant) evidence of Marshallian inefficiency on plots

analysis in the discussion. This is more revealed as the *generalized residual* generated from the first stage selection equation (renting-in decision) is statistically insignificant when included in all the alternative model specifications. Rather, we rely for analysis in this study on results from the household fixed effects model applied on matched plots that satisfied the common support and balancing requirements from propensity score matching.

Table 4: Linear household fixed effects estimates of determinants of yield value per hectare – the role of bargaining power and tenure security of land owners

Explanatory variables[#]	Model 1	Model 2[i]	Model 3[ii]	Model 4[iii]	Model 5[iv]	Model 6[v]
Leased-in plot (dummy)	-0.092					
	(0.066)					
Kin landlord		-0.038				
		(0.081)				
Non-kin landlord		-0.195**				
		(0.083)				
Female landlord			-0.148*			
			(0.087)			
Male landlord			-0.047			
			(0.083)			
Landlord with access to off-farm income[+]				-0.089		
				(0.093)		
Landlord with no access to off-farm income				-0.188**		
				(0.096)		
Landlord with certificate					-0.213**	
					(0.088)	
Landlord with no certificate					-0.055	
					(0.112)	
Pure landlord						-0.172**
						(0.085)
Cultivator landlord						-0.026
						(0.128)
Joint F test for plot quality variables[++]	6.36****	6.58****	6.64 ****	6.36 ****	6.47 ****	6.16 ****
Joint F test for cultivated crop-type variables[+++]	7.45****	7.25****	7.61 ****	6.72 ****	7.09 ****	7.03 ****
Constant	6.92****	6.94****	6.88 ****	6.83 ****	6.91****	6.90****
	(0.197)	(0.229)	(0.230)	(0.231)	(0.229)	(0.231)
R_squared	0.131	0.135	0.129	0.123	0.122	0.132
Number of obs.	997	997	984	884	990	990
Model Test	F(13,759)= 6.82***	F(14,758)= 6.86****	F(14,745)= 6.64****	F(14,646)= 6.46 ****	F(14,652)= 6.47****	F(14,652)= 5.54 ****

Note: * significant at 10%; ** significant at 5%; *** significant at 1%; and **** significant at 0.1

[#] In each alternative model specification, the counterfactual is owner-operated plots of tenants.

[i] A model specification by decomposing leased-in plots based on kinship status of the landlord. See Appendix 2 for detaieled resuts.

[ii] A model specification by decomposing leased-in plots based on gender status of the landlord. See Appendix 3 for deail results.

[iii] A model specification by decomposing leased-in plots based on access to off-farm income sources of landlords. See Appendix 4 for detailed results.

[iv] A model specification by decomposing leased-in plots based on the possesion of certificate by the landlord. See Appendix 5 for detailed results.

[v] A model specification by decomposing leased-in plots based on whether the landlord is an pure or cultivator landlord. See Appendix 6 for dtailed results.

[++] Plot quality variables include: flat plot slope, foothill plot slope, shallow soil depth, medium soil

depth, log (plot distance from residence), homestead plot, conserved plot, and plot size (in *tsimdi*)[11]

[+++] Crop dummy variables include: pulses and oil crops plot, teff plot, barley plot, wheat plot

leased-in from kin-related female landowners[12]. This result confirms the claims that economic dependence and tenure insecurity of female headed households (Holden et al. 2011) limits power of eviction by the landlords to induce the tenant's effort (Bezabih and Holden 2009). This finding is in line with the threat of eviction hypothesis which is consistent with the findings of a study by Kassie and Holden (2007) from the Amhara region in Ethiopia.

The stochastic dominance analyses presented in Figures 1 – 3 support such parametric findings that the distribution of yield on parcels from non-kin and female landlords are not only dominated by owner-operated plots of tenants but also by the distribution of yields on plots operated by kin tenants and plot leased in from male landlords, respectively. Comparing the kinship and gender productivity differential, the non-parametric Kolmogorov-Smirnov significance test for differences in distribution of yield values per hectare (presented in Table 7) also shows that the distribution of yield on plots leased from female landlords is unambiguously dominated not only by owner-operated farms of tenants but also by the distribution of yield per hectare of plots transacted from male landlords.

We also found similar results when other income generating opportunity of the landlord was used to capture the economic (in)dependence of landowners. The results confirm that yields on plots leased from households with limited or no other income generating opportunity are significantly lower than yields on owner-operated plots of sharecroppers. As landowners with no other

[11] 'Tsimdi' is a local area measurement equivalent to a quarter of a hectare.

[12] This result is in line with the findings of Holden and Bezabih (2008) from the Amhara region of Ethiopia.

Table 5: Linear household fixed effects estimates of determinants of yield value per hectare – interaction effects

Explanatory variables	Obs.	Model 1[i]	Model 2[ii]	Model 3[iii]	Model 4[iv]
Kin female landlord	120	-0.182 (0.094)**			
Kin male landlord	97	0.004 (0.097)			
Kin landlord with off-farm income	73		0.067 (0.121)		
Kin landlord with no off-farm income	105		-0.074 (0.123)		
Kin landlord with certificate	111			-0.057 (0.112)	
Kin landlord without certificate	70			0.064 (0.135)	
Kin pure landlord	124				-0.165 (0.089)*
Kin cultivator landlord	57				0.115 (0.153)
Joint F test for plot quality variables[++]		5.38****	4.79****	4.84****	5.10****
Joint F test for crop-type variables[+++]		3.27****	3.67****	3.47****	3.84****
Constant		7.59**** (0.175)	7.01**** (0.294)	7.14 **** (0.283)	7.40 **** (0.208)
R_squared		0.118	0.134	0.122	0.133
Number of obs.		632	599	599	599
Model Test		F(14,467)= 4.47****	F(14,437)= 4.84***	F(14,437)= 4.37****	F(14,437)= 4.80****

Note: * significant at 10%; ** significant at 5%; *** significant at 1%; and **** significant at 0.1

® In each alternative model specification, the counterfactual is owner-operated plots of kin tenants.

[i] A model specification with interaction variables of kinship and gender status of land owners. See Appendix 7 for detaieled resuts.

[ii] A model specification with interaction variables of kinship and off-farm income access of land owners. See Appendix 8 for detaieled resuts.

[iii] A model specification with interaction variables of kinship and certificate possession of land owners. See Appendix 9 for detaieled resuts.

[iv] A model specification with interaction variables of kinship and whether the landlord is an pure landlord or not. See Appendix 10 for detaieled resuts.

income generating opportunity are more likely to be economically dependent (Macours 2004), we expect such dependence to have undermined their bargaining power and efforts of tenants. As shown on Model 2 of Tables 5 and 6, such strategic response to the lack of alternative income sources of landlords was found to be more evident on non-kin operated plots while there is no strong evidence to suggest this when such a parcel is operated by kin tenants.

We also assessed the impacts of tenure insecurity of landowners on sharecroppers' effort using whether or not the landlord is pure landlord as an indicator variable to capture tenure (in)security. Results from Table 4 show, on average, yields on plots leased from pure landlords are significantly lower than on owner-operated plots of sharecroppers. As these groups of landlords are believed to be highly susceptible to confiscation of plots by the government, high reliance on kin-based tenancy arrangements of these landlords can undermine their power of eviction and partly explain such efficiency losses. However, the fact that pure landlords are more likely to live outside the village and/or are landlords who lack the technical (farming) ability, the lack (or high cost) of supervision on tenants effort cannot be ruled-out as a factor for the lower productivity of such plots. Results from Model 4 of Tables 5 and 6 are indicative to suggest such efficiency loss is more explained by strategic response of tenants to landlord's tenure insecurity (contract security of by tenants) than lack of supervision by landlords as such efficiency losses consistent regardless of kinship status of the tenant.

In contrast with our hypothesis that land certificate enhances the landlord's tenure security and, thereby, increases productivity of transacted plots, results from Table 4 shows that yields on plots sharecropped from landlords with land use certificates are found to be significantly lower than on owner-operated plots. The more decomposed analysis (from Tables 5 and 6) shows the efficiency loss is more pronounced when such plots are operated by non-kin sharecroppers. On the outset, despite the fact that results from Table 4 indicates no significant efficiency loss on plots transacted among kin partners, a more decomposed analyses summarized in Table 5 show there is a strong (statistically significant) evidence of Marshallian inefficiency on kin-tenant

operated plots leased from landlords who are female; pure landlords; and landlords who have no access to off-farm income sources[13].

7. Conclusion and policy Implications

Taking advantage of unique information on the kinship, bargaining power and tenure (in)security of matched-landlords, our findings show how strategic sharecroppers are in internalizing such variations in the characteristics of landlords. The results show sharecroppers' yield are significantly lower on plots leased from landlords who are non-kin; female; with lower off-farm income generating capacity; and those who are believed to be tenure insecure than on plots leased from landlords with contrasting characteristics. Therefore, strengthening of property rights and empowerment of the rural poor may not only have a direct productivity-enhancing potential on owner-operated smallholder agriculture but can also have an indirect impact on the performance on transacted plots.

A decomposed analysis (after considering interaction effects of kinship status of tenants with variables controlling for the bargaining power and tenure security status of landlords) also shows a strong (statistically significant) evidence of Marshallian inefficiency on kin-operated plots leased from landlords who are female and those who have no off-farm income generating capacity. The empirical evidence implies that strengthening the property rights of landholders may not only have a direct productivity-enhancing effect on owner-operated smallholder cultivation but also an indirect impact on the productivity of transacted plots. On the other hand, recent changes in the regional land proclamation (TNRS 2006) authorize confiscation of landholdings of households who had their primary source of livelihood outside the village for

[13] This result is in contrast with the findings of Kassie and Holden (2007;2008) and Holden and Bezabih (2008) from the Amhara region of Ethiopia.

more than two years. While this policy serves an equity objective, it may undermine the bargaining power of (potential) landlords and efficiency of transacted plots.

References

Adal, Y. (2002). Review of Landholding Systems and Policies in Ethiopia under the Different Regimes. EEA/Economic Policy Research Institute, Working paper No 5/2002.

Alemu, T. (1999). Land Tenure and Soil Conservation: Evidences from Ethiopia. Unpublished Phd-Dissertation, Göteborg University, Göteborg.

Arcand, J. L., C. R. Ai and F. Ethier (2007). "Moral Hazard and Marshallian Inefficiency: Evidence from Tunisia." Journal of Development Economics **83**(2): 411-445.

Arrow, K. J. (1968). "The Economics of Moral Hazard: Further Comment." American Economic Review **58**(3).

Bell, C. (1977). "Alternative Theories of Sharecropping - Some Tests Using Evidence from Northeast India." Journal of Development Studies **13**(4): 317-346.

Bellemare, M. (2006). Testing between Competing Theories of Reverse Share Tenancy. Duke.

Bellemare, M. F. (2008). "Insecure Land Rights and Reverse Share Tenancy in Madagascar." Working paper **Durham , NC : Duke University**.

Besley, T. and E. Coast (1995). "Group Lending, Repayment Incentives and Social Collateral." Journal Development Economics **46**: 1-18.

Bliss, C. J. and N. H. Stern (1982). Palanpur: The Economy of an Indian Village. Delhi and New York, Oxford University Press.

Deininger, K., D. A. Ali and T. Alemu (2008). Land Rental Markets: Transaction Costs and Tenure Isecurity in Rural Ethiopia. In: S. T. Holden, K. Otsuka and F. M. Place. The Emergence of Land Markets in Africa: Impacts on Poverty, Equity, and Efficiency. Washington DC, Resource For the Future (RFF) publisher.

Deininger, K., D. A. Ali, S. Holden and J. Zevenbergen (2008). "Rural Land Certification in Ethiopia: Process, Initial Impact, and Implications for Other African Countries." World Development **36**(10): 1786-1812.

Deininger, K. and G. Feder (1998). Land Institutions and Land Markets, The World Bank, Development Research Group, Rural Development.

Fafchamps, M. (2004). Market Institutions in Sub-Saharan Africa. Cambridge, Massachusettes & London, The MIT Press.

Feder, G., T. Onchan and Y. Chalamwong (1988). "Land Policies and Farm Performance in Thailand's Forest Reserve Areas." Economic Development and Culture Change **36**(3): 483-501.

Gavian, S. and S. Ehui (1999). "Measuring the Production Efficiency of Alternative Land Tenure Contracts in a Mixed Crop-Livestock System in Ethiopia." Agricultural Economics **20**: 37-49.

Ghebru, H. (2009). Land, Land Rental Markets and Rural Poverty Dynamics in the Tigray Region of Ethiopia. Paper presented at the Annual Conference of the Norwegian Association for Development Research (NFU) 23-24 November, Kristiansand , Norway. .

Ghebru, H. H. and S. T. Holden (2008). Factor Market Imperfections and Rural Land Rental Markets in Northern Ethiopian Highlands. In: S. T. Holden, K. Otsuka and F. M. Place. The Emergence of Land Markets in Africa: Impacts on Poverty, Equity, and Efficiency. Washington DC, Resource For the Future (RFF) publisher.

Hayami, Y. and K. Otsuka (1993). The Economics of Contract Choice: An Agrarian Perspective. Oxford, Clarendon press.

Ho, D. E., K. Imai, G. King and E. A. Stuart (2007). "Matching as Nonparametric Preprocessing for Reducing Model Dependence in Parametric Causal Inference." Political Analysis **15**(3): 199-236.

Hoben, A. (2000). Ethiopian Rural Land Tenure Policy Revisited. Paper Presented at the Symposium for Reviewing Ethiopia's Economic Performance 1991 - 1999. Organized by Inter-Africa Group. Addis Ababa. April 26 - 29.

Holden, S., B. Shiferaw and J. Pender (2001). "Market Imperfections and Land Productivity in the Ethiopian Highlands." Journal of Agricultural Economics **52**(3): 53-70.

Holden, S. T. and M. Bezabih (2008). Gender and Land Productivity on Rented Land in Ethiopia. In: S. T. Holden, K. Otsuka and F. M. Place. The Emergence of Land Markets in Africa: Impacts on Poverty, Equity, and Efficiency. Washington DC, Resource For the Future (RFF) publisher.

Holden, S. T., K. Deininger and H. Ghebru (2009). "Impacts of Low-Cost Land Certification on Investment and Productivity." American Journal of Agricultural Economics **91**(2): 359-373.

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

Holden, S. T. and H. Ghebru (2005). Kinship, Transaction Costs and Land Rental Market Participation. In. Working Paper, Norwegian University of Life Sciences. Ås.

Holden, S. T., K. Otsuka and F. M. Place (2008). Land Markets and Development in Africa. In: S. T. Holden, K. Otsuka and F. M. Place. The Emergence of Land Markets in Africa: Impacts on Poverty, Equity, and Efficiency. Washington DC, Resource For the Future (RFF) publisher.

Holden, S. T. and H. Yohannes (2002). "Land Redistribution, Tenure Insecurity, and Intensity of Production: A Study of Farm Households in Southern Ethiopia." Land Economics **78**(4): 573-590.

Jacoby, H. G. and G. Mansuri (2009). "Incentives, Supervision, and Sharecropper Productivity." Journal of Development Economics **88**(2): 232-241.

Kassie, M. and S. Holden (2007). "Sharecropping Efficiency in Ethiopia: Threats of Eviction and Kinship." Agricultural Economics **37**(2-3): 179-188.

Kassie, M. and S. T. Holden (2008). Kinship, Tenure Insecurity, Input Use and Land Productivity: The Case of Sharecropping in Ethiopia. In: S. T. Holden, K. Otsuka and F. M. Place. The Emergence of Land Markets in Africa: Impacts on Poverty, Equity, and Efficiency. Washington DC, Resource For the Future (RFF) publisher.

Li, G., S. Rozelle and L. Brandt (1998). "Tenure, Land Rights, and Farmer Investment Incentives in China." Agricultural Economics **19 (1-2)**: 63-71.

Macours, K. (2004). "Ethnic Divisions, Contract Choice, and Search Costs in the Guatemalan Land Rental Market." Working paper **Johns Hopkins University**

MUT (2003). "Securing Land Rights in Africa: Can Land Registration Serve the Poor? Interim Report of Mekelle University Team, Mekelle University, Mekelle, Tigray, Ethiopia."

Otsuka, K. (2007). Efficiency and Equity Effects of Land Markets. In. Handbook of Agricultural Economics, Elsevier.

Otsuka, K. and Y. Hayami (1988). "Theories of Share Tenancy: A Critical Survey." Economic Development and Cultural Change **37**(1): 32-68.

Pender, J. and M. Fafchamps (2006). "Land Lease Markets and Agricultural Efficiency in Ethiopia." Journal of African Economies **15(2)**: 251-284.

Pender, J. L., B. Gebremedhin and M. Haile (2002). Economic Returns and Impacts of Policies and Programs Affecting Land Management in Tigray. Policies for sustainable land management in the highlands of Tigray, Northern Ethiopia, Axum Hotel, Mekelle, Ethiopia, EPTD NO.

Rahmato, D. (1984). Agrarian Reform in Ethiopia. Uppsala, Scandinavian Institute of African Studies.

Sadoulet, E., A. de Janvry and S. Fukui (1997). "The Meaning of Kinship in Sharecropping Contracts." American Journal of Agricultural Economics **79**(May): 394-407.

Sadoulet, E., S. Fukui and A. d. Janvry (1994). "Efficient Share Tenancy Contracts under Risk: The Case of Two Rice Growing Villages in Thailand." Journal of Development Economics **45**: 225-243.

Sen, A. K. (1975). Employment, Technology and Development. Oxford, Clarendon Press.

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

Sharma, N. and J. Dreze (1996). "Sharecropping in a North Indian Village." Journal of Development Studies **33**(1): 1 - 39.

Singh, N. (1989). Theories of Sharecropping. In: P. Bardhan. The Economic Theory of Agrarian Institutions. New York, Oxford University Press.

Tadesse, M. A., S. T. Holden and R. Øygard (2008). Contract Chioce and Poverty in Southern Highlands of Ethiopia. In: S. T. Holden, K. Otsuka and F. M. Place. The Emergence of Land Markets in Africa: Impacts on Poverty, Equity, and Efficiency. Washington DC, Resource For the Future (RFF) publisher.

Teklu, T. and A. Lemi (2004). "Factors Affecting Entry and Intensity in Informal Rental Land Markets in Southern Ethiopian Highlands." Agricultural Economics **30**: 117-128.

Table 1: Variable Description

Variable	**Description**
Sex of household head	Gender of the household head (1=female, 0=male)
Age of household head	Age of the head of the household (number of years)
Education of household head	Educational status of the head of household (1=literate, 0=illiterate)
Female labor force	Number of female working-age family members in the household
Male labor force	Number of male working-age family members in the household
Size of household	Number of family members
Number of oxen	Number of oxen
Other livestock endowment	Possession of livestock other than oxen - in Tropical livestock unit
Own a house with an iron roof	If the household possesses a house with an iron roof (1=yes, 0=no)
Farm size	Size of agricultural land owned by the household (in *tsimdi**)
Possess land use certificate	If the household posses a land use certificate (1=yes, 0=no)
Experienced land related dispute	If the household has experienced land related dispute in the last 15 years
Household index of fragmentation	Ratio of own holding to number of owned plots
Ratio of plots with certificate	ratio of the number of plots with certificate to the number of owned plots
No owned land holding	If the household has zero owned (PA allocated) land
Income from self-employment	Amount of income from self employment (Ethiopian Birr)
Income from non-labor activity	Amount of income from rental of oxen, labor, and/or houses (Ethiopian Birr)
Wage income	Amount of income from wage labor employment (Ethiopian Birr)
No operational holding	If the household has zero operational holding (1=yes, 0=no)
pure landlord	If the landlord has leased out all own holding (1=yes, 0=no)
Shallow soil	Shallow soil (1=yes, 0=no)
Medium deep soil	Medium deep soil (1=yes, 0=no)
Deep soil	Deep soil (1=yes, 0=no)
Soil type - clay	Soil type – clay (1=yes, 0=no)
Soil type - black	Soil type – black (1=yes, 0=no)
Soil type - sand	Soil type – sand (1=yes, 0=no)
Soil type - red	Soil type – red (1=yes, 0=no)
homestead	If the plot is a homestead plot (1=yes, 0=no)
Land investment	If there is any soil and water conservation investment on a plot (1=yes, 0=no)
Irrigated plot	If the plot is irrigated (1=yes, 0=no)
Distance to plot	Distance of a plot from homestead (minutes walk)
Output/ha	The log of value of output per hectare
Crop planted with pulses or oil seeds	If crop cultivated on the plot is pulses or oil seeds (1=yes, 0=no)
Crop planted with *teff*	If crop cultivated on the plot is *teff* (1=yes, 0=no)
Crop planted with wheat	If crop cultivated on the plot is wheat (1=yes, 0=no)
Crop planted with barley	If crop cultivated on the plot is barley (1=yes, 0=no)

Table 2: Summary statistics of plots operated by owner-cum-sharecropper

Variable	Owner-operated plots (611)		Kin share-cropped plots(230)		Non-kin Share-cropped plots (156)	
Plot Characteristics	Mean	(St. Err)	Mean	(St. Err)	Mean	(St. Err)
Shallow soil	0.328	(0.470)	0.305	(0.461)	0.328	(0.471)
Medium deep soil	0.275	(0.447)	0.324	(0.469)	0.303	(0.461)
Deep soil	0.384	(0.487)	0.355	(0.480)	0.369	(0.484)
Soil type - clay	0.267	(0.443)	0.222	(0.416)	0.232	(0.423)
Soil type - black	0.270	(0.444)	0.296	(0.457)	0.242	(0.430)
Soil type - sand	0.251	(0.434)	0.237	(0.426)	0.294	(0.457)
Soil type - red	0.207	(0.405)	0.241	(0.429)	0.227	(0.420)
Irrigation	0.045	(0.207)	0.035	(0.183)	0.035	(0.185)
Farm size	1.248	(1.205)	1.261	(1.031)	1.626	(1.177)****
Distance to plot	30.34	(37.89)	35.88	(42.93)	35.94	(42.65)
Output/ha	620.6	(669.2)	518.6	(407.7)	411.9	(482.9)**
Crop Composition And Farm Inputs						
Crop grow – pulses and seeds	0.103	(0.304)	0.092	(0.290)	0.090	(0.287)
Crop grow – *teff*	0.336	(0.473)	0.374	(0.485)	0.360	(0.481)
Crop grow – wheat	0.180	(0.385)	0.172	(0.378)	0.124	(0.330)
Crop grow – barley	0.235	(0.424)	0.172	(0.378)	0.169	(0.375)
Amount of chemical fertilizer	9.23	(16.81)	9.99	(16.22)	11.93	(18.37)
Seed/ha	65.89	(76.22)	58.87	(69.95)	47.84	(85.46)
Plowing man days	5.08	(13.57)	3.15	(4.49)	4.41	(10.34)*
Weeding man days	13.75	(22.54)	10.56	(17.11)	7.82	(8.28)**
Harvesting man days	6.578	(9.044)	5.242	(4.920)	5.087	(5.612)
Threshing man days	4.155	(7.252)	3.618	(4.442)	2.544	(3.588)***
Oxen days	12.55	(24.51)	9.06	(7.70)	9.73	(19.49)
Tenant Characteristics– by plot category						
Sex of household head	0.080	(0.272)	0.108	(0.311)	0.060	(0.238)*
Age of household head	52.46	(11.83)	46.24	(12.54)	50.11	(12.99)****
Household size	6.594	(2.038)	6.192	(2.046)	6.413	(1.880)
Number of oxen	1.673	(1.176)	1.744	(1.205)	2.038	(1.442)**
Number of other livestock^{+}	3.004	(2.450)	2.925	(2.528)	3.474	(3.136)**
Education of household head	0.544	(0.498)	0.596	(0.492)	0.707	(0.457)**
Female labor force	1.553	(0.829)	1.428	(0.784)	1.353	(0.686)
Male labor force	1.841	(1.062)	1.676	(0.991)	1.810	(1.009)
Landlord Characteristics – by plot category						
Sex of household head	-	-	0.570	(0.496)	0.480	(0.501)*
Age of household head	-	-	54.50	(19.07)	55.75	(14.44)
Number of other livestock	-	-	0.235	(0.426)	0.385	(0.489)**
Number of oxen	-	-	0.167	(0.374)	0.154	(0.363)
No operational holding	-	-	0.602	(0.491)	0.478	(0.502)*
Possess land certificate	-	-	0.852	(0.357)	0.856	(0.350)
Pure landlord	-	-	0.797	(0.404)	0.678	(0.470)**
Off-farm labor income opportunity^{++}	-	-	0.138	(0.347)	0.273	(0.448)**
Self-employment income^{++}	-	-	28.1	(111.6)	111.9	(442.4)**

Note: * significant at 10%; ** significant at 5%; *** significant at 1%; and **** significant at 0.1%; $^{+}$ TLU equivalent; $^{++}$ off farm income sources excluding gifts, aid, remittance and other non-labor incomes.

Table 3: Descriptive statistics – Household level characteristics

Variables	Landlord (214)	Tenant (225)	Landlord		Tenant	
			All kin (97)	All Non-kin (78)	All kin (103)	All Non-kin (68)
Age of household head	54.68	49.25****	55.90	55.63	48.43	51.42
	(16.69)	(12.84)	(18.31)	(15.75)	(12.62)	(13.31)
Sex of household head	0.53	0.07****	0.54	0.49	0.07	0.03
	(0.50)	(0.25)	(0.50)	(0.50)	(0.25)	(0.17)
Education of household head	0.54	0.63*	0.52	0.54	0.54	0.72**
	(0.50)	(0.48)	(0.50)	(0.50)	(0.50)	(0.45)
Female labor force	1.07	1.45****	0.88	1.23***	1.51	1.42
	(0.81)	(0.79)	(0.81)	(0.84)	(0.85)	(0.73)
Male labor force	0.90	1.75***	0.82	0.99	1.73	1.76
	(1.07)	(0.97)	(1.06)	(1.12)	(0.98)	(0.96)
Household size	4.00	6.34****	3.49	4.41**	6.29	6.35
	(2.40)	(2.06)	(2.33)	(2.54)	(2.18)	(1.89)
Number of oxen	0.46	1.71****	0.40	0.53	1.51	1.94***
	(0.87)	(1.15)	(0.73)	(1.01)	(0.92)	(1.27)
Other livestock endowment	1.03	2.90****	0.91	0.90	2.48	3.19**
	(1.97)	(2.49)	(1.42)	(1.34)	(1.94)	(2.36)
Own a house with iron roof	0.58	0.88*	0.45	0.75	0.74	1.40*
	(1.09)	(1.99)	(0.79)	(1.44)	(1.83)	(2.69)
Farm size	4.06	3.94	3.35	4.41***	3.15	4.29***
	(2.87)	(2.93)	(2.57)	(2.59)	(2.40)	(2.81)
Posses a certificate	0.86	0.76***	0.86	0.87	0.75	0.81
	(0.35)	(0.43)	(0.35)	(0.34)	(0.44)	(0.40)
Experienced land conflicts	0.06	0.06	0.05	0.06	0.07	0.03
	(0.23)	(0.24)	(0.22)	(0.25)	(0.26)	(0.17)
Fragmentation index	1.35	1.43	1.25	1.38	1.15	1.58**
	(1.02)	(1.30)	(1.09)	(0.75)	(1.09)	(1.38)
Ratio of plots with certificate	0.82	0.80	0.83	0.83	0.80	0.82
	(0.35)	(0.38)	(0.35)	(0.35)	(0.38)	(0.37)
No owned land holding	0.00	0.09	0.00	0.00	0.10	0.06
	0.00	(0.29)	0.00	0.00	(0.31)	(0.23)
Self-employment income	98.58	196.94*	17.73	130.81**	133.08	177.33
	(486)	(927)	(89)	(519)	(728)	(628)
Non-labor income	339.10	125.31*	396.90	307.28	128.70	117.72
	(834)	(581)	(1062)	(664)	(773)	(336)
Wage income	214.58	261.41	143.62	250.96	221.93	260.28
	(1174)	(895)	(1005)	(1272)	(776)	(886)
No operational holding	0.46		0.52	0.40		
	(0.50)		(0.50)	(0.49)		
Ratio of land leased-out	0.69		0.69	0.67		
	(0.46)		(0.46)	(0.47)		

Note: Standard errors are in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%; and **** significant at 0.1%

Table 6: Linear household fixed effects estimates of determinants of yield value per hectare – interaction effects of landlord characteristics

Explanatory variables	Obs	Model 1[i]	Model 2[ii]	Model 3[iii]	Model 4[iv]
Non-kin female landlord	78	-0.218 (0.127)*			
Non-kin male landlord	78	-0.261 (0.126)**			
Non-kin landlord with off-farm income	51		-0.317 (0.143)**		
Non-kin landlord with no off-farm income	45		-0.350 (0.183)***		
Non-kin landlord with certificate	59			-0.431 (0.127)***	
Non-kin landlord without certificate	37			-0.395 (0.209)*	
Non-kin pure landlord	63				-0.476 (0.147)***
Non-kin cultivator landlord	33				-0.203 (0.210)
Joint F test for plot quality variables[++]		2.87****	3.67****	3.53****	3.34****
Joint F test for crop-type variables[+++]		4.46****	5.08****	5.33****	5.22****
Constant		6.78**** (0.380)	6.64**** (0.348)	6.70 **** (0.342)	6.69 **** (0.356)
R_squared		0.164	0.179	0.176	0.176
Number of obs.		448	388	388	388
Model Test		F(14,316)= 4.42****	F(14,260)= 4.04****	F(14,260)= 3.96****	F(14,260)= 3.98****

Note: * significant at 10%; ** significant at 5%; *** significant at 1%; and **** significant at 0.1

® In each alternative model specification, the counterfactual is owner-operated plots of non-kin tenants.

[i] A model specification with interaction variables of non-kin with gender status of land owners. See Appendix 11 for detaieled resuts.

[ii] A model specification with interaction variables of non-kin with off-farm income access of land owners. See Appendix 12 for detaieled resuts.

[iii] A model specification with interaction variables of non-kin with certificate possession of land owners. See Appendix 13 for detaieled resuts.

[iv] A model specification with interaction variables of non-kin with whether the landlord is an pure landlord or not. See Appendix 14 for detaieled resuts.

Table 7: Test results of first-order stochastic dominance of productivity (Two-sample Kolmogorov-Smirnov test)

Basis of category	Tenure status of the plot	Log of value of Output/ha			P-values for two-sample Kolmogorov-Smirnov test†		
		N*	Mean	(Se)	Group A Vs Group B	Group A Vs Group C	Group B Vs Group C
		(1)	(2)	(3)	(4)	(5)	(6)
Land Transaction	Sharecroppers' own plot (Group A)	611	7.429	(0.04)	0.001		
	Leased-in plot (Group B)	386	7.211	(1.04)			
Kinship	Sharecroppers' own plot (Group A)	611	7.429	(0.04)			
	Plot leased-in from kin (Group B)	230	7.348	(0.06)	0.398	0.000	0.021
	Plot leased-in from non-kin (Group C)	156	7.010	(0.09)			
Gender	Sharecroppers' own plot (Group A)	611	7.429	(0.04)			
	Plot leased-in from male (Group B)	199	7.278	(0.07)	0.078	0.002	0.049
	Plot leased-in from female (Group C)	174	7.045	(0.09)			
Off-farm income opportunity	Sharecroppers' own plot (Group A)	611	7.429	(0.04)			
	Leased-in from landlord with off-farm income (Group B)	124	7.220	(0.09)	0.013	0.035	0.972
	Leased-in from landlord without off-farm income (Group C)	149	7.204	(0.09)			
Possession of Certificate	Sharecroppers' own plot (Group A)	611	7.429	(0.04)			
	Plot leased-in from landlord with certificate (Group B)	173	7.175	(0.08)	0.014	0.067	0.318
	Plot leased-in from landlord without certificate (Group C)	106	7.331	(1.09)			
Pure Landlord	Sharecroppers' own plot (Group A)	611	7.429	(0.04)			
	Leased-in from pure landlord (Group B)	167	7.192	(0.07)	0.010	0.0658	0.598
	Plot leased-in from Cultivator landlord (Group C)	112	7.421	(0.12)			

Note: †Test of H_0: distributions are equal against; H_a: distribution of first group stochastically dominates distribution of second group.

* The difference in number of observations is due to loss of data for lack of complete information from the match partner (landlord)

Appendix 1: Linear household fixed effects estimates of determinants of yield value per hectare

Explanatory Variable	Model_1 b/(se)	Model_2 b/(se)	Model_3 b/(se)	Model_4 b/(se)
Leased-in plot (dummy)	-0.172***	-0.146**	-0.092	-0.188
	(0.06)	(0.06)	(0.06)	(0.140)
Plot slope - flat		0.374****	0.355****	0.385****
		(0.09)	(0.09)	(0.09)
Plot slope - foot hill		0.356***	0.313***	0.361****
		(0.11)	(0.10)	(0.09)
Shallow soil		0.026	0.007	0.030
		(0.09)	(0.08)	(0.08)
Medium deep soil		-0.063	-0.064	-0.034
		(0.09)	(0.09)	(0.08)
Conservation (dummy)		0.136	0.097	0.081
		(0.09)	(0.08)	(0.08)
Log of distance to plot		-0.068*	-0.059*	-0.066**
		(0.04)	(0.03)	(0.03)
Homestead plot (dummy)		0.015	0.132	0.115
		(0.14)	(0.14)	(0.14)
Plot size (tsimdi)		-0.039	-0.082*	-0.065
		(0.05)	(0.05)	(0.05)
Crop grown - teff			0.424****	0.376****
			(0.09)	(0.09)
Crop grown - pulse or oilseed			0.162	0.119
			(0.18)	(0.18)
Crop grown - wheat			0.557****	0.547****
			(0.13)	(0.13)
Crop grown - barley			0.325**	0.298**
			(0.13)	(0.13)
Generalized residual				0.103
				(0.09)
Constant	7.419****	7.350****	7.083****	7.114****
	(0.03)	(0.18)	(0.21)	(0.21)
R^2	0.036	0.061	0.131	0.129
Number of Obs.	997	997	997	963
P-value	0.000	0.000	0.000	0.000

Note: * significant at 10%; ** significant at 5%; *** significant at 1%; and **** significant at 0.1%;
[+] Standard errors, corrected for clustering at household level, are included in parentheses..
[++] Dependent variable is log of output value per hectare.
[+++] Counterfactual: Owner-operated plots of tenants

Appendix 2: Linear household fixed effects estimates of determinants of yield value per hectare – the role of kinship contracts

Explanatory Variables	Model_1 b/(se)	Model_2 b/(se)	Model_3 b/(se)	Model_4 b/(se)
Kin landlord	-0.083	-0.059	-0.037	-0.123
	(0.08)	(0.08)	(0.08)	(0.14)
Non-kin landlord	-0.256***	-0.225***	-0.195**	-0.268**
	(0.09)	(0.08)	(0.08)	(0.13)
Plot slope - flat		0.419****	0.400****	0.431****
		(0.10)	(0.10)	(0.10)
Plot slope - foot hill		0.372****	0.330***	0.377****
		(0.11)	(0.10)	(0.10)
Shallow soil		0.006	-0.014	0.006
		(0.09)	(0.09)	(0.09)
Medium deep soil		-0.064	-0.065	-0.036
		(0.09)	(0.09)	(0.08)
Conservation (dummy)		0.159	0.113	0.097
		(0.10)	(0.09)	(0.09)
Log of distance to plot		-0.070**	-0.060*	-0.066*
		(0.04)	(0.03)	(0.03)
Homestead plot (dummy)		-0.000	0.121	0.106
		(0.14)	(0.14)	(0.14)
Plot size (tsimdi)		-0.030	-0.079*	-0.062
		(0.05)	(0.05)	(0.05)
Crop grown - teff			0.444****	0.401****
			(0.10)	(0.10)
Crop grown - pulse or oilseed			0.218	0.179
			(0.21)	(0.22)
Crop grown - wheat			0.586****	0.582****
			(0.14)	(0.14)
Crop grown - barley			0.374**	0.355**
			(0.16)	(0.17)
Generalized residual				0.062
				(0.09)
Constant	7.404****	7.302****	7.016****	7.030****
	(0.02)	(0.20)	(0.24)	(0.25)
R^2	0.073	0.066	0.135	0.123
Number of Obs.	997	997	997	964
P-value	0.036	0.000	0.000	0.000

Note: * significant at 10%; ** significant at 5%; *** significant at 1%; and **** significant at 0.1%;
[+] Standard errors, corrected for clustering at household level, are included in parentheses..
[++] Dependent variable is log of output value per hectare.
[+++] Counterfactual: Owner-operated plots of tenants

Appendix 3: Linear household fixed effects estimates of determinants of yield value per hectare – the role of gender of the landlord

Explanatory Variables	Model_1 b/(se)	Model_2 b/(se)	Model_3 b/(se)	Model_4 b/(se)
Female landlord	-0.180**	-0.156*	-0.148*	-0.236*
	(0.09)	(0.09)	(0.09)	(0.14)
Male landlord	-0.117	-0.086	-0.047	-0.156
	(0.08)	(0.08)	(0.08)	(0.14)
Plot slope - flat		0.424****	0.398****	0.429****
		(0.10)	(0.10)	(0.10)
Plot slope - foot hill		0.362***	0.318***	0.365****
		(0.11)	(0.10)	(0.10)
Shallow soil		0.029	0.011	0.033
		(0.09)	(0.09)	(0.09)
Medium deep soil		-0.047	-0.043	-0.014
		(0.09)	(0.09)	(0.08)
Conservation (dummy)		0.141	0.104	0.087
		(0.09)	(0.08)	(0.08)
Log of distance to plot		-0.066*	-0.057*	-0.064*
		(0.04)	(0.03)	(0.03)
Homestead plot (dummy)		0.022	0.147	0.129
		(0.14)	(0.14)	(0.14)
Plot size (tsimdi)		-0.042	-0.084*	-0.066
		(0.05)	(0.05)	(0.05)
Crop grown - teff			0.423****	0.374****
			(0.09)	(0.09)
Crop grown - pulse or oilseed			0.142	0.099
			(0.17)	(0.17)
Crop grown - wheat			0.549****	0.542****
			(0.12)	(0.12)
Crop grown - barley			0.304**	0.280**
			(0.12)	(0.12)
Generalized residual				0.075
				(0.10)
Constant	7.406****	7.307****	7.045****	7.068****
	(0.02)	(0.19)	(0.21)	(0.22)
R^2	0.016	0.067	0.129	0.120
Number of Obs.	984	984	984	951
P-value	0.104	0.000	0.000	0.000

Note: * significant at 10%; ** significant at 5%; *** significant at 1%; and **** significant at 0.1%;
[+] Standard errors, corrected for clustering at household level, are included in parentheses..
[++] Dependent variable is log of output value per hectare.
[+++] Counterfactual: Owner-operated plots of tenants

Appendix 4: Linear household fixed effects estimates of determinants of yield value per hectare – the role of landlord's access to off-farm income

Explanatory Variables	Model_1 b/(se)	Model_2 b/(se)	Model_3 b/(se)	Model_4 b/(se)
Landlord with off-farm	-0.132	-0.091	-0.089	-0.206
Income source	(0.10)	(0.09)	(0.09)	(0.16)
Landlord with no off-farm	-0.256**	-0.208**	-0.188*	-0.310**
Income source	(0.10)	(0.10)	(0.10)	(0.14)
Plot slope - flat		0.455****	0.429****	0.460****
		(0.11)	(0.11)	(0.11)
Plot slope - foot hill		0.382***	0.332***	0.399****
		(0.11)	(0.11)	(0.10)
Shallow soil		0.047	0.030	0.046
		(0.10)	(0.09)	(0.09)
Medium deep soil		-0.011	-0.016	0.004
		(0.10)	(0.09)	(0.08)
Conservation (dummy)		0.203**	0.160*	0.131
		(0.09)	(0.08)	(0.08)
Log of distance to plot		-0.063	-0.055	-0.064*
		(0.04)	(0.04)	(0.04)
Homestead plot (dummy)		0.014	0.127	0.108
		(0.15)	(0.15)	(0.15)
Plot size (tsimdi)		-0.029	-0.066	-0.051
		(0.05)	(0.05)	(0.05)
Crop grown - teff			0.393****	0.331****
			(0.10)	(0.09)
Crop grown - pulse or oilseed			0.113	0.079
			(0.18)	(0.19)
Crop grown - wheat			0.591****	0.552****
			(0.13)	(0.13)
Crop grown - barley			0.333**	0.310**
			(0.13)	(0.14)
Generalized residual				0.095
				(0.10)
Constant	7.424****	7.222****	6.964****	7.019****
	(0.02)	(0.20)	(0.23)	(0.24)
R^2	0.012	0.079	0.123	0.130
Number of Obs.	884	884	884	863
P-value	0.053	0.000	0.000	0.000

Note: * significant at 10%; ** significant at 5%; *** significant at 1%; and **** significant at 0.1%;
[+] Standard errors, corrected for clustering at household level, are included in parentheses..
[++] Dependent variable is log of output value per hectare.
[+++] Counterfactual: Owner-operated plots of tenants

Appendix 5: Linear household fixed effects estimates of determinants of yield value per hectare – the role of possession of land certificates by the landlord

Explanatory Variable	Model_1 b/(se)	Model_2 b/(se)	Model_3 b/(se)	Model_4 b/(se)
Landlord with land certificate	-0.257*** (0.09)	-0.241*** (0.09)	-0.213** (0.09)	-0.316** (0.14)
Landlord with no land certificate	-0.109 (0.12)	-0.034 (0.11)	-0.055 (0.11)	-0.146 (0.16)
Plot slope - flat		0.434**** (0.12)	0.409**** (0.12)	0.448**** (0.12)
Plot slope - foot hill		0.376*** (0.12)	0.324*** (0.11)	0.393**** (0.10)
Shallow soil		0.050 (0.10)	0.035 (0.09)	0.048 (0.09)
Medium deep soil		-0.020 (0.10)	-0.024 (0.09)	-0.004 (0.08)
Conservation (dummy)		0.193** (0.09)	0.151* (0.08)	0.123 (0.08)
Log of distance to plot		-0.070* (0.04)	-0.061 (0.04)	-0.068* (0.04)
Homestead plot (dummy)		-0.006 (0.15)	0.115 (0.15)	0.099 (0.15)
Plot size (tsimdi)		-0.025 (0.05)	-0.066 (0.05)	-0.050 (0.05)
Crop grown - teff			0.411**** (0.10)	0.351**** (0.09)
Crop grown - pulse or oilseed			0.125 (0.18)	0.092 (0.19)
Crop grown - wheat			0.598**** (0.13)	0.560**** (0.13)
Crop grown - barley			0.341** (0.13)	0.318** (0.14)
Generalized residual				0.076 (0.10)
Constant	7.431**** (0.02)	7.264**** (0.21)	6.995**** (0.23)	7.034**** (0.24)
R^2	0.016	0.079	0.122	0.130
Number of Obs.	990	990	990	866
P-value	0.036	0.000	0.000	0.000

Note: * significant at 10%; ** significant at 5%; *** significant at 1%; and **** significant at 0.1%;
[+] Standard errors, corrected for clustering at household level, are included in parentheses..
[++] Dependent variable is log of output value per hectare.
[+++] Counterfactual: Owner-operated plots of tenants

Appendix 6: Linear household fixed effects estimates of determinants of yield value per hectare – the role of being pure or cultivator landlord

Explanatory Variables	Model_1 b/(se)	Model_2 b/(se)	Model_3 b/(se)	Model_4 b/(se)
Pure landlord	-0.237***	-0.188**	-0.172**	-0.275*
	(0.09)	(0.08)	(0.08)	(0.14)
Cultivator landlord	-0.017	0.003	-0.026	-0.125
	(0.12)	(0.13)	(0.13)	(0.18)
Plot slope - flat		0.423****	0.401****	0.440****
		(0.11)	(0.12)	(0.12)
Plot slope - foot hill		0.367***	0.317***	0.386****
		(0.11)	(0.11)	(0.10)
Shallow soil		0.051	0.035	0.045
		(0.10)	(0.09)	(0.09)
Medium deep soil		-0.009	-0.016	0.002
		(0.10)	(0.09)	(0.08)
Conservation (dummy)		0.196**	0.152*	0.124
		(0.09)	(0.08)	(0.08)
Log of distance to plot		-0.071*	-0.060	-0.068*
		(0.04)	(0.04)	(0.04)
Homestead plot (dummy)		-0.007	0.118	0.101
		(0.15)	(0.15)	(0.15)
Plot size (tsimdi)		-0.023	-0.064	-0.049
		(0.05)	(0.05)	(0.05)
Crop grown - teff			0.415****	0.355****
			(0.10)	(0.09)
Crop grown - pulse or oilseed			0.120	0.088
			(0.19)	(0.19)
Crop grown - wheat			0.602****	0.567****
			(0.13)	(0.13)
Crop grown - barley			0.343**	0.322**
			(0.13)	(0.14)
Generalized residual				0.082
				(0.10)
Constant	7.430****	7.261****	6.989****	7.030****
	(0.02)	(0.20)	(0.23)	(0.24)
R^2	0.017	0.075	0.132	0.129
Number of Obs.	890	890	890	867
P-value	0.000	0.000	0.000	0.000

Note: * significant at 10%; ** significant at 5%; *** significant at 1%; and **** significant at 0.1%;
[+] Standard errors, corrected for clustering at household level, are included in parentheses..
[++] Dependent variable is log of output value per hectare.
[+++] Counterfactual: Owner-operated plots of tenants

Appendix 7: Linear household fixed effects estimates of determinants of yield value per hectare – kinship and gender interaction effect

Explanatory Variable	Model_1 b/se	Model_2 b/se	Model_3 b/se	Model_4 b/se
Female kin landlord	-0.227**	-0.182*	-0.182*	-0.286*
	(0.10)	(0.10)	(0.09)	(0.15)
Male kin landlord	-0.051	-0.024	0.004	-0.133
	(0.09)	(0.10)	(0.10)	(0.13)
Plot slope - flat		0.270***	0.251***	0.278***
		(0.09)	(0.09)	(0.09)
Plot slope - foot hill		0.251**	0.204**	0.241**
		(0.10)	(0.09)	(0.09)
Shallow soil		-0.083	-0.070	-0.072
		(0.08)	(0.08)	(0.08)
Medium deep soil		-0.176**	-0.145*	-0.173**
		(0.08)	(0.08)	(0.08)
Conservation (dummy)		0.044	0.031	0.025
		(0.08)	(0.07)	(0.08)
Log of distance to plot		-0.109***	-0.108***	-0.108***
		(0.04)	(0.03)	(0.03)
Homestead plot (dummy)		-0.002	0.061	0.070
		(0.16)	(0.15)	(0.16)
Plot size (Tsimdi)		-0.046	-0.068	-0.055
		(0.05)	(0.05)	(0.05)
Crop grown - TEFF			0.264**	0.219**
			(0.10)	(0.10)
Crop grown - pulse or oilseed				0.166 0.133
			(0.12)	(0.13)
Crop grown - wheat			0.342***	0.317***
			(0.11)	(0.11)
Crop grown - barley			0.098	0.069
			(0.11)	(0.11)
Generalized residual				0.083
				(0.09)
Constant	7.514****	7.761****	7.594****	7.632****
	(0.02)	(0.16)	(0.18)	(0.18)
R^2	0.015	0.089	0.118	0.126
Number of Obs.	632	632	632	608
P-value	0.000	0.000	0.000	0.000

Note: * significant at 10%; ** significant at 5%; *** significant at 1%; and **** significant at 0.1%;
[+] Standard errors, corrected for clustering at household level, are included in parentheses..
[++] Dependent variable is log of output value per hectare.
[+++] Counterfactual: Owner-operated plots of kin tenants

Appendix 8: Linear household fixed effects estimates of determinants of yield value per hectare – kinship and off-farm income access interaction effect

	Model_1 b/se	Model_2 b/se	Model_3 b/se	Model_4 b/se
Kin landlord with off-farm Income source	0.021 (0.13)	0.075 (0.12)	0.067 (0.12)	-0.051 (0.20)
Kin landlord with no off-farm income source	-0.182 (0.12)	-0.113 (0.12)	-0.075 (0.12)	-0.183 (0.19)
Plot slope - flat		0.572**** (0.15)	0.536**** (0.15)	0.553**** (0.15)
Plot slope - foot hill		0.437*** (0.14)	0.371*** (0.13)	0.405*** (0.13)
Shallow soil		0.003 (0.12)	0.010 (0.12)	0.006 (0.13)
Medium deep soil		0.048 (0.12)	0.063 (0.11)	0.034 (0.11)
Conservation (dummy)		0.158 (0.11)	0.110 (0.10)	0.104 (0.10)
Log of distance to plot		-0.110** (0.04)	-0.108** (0.04)	-0.109** (0.04)
Homestead plot (dummy)		-0.122 (0.18)	-0.032 (0.19)	-0.031 (0.19)
Plot size (Tsimdi)		0.046 (0.06)	0.019 (0.06)	0.034 (0.06)
Crop grown - TEFF			0.372*** (0.12)	0.330** (0.13)
Crop grown - pulse or oilseed			0.072 (0.26)	0.035 (0.27)
Crop grown - wheat			0.583*** (0.18)	0.561*** (0.19)
Crop grown - barley			0.351* (0.19)	0.342* (0.20)
Generalized residual				0.080 (0.12)
Constant	7.462**** (0.03)	7.268**** (0.25)	7.009**** (0.29)	7.044**** (0.31)
R^2	0.005	0.094	0.134	0.139
Number of Obs.	602	602	602	578
P-value	0.278	0.000	0.000	0.000

Note: * significant at 10%; ** significant at 5%; *** significant at 1%; and **** significant at 0.1%;
[+] Standard errors, corrected for clustering at household level, are included in parentheses..
[++] Dependent variable is log of output value per hectare.
[+++] Counterfactual: Owner-operated plots of kin tenants

Appendix 9: Linear household fixed effects estimates of determinants of yield value per hectare – kinship and certificate interaction effect

Explanatory Variables	Model_1 b/se	Model_2 b/se	Model_3 b/se	Model_4 b/se
Kin landlord with land certificate	-0.125 (0.11)	-0.106 (0.11)	-0.057 (0.11)	-0.132 (0.18)
Kin landlord with no Land certificate	0.002 (0.13)	0.090 (0.14)	0.064 (0.13)	0.012 (0.21)
Plot slope - flat		0.522**** (0.15)	0.493*** (0.15)	0.527**** (0.15)
Plot slope - foot hill		0.368*** (0.13)	0.304** (0.12)	0.347*** (0.12)
Shallow soil		-0.032 (0.12)	-0.024 (0.12)	-0.037 (0.12)
Medium deep soil		-0.019 (0.11)	0.006 (0.10)	-0.027 (0.10)
Conservation (dummy)		0.109 (0.10)	0.060 (0.09)	0.054 (0.09)
Log of distance to plot		-0.110** (0.04)	-0.110*** (0.04)	-0.108** (0.04)
Homestead plot (dummy)		-0.106 (0.18)	-0.028 (0.18)	-0.020 (0.19)
Plot size (Tsimdi)		0.035 (0.06)	-0.001 (0.06)	0.013 (0.06)
Crop grown - TEFF			0.367*** (0.12)	0.328** (0.13)
Crop grown - pulse or oilseed			0.203 (0.22)	0.171 (0.23)
Crop grown - wheat			0.572*** (0.17)	0.553*** (0.18)
Crop grown - barley			0.344* (0.18)	0.340* (0.20)
Generalized residual				0.043 (0.12)
Constant	7.473**** (0.03)	7.394**** (0.24)	7.139**** (0.28)	7.148**** (0.30)
R^2	0.002	0.083	0.122	0.128
Number of Obs.	602	602	602	578
P-value	0.000	0.000	0.000	0.000

Note: * significant at 10%; ** significant at 5%; *** significant at 1%; and **** significant at 0.1%;
[+] Standard errors, corrected for clustering at household level, are included in parentheses..
[++] Dependent variable is log of output value per hectare.
[+++] Counterfactual: Owner-operated plots of kin tenants

Appendix 10: Linear household fixed effects estimates of determinants of yield value per hectare – kinship and pure landlord interaction effect

Explanatory Variables	Model_1 b/se	Model_2 b/se	Model_3 b/se	Model_4 b/se
Kin cultivator landlord	0.049	0.087	0.115	-0.072
	(0.15)	(0.16)	(0.15)	(0.21)
Kin pure landlord	-0.231**	-0.172*	-0.166*	-0.370***
	(0.09)	(0.09)	(0.09)	(0.14)
Plot slope - flat		0.371****	0.341***	0.368****
		(0.10)	(0.10)	(0.10)
Plot slope - foot hill		0.329***	0.280**	0.326***
		(0.12)	(0.11)	(0.11)
Shallow soil		-0.065	-0.047	-0.058
		(0.09)	(0.09)	(0.09)
Medium deep soil		-0.053	-0.040	-0.073
		(0.10)	(0.09)	(0.09)
Conservation (dummy)		0.139	0.122	0.116
		(0.09)	(0.09)	(0.09)
Log of distance to plot		-0.123***	-0.118***	-0.121***
		(0.04)	(0.04)	(0.04)
Homestead plot (dummy)		-0.072	0.018	0.027
		(0.17)	(0.17)	(0.17)
Plot size (Tsimdi)		-0.014	-0.028	-0.014
		(0.05)	(0.05)	(0.05)
Crop grown - TEFF			0.308***	0.258**
			(0.11)	(0.11)
Crop grown - pulse or oilseed			-0.015	-0.063
			(0.19)	(0.19)
Crop grown - wheat			0.394****	0.362***
			(0.11)	(0.12)
Crop grown - barley			0.172	0.158
			(0.12)	(0.13)
Generalized residual				0.155
				(0.09)
Constant	7.526****	7.605****	7.401****	7.464****
	(0.02)	(0.19)	(0.21)	(0.21)
R^2	0.016	0.098	0.133	0.146
Number of Obs.	602	602	602	578
P-valuse	0.000	0.000	0.000	0.000

Note: * significant at 10%; ** significant at 5%; *** significant at 1%; and **** significant at 0.1%;
[+] Standard errors, corrected for clustering at household level, are included in parentheses..
[++] Dependent variable is log of output value per hectare.
[+++] Counterfactual: Owner-operated plots of kin tenants

Appendix 11: Linear household fixed effects estimates of determinants of yield value per hectare – non-kinship and gender interaction effect

Explanatory Variables	Model_1 b/se	Model_2 b/se	Model_3 b/se	Model_4 b/se
Non-kin female landlord	-0.309**	-0.282**	-0.218*	-0.267
	(0.13)	(0.12)	(0.13)	(0.22)
Non-kin male landlord	-0.361**	-0.308**	-0.261**	-0.351
	(0.15)	(0.13)	(0.13)	(0.22)
Plot slope - flat		0.316**	0.318**	0.351**
		(0.15)	(0.15)	(0.15)
Plot slope - foot hill		0.299*	0.288*	0.379***
		(0.17)	(0.16)	(0.14)
Shallow soil		-0.037	-0.093	-0.047
		(0.14)	(0.14)	(0.14)
Medium deep soil		-0.111	-0.155	-0.078
		(0.15)	(0.14)	(0.12)
Conservation (dummy)		0.258	0.176	0.130
		(0.17)	(0.14)	(0.13)
Log of distance to plot		-0.032	0.004	-0.010
		(0.06)	(0.06)	(0.06)
Homestead plot (dummy)		0.122	0.291	0.248
		(0.21)	(0.21)	(0.21)
Plot size (Tsimdi)		-0.066	-0.147***	-0.124**
		(0.06)	(0.05)	(0.05)
Crop grown - TEFF			0.550***	0.487***
			(0.17)	(0.16)
Crop grown - pulse or oilseed			0.610	0.544
			(0.38)	(0.39)
Crop grown - wheat			0.749****	0.752****
			(0.22)	(0.20)
Crop grown - barley			0.686**	0.669**
			(0.27)	(0.26)
Generalized residual				0.059
				(0.17)
Constant	7.363****	7.224****	6.784****	6.811****
	(0.04)	(0.31)	(0.38)	(0.37)
R^2	0.030	0.080	0.164	0.177
Number of Obs.	448	448	448	431
P-value	0.000	0.000	0.000	0.000

Note: * significant at 10%; ** significant at 5%; *** significant at 1%; and **** significant at 0.1%;

[+] Standard errors, corrected for clustering at household level, are included in parentheses..

[++] Dependent variable is log of output value per hectare.

[+++] Counterfactual: Owner-operated plots of non-kin tenants

Appendix 12: Linear household fixed effects estimates of determinants of yield value per hectare – non-kinship and off-farm income access interaction effect

Explanatory Variables	Model_1 b/se	Model_2 b/se	Model_3 b/se	Model_4 b/se
Non-kin landlord with off-Farm income source	-0.389*** (0.14)	-0.366*** (0.14)	-0.317** (0.14)	-0.317 (0.29)
Non-kin landlord with no Off-farm income source	-0.601*** (0.22)	-0.520*** (0.19)	-0.530*** (0.18)	-0.534 (0.34)
Plot slope - flat		0.378** (0.18)	0.364** (0.17)	0.416** (0.17)
Plot slope - foot hill		0.379* (0.20)	0.335* (0.18)	0.475*** (0.16)
Shallow soil		0.101 (0.18)	0.036 (0.16)	0.070 (0.16)
Medium deep soil		-0.021 (0.17)	-0.068 (0.16)	-0.012 (0.14)
Conservation (dummy)		0.286* (0.15)	0.206 (0.13)	0.139 (0.12)
Log of distance to plot		-0.028 (0.07)	0.015 (0.07)	-0.002 (0.06)
Homestead plot (dummy)		0.178 (0.22)	0.341 (0.23)	0.291 (0.23)
Plot size (Tsimdi)		-0.061 (0.06)	-0.113 (0.07)	-0.094 (0.07)
Crop grown - TEFF			0.505*** (0.16)	0.409*** (0.13)
Crop grown - pulse or oilseed			0.247 (0.33)	0.185 (0.35)
Crop grown - wheat			0.741**** (0.18)	0.691**** (0.16)
Crop grown - barley			0.615*** (0.20)	0.577*** (0.19)
Generalized residual				0.010 (0.22)
Constant	7.370**** (0.03)	7.065**** (0.30)	6.641**** (0.35)	6.708**** (0.33)
R^2	0.049	0.115	0.179	0.193
Number of Obs.	388	388	388	378
P-value	0.000	0.000	0.000	0.000

Note: * significant at 10%; ** significant at 5%; *** significant at 1%; and **** significant at 0.1%;
[+] Standard errors, corrected for clustering at household level, are included in parentheses..
[++] Dependent variable is log of output value per hectare.
[+++] Counterfactual: Owner-operated plots of non-kin tenants

Appendix 13: Linear household fixed effects estimates of determinants of yield value per hectare – non-kinship and certificate interaction effect

Explanatory Variables	Model_1 b/se	Model_2 b/se	Model_3 b/se	Model_4 b/se
Non-kin landlord with	-0.450****	-0.433****	-0.431****	-0.406
Land certificate	(0.13)	(0.11)	(0.13)	(0.28)
Non-kin landlord with	-0.522*	-0.430*	-0.395*	-0.389
No land certificate	(0.27)	(0.23)	(0.21)	(0.35)
Plot slope - flat		0.337*	0.326*	0.376**
		(0.19)	(0.18)	(0.18)
Plot slope - foot hill		0.372*	0.334*	0.470***
		(0.20)	(0.18)	(0.16)
Shallow soil		0.126	0.057	0.090
		(0.18)	(0.17)	(0.16)
Medium deep soil		-0.024	-0.076	-0.022
		(0.17)	(0.16)	(0.14)
Conservation (dummy)		0.263*	0.185	0.118
		(0.15)	(0.14)	(0.13)
Log of distance to plot		-0.047	-0.000	-0.016
		(0.07)	(0.07)	(0.06)
Homestead plot (dummy)		0.118	0.305	0.255
		(0.24)	(0.24)	(0.24)
Plot size (Tsimdi)		-0.061	-0.115	-0.097
		(0.06)	(0.07)	(0.07)
Crop grown - TEFF			0.550***	0.455***
			(0.16)	(0.14)
Crop grown - pulse or oilseed			0.273	0.209
			(0.33)	(0.34)
Crop grown - wheat			0.760****	0.713****
			(0.18)	(0.16)
Crop grown - barley			0.625***	0.589***
			(0.20)	(0.19)
Generalized residual				-0.010
				(0.22)
Constant	7.375****	7.158****	6.699****	6.765****
	(0.03)	(0.31)	(0.34)	(0.33)
R^2	0.045	0.106	0.176	0.187
Number of Obs.	388	388	388	379
P-value	0.000	0.000	0.000	0.000

Note: * significant at 10%; ** significant at 5%; *** significant at 1%; and **** significant at 0.1%;
[+] Standard errors, corrected for clustering at household level, are included in parentheses..
[++] Dependent variable is log of output value per hectare.
[+++] Counterfactual: Owner-operated plots of non-kin tenants

Appendix 14: Linear household fixed effects estimates of determinants of yield value per hectare – non-kinship and pure landlord interaction effect

Explanatory Variables	Model_1 b/se	Model_2 b/se	Model_3 b/se	Model_4 b/se
Non-kin cultivator landlord	-0.110	-0.068	-0.203	-0.128
	(0.22)	(0.23)	(0.21)	(0.33)
Non-kin pure landlord	-0.598****	-0.536****	-0.476***	-0.397
	(0.17)	(0.15)	(0.15)	(0.33)
Plot slope - flat		0.320*	0.322*	0.372**
		(0.19)	(0.18)	(0.18)
Plot slope - foot hill		0.342*	0.316*	0.446***
		(0.20)	(0.18)	(0.17)
Shallow soil		0.117	0.047	0.077
		(0.17)	(0.16)	(0.15)
Medium deep soil		-0.012	-0.071	-0.026
		(0.17)	(0.16)	(0.13)
Conservation (dummy)		0.275*	0.190	0.124
		(0.15)	(0.14)	(0.13)
Log of distance to plot		-0.043	0.002	-0.011
		(0.07)	(0.07)	(0.07)
Homestead plot (dummy)		0.162	0.328	0.282
		(0.24)	(0.25)	(0.25)
Plot size (Tsimdi)		-0.046	-0.103	-0.085
		(0.06)	(0.07)	(0.07)
Crop grown - TEFF			0.534***	0.444***
			(0.16)	(0.14)
Crop grown - pulse or oilseed			0.238	0.172
			(0.34)	(0.37)
Crop grown - wheat			0.737****	0.697****
			(0.17)	(0.16)
Crop grown - barley			0.617***	0.589***
			(0.20)	(0.18)
Generalized residual				-0.074
				(0.25)
Constant	7.375****	7.120****	6.687****	6.739****
	(0.03)	(0.32)	(0.36)	(0.35)
R^2	0.051	0.111	0.176	0.188
Number of Obs.	388	388	388	379
P-value	0.000	0.000	0.000	0.000

Note: * significant at 10%; ** significant at 5%; *** significant at 1%; and **** significant at 0.1%;

[+] Standard errors, corrected for clustering at household level, are included in parentheses..

[++] Dependent variable is log of output value per hectare.

[+++] Counterfactual: Owner-operated plots of non-kin tenants