Moral Hazard, Adverse Selection and Sharecropping in Ethiopia

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Abstract

Sharecropping is commonly practised in developing countries but the debate over the existence and magnitude of its disincentive effects on productivity remains controversial under competing contracting models. We address the two issues by analysing the effects of sharecropping contracts on tenant's performance in two environments: selection bias into share tenancy due to cultivator heterogeneity and adverse selection from landowner side on land characteristics. Using longitudinal data collected for owner-cum-sharecroppers in Amhara, Ethiopia, controlling for the selection biases, we found significantly negative effects of sharecropping contracts on production outcomes and input provision. However, sharecropping inefficiency can be mitigated by cultivator-specific characteristics as household size, gender and productive assets, making policy suggestions on reducing market imperfections more relevant.

1 Introduction

Sharecropping is a common type of agricultural land contract in which a tenant and a landowner share the final yields without sharing responsibility for all inputs. In practice, sharecropping is prevalent and persistent in agriculture, particularly in developing countries. Production inputs applied by the tenant are often not verifiable and hence, not enforceable by the landowner. When the cultivator has to share with the landowner a proportion of returns, his interest to cultivate intensively on the rented land lowers. Theoretical claims about the disincentive effects and efficiency losses, together with its prevalent existence of sharecropping contract in developing countries make share tenancy unambiguously one of the most controversial topics in agricultural economics.

Following the classical argument about the inefficiency of sharecropping - “hurtful to the whole society”, by Adam Smith, Marshall (1920) to Johnson (1950), the modern theories of sharecropping focus on the emergence and disincentive effects of share tenancy. Among others, these are (i) risk-sharing and incentive trade-off (Cheung, 1969a, 1969b; Stiglitz, 1974; Braverman and Stiglitz, 1982); (ii) information-rent trade-off (Hallagan, 1978; Otsuka and Hayami, 1988); (iii) opportunistic behaviors originating from double moral hazard (Reid, 1976; Aswaran and Kotwal, 1985; Ghatak and Pandey, 2000); (iv) limited liability (Shetty, 1988; Basu, 1992; Laffont, 1995; Sengupta, 1997; Ray and Singh, 2004; Banerjee et. al, 2002; Jacoby and Mansuri, 2009); and (v) incentives and land long-term fertility trade-off (Dubois, 2004). Despite large variation in theoretical arguments, there appears to be a consensus that sharecropping is a suboptimal solution which fails to induce technically optimal incentives, namely the Marshallian inefficiency.

In this paper, we focus on providing a credible estimation of the effect of sharecropping on agricultural outcomes. We ask whether share tenancy results in inefficient productivity and resource allocation regardless of underlying contractual mechanism. Particularly, we examine if, within a given Ethiopian farming household, productivity and labour input on sharecropped-in plots are lower than on owner-cultivated plots. We use information from the Ethiopian Rural Household Survey in 1999 and 2004 to obtain household economic conditions, demographics and plot-specific features. The group of landlords and of sharecroppers may have different farming abilities in general and hence, there exists the selection bias into sharecropping contracts. We use household fixed effects for the group of owner-cum-sharecroppers to purge this bias. However, even if resources allocations are efficient within cultivating households, productivity on sharecropped-in plots can still be lower than that on owner-cultivated plots if the landowner sharecrops out low-quality land. We balance observed plot characteristics between two types of plots and use propensity score weighting with regression adjustment to identify productivity discrepancy due to adverse selection.

Controlling for the cultivator heterogeneity in farming abilities, we find that the share tenancy leads to lower yields and inefficient labour allocation of labour input. Yields on sharecropped-in plots are about 12% lower than that on owner-cultivated plots. The estimate for labour input suggests that labour supply of a household with multiple plots is about 11% lower on sharecropped-in plots than on owner-planted plots. We provide suggestive evidence on productivity inefficiency after controlling for the heterogeneity in plot quality. Compare with owner-cultivated plots of similar quality, productivity on sharecropped-in plots is still lower from 17% to 18%. To limit the effect of household heterogeneity, we restrict to the owner-cum-sharecropper sample and balance cultivators' characteristics as well as plot-specific observables.

This paper is broadly related to a large body of empirical literature on the Marshallian inefficiency debate - whether sharecropping is less efficient than owner-cultivating or fixed rental contracts. Empirical evidence is inconclusive whether the disincentive effects and productivity losses are present (Hayami and Otsuka, 1992; Otsuka, 2007). Not only the existence and magnitude of negative effects of crop sharing on productivity and input allocation vary significantly across different locations, they are also far from universal even for a specific site of interest. Recently, studies on sharecropping seek to establish particular circumstances under which share tenancy can be as efficient as owner-cultivation or fixed rental. Such institutions can be i) indigenous institutions as kinship ties between landowner and tenant (Sadoulet et al., 1994, 1997; Kassie and Holden, 2007, 2008; Ghebru and Holden, 2015), ii) monitoring frequency (Jacoby and Mansuri, 2009), iii) land-to-the-tiller policy (Aryal & Holden, 2012).

Among them, Kassie and Holden (2008) and Ghebru and Holden (2015) are particularly relevant for the case of Amhara, Ethiopia - our location of interest. The authors focus on the role of kinship ties as an indigenous institution on absorbing the negative effect of share tenancy. In comparison with these studies, we are interested in establishing a bound for the magnitude of sharecropping effects on agricultural outcomes across different periods of time, to examine, in general, whether these negative effects persist regardless changes in institutional environment. Among other things, we believe that the findings can help justify land policies in a broader scope as opposed to policies that respond to particular situations.

Additional features that help distinguish this study from the existing papers. First, our study examines the effect of share tenancy in two periods, before and after a land reform, to pinpoint the persistence of Marshallian inefficiency regardless of environmental changes. Among the papers mentioned, only Jacoby and Mansuri (2009) conducts such an investigation on a similar dataset in Pakistan. However, we deviate from them in that we are able to disentangle the impact of changes in household observables across time on productivity from that of sharecropping contracts. It is plausible that unobserved household farming abilities, which are always emphasized in the empirical literature, may not vary significantly during the short period of five years. Hence, their effects on productivity are almost negligible. This paper also adds to the existing literature by using the doubly robust propensity score weighting with regression adjustment to provide a robust estimation of Marshallian inefficiency under the potential adverse selection on land quality.

2 Background and Conceptual Framework

2.1 Institutional settings: two land reforms

Agriculture is the most important sector in the Ethiopian economy with sharecropping being a dominant form of agricultural contracts in Ethiopia since the second land reform in 1991. This sharing system had existed under the Abyssian empire, mostly disappeared from 1974 to 1991 and has widespread again in 1991 when the prohibition of land rental and exchange market was removed.

The land reform in 1975, based on the principles of justice and equality, aimed to address the severe exploitation by landlords in the past and promised a future that all Ethiopian peasants would have equal access and rights to cultivate on land. However this phase of tenancy reform was generally not successful with ambiguous and mixed outcomes. This was for two reasons. Firstly, land rental and exchange markets prohibited transferring land ownership together with growing population perpetuated the problem of land scarcity and food security. Secondly, assigning to peasants only usufruct ownership proved to be two-sided strategy. On the upside, the pre-1974 landless or renting-in land population benefited from increase in tenancy security. On the downside, the inheritable land policy and frequent redistribution decreased tenure security. Therefore, there were negative effects on the long-term investment incentive of farmers as a whole population, because they could be less confident of ensuring enjoyment the fruits of their efforts. These policies, together with collectivization had increasingly negative impacts on the Ethiopian agricultural sector and fundamentally transformed the feudal system of landlords and tribute become a state-controlled agrarian system.

When the military coup dismissed the Derg in 1991, it was expected by many international development organizations that post-communist Ethiopia, implementing a land titling system, would rapidly privatize land rights. However, it was also soon realized that the new government, despite some minor changes, would generally resist these pressures and continue using the old land policies of the Derg. In 1995, the government explicitly declared the state ownership of land by re-codifying the Ethiopian constitution (Article 40). The content was justified on the pillar of equity and justice in the sense that the state would act as a guarantor - protecting the vulnerable farmers from arbitrary eviction and exploitation by landowners. Yet, the constitution also granted the state authority the rights to appropriate land without payment for redistributive purposes.

Though the 1995 constitution, in general, meant continuing usage of the Derg policies with respect to tenancy system, there are also some new features. Firstly, three components of the 1975 Proclamation were removed: (i) the prohibition of use of hired labour, (ii) the prohibition of leasing out allocated land and (iii) the individual plot size limitation to 10 hectares. Secondly and perhaps more importantly, the constitution leaves it to the local farming authority (not the administrative authority) to determine land redistribution and, in some cases, land policies. The extent of de facto autonomy for the local authorities in land policy can be doubted due to the political-power dominance of the EPRDF party. However, this delegation of power still plays a crucial role in understanding the variability on land and tenancy patterns across Ethiopian rural areas. For example, Oromia region explicitly sets out land redistribution scheme in advance while in Tigray, there is no specified rule. Two others (Amhara and the SNNPR) practice redistribution according to the regional demands and "scientific" suggestions based on yields.

2.2 Data

Data source

Our empirical study relies on the Ethiopia Rural Household Survey (ERHS), which is supervised by the Addis Ababa University (Economics/AAU), the Centre for Studies of African Economies (CSAE), University of Oxford and the International Food Policy Research Institute (IFPRI). The data are well-documented and broadly representative for the diversity in the farming systems in Ethiopia (Dercon, 2006). At the national wide level, the first round in 1999 collects data from 1299 households in four regions and 18 villages. The ERHS-2004 includes 15 of the 18 surveyed villages in ERHS-1999. The tracing rule across rounds ensures a household is continually tracked in the sample as long as its members, that is included in the ERHS-1999, are living in the village even if the household head had left or died (Dercon, 2006). Attrition at the household level is low at about 5.2% between 1999 and 2004.

We conduct empirical analysis on the sample of Amharic farms because information and the sample size in this region is the most fully provided compared to the three other regions. The sub-sample of Amhara farmers, we use in the following analysis have the same set of surveyed PAs and households during 1999-2004. Information extracted from the data is rich and available on household characteristics, consumption and income, asset ownership with focus on livestock, and land tenure and land ownership. Both ERHS-1999 and ERHS-2004 provide information about plot-level productivity which is used to conduct main empirical analysis about the effect of sharecropping on productivity. Moreover, we also use plot-level data on labour and non-labour input in ERHS-1999 to further test the disincentive effects of share tenancy.

Household demographics by tenancy status

Table 1 reports basic information on household demography, cultivated land characteristics and key factors of agricultural production in 1999 for 427 farming households in Amhara across seven Peasant Associations. In the two first columns of Table 1, our descriptive data are highly consistent and comparable with results for household characteristics from previous studies on Ethiopian tenancy system (Deininger and Ghebru, 2011; Ghebru and Holden, 2015), showing distinguishable features of the reverse tenancy system in Ethiopia. Generally, fixed renters in and sharecroppers come from wealthier, younger, more educated households and those households also rely on agriculture more than their counterparts. For example, on average, 53.9% of household heads of the leasing in households are literate while the figure for the leasing out group is just around 18.9%. Leasing in households own significantly higher levels of productive assets than the landowners, being around four times higher in all available indicators, such as nominal value of livestocks (3791.5 vs. 1071.9 Birr/household) and numbers of oxen (0.4 vs. 1.9). Data also confirms the existence of the culture taboo against woman in Ethiopia (MUT, 2003; Holden et al., 2011; Ghebru and Holden, 2015). Specifically, female-headed households are more likely to lease out their land to male-headed renters in, i.e., 44.2% of households leasing out land have male heads while the number for the leasing in is 93%.

The third column for pure owner-cultivators strengthens our observation for reverse sharecropping situation in Ethiopia. While economic conditions of pure owner-cum-renters and landlords are both relatively lower than that of leasing-in households, the figures for the first group appear to be intermediate in most of the categories. Specifically, on the one hand, pure owner-cultivators come from larger-size households, have higher level of consumption, are more educated and possess more productive assets than leasing out households. On the other hand, these numbers for pure owner-cultivators are lower compared with those of leasing in farmers. It suggests that, on average, the group of land-abundant households with poor economic conditions are more likely to lease out land, and pure owner-cultivators with sufficient economic resources stay in autarkic regime.

While statistics for household characteristics indicate clear differences across three groups, distinction in land characteristics is less pronounced, exception of total cultivated area. The renting in households with larger household size and more productive assets tend to cultivate on significantly greater land area compared with the leasing out households (2.1 hectare vs. 1.1 hectare) and also with the pure owner-cultivators (1.5 hectare). However, regarding observables land characteristics, such as perceived quality and slope, these values are highly comparable across all groups of households.

Last rows of Table 2 depict major changes in household-specific features across two survey rounds, implying that the land registration process in 2000 in Amhara has sharply improved farmers' perception about tenure security and women's access to and control of land. In 2004, 31% of leasing in households expected to cultivate on the same size of land in next five years, compared to 24% among leasing in households, while the numbers in 1999 are around 5% and 15%, respectively. In terms of accessing to land, the renting out group with 63% female-headed households appear to be benefited the most from the reform. Specifically, within the group of renters out, the proportion of household heads having farming as primary occupation increasing significantly from 32% in 1999 to 77% in 2004, and the total cultivated land area in 2004 is around 25% higher, whereas the changes for the renters in and autarkic households are only 2% and 4%. Despite the considerable changes in land-related variables for the leasing out group, changes in household characteristics, such as off-farm opportunities, levels of productive assets and consumptions, are somewhat more positive and pronounced for the leasing in households and pure owner-cultivators.

3 Main empirical results

3.1 Identification strategy

To examine the effect of sharecropping contracts on productivity, we compare outcomes from sharecropped-in plots to owner-cultivated plots. Data from the two survey rounds provide a sufficiently large sample of owner-cum-sharecroppers to conduct empirical tests. The ERHS surveys track household identities but not plot identities. We pool all plot observations in two ways: i) the household-based sample which groups all plots of a given household irrespective of survey rounds, ii) the household-round-based sample which group plots of a given household with respect to survey rounds. We seek to isolate deviations in the outcome on sharecropped-in plots from the mean outcome within a given household. Correspondingly, two specifications are used to elicit the effects of sharecropping on productivity.

In the first specification, to test for incentive effects of crop sharing contracts on productivity, we estimate the household unobserved effects model:

$$\textbf{(1)}\ Y_{ij} = \alpha_i + \beta\, C_{ij} + \gamma'\, X_{ij} + \rho'\, P_{ij} + \tau T + e_{ij}$$

C_{ij} is a tenancy dummy that equals one if plot j cultivated by farmer i is sharecropped-in and zero if owner-cultivated, thus, the coefficient of interest is β; Y_{ij} is the outcome Y realized on plot j by cultivator i; α_i is household-level dummy that captures unobserved household-level effects, such as farming ability and knowledge; X_{ij} denotes the time-varying observables of household i who cultivates plot j; P_{ij} represents observed plot-specific features of plot j cultivated by household i; T is a time dummy that equals one if the plot observation comes from the fifth round in 1999 and zero otherwise.

There are some remarks about the specification (1). First, we separate household fixed effects, captured by α_i, for each farming household. Plot observations are pooled across two survey rounds, hence, it is necessary to assume that α_i is unchanged over time. This is a reasonable assumption given that the time span of five years is short. Second, since changes in household characteristics across the two rounds are not negligible, we include the vector X_{ij} to examine effects of household-level factors on productivity. Importantly, we expect a non-zero correlation between characteristics of owner-cum-sharecropper and contractual decisions, i.e., $E(X_{ij}\ |C_{ij}=1) \neq 0$. Specifically, regarding economic conditions, our data suggest that sharecroppers are, on average, wealthier in terms of having higher level of productive assets, come from larger households. The inclusion of X ij allows us to examine whether leasing in land, which help farmers to obtain optimal operational land size, may mitigate the negative effect of crop sharing contracts on productivity. Jacoby and Mansuri (2009) use the same specification for the productivity effects of sharecropping contracts but they did not attempt to disentangle effects of a i and X i on productivity, possibly due to the lack of time variation of household observables. We correct standard errors by clustering at the household level to deal with possible serial correlation in the error terms because when pooling observations, one plot may be surveyed in both two rounds.

In the second specification, we separate plots by year and run the following household unobserved effects model:

$$\textbf{(2)}\ Y_{ijt} = \alpha_{it} + \beta\, C_{ijt} + \gamma' X_{it} + \rho' P_{ijt} + \varepsilon_{ijt}$$

in which t={1,2}, t=1 for observations from ERHS-1999 and t=2 for those from ERHS-2004. The interpretation of covariates is similar to specification (1) except that the subscript *t* which indicates we treat household *i* from ERHS-1999 and ERHS-2004 as two different households. An advantage of the second model is that time separation allows for changes in household fixed effects, α_{it}, across five years. However, to elimate α_{it}, the vector of X_i is also swept away by the fixed effect transformation and cannot be disentangled from unobserved effects.

The decision on pooling observations does not change our identification strategy and concerns about the biasedness of β remains. Hence, we use notations from the first specification. The similar reasons apply for the second specification. The first source of bias comes from selection into sharing contracts which is correlated to tenant's unobserved characteristics, α_i, i.e., $E(\alpha_i|C_{ij}=1)\neq 0$. To control for this selection bias, we limit the sample to that of owner-cum-sharecropper households, who operate multiple plots, both owned and sharecropped-in (Bell, 1977; Shaban, 1987; Jacoby and Mansuri, 2009; Deininger et. al, 2013). Different from the standard assumption that sharecroppers' characteristics are inferior to those of their counterparts, i.e., $E(\alpha_i \mid C_{ij}=1)<0$. For example, sharecropping models with limited liability (Laffont and Matoussi, 1995; Banerjee et al., 2002) suggest that wealthy tenants, who have higher level of productive assets, are less likely to sharecrop. In the reverse tenancy system in Amhara, as shown in the descriptive statistics, it is very likely that $E(\alpha_i|C_{ij}=1)>0$, e.g. sharecroppers are, on average, wealthier than landowners.

Third, it is necessary to assume that the history of productivity on a given plot does not determine the contractual decision of the landlord in the future, since otherwise the estimate β would be biased. Simultaneity exists if the landlord and the tenant can regularly renew or terminate a contract on the basis of observed productivity over the past. Though different regions impose different restrictions on the length of contracts, 65.35% of leasing contracts in our data are short term and last from one year to four years at most, with 62.53% for sharecropping and 74.05% for fixed rental, suggesting that contracts are regularly renewed. Unfortunately, the ERHS data do not allow us to know exactly whether the contract is renewed is a new contract.

3.2 Sharecropping effects on productivity

The six columns of Table 3 report the estimates of the coefficients of C_{ij}, i.e., the magnitude of Marshallian inefficiency on productivity. Our estimations control for essential plot characteristics: area, land quality, land slope and acquisition source (kinship ties). Significant changes in household observables in the transition table suggest the inclusion of these time-varying covariates, such as household size, head characteristics (age, sex and literacy) and productive assets (oxen, livestocks value). F-tests show that the included regressors are jointly significant in all equations at the 1% level. To allow for that year-specific unobserved factors affect both productivity and the regressors, a time dummy is included in all models exception of those run by the household-year basis. In the following analysis, we consider the most conservative strategy and include time dummy in all equations.

Column (3a)-(3d) show the estimated effects of share tenancy on productivity using the household-based sample. Regardless of different controls, the coefficients are significantly negative, indicating the presence of Marshallian inefficiency and that within owner-cum-sharecropper households, on average, productivity from sharecropped-in plots is lower than owner-cultivated plots. With share tenancy as the only covariate, gross revenue realized on sharecropped-in plots is around 20% lower than that on owner-farmed plots within a given household. Adding more control variables for plot and changes in household endowments in columns (3b), (3c) lowers the magnitude of productivity differential to around 18% and 15%, respectively, but does not change the results qualitatively. The magnitude of Marshallian inefficiency is approximately 16% in column (3d) when including both household and plot characteristics. All plot-specific observables have expected signs and are statistically significant. High quality and flat slope significantly increase yields. In addition, the significantly negative coefficient of plot size is consistent with the theory and empirical evidence on the inverse farm size-productivity relationship in agriculture (Carter, 1984; Barret, 1996). Among the household observables, the coefficient of the household head's gender is negative in both column (3b) and (3d), indicating that productivity on plots cultivated by female-headed households would be from 29% to 37% higher than those cultivated by male-headed households. The estimates of gender effects seems to stand in contrast to does not necessarily suggest that plots cultivated by male-headed households are more productive than by the female-headed. Indeed, these results are possibly due to the fact that female-headed farms are targeting beneficiaries of land reforms, thus are more likely to have access or receive agricultural extension, which, in turn, positively affects productivity.

Column (3e) and (3f) report estimates of Marshallian inefficiency, using the household-year sample. Note that the use of the household-year sample limits the set of explanators in the household fixed effects to plot characteristics $\{P_{ij}\}$. The results suggest that in a given owner-cum-sharecropper farm, productivity on sharecropped-in plots is approximately from 12% to 19% lower than on owner-cultivated plot, depending on controlling for a full set of covariates or including only the dummy of share tenancy. These coefficients are also statistically significant at the level of 1% and 5%, respectively.

4 Discussion and Additional Results

This section extend the previous result to examine the disincentive effects of sharecropping on production inputs. In addition, we re-examine the previous results on productivity in the presence of additional market failures, such as adverse selection and market distortions caused by land reform. This is particularly relevant for policy because the suggested inefficiency of sharecropping is one of the main rationale for land reform in developing countries.

4.1 Sharecropping effects on Labour and non-labour inputs

The regressions thus far have estimated the effects of share tenancy on productivity. We have used gross yields as the indicator for productivity, which can be noisy due to the inclusion of production costs. A complementary test for the existence of Marshallian inefficiency is to test the disincentive effects of sharecropping on labour supply. Among the two surveys, only ERHS-1999 provides information on plot-level labor and non-labor inputs. Labour input is disaggregated by characteristics (gender and age) and by tasks (weeding, sowing, harvesting and threshing), but not by source (hired, shared or family). We initially sum all types of labour and take its logs. As the previous estimation, we identify the coefficient of share tenancy by isolating deviations of labour supply on sharecropped-in plots from the mean labour provision in a given household. The dependent variables are: i) total labour input, ii) labour input excluded child labour, iii) hard- or easy-to-monitor tasks.

Columns (5a) - (5e) show estimates of the effect of sharecropping on labour input from household fixed effects model. The estimates of Marshallian inefficiency are stable and consistent, both in magnitude and significance when including all controls for plot-specific features. As expected, there is a considerable gain in estimation precision compared to the results for productivity, indicating by sharply smaller standard errors in all regressions. Including or excluding child labour from the measure of labour supply does not alter our results in Column (5b) and (5c), i.e., total labour supply on sharecropped-in plots are around 21% lower than that on owned plots. The results are virtually identical when we further exclude child labour from measurement or disaggregate labour supply by tasks which can be easy or hard to monitor. The statistical significance of the coefficients on share tenancy in labour supply equations provides supporting evidence that sharecropping contracts have negative effects on agricultural outcomes. The effect on labour supply is also considerably larger than on yields, being around 21% (Column (5b) and (5c)) versus 12% (Column (4d) and (4f)).

4.2 Disincentive effects under adverse selection

The regression results so far have quantified the magnitude of disincentive effects of sharecropping by eliminating the household fixed effects. Fixed-effect estimates for productivity and labour input is not robust in the presence of adverse selection, which implies that leasing out plots often have lower unobserved quality than those cultivated by the landowner, i.e., $E(\varepsilon_{ij} \mid C_{ij} = 1) < 0$ (Jacoby, Mansuri, 2009). Specifically, even in the ideal situation of no Marshallian inefficiency, within a farm, productivity on sharecropped in plots can be still lower than on owner-cultivated plots because the latter is more fertile. However, in Amhara, it is common for landowners, particularly female-headed households, to reside away from the place in which they have land. Thus, we expect many quality attributes, such as texture and drainage, which are difficult to observe to the tenant, may not also be observed by the landowner, especially non-residential landowners.

Though this bias is unlikely to affect our results, the failure to account for adverse selection may lead us to overstate the disincentive effects of share tenancy. To deal with this bias, we employ propensity score method (PSM) by inverse weighting with regression adjustment (IPWRA) (Robins and Rotnitzky, 1995; Robins et al.,1995), based on plot-specific observables to balance plot charecteristics between sharecropped in plots and its counterparts. The identification strategy is to assume that controlling for propensity scores on household and/or plot observables, the leasing status of a plot, either owned-cultivated or sharecropped-in, is independent of potential outcomes realized on that plot. Specifically, we first estimate propensity scores for C_j by a logit model

$$\textbf{(3)} \qquad p(C_{ij}=1 \mid X_{ij},P_{ij}) = p(\lambda' X_{ij} + \mu' P_{ij} + \nu_{ij} > 0)$$

Additionally, we have two linear regressions for productivity as

$$\textbf{(4)} \qquad E(Y_{ij} \mid X_{ij},P_{ij}) = \tau'_C X_{ijC} + \varphi'_C P_{ijC}$$

in which C={0,1}, corresponding to two types of plots: owner-cultivated and sharecropped-in. To obtain estimates of (τ_0, φ_0) and (τ_1, φ_1) , we solve the inverse propensity weighting least squares

$$\min_{\tau_0,\varphi_0} \sum_{\mathscr{C}=0} \frac{(Y_{ij} - \tau_0'(X_i - \bar{X}) + \varphi_0'(P_j - \bar{P}))^2}{\hat{p}(\mathscr{C} = 1|X, P)}$$

$$\min_{\tau_1,\varphi_1} \sum_{\mathscr{C}_i=1} \frac{(Y_{ij} - \tau_0'(X_i - \bar{X}) + \varphi_0'(P_j - \bar{P}))^2}{1 - \hat{p}(\mathscr{C} = 1|X, P)}$$

In other words, we fit the weighted least squares models of the outcome for each level of treatment. Then we obtain the predicted outcomes for each unit which are treatment-specific. In the third step, we compute the average of the treatment-specific estimated outcomes. The contrasts of the averages are the estimands of the average treatments effects (ATEs). To calculate the average treatment effects on the treated (ATTs), we restrict the computations of the averages to the subgroup of treated individuals. We are interested in estimating ATTs.

Columns (3g) and (3h) present estimates of Marshallian inefficiency on productivity using IPWRA to address possible adverse selection. For model (3) of participation probability, we include only pre-determined covariates, but not decisional variables. Therefore, the vectors $\{X_{ij}, P_{ij}\}$ in the models (3) do not include acquisition source of land, which is likely to be a decision. For adjustment regressions, i.e., model (3), we preserve the most conservative strategy for the productivity regression, i.e., we use the full set of covariates $\{X_{ij}, P_{ij}\}$ and include time dummies and dummies for Peasant Associations throughout.

The covariates of the model (3), estimating propensity scores for contractual decisions, can be either only P_{ij} or both P_{ij} and X_{ij}, and their inclusion in logit is indicated in columns (3g) and (3h). We use bootstrapping with 100 repetitions to correct standard errors of the estimates. As it happens, the PSM negative estimates of β are larger in absolute terms than their fixed effects counterparts. Column (3h), using the most conservative strategy in both productivity regressions and logit equation, suggest that productivity on sharecropped-in plots is around 17% lower than on owner-cultivated plots. The results are consistent with the aforementioned argument that PSM fails to capture within-household unobserved effects, which are positively correlated with the contractual decision in the Amhara context, i.e., $E(\alpha_i, X_i \mid C_j = 1) > 0$. Indeed, the two PSM estimates of β are all statistically significant at the 1% level and only slightly different regardless of the covariates used in the participation model, ranging from 16% (Column (3g)) to 17% (Column (3h)). As it happens, either balancing plots on the plot-specific variables or on the household-specific variables alters the estimated magnitude of Marshallian inefficiency slightly. Adverse selection on plot quality, therefore, does not appear to have large impact on productivity.

First-stage adjusted regressions estimating yields separately for the two groups of owner-cultivated and sharecropped-in plots are reported in the columns (5a)-(5c) of Table 5. The dependent variable is plot yield in logs. The coefficients differ slightly in magnitude while their signs remain unchanged across different specifications and sub-samples. As expected, the inverse relationship between farm size and productivity is statistically significant. Additionally, there is a positive and statistically significant relationship between yields and plot and household characteristics, such as good quality of land, household ownership of oxen and education of household head. These predictors and time and village dummies are jointly strong: the test for joint significance in the most conservative specification (with household- and plot-level explanators and time and peasant association dummies) is significant at the level of 1%.

Logit equations predicting the participation into two types of cultivation are shown in the columns (5d) and (5e) of Table 5. The binary dependent is equal one for sharecropping and zero for owner-cultivation. Quality and size of plot as well as household residence (represented by village dummies), education and age of household heads are strong predictors for cultivatorship on a given plot. Specifically, consider the full specification with household and plot covariates, Column (5e) shows that within the owner-cum-sharecropper group, sharecropped in plots are more likely to be of larger size, lower land quality and cultivated by cultivators from households with highly educated and older heads. Again, the logit equations have high predictive power for the cultivating decision, with the correct classification rates being 68% (logit with plot-level predictors) and 69% (with plot and household level predictors).

Conclusion

By providing credible estimates of the causal effects of sharecropping on productivity and labour inputs, we contribute to the debate of the existence of Marshallian inefficiency. The main novelty is the ability to disentangle the effect of time-variant cultivator characteristics from within-household fixed effects and to estimate the magnitude of inefficiency in the presence of adverse selection on land characteristics by landowners.

The evidence indicates that yields on sharecropped-in land are, on average, 12% - 16% lower than that on owner-cultivated land. The estimates of sharecropping effects on productivity remain similar in the presence of different market imperfections. The negative effect of share tenancy on labour input - a less noisy measure, is even more pronounced, showing that labour supply on sharecropped-in plots is about 21% lower than on owner-cultivated plots. Moreover, we also find the evidence for i) the significantly inverse relationship between farm size and productivity, ii) the clear division between landlords and sharecroppers in terms of productive assets and demography.

These results altogether suggest that the constraints on contractual choices induced by policies can have large impacts on agricultural efficiency. Policies to reduce the likelihood of share tenancy may be worthwhile as this arrangement lowers productivity significantly. In particular, policies should aim at reducing market imperfections and improving land equity. Our suggestions for Ethiopia are different from other settings such as India (Deininger et al., 2013), Pakistan (Jacoby and Mansuri, 2009) and Tunisia (Laffont, 1995), where credit constraints of tenants are proved to be the main cause of sharecropping. In Ethiopia, shortage of labour supply and oxen of landlords plays the important role in the decision of renting out land (Deininger et al., 2008). Therefore, we suggest that first, woman and female-headed should have equal access to land as their male counterparts and cultural taboos preventing woman from some specific agricultural tasks should be removed. Second, policies to improve functioning of labour and oxen markets may increase productivity through two channels: i) better-accessed inputs have direct effects on productivity in the production function, ii) landlords lacking of productive assets and labour supply may less likely to engage in sharecropping, then, suffer less from productivity inefficiency.

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Appendix

Table 1:Household descriptive statistics decomposed by tenancy types in 1999

Types of households	Leasing out	Leasing in	Pure owner-cultivating	Owner-sharecropper
Household demographics				
Household size	3.885	6.076	5.273	5.957
Age of household heads	52.991	46.038	51.352	46.616
Highest grades taken by household heads	0.611	1.391	1.072	1.438
Male as household head (%)	44.248	92.994	76.923	92.754
Literate household head (%)	18.947	53.906	37.600	57.143
Having offarm income in last 12 months (%)	26.549	24.204	26.056	26.087
Having offarm income in last 4 months (%)	20.354	16.561	16.901	17.391
Household head having farming as primary occupation (%)	32.110	92.903	73.759	91.912
Poor households (%)	21.239	26.752	26.573	23.913
Households having any oxen (%)	28.037	93.590	84.397	93.431
Households having any loan in last 12 months (%)	38.835	26.087	39.850	26.446
Nominal values of livestock (Birr/household)	1071.956	3791.554	2789.015	3587.297
Number of tropical livestocks (Birr/household)	1.669	5.585	4.199	5.351
Number of oxen	0.402	1.955	1.511	1.912
Real consumption per capita (Birr/person)	116.376	102.049	107.611	101.238
Food expenditure per capita (Birr/person)	103.312	94.525	99.569	90.172
Land characteristics				
Total area cultivated (Hectare/household)	1.054	2.053	1.516	2.014
Total area with main crops (Hectare/household)	0.793	1.484	1.031	1.458
Weight mean land quality	1.753	1.766	1.805	1.770
Weighted mean land slope	1.161	1.169	1.230	1.172
Total household labour input (Working days/Hectare)	388.629	604.020	407.513	612.561
Total household labour input excl. child (Working	352.979	547.734	382.552	

days/Hectare)				
Total household yields for main crops (Birr/hec)	4005.454	7022.433	4208.198	551.368
Expectation about land in next 5 years (%)				
The same land	4.550	16.030	10.490	15.330
Larger land	14.550	25.000	25.870	27.01
Smaller	23.640	19.230	16.780	18.25
Dont know	57.270	39.740	46.850	39.420
N	113	157	143	138

Table 2:Major changes in household-specific characteristics between 1999 and 2004

Types of households	Leasing out	Leasing in	Pure owner-cultivating	Owner-sharecropper
Household demographics				
Household size	-0.439	0.101	-0.205	0.097
Male as household head (%)	-7.291	1.237	-7.692	1.820
Having offarm income in last 12 months (%)	6.430	23.265	21.860	25.058
Having offarm income in last 4 months (%)	12.625	21.414	21.987	23.067
Household head having farming as primary occupation (%)	44.973	3.763	21.199	4.088
Households having any oxen (%)	-8.450	-1.870	-16.312	-2.661
Nominal values of livestock (Birr/household)	394.913	2516.856	1251.044	2407.980
Number of tropical livestocks (Birr/household)	-0.044	0.612	-0.108	0.505
Number of oxen	-0.134	-0.165	-0.340	-0.151
Land characteristics				
Total area cultivated (Hectare/household)	0.269	0.046	0.067	-0.100
Weight mean land quality	-0.117	-0.068	-0.059	-0.097
Weighted mean land slope	0.005	0.047	-0.012	0.030
Total household yields for main crops (Birr/hec)	-380.832	3495.437	313.406	3787.644
Expectation about land in next 5 years (%)				
The same land	26.450	7.840	25.370	10.250
Larger land	-5.550	-1.770	-16.210	-4.530
Smaller	-9.640	-3.100	-8.500	-2.750
Dont know	-11.270	-2.970	-0.640	-2.990

Table 3:Sharecropping effects on productivity

Dependent variable	Yields in logs							
	Within-household fixed effects						IPWRA	
	(3a)	(3b)	(3c)	(3d)	(3e)	(3f)	(3g)	(3h)
Tenancy	-0.202***	-0.178***	-0.153**	-0.163**	-0.194***	-0.124**	-0.180***	-0.166***
(Sharecropping=1, owner-cultivating=0)	(0.0603)	(0.0664)	(0.0611)	(0.0697)	(0.060)	-0.0608	(0.0589)	(.0599)
Round	-0.073	0.042	-0.006	0.033			Yes	Yes
(1999=1, 2004=0)	(0.0870)	(0.1722)	(0.0868)	(0.1611)				
Oxen ownership		0.016		0.123				Yes
(Having any oxen=1, No=0)		(0.1569)		(0.1597)				
Household size		0.440		0.506				Yes
		(0.4899)		(0.4697)				
Literacy of head		0.091		0.136				Yes
(Literate=1, Illiterate=0)		(0.1763)		(0.1664)				
Age of head		0.030		0.020				Yes
		(0.0194)		(0.0183)				
Gender of head		-0.131		0.081				Yes
(Male=1, Female=0)		(0.4964)		(0.4814)				
Plot size (log)			-0.388***	-0.356***		-0.384***	Yes	Yes
			(0.0648)	(0.0765)		(-0.0671)		
Plot quality			0.127**	0.119*		0.183***	Yes	Yes
(Good =1, Bad=0)			(0.0558)	(0.0634)		(-0.0596)		
Plot slope			0.186*	0.224*		0.131*	Yes	Yes

(Flat=1, Steep=0)			(0.1071)	(0.1224)		(-0.0788)		
Plot acquired from			0.031	0.093		-0.015	Yes	Yes
(Relative=1, Non-relative=0)			(0.0749)	(0.0857)		(-0.0826)		
N	1128	903	1126	903	1133	1131		972

* p<0.1, ** p<0.05, ***p<0.01

Table 4:Sharecropping effects on labour input

	Total labour		Exclude child	Hard task	Easy task
	(5a)	(5b)	(5c)	(5d)	(5e)
Tenancy	-0.271***	-0.206***	-0.215***	-0.239***	-0.217***
(Sharecropping=1, owner-cultivating=0)	(0.0672)	(0.0786)	(0.0750)	(0.0845)	(0.0723)
Plot size (log)		-0.438***	-0.433***	-0.408***	-0.583***
		(0.0981)	(0.0971)	(0.0875)	(0.0778)
Plot quality		0.203***	0.199***	0.300***	0.023
(Good =1, Bad=0)		(0.0717)	(0.0704)	(0.0828)	(0.0595)
Plot slope		0.020	0.041	0.086	0.109
(Flat=1, Steep=0)		(0.0947)	(0.0940)	(0.1074)	(0.1041)
Plot acquired from		0.052	0.053	0.029	0.078
(Relative=1, Non-relative=0)		(0.0932)	(0.0920)	(0.1127)	(0.0816)
Irrigation		0.258	0.229	0.212	0.522
(Yes=1, No=0)		(0.2955)	(0.3001)	(0.2591)	(0.3886)
Distance from home (minutes)		0.001	0.002	0.002	0.003
		(0.0030)	(0.0028)	(0.0024)	(0.0024)
Plot under extension program		-0.689***	-0.500	-0.567***	-0.384*
		(0.2493)	(0.3297)	(0.2021)	(0.2036)
N	1055	996	996	914	904

* p<0.1, ** p<0.05, ***p<0.01

Table 5:Regression adjustment and Propensity score estimation for IPWRA models

	Regression Adjustment			Propensity score by Logit	
Dependent variable	Yields in logs			Contract dummy	
	Owner-cultivated plots		Sharecropped-in plots		
	IPWRA (1)	IPWRA (2)	IPWRA(1) & (2)	IPWRA(1)	IPWRA(2)
	(5a)	(5b)	(5c)	(5d)	(5e)
Round	0.148**	0.115	0.059	0.535***	0.540***
(1999=1, 2004=0)	(0.0674)	(0.0702)	(0.0787)	(0.1392)	(0.1414)
Oxen ownership	0.620***	0.591***	0.135	0.149	
(Having any oxen=1, No=0)	(0.1644)	(0.1484)	(0.1129)	(0.2988)	
Household size	0.013	0.039	0.302***	-0.146	
	(0.1097)	(0.1057)	(0.1025)	(0.2089)	
Literacy of household head	0.035**	0.035**	-0.045**	0.110***	
(Literate=1, Illiterate=0)	(0.0170)	(0.0175)	(0.0203)	(0.0366)	
Age of head	-0.000	-0.002	-0.001	0.018***	
(0.0030)	(0.0030)	(0.0030)	(0.0057)		
Gender of head	0.090	0.130	-0.210	-0.087	
(Male=1, Female=0)	(0.1316)	(0.1423)	(0.1312)	(0.2930)	
Plot acquired from	0.025	0.003	-0.011		
(Relative=1, Non-relative=0)	(0.0640)	(0.0669)	(0.0704)		
Plot size (log)	-0.370***	-0.357***	-0.364***	0.449***	0.437***
	(0.0603)	(0.0578)	(0.0802)	(0.1063)	(0.1073)
Plot quality	0.138*	0.148*	0.158**	-0.282*	-0.289**
(Good =1, Bad=0)	(0.0726)	(0.0758)	(0.0744)	(0.1438)	(0.1460)
Plot slope	0.082	0.092	0.074	0.362*	0.407**
(Flat=1, Steep=0)	(0.0819)	(0.0847)	(0.1039)	(0.1890)	(0.1929)
N			972		

* p<0.1, ** p<0.05, ***p<0.01

*Note: IPWRA (1) and IPWRA (2) correspond to the model (3g) and (3h) in Table 3, respectively