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On the Choice of Tenancy Contracts in Rural India

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This paper uses data from rural India to analyse how cultivating household and plot level characteristics affect contract choice on a particular plot of land. We estimate a sequential choice model where the landowner first decides whether to cultivate the land on his own (possibly with hired labour) or to lease it out. If the latter, then a choice is made between fixed-rent or share-cropping. One interesting finding is that the greater the value of the plot, the greater is the probability that the plot is owner cultivated. Moreover, among tenant cultivated plots, higher value plots are share-cropped.

INTRODUCTION

Land tenancy contracts can be classified into two broad categories: (1) owner cultivation, where the owner cultivates the land himself possibly using hired labour, and (2) a land lease agreement, where the landowner leases out the land to be cultivated by a tenant and in turn asks for either a fixed rental payment every period (a fixed rent contract) or a predetermined share of the output (share-cropping contract). There is a large body of literature that addresses the issue of land tenure contracts; see N. Singh (1989), Basu (1996) and Ray (1998) for excellent surveys.

All three contractual forms often coexist in close proximity. Shaban (1987), in a study of eight Indian villages, finds that often even adjoining plots of land are characterized by different contractual forms. The question therefore is: what explains the actual choice of contract on a particular plot of land? This paper uses data from three villages in India to examine the question. We examine the effect of cultivating household and plot characteristics to examine the type of contract that prevails on a particular plot. Prior theoretical and empirical research in the area has treated the choice of a tenancy contract as a process that involves choosing one out of a set with three elements (owner cultivation, fixed rent tenancy and share tenancy). (See Hallagan 1978, F. Allen 1982, 1985, and Eswaran and Kotwal 1985 for representative theoretical papers, and D. W. Allen and Lueck 1992, 1999 for representative empirical papers.) However, as Bell (1995) points out, 'any attempts to integrate land and labour contracts must come to grips with two salient features of agrarian organization in Asia, namely, that cultivating households make very extensive use of casual labour, and that most landowning households are not active in the market for tenancies.' This essentially means that the decision for the owner concerning whether to lease out the plot to be cultivated by a tenant or to cultivate the plot himself is quite distinct from the decision on what kind of a contract to offer, conditional on the decision to lease out the plot. We therefore think that the choice of a tenancy contract is better modelled as a sequential choice. In the sequential model the choice of a contract is a two step problem:

the landowner first decides whether to cultivate the plot on his own or lease it out to be cultivated by a tenant; then, once he decides to lease out the plot, he has to decide whether to use a fixed-rent or a share-cropping contract. There is an alternative way of modelling contract choice whereby the landowner makes a simultaneous choice of one out of three available options (owner cultivation, fixed-rent tenancy and share tenancy) to maximize his payoff. This, as mentioned above, is the usual approach in the existing literature. For the sake of completeness, and for purposes of comparison, we derive estimates using a simultaneous choice model as well. Incidentally, the coexistence of different contract forms is not specific to agricultural contracts: they are seen in business format franchising (see Lafontaine 1992) as well. Hsiao *et al.* (1998) report similar findings in Chinese township and village enterprises.

Our estimation results show that several household and plot characteristics are significant in explaining the choice of contract on a particular plot of land. One interesting finding is that the greater the value of the plot, the greater is the probability that the plot is under owner cultivation. Further, conditional on the plot being under tenancy, the higher the value of the plot, the higher is the probability that the plot is under share tenancy. Given that the value of the plot is a measure of plot quality, we argue that the most productive plots are cultivated by the owner, the least productive plots are cultivated by a fixed-rent tenant, and the intermediate plots are cultivated by a share tenant.

The paper is organized as follows. Section I presents an overview of the data and selected descriptive statistics. Section II presents the econometric methodology used, first discussing the sequential choice problem, which is our principal focus in this paper, and then analysing the simultaneous choice issue. Section III discusses the results, and Section IV concludes.

I. DATA

The data-set used in this study comes from the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and was part of ICRISAT's longitudinal village-level surveys in the semi-arid tropics of India. The survey was conducted over the period 1975–84 but the labour market data exist only for 1979–84. This is the period that we consider. We use data from the villages of Aurepalle, Shirapur and Kanzara, which are situated in south–central India (in the states of Andhra Pradesh and Maharashtra) and are predominantly agricultural, with more than 94% of the households dependent on agriculture as the main source of income (either as cultivators or farm labourers). Even by Indian standards these villages are poor, with a monthly per capita income of Rs 700 (averaged over the survey period at 1977 prices) compared with the All-India per capita monthly income of Rs 1080 using the same base year. The data are from a stratified sample of 40 randomly chosen households in each village, 10 in each of the categories: (1) large farmers owning more than 3.2 acres in Aurepalle and more than 5.3 acres in Shirapur and Kanzara; (2) medium farmers owning between 1.2 and 3.2 acres in Aurepalle, between 2 and 5.3 acres in Shirapur and between 1.8 and 5.3 acres in Kanzara; (3) small farmers owning between 0.2 and 1.2 acres in Aurepalle, between 0.2 and 2.0 acres in Shirapur and between 0.2 and 1.8 acres in Kanzara; and (4) landless labourers who own less than 0.2 acre. The richness of the data from these surveys, in terms of both the breadth of information conveyed and the level of detail pertaining to each aspect of household decision-making, is amply illustrated by the numerous studies that have been conducted by economists around the world using this data-set. Walker and Ryan (1990) and R. P. Singh *et al.* (1985) provide details of the region and the survey. Table 1 presents selected descriptive statistics for some of the variables that are included in the regressions.

Our interest is in investigating the nature of the contract under which each plot is cultivated, and to this end we examine data from each plot of land under consideration. We use data from 375 plots in Aurepalle, 256 plots in Shirapur and 604 in Kanzara, giving us a total of 1235 plots. The majority of plots are under owner cultivation—in fact, the data show (see Table 2) that 83% of all plots are under owner cultivation. Owner cultivation is particularly widespread in Aurepalle and Kanzara: 91.73% of the plots in Aurepalle and 85.43% of the plots in Kanzara are owner-cultivated. This is not particularly surprising, because I. Singh (1988) argues that owner cultivation, using hired labour, is by far the most common form of cultivation in Indian agriculture. In Shirapur share contracts are much more prevalent—nearly 35% of plots in Shirapur are under share tenancy. Note that only 23 of the 1235 plots are under fixed-rent tenancy.

Table 2 also presents a breakdown of the plots on the basis of soil characteristics and the main form of irrigation used on the plot. Notice that there is significant variation in the soil types across the three villages. For example, in Kanzara more than 85% of the plots have 'medium black' soil, while in Shirapur majority of the plots have either 'medium black' to 'shallow black' or 'gravelly' soil. Finally in Aurepalle the majority of the plots have 'shallow red' soil. As far as irrigation is concerned, the majority of the plots in all three villages are irrigated using a well with a traditional device.

TABLE 1

SELECTED DESCRIPTIVE STATISTICS FOR CULTIVATING HOUSEHOLD CHARACTERISTICS

	Entire sample			Plots under tenancy		
Variable	*N*	Mean	Count	*N*	Mean	Count
AGE	1235	48.66		210	49.71	
TOTMAL	1235	2.13		210	1.94	
TOTFEM	1235	1.75		210	1.81	
TOTCHILD	1235	2.97		210	2.86	
TOTOLD	1235	0.44		210	0.23	
MARITAL1	1235		131[a]	210		15[a]
			1104[b]			195[b]
MALEILL	1235		1066[a]	210		187[a]
			169[b]			23[b]
FEMILL	1235		1224[a]	210		209[a]
			11[b]			1[b]

[a] Count = 0
[b] Count = 1

TABLE 2

NUMBER OF PLOTS, CLASSIFIED BY OWNERSHIP STATUS, SOIL TYPE AND IRRIGATION

	Source		
	Aurepalle	Shirapur	Kanzara
Ownership status			
Owner-operated	334	165	516
Fixed-rent	13	0	10
Share tenancy	18	91	78
Total under tenancy	31	91	88
Soil type			
Deep black	0	19	57
Medium black	48	39	518
Medium to shallow black	63	102	29
Shallow red	253	0	0
Gravelly	3	91	0
Problem soil*	7	1	0
Others	1	4	0
Irrigation source			
Well with traditional device	291	221	588
Tank	2	0	1
Canal	2	0	0
Well with electric motor	80	15	15
Well with oil engine	0	19	0
Other	0	1	0

* For example, saline soil.

II. CONTRACT CHOICE: ECONOMETRIC METHODOLOGY

We consider two alternative forms of contract choice. The first is the sequential choice model, which is our principal interest in this paper. In this case, the landlord first decides whether to cultivate the plot on his own (possibly using hired labour) or to lease it out to be cultivated by a tenant. The landlord therefore chooses one contract out of the following two: $\{OWNER, LEASE\}$. If he decides to lease it out, the question then is whether to lease the plot out to be cultivated by a share tenant or by a fixed-rent tenant.

As mentioned, the existing theoretical literature on contract choice has focused almost exclusively on a simultaneous choice model where the landlord, given a choice of three different contract forms, chooses the one that is likely to yield the maximum payoff. In this case the landlord chooses one contract out of a set of three: $\{OWNER, RENTAL, SHARE\}$.[1] We examine both the sequential and the simultaneous choice models.

Sequential contract choice

Contract choice is modelled as a two-stage problem. In the first stage the owner has to decide whether to cultivate the plot himself or lease it out to be cultivated by a tenant. In the second stage, conditional on the owner choosing a tenancy contract, he has to decide whether to lease the plot out on a fixed-rent or a share-cropping contract.

In the first stage, define a variable TENANT such that

$$TENANT = \begin{cases} 0 \text{ if the plot is cultivated by the owner} \\ 1 \text{ if the plot is cultivated by a tenant} \end{cases}$$

Let us assume that there is an underlying response variable $TENANT^*$, which is unobservable and has a linear specification of the form

$$(1) \qquad TENANT^* = \beta X + u \qquad u \sim IN(0, \sigma_u^2)$$

and X is a vector of agent and plot characteristics. While $TENANT^*$ is not observable, what we do observe is a dummy variable $TENANT$ such that

$$TENANT = \begin{cases} 0 \text{ if } TENANT^* \leqslant 0 \\ 1 \text{ otherwise} \end{cases}$$

The probability that $TENANT = 0$ (the land is cultivated by the owner himself) is $\Phi(-\beta X)$, while the probability that $TENANT = 1$ (the land is cultivated by a tenant) is $\Phi(\beta X)$, giving us the log likelihood function

$$L(\beta) = \sum_{TENANT=0} \ln \Phi(-\beta X) + \sum_{TENANT=1} \ln \Phi(\beta X).$$

Indexing plots by p and cultivating households by h, the estimating equation is

$$(2) \qquad TENANT_{ph} = \beta_0 + \beta_1 X_{1h} + \beta_2 X_{2p} + u_{ph}, \qquad p = 1, \ldots, P; \; h = 1, \ldots, H,$$

where X_{1h} represents agent characteristics and X_{2p} represents plot characteristics.

There is a second stage to the problem. Once the landlord has decided to lease out the land, he has to decide whether to choose a fixed-rent contract or a share-cropping contract. Define a variable $TENANT2$ such that

$$TENANT2 = \begin{cases} 0 \text{ if the plot is under fixed rent} \\ 1 \text{ if the plot is under share-cropping} \end{cases}$$

Let us assume that the underlying response variable for $TENANT2$ is $TENANT2^*$, which has the form

$$(3) \qquad TENANT2^* = \gamma Z + e, \qquad e \sim IN(0, \sigma_e^2).$$

As in the first stage of the problem, the estimating equation in the second stage can be written as

$$(4) \qquad TENANT2_{ph} = \gamma_0 + \gamma_1 Z_{1h} + \gamma_2 Z_{2p} + e_{ph}, \qquad p = 1, \ldots, P; \; h = 1, \ldots, H,$$

where Z_{1h} represents cultivating household characteristics and Z_{2p} represents plot characteristics.

However, $TENANT2$ is observed only when $TENANT = 1$, and so in the second stage we have a censored sample. Since $TENANT2$ is not a continuous variable, Heckman's two-step procedure to correct for sample selection will not lead to consistent estimates. Equations (1) and (3) together constitute a bivariate qualitative dependent variable model that is characterized by partial observability. The setup is as follows:

$$TENANT^{*} = \beta X + u;$$

$$TENANT = \begin{cases} 0 \text{ if the plot is cultivated by the owner} \\ 1 \text{ if the plot is cultivated by a tenant} \end{cases}$$

$$TENANT2^{*} = \gamma Z + e;$$

$$TENANT2 = \begin{cases} 0 \text{ if the plot is under fixed rent cultivation} \\ 1 \text{ if the plot is under share-cropping} \end{cases}$$

and $TENANT2$ is observed only when $TENANT = 1$.

The model is one of partial observability, because we observe only three possible outcomes:

1. $TENANT = 0$
2. $TENANT = 1$, $TENANT2 = 0$
3. $TENANT = 1$, $TENANT2 = 1$

The corresponding log likelihood function for the sample of P plots and H households can be written as (see Meng and Schmidt 1985):

$$(5) \qquad L(\beta, \gamma, \rho) = \sum_{h} \sum_{p} \left[\begin{array}{c} TENANT_{ph} TENANT2_{ph} \ln F(\beta X_{ph}, \gamma Z_{ph};\ \rho) \\ + TENANT_{ph}(1 - TENANT2_{ph}) \\ \times \ln [\Phi(\beta X_{ph}) - F(\beta X_{ph}, \gamma Z_{ph};\ \rho)] \\ + (1 - TENANT_{ph}) \ln (1 - \Phi(\beta X_{ph})) \end{array} \right]$$

where $F(\cdot)$ and $\Phi(\cdot)$ denote the bivariate standard normal cumulative distribution function and the univariate standard normal cumulative distribution function, respectively. Estimates of the parameters are obtained by maximizing the log likelihood function in (5). The joint approach accounts for the potential correlation between the two error terms and corrects for potential bias in sample selection that would be incurred by estimating (1) and (3) separately.

Note that, if the estimated correlation coefficient (ρ_{ue}) between the two error terms u and e is not significant, it implies that the error terms in (1) and (3) are not correlated and we can estimate the second-stage equation (estimate $TENANT2$ (equation (4)) separately by running a binary probit in stage 2).

The vector of explanatory variables consists of cultivating household and plot characteristics. Household characteristics include the following: age, square of the age and marital status of the household head (*AGEHEAD*, *AGE2HEAD* and *MARITAL1*, respectively), and dummies for the disability status of the adult members in the household (*MALEILL* and *FEMILL*).[2] The regressions also control for the composition of each household, including total number of males, females, children and old persons (*TOTMAL*, *TOTFEM*, *TOTCHILD* and *TOTOLD*, respectively). The age of the household head (*AGEHEAD*) and the square of the age (*AGE2HEAD*) are proxies for the level of experience of the cultivator. Plot characteristics include value of the plot in rupees (*VALUE*), dummies for the main source of irrigation for the plot,[3] and for alternative soil types[4] and the percentage of total cultivated area that is irrigated (*IRR*). *VALUE* is the monetary value of a plot and is a proxy for land quality. Per-acre estimated value of the plot in Rs 100 were recorded based on information obtained from either the *patwari* (land assessor) or some other knowledgeable person in the village. While recording the value of the plot, the potential sale value of the plot, the location of the plot, irrigation and topography are taken into account. (See Table A1 for a description of all the explanatory variables in our analysis.)

Finally, we include two village dummies ($DV1$ and $DV2$) to account for any unobserved heterogeneity: $DV1 = 1$ if Aurepalle and $DV2 = 1$ if Shirapur. The reference case is the village of Kanzara. We would also like to point out that the data-set is indeed a panel; however, we do not include the panel aspect of the data because the average length of a contract in the ICRISAT region is more than 14 years and one might assume, without any loss of generality, that the contracts are stable for each plot over the six years that we consider.

Simultaneous contract choice

In this case the principal chooses one of three contracts (owner cultivation, fixed-rent tenancy, share tenancy) to maximize his profits. This is a problem with a polychotomous dependent variable, which can take three distinct values. A variety of qualitative response models have been devised to deal with such cases. They fall into two types: models designed to deal with ordered responses, and models designed to deal with unordered responses. Since *ex ante* there is no obvious way to order the three contracts, we believe that a model designed to deal with unordered responses is the appropriate one to use in this context. Hence we derive our parameter estimates using a multinomial logit model.

Define a variable *CONTRACT* such that

$$CONTRACT = \begin{cases} 0 \text{ if the plot is under owner cultivation} \\ 1 \text{ if the plot is under fixed-rent tenancy} \\ 2 \text{ if the plot is under share-cropping} \end{cases}$$

We wish to examine the choice of contract for each plot. As before, assume that there is an underlying response variable $CONTRACT^*$ defined by the following:

$$CONTRACT^* = \beta X + \varepsilon; \qquad \varepsilon \sim IN(0, \sigma_\varepsilon^2).$$

Now $CONTRACT^*$ is unobservable, and instead we observe the variable *CONTRACT* such that

$$CONTRACT = \begin{cases} 0 \text{ if } CONTRACT^* \leqslant \mu_1 \\ 1 \text{ if } \mu_1 \leqslant CONTRACT^* \leqslant \mu_2 \\ 2 \text{ if } CONTRACT^* \geqslant \mu_2 \end{cases}$$

We normalize $\mu_1 = 0$. Then the probability that the plot is under owner cultivation is given by $\Pr\{CONTRACT = 0\}$, which is equal to $\Phi(-\beta X)$; the probability that the plot is under fixed rent is given by $\Pr\{CONTRACT = 1\}$, which is equal to $(\Phi(\beta X - \mu_2) - \Phi(-\beta X)\}$; and finally, the probability that the plot is share-cropped is given by $\Pr\{CONTRACT = 2\}$, which is $\Phi(\beta X - \mu_2)$. Then the log-likelihood function can be written as

$$L(\beta;\ \mu_2) = \sum_{CONTRACT=0} \log\ (\Phi(-\beta X)) + \sum_{CONTRACT=2} \log\ (\Phi(\beta X - \mu_2)) + \sum_{CONTRACT=1} \log\ (\Phi(\beta X - \mu_2) - \log\ (\Phi(-\beta X))).$$

The vectors of explanatory variables are exactly the same as before and hence we do not discuss them again.

III. Results

Let us now turn to the estimation results. We present first the results from the sequential choice model and then the results from the simultaneous choice model.

Results from the sequential choice model

The maximum likelihood probit results for the first-stage estimation (choice of cultivation status) are presented in Table 3. A positive value of the coefficient indicates that the variable increases the probability of tenant cultivation while a negative value of a coefficient indicates that the variable decreases the probability of tenant cultivation. Relative to Kanzara, the probability that a plot is under tenant cultivation is significantly higher in Shirapur. The model has substantial predictive power; in particular, it predicts correctly more than 86% of the time.

Let us first examine the cultivating household characteristics. Notice first that *AGEHEAD* is positive and significant. However, this does not necessarily imply that an increase in the age of the household head increases the probability that the plot is cultivated by a tenant. This is because the data-set poses a problem in that when we look at tenant-cultivated plots we have data about the tenant household (the agent), while on owner-cultivated plots we have data on the owner of the plot (the principal). Hence on owner-cultivated plots we are missing the data for the tenants (the agent). This missing data make a comparison of the age of the cultivating household head on a particular plot of land problematic. Consider three household heads A, B and C. Suppose A is an owner–cultivator cultivating his own plot. C also owns a plot of land, but instead of cultivating it himself, he hires B as a tenant. Also, suppose A is younger than B. There is nothing in the available data that allows us to argue that A had competed with B to be given the right to cultivate the plot owned by C as a tenant and was unsuccessful purely because of the fact that B is older.[5] However, even though the above result does not have a ready interpretation, it

TABLE 3
BINARY PROBIT ESTIMATES FOR FIRST-STAGE CULTIVATION STATUS
(DEPENDENT VARIABLE *TENANT*)

Variable	Coefficient	Standard error
CONSTANT	−2.008	1.143
DV2	1.108**	0.190
DV1	−0.305	0.225
AGEHEAD	0.085**	0.035
AGE2HEAD	0.000	0.000
MARITAL1	0.603**	0.205
TOTMAL	−0.216*	0.062
TOTFEM	0.066	0.062
TOTCHILD	0.088***	0.032
TOTOLD	−0.756***	0.108
MALEILL	−0.261	0.176
FEMILL	−0.410	0.558
IRRD0	−1.855**	0.702
IRRD3	−1.961**	0.630
IRRD4	−2.441***	0.754
SOILD1	−0.134	0.220
SOILD3	0.147	0.171
SOILD5	−0.372	0.249
SOILD6	−0.916***	0.251
IRR	−0.010*	0.005
VALUE	−1.933E-04***	5.958E-05

* Significant at 10%
** Significant at 5%
*** Significant at 1%

is still important to control for the age of the household head in the regressions because the predictive power of the regressions is lower if we ignore the household characteristics and in particular if we ignore the age of the household head as an explanatory variable. Additionally, we find that an increase in the total number of males in the household or an increase in the number of elderly members in the household reduces the probability that the plot is cultivated by a tenant, whereas an increase in the number of children in the household increases the probability that the plot is cultivated by a tenant.

Let us now turn to the plot characteristics. The most interesting result concerns the sign and significance of *VALUE*. Remember that *VALUE* is a measure of the land quality of a particular plot. We find that the coefficient of *VALUE* is negative and significant, which implies that an increase in plot quality reduces the probability that the plot is cultivated by a tenant. The marginal results (not presented but available on request) show that a Rs 100,000 increase in the value of the plot decreases the probability that the plot is under tenant cultivation by 37 percentage points. Of the other plot characteristics, all three irrigation dummies are negative and significant, indicating that a plot where the main source of irrigation is a well with traditional device or a well with electric motor or a well with oil engine is less likely to be cultivated by a tenant. A plot where the soil is gravelly is less likely to be cultivated by a tenant, as is a plot with a higher proportion of the area under irrigation. One could argue that the value of a plot is determined (at least partly) by the soil type of that plot, the kind of irrigation facility that is available on the plot and the proportion of the plot that is irrigated, and hence it is meaningless to include both the value of the plot and the other plot level characteristics as explanatory variables. Therefore we examined an alternative specification, where we included only VALUE and excluded all the other plot-level characteristics. We do not report the results, because the results remain the same: *VALUE* is still negative and significant. In fact, the marginal results show that in this case *VALUE* has a stronger negative effect on the probability of the plot being under owner cultivation—a Rs 100,000 increase in the value of the plot reduces the probability that the plot is under tenant cultivation by more than 42 percentage points. Therefore, while there is some incidental association between the value of the plot (as measured by *VALUE*) and other plot level characteristics, this association is not very strong.

Table 4 presents the estimated coefficients for the second stage. Conditional on the plot being cultivated by a tenant, what are the factors that affect the probability that the plot is cultivated by a fixed-rent tenant as opposed to a share tenant? Here we present two sets of results: the binary probit results for *TENANT2*, where we do not correct for sample selection, and the full information maximum likelihood (FIML) results from the joint estimation of *TENANT* and *TENANT2*, where we do correct for sample selection—the Partial Observability model. Note that in the second stage the estimation sample is quite small and hence we are unable to include the entire set of explanatory variables as in stage 1 (Table 3). Note also that the correlation coefficient

TABLE 4
BINARY PROBIT AND FIML ESTIMATES FOR SECOND-STAGE TENANCY STATUS (DEPENDENT VARIABLES *TENANT2*)

	Binary probit estimates		FIML estimates	
Variable	Coefficient	Standard error	Coefficient	Standard error
CONSTANT	115.090*	61.770	74.413	154.357
DV2	7.324	170,995.960		
DV1	−6.508**	2.629		
AGEHEAD	−4.532**	2.297	−2.804	5.977
AGE2HEAD	0.043*	0.022	0.026	0.056
TOTMAL	0.320	0.672	−0.643	2.387
TOTFEM	0.375	0.798	0.292	1.257
TOTCHILD	0.233	0.545	0.574	1.987
TOTOLD	0.514	2.169	0.561	5.287
MALEILL	3.937	3.604	4.438	12.129
FEMILL	2.571	3,197,910.200	2.861	201,456.020
IRROD0	2.122	9.248	2.315	7.406
SOILD3	0.660	2.111	−1.994	5.700
SOILD5	0.425	4.216	−6.193	19.792
VALUE	0.002*	0.001	0.002	0.004
ρ_{ue}			−0.721	3.007

*Significant at 10%
**Significant at 5%
***Significant at 1%

between the two error terms u and $e(\rho_{ue})$ is not significant. Therefore a binomial probit is a good benchmark in this situation. Further, when we look at the results from the FIML estimates, we see that none of the explanatory variables significantly affect the conditional probability of the plot being cultivated by a share tenant.[6] The binary probit results show that the conditional probability of the plot being under share tenancy is significantly lower in Aurepalle (relative to Kanzara). Age of the household head (*AGEHEAD*) is negative and significant, indicating that the conditional probability of being a share tenant is significantly lower for an older tenant. However, notice that there is a nonlinearity in the effect of the age of the head of the household, as indicated in the positive and significant sign of the square of the age of the household head (*AGE2HEAD*). None of the other household-level characteristics and none of the plot-level characteristics except *VALUE*, have a significant effect on the conditional probability that the plot is under share tenancy. *VALUE* is positive and significant—implying that an increase in the value of the plot increases the conditional probability that the plot is under share tenancy. As in stage 1, we re-estimate the model ignoring all the plot-level characteristics with the exception of *VALUE*, since it could be argued that the value of a particular plot is determined at least partly by the other plot-level characteristics. As before, the age of the head (*AGEHEAD*) of the cultivating household has a significant and negative effect on the conditional probability that the plot is under share tenancy. There is again a significant nonlinearity in the age of the household head effect: *AGE2HEAD* is positive and significant. Once again, the value of the plot (*VALUE*) has a significant and positive effect on the conditional probability that the plot is under share tenancy.

Notice that *VALUE* is positive and significant in step 2 (see Table 4). This implies that, as the value of a plot increases, the conditional probability that it is cultivated by a share tenant increases. This result, combined with the fact that *VALUE* is negative and significant in stage 1 (Table 3), implies the following. First, the highest-quality plots are cultivated by the owner. Second, conditional on the plot being leased out, the higher-quality plots are cultivated by a share tenant. VALUE is a proxy for land quality. So, essentially, the highest-quality plots are cultivated by the owner, the lowest-quality plots are cultivated by a fixed-rent tenant and the intermediate quality plots are cultivated by a share tenant.

We re-estimated the model with only plot characteristics as the set of explanatory variables. In this case however we did include the village dummies. The predictive power of the model was reduced. The estimated coefficients from the binary probit models are presented in Table 5. The null hypothesis of zero correlation between the two error terms u and $e(\rho_{ue})$ cannot be rejected, and therefore binary probit in stage 2 gives consistent estimates. The results are not significantly affected. In particular, *VALUE* is negative and significant in stage 1 and is positive and significant in stage 2. This implies that, as before, better-quality plots are owner-cultivated but, conditional on the plot being under tenancy, better-quality plots are under share tenancy.

Finally, we added two dummies, *LMWD* and *LFWD*, as additional household characteristics. *LMWD* equals 1 if any adult male member of the household worked in the village labour market in the previous year and *LFWD* equals 1 if any adult female member of the household worked in the village labour market in the previous year. We did this because we wanted to examine

TABLE 5

BINARY PROBIT ESTIMATES FOR FIRST AND SECOND STAGE: PLOT CHARACTERISTICS ONLY

	First-stage estimates		Second-stage estimates	
Variable	Coefficient	Standard error	Coefficient	Standard error
CONSTANT	1.204*	0.714	0.074	1.051
DV2	0.992***	0.170	6.663	17,2377.740
DV1	−0.173	0.203	−1.172*	0.695
IRSD0	−1.938***	0.698	0.277	0.978
IRRD3	−2.024***	0.621		
IRRD4	−2.133***	0.745		
SOILD1	0.070	0.210		
SOILD3	0.246	0.163	0.150	0.636
SOILD5	−0.184	0.231	0.133	0.762
SOILD6	−0.750***	0.226		
IRR	−0.009**	0.005		
VALUE	1.958E−04***	5.604E−05	6.818E−04**	3.250E−04

* Significant at 10%
** Significant at 5%
*** Significant at 1%

the effect of alternative employment opportunities on agricultural contracts. Because of space constraints, these estimation results are not presented. They are however available on request. In the first-stage regressions both *LMWD* and *LFWD* are negative and significant implying that the probability that the household is a tenant is significantly reduced by labour market participation of the members. *LMWD* and *LFWD* do not have a significant effect on the conditional probability of the plot being under share tenancy. Owners are therefore unwilling to lease out plots to households where members have access to alternative employment opportunities.

Results for the simultaneous choice model

The results for the simultaneous choice model are presented in Table 6. We present the multinomial logit estimates for the complete case only, i.e. the set of explanatory variables includes both household and plot characteristics. We conducted similar robustness tests as in the sequential contract choice model and the results are available on request. The baseline category is where the plot is under owner cultivation ($CONTRACT = 0$).[7] The results are as expected. Relative to the baseline category, households with more children are more likely to be hired as tenants (both fixed-rent and share-cropper), and households with more elderly are less likely to be hired as tenants. A plot where the soil is shallow red is less likely to be leased out to a tenant, while a plot where the soil is gravelly is less likely to be leased out to a share tenant. If we examine the signs of *VALUE* we find that an increase in the value of the plot moves the plot away from both fixed-rent cultivation and share-cropping to owner cultivation. The marginal results (not presented) show that a Rs 100,000 increase in the value of the plot increases the probability of owner cultivation by 29 percentage points and reduces the probability of fixed-rent

TABLE 6
MULTINOMIAL LOGIT ESTIMATES FOR THE SIMULTANEOUS CHOICE MODEL (DEPENDENT VARIABLE: *CONTRACT*)

	Fixed-rent contract		Share-cropping contract	
Variable	Coefficient	Standard error	Coefficient	Standard error
CONSTANT	−152.458	3,727,998.000	−2.479	2.405
DV2	−41.879	2,728,062.400	2.071***	0.352
DV1	3.547**	1.467	−0.752	0.484
AGEHEAD	3.700	2.365	0.140*	0.076
AGE2HEAD	−0.031	0.022	−0.001	0.001
MARITAL1	34.281	3,199,289.600	0.886**	0.394
TOTMAL	−1.098*	0.585	−0.418***	0.123
TOTFEM	−0.088	0.512	0.102	0.121
TOTCHILD	0.927***	0.297	0.149**	0.062
TOTOLD	−6.150***	2.017	−1.187***	0.202
MALEILL	−0.332	0.968	−0.499	0.359
FEMILL	−22.927	10,382,971.000	−0.698	1.102
IRRD0	13.583	1,913,865.100	−3.777**	1.468
IRRD3	−40.347	3,980,029.800	−3.614***	1.324
IRRD4	5.668	9,976,413.700	−4.062***	1.558
SOILD1	−32.524	4,152,479.300	−0.132	0.409
SOILD3	−1.662	1.254	0.148	0.326
SOILD5	−4.881***	1.747	−0.962*	0.567
SOILD6	−25.959	3,151,152.800	−1.525***	0.459
IRR	0.230	19,138.651	−0.026**	0.011
VALUE	−0.005***	0.001	−3.490E−04***	1.307E−04

* Significant at 10%
** Significant at 5%
*** Significant at 1%
Baseline category: plot is under owner cultivation.

tenancy by 1 percentage point and the probability of share tenancy by 28 percentage points. This is interesting and is further proof that owners tend to cultivate the best-quality plots themselves.

IV. CONCLUSION

This paper seeks to explain the choice of a tenancy contract on a particular plot of land by looking at the characteristics of the household cultivating that plot of land as well as the characteristics of the plot itself. Our estimation results show that several household and plot characteristics are significant in explaining the choice of contract on a particular plot of land. We find an interesting relationship between the value of a particular plot and the contract offered. First, the greater the value of the plot, the greater is the probability that the plot is under owner cultivation. Second, conditional on the plot being under tenancy, the higher the value of the plot, the higher is the probability that the plot is under share tenancy. The value of the plot is a measure of plot quality. We therefore argue that the most productive plots are cultivated by the owner, the less valuable plots are cultivated by a fixed-rent tenant, and the intermediate plots are cultivated by a share tenant.

APPENDIX

Table A1 lists and defines all variables used in our analysis

TABLE A1
DEFINITION OF VARIABLES

Variable	Definition
DV1	= 1 if village is Kanzara
DV2	= 1 if village is Shirapur
MARITAL1	= 1 if the household head is married
MALEILL	= 1 if any adult male member of the household is disabled
FEMILL	= 1 if any adult female member of the household is disabled
AGEHEAD	Age of the household head
AGE2HEAD	Square of the age of the household head
TOTMAL	Total number of adult (working-age) males in the household
TOTFEM	Total number of adult (working-age) females in the household
TOTCHILD	Total number of children in the household
TOTOLD	Total number of elderly in the household
VALUE	Value of the plot in Rs '000
IRR	Proportion of the plot that is irrigated
IRRD0	= 1 if source of irrigation is a well with traditional device
IRRD3	= 1 if source of irrigation is a well with electric motor
IRRD4	= 1 if source of irrigation is a well with oil engine
SOILD1	= 1 if soil type is medium black
SOILD2	= 1 if soil type is deep black
SOILD3	= 1 if soil type is medium to shallow red
SOILD5	= 1 if soil type is shallow red
SOILD6	= 1 if soil type is gravelly

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NOTES

1. We refer to a fixed-rent contract as a rental contract (*RENTAL*).
2. The reference category is that an old member of the household is ill (*OLDILL*). We tried to include the sex of the household head as an explanatory variable, but that led to problems in the estimation because in the ICRISAT region (as in most of South Asia) the majority of the households are male-headed and there is therefore very little variation in the explanatory variable.
3. *IRRD*0, *IRRD*3, *IRRD*4. *IRRD*0 = 1 if the main source of irrigation is a well with traditional device, *IRRD*3 = 1 if the main source of irrigation is a well with electric motor, and *IRRD*4 = 1 if the main source of irrigation is a well with oil engine.
4. *SOILD*1, *SOILD*3, *SOILD*5, *SOILD*6. *SOILD*1 = 1 if soil type is medium black, *SOILD*2 = 1 if soil type is deep black, *SOILD*3 = 1 if soil type is medium to shallow red, *SOILD*5 = 1 if soil type is shallow red, and *SOILD*6 = 1 if soil type is gravelly.
5. We would like to thank an anonymous referee for bringing this point to our attention and also for providing us with the above example illustrating the problem at hand. The paper is much improved from the insights and feedback provided by this referee.

6. Notice that the standard errors in many cases are very large. We think that this is due to the small number of plots that are under fixed-rent tenancy. It has some effect on the precision of the estimates.
7. Note once again that several of the estimated standard errors are very high in the category *CONTRACT = 1*. This is due to the very small number of plots under fixed-rent tenancy.

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