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Determinants of the Choice of Agricultural Tenancy Contracts in Rural Bangladesh

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1 Introduction

In recent years economists have revisit to the role of informal intuitions' in economic development. Literatures on this issue often deal with explaining the underlying motivation and outcome of different economic institutions observed in agrarian economies by exploring problems of imperfect information and missing markets. The primary focus of this trend is that informal tenancy market with different types of contracts emerge as substitutes for imperfect markets in an environment of pervasive risk, information asymmetry, social norms and moral hazard.[1] Among other things, recent works inspect the implications of factors such as cash constraints, transaction costs and multitasking for optimal contracts.[2] Hence, theoretical researches advance a number of hypotheses on contracting that explain the trade-off between own cultivation and tenancy cultivation and the choice of crop share over cash lease in agriculture. These hypotheses include: optimal risk sharing, optimal incentives, transaction cost, screening/ sorting and moral hazard (Fukunaga and Hauffman, 2009). Among these hypotheses, recent attention has focused on risk sharing and low transaction cost approach. It is important to recognize that most of the outcomes draw from these models in the theoretical literatures based on specific assumptions. Hence, it is widely recognized that extensive empirical works are vital for understanding the generality of the theoretical results.

To fill the empirical research gap, this study brings together two separate strands of literature. It provides the first joint analysis of decision to participate and contract type chosen by both contracting parties by testing for all three main hypotheses. This joint estimation method has an economic and econometric contribution is that through this the sample selection bias can be avoided that plagues studies on tenancy choice very often. Chaudhuri and Maitra (2001) use a joint analysis, though their model depends on plot level data and includes only tenant characteristics. The main contribution of this study is that it offers an opportunity to re-evaluate the tenant-landlord contract choices. This has been done, firstly, by focusing on the transaction costs on the initial decision to enter into informal tenancy market and secondly, on the effect of risk averseness of the tenant and moral hazard problem of the landlord as reflected through their attributes.

The empirical evidences in favour of above hypotheses are mixed and challenging. For example, Holmstrom (1979) shown that in the presence of imperfect

[1] Stiglitz, 1988; Bardhan, 1989; Fukunaga and Haffman, 2009

[2] Shaban (1987), Allen and Lueck (1992, 1993, 1995, 1999), Laffont and Matoussi (1995)

markets contract choice is driven primarily by risk sharing and setting incentives for effort. However, Allen and Lueck (1992, 1993, and 1999) use wealth as proxy to represent the effects of key parameters on contract choice and conclude that risk sharing associated with contract choice is not a major factor in North American agriculture. They also find that the land lords want to minimize transaction costs by minimizing problems of marketing of final outputs or by monitoring the tenants. Their results contradict a common assumption of principal-agent models that the tenants' risk aversion is important to contract choice. Allen and Lueck conclude that transaction cost, rather than risk sharing, is important in contract choice. Ackerberg and Botticini (2000) provide a re-examination of the risk aversion in contracting. Their works limit heterogeneity of the tenants to risk aversion and of the land lords to the riskiness of the task contracted. In their empirical work, they model risk preference of the tenant as an unobserved variable and find that the land lord's type of cropland and the wealth level of the tenant are correlated with the tenant's risk aversion. In related empirical work, Laffont and Matoussi (1995) consider the choice of share tenancy versus cash rent versus wage contract in Tunisia. They explain the costs of collecting rent payments under moral hazard or default and imperfections in input markets. Hence, reputation, risk sharing and moral hazard are important in their results. Huffman and Just (2004), in contrast to other contracting studies, consider equilibrium in the landlord-tenant relation where supply of potential agents is larger than required to meet all contracts offered by the principals. Under this assumption, competition among agents creates an incentive for each principal to select agents with less risk aversion. In their paper it reveals that both plot and the tenants attributes are key determinants of optimal tenure contract choice.

Therefore, most of the empirical works focus on single hypothesis using either the tenant characteristics or plot characteristics. While, in most of the developing countries including rural Bangladesh, there is an indication that transaction cost, risk averseness of the tenant and moral hazard of the landlord all these factors may effect simultaneously on the informal land rental market . Consequently, it is worth considering all of them. Ackerberg and Botticini's (2000) works is the first one that test all three hypotheses. Their estimates suggest that moral hazard and imperfect capital markets are important factors in Tuscan agriculture. Yet, there is no significant empirical support that risk sharing played an important role in contract choice. But their model also based on only tenant's and plot level characteristics and omit landlord's attributes to contract choice.

So far, Rainey et. al. (2005) and Fukunaga and Hauffman (2009) are the

only studies providing some support that attributes of landlords may also affect tenancy choice. However, their results are somewhat unconvincing. this is because the estimates consider only a group of landlords who lease out land and omits the tenants who lease in land. Rainey et. al. (2005) use survey data obtained from landlords who leased land to tenants in selected Arkansas districts. His results shows that a land lord's attributes significantly affect contract choice. Fukunaga and Huffman (2009) in their study also include both the tenant's and the landlord's attributes but their sample unit is not an individual tenant or landlord, but a particular contract between a tenant and a landlord. While very insightful, these works do not jointly examine and compare the factors which may affect the initial decision of farmers to participate in the informal land rental market and then chose a contract. When arguing about the type of contract chosen, earlier works do not examine the possibility that, there may be some situations under which a farmer has to enter into the tenancy market as a tenant or as a landlord. Although he may know that the outcome from the tenancy cultivation is not as efficient as it is from own cultivation. Most of the empirical literatures in this field focus mainly on finding determinants of contract choice assuming that the farmers already have taken the decision to participate in land lease market.

A further question is whether choosing a particular type of contract by the tenant or the landlord is driven by some endogenous matching. The problem of endogeneity in this type of literature comes from the fact that in theoretical models, there is no measurement problem regarding principal, agent and task characteristics. However, in empirical models many potentially relevant characteristics may be unobserved, partially observed or observed with error. In 2002, Ackerberg and Botticini are the first one to argue that if principal and the agents with are endogenously match with each other then determinants of contract can become bias. For example, if the tenant's risk aversion if perfectly measurable, then this endogenous matching would be solved by regressing contract choice only on the tenant's risk aversion (Allen and Leuck, 2004). However, in empirical analysis usually proxies for risk aversion are used such as age, wealth or property. Ackerberg and Botticini (2002) believe that using proxies for risk aversion does not solve the endogenous problem. In their empirical analysis on data from Tuscan they find strong evidence of matching between principal and agent. They use crop type to check for this endogeneity and find that the tenants who offered a share contract end up producing vine and the tenants who get a fixed rent contracts produce wheat or corn. Following their works, Fukunaga and Huffman (2009) consider decisions on contract type and land type, with land type being endogenous in the

contract choice equation. Their estimates conclude that in the U.S. the landlord-tenant contract choice endogeneity of the land type leased is not a serious problem. Hence, endogenous matching surely is not universal for all agrarian economy. Thus, there is this puzzle that whether or not farmers in rural Bangladesh also face endogenous matching for contract choice. Through a separate model, to test the endogeneity of matching, my study incorporates both the tenant's and the landlord's aspects together to select a contract type. This will help to compare the behavior of two parties participating in the tenancy market in rural Bangladesh, which will help for rational policy formulation.

As far as we know, this is the first extensive examination of these issues that include all steps of decision for both the tenant and the landlord. Besides,although tenancy cultivation is a very common feature of Bangladesh agriculture, there is not sufficient empirical works on contract choices exist in rural Bangladesh . Nonetheless, adequate evidence from empirical analysis is necessary for any policy formulation.

About 73% of the 116 million people who live in rural Bangladesh depend on agricultural activities for their income and employment. However, agricultural land is a scarce commodity in Bangladesh. Per capita available cropland has diminished by about 50% in Bangladesh from 1970 to 1990, which stood at only 0.08 ha against world average 0.27 ha (World Bank, 1997). Since land is in short supply in this densely populated agrarian economy, access to land through land rental markets has been important source to increase operational farm size. About 23 % of the total cultivated land is farmed under different tenurial arrangements. Furthermore,among the tenant farmers under different tenurial arrangements, 63% live below poverty line (World Bank, 2003). The most common form of tenancy relationship in Bangladesh is sharecropping (*bargadari*), which gives the land lord usually half of the production, while the sharecropper after providing all labour receives another half. This system is usually known as *adhi barga*, which represent half of the share. In some areas land owners receives a predetermined amount of money for a specific time period or crop from tenants and this is called fixed rent contract. In few areas the *tin barga* (three shares) system has been introduced, where production is divided into three shares against land, labour and capital.

The choice of land tenure systems for development has been a controversial policy issue for many parts of the world (Otsuka and Hayami, 1992; Biswanger et.al., 1995; Deininger, 2003). Bangladesh is no exception to this. Indeed, policy discussions in Bangladesh (as reported by various organization such as Center for Policy Dialogue, CPD, Grameen Bank, etc.) have been focused on the gap

of information regarding informal agricultural land rental market. However, so far Bangladesh does not have any success to implement any of its agricultural land reform policies. Further rethinking and research is necessary to assess the impact of this informal land rental market, which has been there for almost four decades, for realistic policy formulation. Note that agricultural activities in rural Bangladesh are administered by the Ministry of Agriculture, while agricultural land issues are administered by the Ministry of Land. Unfortunately, no study in recent years addressed role the of tenant's and the landlord's attributes in decision to participate in land rental market and in choice of contract. This study examines the landlord-tenant contracts in rural Bangladesh. To understand this, present study focus on the contribution of explanatory variables (such as number of the household participating in the tenancy market, the tenant's and the landlord's wealth and working capital, age, education and sex if the household head, etc.) that represent transaction cost, risk-sharing incentives and moral hazard problem.

Present study thus, is intended to investigate determinants of the share tenancy in rural Bangladesh. For this study purpose both the landlord and the tenant characteristics and some plot level characteristics are used. Econometric methods used here are somewhat modest and some empirical results are not robust. The findings of the study support the presence of transaction costs in tenancy cultivation at least when the farmers take the initial decision to enter into the informal tenancy market. Results also show that in general moral hazard problem of the landlord rather than risk, represented by wealth effect, is the determinants of contract choice in rural Bangladesh. Share tenancy are offered when the landlord ensure monitoring of the tenant farmers. On the other hand possession of other types of land among the landlords has a positive impact on the adoption of share tenancy possibly because of their effects in stabilizing income from other sources, thereby supporting the prediction of the presence of moral hazard. Conversely, the findings are not in the line with existing evidence that sharecropping contracts are more likely to be offered to poor tenants[3]. I do not have significant support for wealth effect on risk sharing hypothesis through the empirical analysis. Risk averseness of the tenant in this study is mostly supported by the tenant's own characteristics(such as age of head and other job opportunity). However, the empirical results do have some support for endogenous matching in that share contract seems to be chosen by the tenant and the landlord for a particular type of land. In contrast to the survey data generally used in literature, the data used here contain information on both contracting parties and thus provide a more

[3]See Ackerberg and Botticini (2002), Dubois (2002) and Laffont and Matoussi (1995)

complete picture of the determinants of contractual structure.

The reminder of the paper is organized as follows: the proceeding section draws ideas of imperfections in the land rental market and determinants of contracts from the existing theoretical literature. Section 3 and 4 describe the data set used here and the methodology respectively. Section 5 provides main findings. Section 6 presents discussion on extensions and econometric concerns. Section 7 concludes presentation.

2 Conceptual Framework

This section summarizes three key concepts: transaction costs, moral hazard and risk sharing.

2.1 Market imperfections and participants of land rental market: Ideas from Theory

This paper focuses on the factors that may affect the initial decision of a farmer to enter into the informal land rental market either as a tenant or as a landlord. In the crop production, since land is an immobile resource in physical sense, other resources have to be bought to it for agricultural production. The fact that in many countries, many households participate in informal land rental markets clearly indicate that the amount of land they wish to cultivate is not identical with the amount of land they own or not own at all. Many authors, to date, (e.g. Bliss and Stern, 1982; Binswagner and Rosenweig, 1984) show that with perfect market for other factors of production, there would be no need for a land rental market to achieve efficiency in production. However, in the presence of incomplete markets rural producers will try to maximize their utility from crop output by deciding how to combine their own resource endowments with resources obtained through the imperfect factor markets. This participation becomes more difficult when the farmers who participate are mostly poor as I see in rural Bangladesh. Therefore, the decision of participating in the informal land market must have some transaction costs. Moreover, the imperfections in factor markets together with unobserved risk of production may create moral hazard problem for the landlords who lease out land and may tend to make tenants, who lease in land, more risk averse.

As mentioned earlier, in the agricultural land lease markets there are two distinct groups of farmers. One group wants to lease out land hence identify as

the landlord. Other group who wish to lease in some land are the tenants. At the beginning of a cropping season, these two parties have to make decision over whether or not to participate in the land rental markets. Very often this decision is focus on completely different factors.

2.2 Contract type: Fixed rent versus sharecropping

Existing literature of tenancy contracts armed with the theory of contracts usually addresses two aspects: moral hazard and risk sharing. The landlord suffering for a moral hazard problem in which he can not monitor or verify the tenants' action. From the landlord's side, it is always preferable to him to offer a fixed rent contract rather than a sharecropping contract. This is because output sharing (share-tenancy) causes the market of land leases not clear as in the normal case. The share paid by the land lord to the tenant does not always work the same way as price. In addition, it is not always possible to fully monitor the tenant's effort in crop production. There are always risks of crop loss from many unobservable factors such as flood, draught, pest infestation etc. Therefore, when the plot is under sharecropping system, the low output may be from unobservable effects of nature or from low effort from the tenant farmers. Hence, a landlord faces moral hazard problems by the possible disincentive effect that output sharing may cause to the tenant. However, for the landlord it is not always possible to offer fixed rent contract to all the tenants, especially in an economy where most of the tenant farmers are poor and unable to pay fixed rent.

Similarly, a tenant's ability to enter the rental market and to choose a particular type of contract may depend on the possession of non-land resources and reputation of the farmer as a tenant. These are again characterized by his possession of sources of wealth and working capital that may be used to incur the cost of non labour inputs. However, a fixed rent contract imposes too much risk to the tenant because he is obliged to pay the fixed rent no matter what the actual output might be. The poorer and risk averse tenants may like an output share contract rather than a fixed rent contract. With a sharecropping contract the tenant can share the production risk with the landlord.[4] This implies decisions taken by the land lord and the tenant may be different and they may represent the two sides of the market. Moreover, given participation as a tenant or as a land lord, it is still possible that there may be considerable variations in the factors

[4]Theoritically, the landlord can mix these methods by offering a share tenancy with some fixed rent component. But in rural Bangladesh we do not see such mixed contract (Rahman and Rahman, 2009).

between these two groups in choosing either share cropping contract or fixed rent contract.

This theoretical model of risk sharing proposes three predictions that are subject to empirical testing. Firstly, because share tenancy can not fully motivate the tenant to work, but reduces risk from the tenant, it is predicted to be adopted by the tenant with greater risk aversion. Theoretically, income and assets affect the tenant's risk aversion. Practically, the tenants are thought to be more risk averse if they have lower wealth.[5] In this sense, also, having more opportunities of stable employment strengthens the tenant's tolerance to risk and choosing fixed rent contract. Secondly,the landlord will consider his capacity to monitor the tenant when he chooses to offer a particular contract. In this paper I empirically examine following hypotheses using data from rural Bangladesh:

(i) transaction cost: the higher the transaction cost of participating in land rental market the lower the probability that farmers will participate.

(ii) risk aversion: if risk sharing is important, then the more risk averse a tenant is, the lower the likelihood that a fixed rent contract will be chosen.

(iii) moral hazard: the higher the marginal cost of evaluating the effort devoted by the tenant to production, the larger the probability that fixed rent contract are offered since they offer more incentive.

3 Data and variables

3.1 Data and variables

The empirical study is based on cross-section micro-level data on farmers of rural Bangladesh. The data collected from a survey conducted by the International Rice Research Institute (IRRI). The sample survey is based on farm level cross section data for the crop year 2000. The survey was conducted from February to April 2000. A multi stage random sampling method followed for sample selection from 62 unions in 57 districts (out of 64 districts, omitting urban districts). Then one village was selected purposively from each union such that the population density and literacy rate for the village are similar to those for the selected union (this information was collected from the district census reports). A census of all the households in the selected villages was undertaken to collect information on landholding and sources of income of the household. At this stage two villages were dropped because of the logistical problems of implementing the survey. The

[5] See Binswanger, 1981; Rosenweig and Binswanger, 1993.

households were then stratified into eight groups on the basis of four landholding and two land tenure categories, and 20 households were drawn at random for each village according to their probability proportion. The stratification was based on wealth ranking technique of the participatory rural appraisal (PRA) method, because, the survey was initially conducted for a study of the impact of rice research on poverty reduction in rural Bangladesh. Detailed information on land ownership patterns, tenancy status and selected socioeconomic indicators for individual households was collected in this survey. The data set also include some plot level characteristics. Model variable definitions utilized from the survey data are reported in Table 3.1.

Summary statistics of the variables used in the empirical analysis are given in Table 3.2. Although the average household size is approx. 5, the non agricultural labour in a household is much lower than that of agricultural labour. This indicates lack of other job opportunities in rural Bangladesh. Illiteracy is considered as major problem for the economic emancipation in rural Bangladesh (FAO report, 2007). This is also supported by the data where Table 3.2 shows that only 40% of the household head has access to primary education. The average age of head of the household is approx. 46. Thus, they are of retirement age or close to it. Among other sources of income, reported in the table, income from tree plantation gives considerable side earnings.

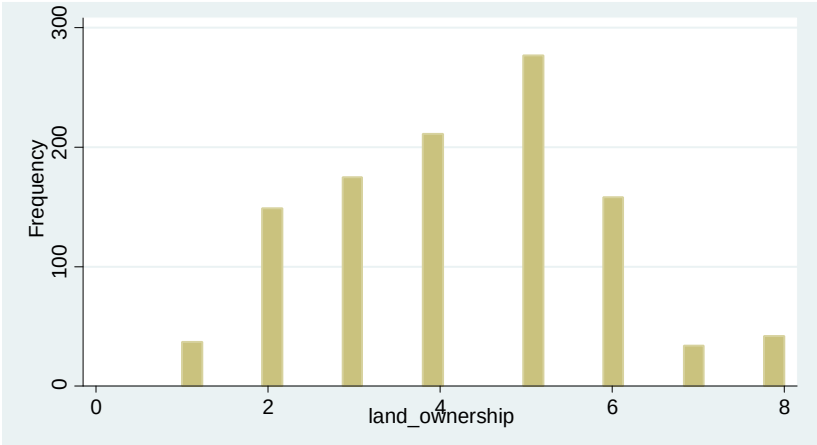
Table 3.1 Variable definitions

Variable	Description
	Selection model dependent variables
d_leasein	= 1 if HH lease in land; = 0 otherwise
d_leaseout	= 1 if HH lease out land; = 0 otherwise
	Full model dependent variables
Type_leasein	= 1 if HH sharecropping in the plot; = 0 if HH fixed rent in the plot
Type_leaseout	= 1 if HH sharecropping out the plot; = 0 if HH fixed rent out the plot
	Other binary variables
share	= 1 if share contract
rent	= 1 if fixed rent contract
	Independent variables
	HH characteristics variables
hhsize	Household (HH) size (number)
total_worker	Total active labour force in a HH (16-60 years) (number)
total_agri_male	Total male agri worker (number)
total_agri_female	Total female agri worker (number)
total_nonagri_male	Total male non-agri worker (number)
total_nonagri_female	Total female non-agri worker (number)
	Socio- economic variables
edu_head	Education of HH head ; =1 if completed primary education; =0 otherwise
healthyp	No. of healthy population in a HH
sexh	Sex of HH; = 1 if HH head is male; =0 otherwise
age_head	Age of head (number)
prim_occu_head	= 1 if the primary occupation of the head of HH is agriculture; =0 otherwise
cow_pp	Market price of bullocks used in cultivation
	Plot level characteristics
highland	= 1 if cultivable land is high land area ; =0 otherwise
highl	= 1if leased plot is high or medium high land
lowl	= 1 if leased plot is low or very low land
own_irrigated_area	Total irrigated area of cultivable land
riceplot	= 1 if only rice cultivated; = 0 if only non rice crop cultivated; =2 if both type cultivated
	Wealth variables of the HH
homestead_land	Ownland: homestead (ha)
garden_fruit_land	Ownland: garden& fruits (ha)
pond_land	Ownland: pond (ha)
cultivated_land	Ownland: cultivable (ha)
	Working capital variables of the HH
for_loan	Amount of credit from formal institutions (tk.)
infor_loan	Amount of credit from informal institutions (tk.)
goat_inc	Annual income from goat rearing (tk.)
poultry_inc	Annual income from poultry rearing (tk.)
Income_tree_plant	Annual income from tree, other plants (tk.)

Table 3.2 Means and standard deviation

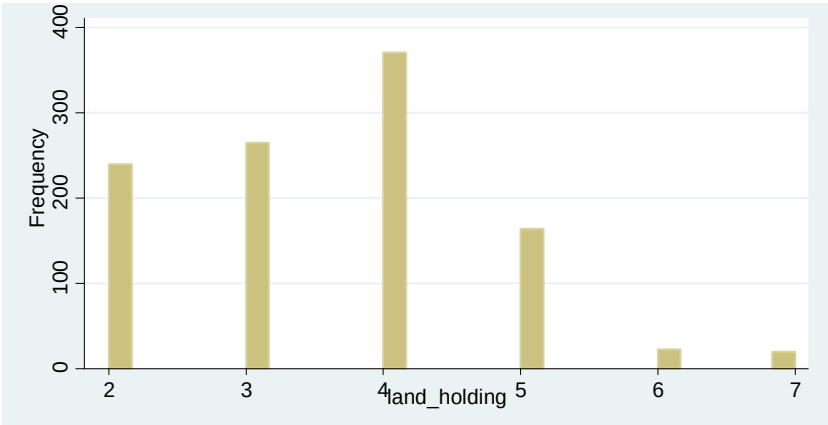
Variable	Mean	Standard deviation
hhsize	5.69	2.501
active_labor	3.29	1.598
total worker	1.735	0.994
total_agri_male	1.32	0.815
total_agri_female	0.017	0.131
total_non-agri_male	0.739	0.843
total_non-agri_female	0.048	0.226
edu_head	0.416	0.493
healthyp	5.141	2.449
sexh	0.973	0.164
age_head	45.94	12.549
hland	0.778	0.415
riceplot	1.417	0.594
cow_pp	9182.82	11038.81
own_irrigated_area	0642	1.054
homestead_land	0.059	0.066
garden_fruit_land	0.039	0.115
pond_land	0.018	0.054
own_cul_land	0.443	0.766
for_loan	2686.16	8826.85
infor_loan	1481.44	10790.04
goat_inc	7.756	125.25
poul_inc	407.41	815.87
income_tree_plant	2924.28	9240.345
d_leasein	0.465	0.499
d_leaseout	0.180	0.384
type_leasein	0.659	0.474
type_leaseout	0.465	0.499

Figure 3.1: Distribution of land ownership groups (data from rural Bangladesh, 2000)



1= absolute landless; 2= own only homestead; 3= functionally landless (<= 0.20); 4= marginal land owner (0.21-0.40); 5 = small land owner (0.41-1.00); 6 = lower medium land owner (1.01- 2.00); 7 = upper medium land owner (2.10-3.00); large land owner (>3.00ha)

Figure 3.2: Distribution of land holding groups (data from rural Bangladesh, 2000)



2= up to 0.20 ha; 3=0.21-0.40; 4= 0.41-1.0; 5=1.01- 2; 6 =2.10-3; 7 = 3+

Figure 3.1 and 3.2 illustrate distribution of land among the households in the survey data. In Bangladesh households are classified into seven groups (mentioned in the figure) based on their ownership of land. above figures show that in rural Bangladesh only few farmers are medium to large land owners compare to the huge amount of landless and marginal farmers.

4 Empirical methodology

The analysis focuses on the determinants of the decision to participate in the tenancy market and of the choice between fixed rent and share cropping contracts.

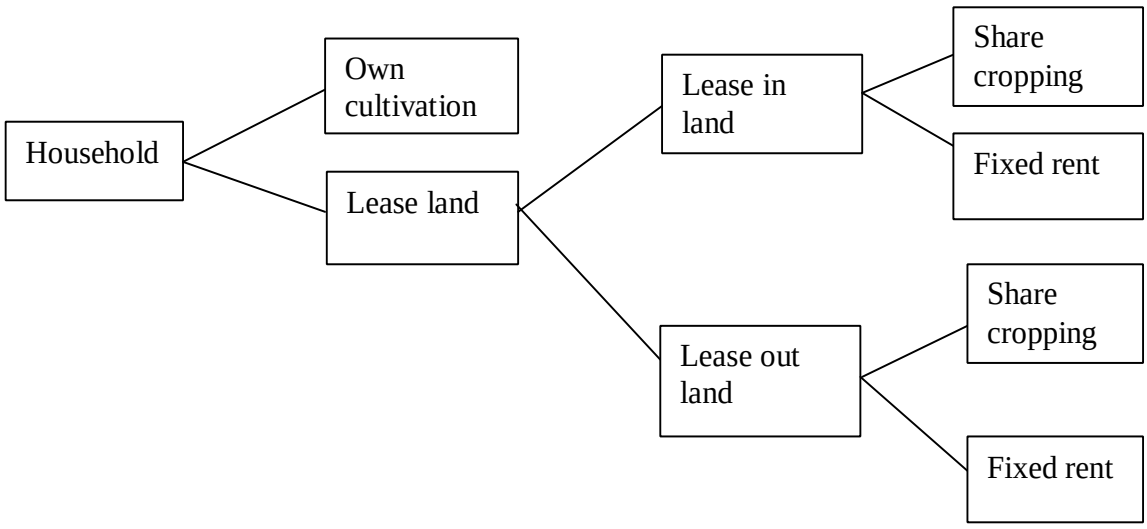
In rural Bangladesh (as elsewhere) social concerns and influences shape economic decisions including participation in informal land market. Due to this social and economic complexity, it would be very difficult to estimate a truly structural model of contract choice determination. As such, the current best practice methodology when it comes to estimate models of contract choice is through the use of different binary choice models.

4.1 Econometric models: Bivariate two stage model

Decision of leasing in and leasing out land and conditional on these decisions of types of rental contracts chosen are defined as dichotomous latent variables. In general, the study designates those who lease-out land as land lords and those who lease-in land as tenants. Let us assume that these two groups of farmers are distinctly different with respect to their socioeconomic circumstances. Most of the literature examining the determinants of land market transactions (e.g. Deininger et.al. 2003; Teklu and Remi, 2004; Masterson, 2007; Holden et.al. 2007) also implicitly assumed that the decision to lease-in and lease-out land are independent of each other.

My two stage model is based on a tree structure of choice of tenancy contract path. Farmers in rural Bangladesh at the beginning of the cropping season are assumed to follow two sequential decisions. First, whether a household wants to lease in or lease out land and second, depending on the outcome of first stage what type of contract a farmer would choose, i.e. if farmers what to lease in some land, then he have to choose between sharecropping in contract and fixed rent in contract. Similarly, if the farmer decides to lease out some land, then he has to choose a contract between sharecropping out and fixed rent out (fig 4.1).

Fig. 4.1 Tree for two stage model



However, decision variables in each stage are likely to be connected and some unobservable variables may affect both the decision. Thus, my empirical strategy relies on first estimating two seemingly unrelated probit models. This allows us to determine whether a joint estimation is appropriate or not (Maddlala, 1983). These models allow us to correct for 'sample selection biases' and is expected to increase the efficiency of the estimation. Finally, to provide additional insight into the nature of the joint choices made by individuals, we calculate the marginal effects of covariates on the probabilities of each combination of alternatives. The marginal effect allows us to understand changes in socioeconomic characteristics which may affect on the final four choices[6].

The two first order conditions of the tenants and landlords maximization problem yield the optimal decision (q_1^*) and choice of contract (q_2^*) as a function of each other and endogenous variables.

Assuming linearity , the model is,

$$q_{1i}^* = \alpha \; q_2^* + \beta_{1i} \; X_{1i} \; + \; \mu_{1i} \tag{1}$$

[6]Results are in appendix

$$q_{2i}^{*} = \alpha\ q_{1}^{*} + \beta_{2i}\ Y_{2i}\ +\ \mu_{2i} \tag{2}$$

Where $i = tenant\ or\ landlord$ and X_{1i} refers to the observed determinants of the decision of the tenant and land lord to participate in the tenancy market. Y_{2i} refers to the observed determinants of the decision of the tenant and landlord to either choose sharecropping contract or fixed rent contract in the tenancy market. β_{1i} and β_{2i} are the associate parameters, and μ_{1i} and μ_{2i} are a random error term. The data does not contain information on q_{1i}^{*} and q_{2i}^{*}. Instead we observe four discrete variables. q_{1i}^{*} and q_{2i}^{*} are equal to one when a tenant or a landlord decide to participate in the land rental market, zero otherwise. The decisions rules are then,

$$q_{1i}^{*} = \begin{Bmatrix} 1,\ if\ q_{1i}^{*}\ > 0 \\ 0,\ otherwise \end{Bmatrix} \tag{3}$$

$$q_{2i}^{*} = \begin{Bmatrix} 1,\ if\ q_{2i}^{*}\ > 0 \\ 0,\ otherwise \end{Bmatrix} \tag{4}$$

Yet, because the two decision of the tenant and the landlord are potentially taken simultaneously and explained by some common determinants, the error terms of the two models are might be dependent and distributed as a bivariate normal, so that $E(\mu_{1i}) = E(\mu_{2i}) = 0$, $var(\mu_{1i}) = var(\mu_{2i}) = 1$ and $\rho = cov(\mu_{1i}, \mu_{2i})$. A Wald test for $\rho = 0$ indicates these two stages should be jointly estimated. Hence, the study analyses two models one each for the tenant and another for the landlord and a total of four equations.

As mentioned above, in the first stage a household decides to lease in or lease out land or cultivate by own. I assume that this decision of the household largely related to his labour and non labour endowments. Furthermore, there may be some effect of socioeconomic parameters of the household to make a decision to participate in the land lease market. In this respect, estimates include several household characteristics as well as socio economic characteristics; this should also reflect the presence of transaction costs for the participation in tenancy market. The second stage particularly give attention to the factors that may represent degree of risk averseness of the tenant and moral hazard of the landlord when the two parties have to choose between share cropping contract and fixed rent

contract.

4.2 Testable implications

The landlords and the tenants in this study chose first whether or not to participate in the land lease market and then depending on this decision, chose between following contract types: crop- share and fixed rent. In a crop share contract in rural Bangladesh usually the tenant is responsible for all labour input but shares the cost of non labour inputs and the final production output. A fixed rent contract requires the tenant to pay the land owner a fixed cash payment and be responsible for all operating expenses. As mentioned earlier, through this study we test a set of hypotheses about the coefficients of explanatory variables in the contract choice equation, emphasizing imperfections in the existing markets, transaction costs, risk averseness and moral hazard problems. I investigate the market imperfections by using preliminary evidence from the data set. Following Tikabo and Holden (2007) the initial test for the role of transaction costs in through the extent of participation of farmers in the lease market and by using other parameters. Where there are imperfections in the market or absence of trade, there is costs associated with transactions in factor services, such as labour or bullock power or access to irrigation. Thus the household having surplus labour (mostly family labour) and /or bullocks lease in land while household with excess cultivable land in relation to their factor endowments lease out land.

A number of proxies has been used to test the transaction costs and risk sharing hypothesis in the first stage of the bivariate model. These proxies include: household size, education, age and sex of household head, number of healthy population in a household and bullock power. For this, I consider the household size as a proxy of household subsistence pressure (Teklu and Lemi, 2004). The higher the subsistence pressure the lower the rate of participation in the tenancy market. Hence, the likelihood of renting out and renting in land is higher among households with relatively less subsistence pressure (i.e. lower family pressure). While, number of healthy population in a family may reduce the transaction cost in a tenancy market. Accordingly, the rate of participation in the tenancy market increases with the increase in number of healthy population. Age of the household head use as a proxy for risk averseness: as the head of the farming household become older, he become more experienced but less physically able to take major part in the crop cultivation as well as supervising other family labourers. Thus, he becomes more risk averse. Similar explanation can also used for education level

and sex of the household head. The higher the education level of the household head, the more productive the household become, the less risk averse he/she would be. Also female household head assumed to be more risk averse than male headed household. Since, she has a major role running the household and taking care of dependents, it is traditionally assumed that female household head has less time to take part or supervise farm activities than male head.

In the second stage, from the principal agent perspective we look into the tenant's and the landlord's choice of contracts under different observable factors. Risk sharing hypothesis is tested mainly by looking for an effect of tenant's wealth and working capital on contract choice and some plot level characteristics of the leased in plot. There is strong evidence that higher-wealth individuals are less risk averse.[7]The tenants with more financial strength and the tenants who own some king of usable land may have been less risk-averse and therefore more willing to work under fixed rent contracts. In addition, considering the prevailing condition of the rural Bangladesh, topography of the leased land can also be a significant factor for choice of contract.

An alternative look at the hypothesis is the landlord's monitoring ability. If moral hazard and monitoring are important issues, female landlords or the landlords practicing non agricultural occupations or with more household members would likely to have higher cost of monitoring. Thus they would not want to participate in lease market. If participate would be more prone to choose fixed rent contracts. Moreover, as noted in Rainey's (2005) work, for the land lords, their wealth, working capital and access to credit should indicate their financial strength. Therefore, these variables hypothesized to increase the probability of choosing a sharecropping contract. Access to irrigation is a major concern for the landlord in rural Bangladesh to ensure a good production of crops. Thus, if the land is properly irrigated, the landlord is more likely to offer a crop share contract.

A few other control variables are also included in both stages of the selection model to emphasize the key variables discussed above; for example, the type of crop cultivated in leased plot and the type of labours in a household.

[7]Rosenzweig and Biswanger, 1993, provide striking results for India.

5 Empirical Results

5.1 Preliminary evidence

Table 5.1 presents an initial comparative study of the three groups of farmers: non participating owner farmers, the landlords and the tenants. In the table, 39.5% of the households lease-in land and 14.7% of the household lease-out land. Nearly 55% of the household take part in some kind of land transaction through land rental markets. Therefore approx. 46% of the households are not participating in the land rental market. One of the explanations of non-participation in the land rental market is the transaction cost (Teklu and Lemi, 2004; Tikabo and Holden, 2004). Bell and Sussangkarn (1988) show that transaction cost would drive a wedge between the costs and benefits of tenancy as a landlord and as a tenant. Non-participation of 46% of the households in the land rental market therefore, is an indication of fixed transaction costs in the market. ,since in rural Bangladesh, it is highly unlikely that all non-participating household have a perfect combination of land and non land factors for cop cultivation.

The socio economic profile of the participating farm households presented in the Table 5.1 shows some distinct variations from the non-participating households. The average size of the cultivated land per household is only about 0.45 ha. Hence, the functional amount of cultivable land per household is very small. Each household consists of on average 5 members in the family and 2 workers/household. In addition, the table confirms that 97% of the family are headed by male and 41.64% of the head of the household at least finish 4 year schooling. Therefore, the level of literacy is generally low among the farmers who lease in land and highest among the farmers who lease out land. Looking at the wealth variables other than own cultivable land, on average an individual household has only 0.06ha homestead land, 0.04 ha garden and fruit land and much smaller pond area. Considering the source of working capital, a household earns on an average 3000 taka (tk here after) from tree plantation annually, only 408 tk from poultry rearing and negligible amount from goat rearing. Incomes from goat rearing and income from tree plantation are lower for participating household than from non participating household. It is similar for access to credit as well. Hence, income from other sources such as goat, poultry and threes are higher in non participating households and landlords than tenant households. Similar picture can be seen in case of access to credit from formal and non formal sources. The table indicates that the tenant households in rural Bangladesh are the most disadvantaged portion of the

society. This group of farmers who are leasing in exhibit many characteristics of the rural poor in rural Bangladesh. Low asset ownership (land and other capital asset, access to credit) and low education level. As these households have some labour and non labour inputs that they can use for crop cultivation, the only way to do it is through tenancy. In the table, 47.37% individual household only grow rice, 47.18% grow rice and some other crop and only 5.45% grow non-rice crop. Among plot characteristics majority of the plot under study are either highland or medium high land or rest are low land.

Table 5.1 Differences in farm endowment, socio economic characteristics and extent of land transaction by participation status

Variables	Participating households				Non-participating households	
	Lease in		Lease out			
	mean	SD	mean	SD	mean	SD
Percentage of transacting households	39.5		14.7		45.8	
Household size	5.4	2.09	6.2	3.09	5.5	2.42
Healthy population in a HH(no.)	5	2.08	5.5	3.10	4.9	2.34
Age of head (year)	44	11.88	49	13.82	46	12.37
Education of head (school year)	2.9	3.56	6.06	4.6	5.6	4.38
Total worker in HH (no.)	1.7	0.99	1.8	0.97	1.8	0.98
Total male agri .worker in HH (no.)	1.32	0.76	1.3	0.88	1.3	0.87
Total female agri .worker in HH (no.)	0.02	0.11	0.01	0.10	0.03	0.17
Total male non-agri .worker in HH (no.)	0.72	0.86	0.8	0.80	0.74	0.78
Total female non-agri .worker in HH (no.)	0.04	0.19	0.06	0.26	0.05	0.22
Homestead land (ha)	0.05	0.07	0.08	0.06	0.06	0.04
Garden and fruit area (ha)	0.02	0.06	0.09	0.18	0.03	0.07
Pond land (ha)	0.008	0.03	0.04	0.11	0.02	0.03
Own cultivated area (ha)	0.22	0.43	1.52	1.50	0.58	0.73
Income from goat (tk.)	4.6	57.09	6.15	85.93	12	202.13
Income from poultry (tk.)	414.86	1005.37	503.94	771.41	327.81	510.02
Income from trees and plants (tk.)	1752.89	3175.51	6504.92	18040.45	1848.45	3551.37
Loan amount from formal lending institutions	1678.47	3259.34	2389.74	5848.77	2460.57	7482.89
Loan amount from informal landing source	1040.47	4645.64	2081.02	9618.98	1665	14128.72

Hence, the summary statistics presented in table 5.1 somewhat confirms the accumulated evidence of the prevalence of imperfections in markets of labour and non labour endowments. In rural Bangladesh, the market of hired labour is largely missing. This may be due to the extreme seasonality of demand for agricultural labour. The farmers relying greatly on hired labour may not have a guaranteed

supply of sufficient labour during peak season. The same explanation is also applicable for non labour inputs specially, bullock power. Thus, for rural Bangladesh, two inputs other than land that are essential for cultivation are family labour and draft power.

Figure 5.2 Distribution of different household characteristics among tenants

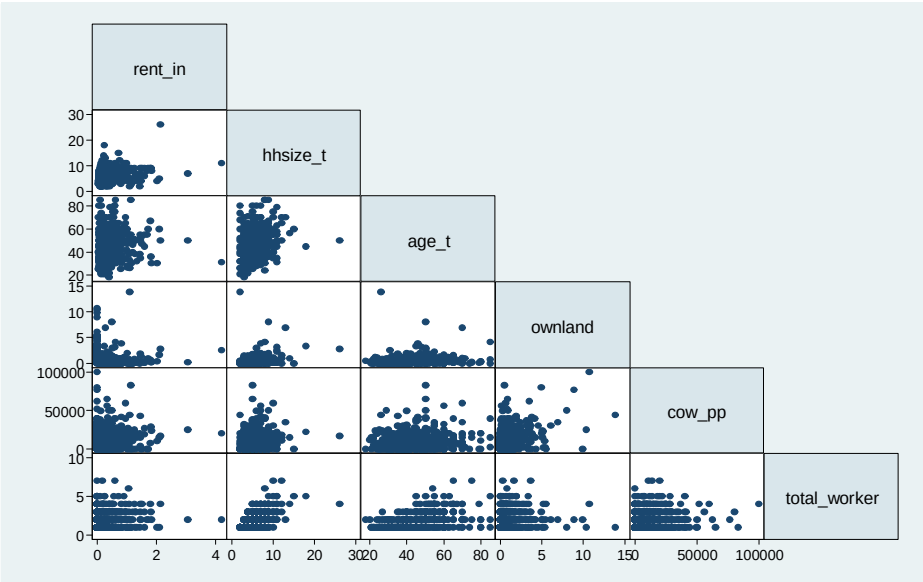


Figure 5.3 Distribution of different household characteristics among landlords

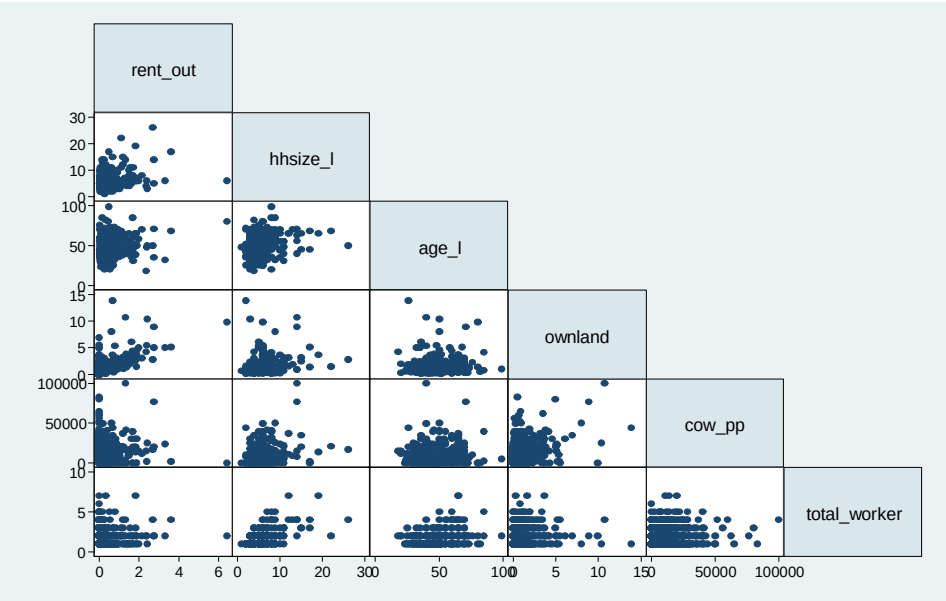


Figure 5.2 and 5.3 present the distribution of different households' characteristics among the tenants and the landlords and their correlations. Descriptively, the

tenants and the landlords have similar size of households though average age of the household head of the tenants is lower than that of the landlords. The tenants have less owned land than the landlord. Thus, this data from rural Bangladesh shows that marginal/small landowners rent in land from large landowners. This contradicts with the findings of Fujita (2010) who study land mortgage in Tangail district in Bangladesh and finds that marginal/small landowners rent land to medium landowners. In the figures above I use the actual amount of land rent in or rent out to estimate pair wise correlations among variables of interest. However, there are no significant relationship among the variables . It is thus, interesting to find whether this association holds when binary choice dependent variables are use for biprobit models.

Before setting off to estimate bivariate probit model it is worth looking at the distribution of two types of contracts (share cropping and fixed rent) in rural Bangladesh, represented by the survey data used here. These distributions are shown in figure 5.4.

Figure 5.4 Distribution of different contract choice between tenants and landlords

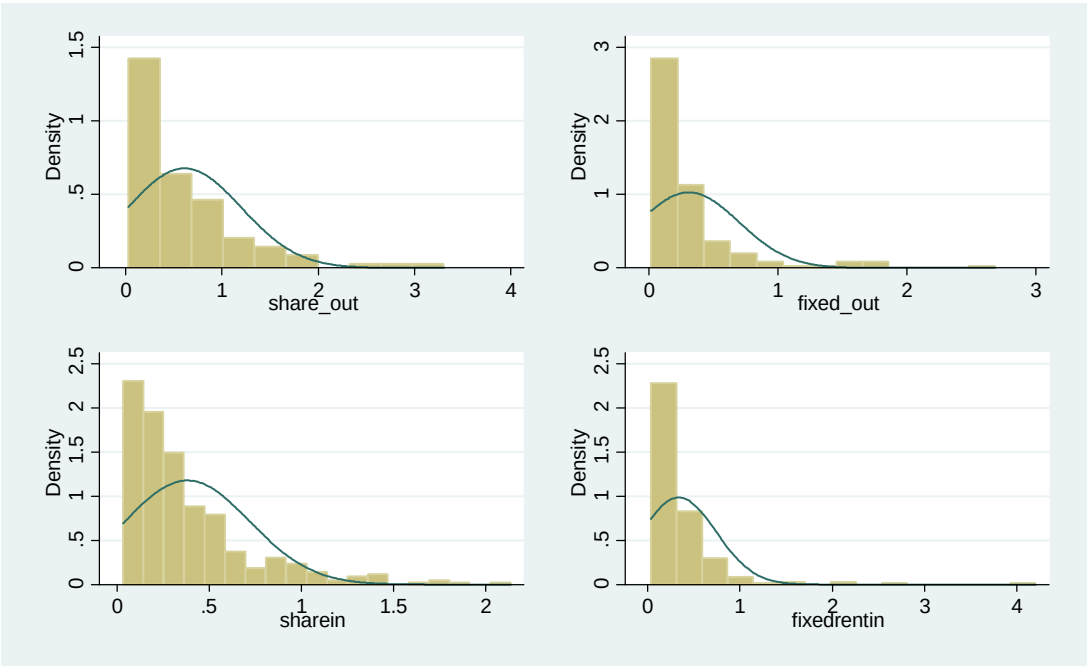


Figure 5.4 reveals that, like most of the developing country, land transactions in rural Bangladesh in 2000 are very much skewed. The average amount of land landlord sharecropped out or fixed rent out is higher than the average amount of land tenant sharecropped in or fixed rent in. The implication is that the land

rental markets do not perfectly serve well in correcting factor proportion at the farm-level (consistent with the findings of Taslim, 1989). Hence, there may be other factors like risk averseness and/or moral hazard which affect the contract choice.

5.2 Empirical findings: Bivariate model

Table 4 reports the results of first stage of a bivariate probit model which deals with the decision of a farm household to lease in (tenant farmer) or lease out (landlord) land.

First stage of biprobit model finds out determinants which influence the participation in land rental markets. I test this with same set of factors for the tenant and the landlord households. As shown in table 5.2, there are some common factors and also some different factors that explain the participation in the land rental market as a tenant or as a land lord. For example, for both the tenant and the landlord household, the bigger the size of the household, the lesser the probability of a household to lease in or lease out land. As mentioned earlier, we consider household size as a proxy of household subsistence pressure. Thus, household size has a negative but diminishing effect on the decision to participate in land rental markets. This also supports the transaction costs hypothesis. Similarly, when the effect of the household composition is controlled (number of healthy population), the effect of household size on the intensity of participation is positive. This result is consistent with the findings of Teklu and Lemi (2004) and Rahman (2009), though Teklu and Lemi used the ratio of adults in the age category of 15-64 years to the total household size. The model includes the number of total workers in the family which also have positive but weak impact on participation in land rental market. However, some literatures which focus on transaction costs hypothesis claim that household with more workers will lease out less land and conversely household with more workers tend to lease in more land. In my model, I do not find any significant relationship between number of workers and decision to lease in or lease out.

To check for risk sharing hypothesis, the results reveal that, age of the household head has a significant negative impact on the decision of lease in land but its effect on the intensity of lease out land is positive though weak. Therefore, as the household head become old, he/she becomes more risk averse. Possibly, this causes less participation in leasing market.

Table 5.2 Stage 1: selection model
Dependent variables: 1 if HH lease in land , 0 otherwise ; 1 if HH lease out land , 0 otherwise

variables	HH decision of leasing in land	HH decision of leasing out land
HH size	-0.397*	-0.207*
	(0.109)	(0.103)
Education HH head	0.170	0.265
	(0.199)	(0.214)
No. of healthy population	0.315*	0.177**
In HH	(0.112)	(0.106)
Age of HH head	-0.018*	0.006
	(0.009)	(0.007)
Sex of HH head	0.791	-0.587
	(0.613)	(0.502)
Total workers in a HH	0.271	0.332
	(0.217)	(0.242)
No. of male	0.091	-0.246
agricultural labour	(0.248)	(0.216)
No. of female	0.325	-1.177
agricultural labour	(0.700)	(0.900)
No. of male	-0.234	-0.372*
non-agricultural labour	(0.170)	(0.181)
No. of female	-0.692	-0.221
non-agricultural labour	(0.447)	(0.372)
Own cultivated land	-0.302*	0.151
	(0.153)	(0.115)
Market price of bullocks owned	0.00001	-0.00002*
	(0.00001)	(9.92e-06)
C	1.107*	1.118
	(0.701)	(0.628)

* : significance in 95% confidence interval ; ** significance in 90% confidence interval; S.E. are in parenthesis

Similar explanation can be given for number of non agricultural male members in a household who act as a landlord. This variable has significant negative impact on the participation in the lease market as the landlord. The household who wants to lease out land have to have sufficient monitoring capacity of tenant's activity to minimize moral hazard problem. This will ensure some degree of production certainty. If a household has more members involved in non agricultural activities, this will lessen the number of member who can monitor his tenants during cropping season. Therefore, this factor may decrease the probability of a potential household not to lease out land.

It is earlier stated that number of agricultural labour and bullock power should have significant effect on the decision on participation in lease market. However, in the estimation although I have the correct sign but they do not have any significant effect on the either decision of leasing in or leasing out land. Furthermore, bullock power has a negative significant impact on landlord's participation but the value

of coefficient is very small.

The second stage of the selection model allows one to examine how a household decides over a particular contract. Conditional on the decision of leasing in land or leasing out land, a household has to choose a contract between sharecropping and fixed rent. As a consequence, a tenant or a landlord has to choose to take or to offer either sharecropping in contract or fixed rent in contract respectively. I assume that for the tenant the more risk averse he is the more he chooses sharecropping contract. Similarly, for the landlord the decision to offer a particular contract more depend on degree of expectations over moral hazard and monitoring cost of production.

For each bivariate probit analysis, I try three models. Model 1, which is the base model here, includes all kinds of wealth and working capital variables a tenant and a land lord can possible consider making a decision over choosing a tenancy contract. Model 2 I accumulate working capital variable and includes all wealth variables as before. And in model three I used accumulated wealth and working capital variables. All three models also includes some household level characteristics and plot level characteristics. Since a priory information is not available on which variables effect the decision of a tenant or a land lord household, estimation uses the same set of variables in both analyses. However, one is expected to see differential influences of these factors on the decision to participate as tenants or as landlords and select a particular contract.

The assumptions of wealth effect on absolute risk aversion for the tenant farmers are quite popular in literature [8]. This implies that wealthier farmers should choose fixed rent contract more often than poor farmers. This follows, because as wealth increases, the amount of exogenous risk the farmer is willing to bear should rise. In rural Bangladesh, the ownership of any type of arable land consider as a measure of wealthier households. The survey data set have information on several types of land owned by a farm household. In addition, data set also have the information on income of a household from sources except crop cultivation, which includes here as working capital variables. Although these data do not perfectly measure wealth and working capital status of a household, they are close approximations because farmers in rural Bangladesh tend to derive most of their income from farm activities, and each of these variables measure wealth and working capital is assumed to be exogenous to the farm land contracts we examine.

Overall as table 5.3 shows, for the tenants, the estimates do not give much support to the wealth effect in risk sharing hypothesis. The biprobit estimates

[8] Laffont and Matoussi, 1995; Allen and Leuck, 2001

for all wealth and working capital coefficients, broken into components are insignificantly different from zero failing to support for risk averseness of the tenant. Only for model 2 the garden and fruit land owned by a tenant farmer is positively significant but weak.

The only three variables that have significant effect on the decision of choosing sharecropping contract by a tenant farmer are topography of cultivated land represented by dummy for high land, non agricultural male labour in the household and the age of head. Firstly, tenants cultivating elevated land are more likely to go for sharecropping contract. The sign of this coefficient is consistent with prevailing situation of flood prone rural Bangladesh. Crop cultivated in high land have less chance of destruction from seasonal flood waters. Thus, this assures higher outcome than that of low land. Secondly, in the estimates, if more male members in a tenant family involved in non agricultural job, they are more likely to go for fixed rent contract. This may be due to the fact that non agricultural job opportunity tends to give more household income security if a crop loss does occur. Hence, tenants are willing to take risk if they have other source of income. Thirdly, we find that, age (proxy for experience) is positive and significant. Comparing both stages we can say that: most experienced agent does not want to participate is tenancy market. However, conditional on the agent participates in the rental market, more experienced tenant farmer prefer sharecropping contract than fixed rent contract. This reflects the risk averseness of the tenant farmers. In fixed rent contracts tenant farmers has to bear the whole production risk. The more experienced a tenant becomes, the more risk averse a tenant becomes which leads him to choose sharecropping contract where he is able to share risk with land lord. In this regard, Maitra (2001) and Rahman (2009) find no effect of experience represented by age of the head on the type of contract chosen.

Focusing on the other side of the market, empirical estimation on the landlord's choice over type of contract offered to the tenant reflect the presence of moral hazard hypothesis. For the landlord, the possession of more homestead land and garden and fruit land increase the likelihood of offering a sharecropping contract. This may be due to the fact that, possession of these lands ensure a raise in total household income which makes the land lord more risk neutral in the rental market. Similarly, access to irrigation on lease out plot decrease the risk of crop loss and also increase the fertility necessary for crop production. Hence, it has a positive influence on the decision to offer a share cropping contract.

Finally, among the household level variables increase in female agricultural labour in a landlord household decrease the probability to rent out a land under

sharecropping. This finding is consistent with the theory of pressure of moral hazard as in rural Bangladesh male members usually responsible to monitor tenant farmer's work in the field. Some explanation of moral hazard can be applied to the negative significance of household size means less time to spent monitoring tenant farmers in the field which leads to decrease in the likelihood of offering sharecropping contract rather than fixed rent contract. Bullock power or agricultural labour inputs seems to have no such effect on the decision to offer a particular type of contract to a tenant, though it is often assumed in the literature that possession of own factor endowments by a land lord affect the decision of offering a certain type of contracts to his tenants.

Table 5.3 : Stage 2: full model

variables	Dependent variable : 1 if HH share in plot, 0 HH fixed rent in			Dependent variable : 1 if HH share out plot, 0 HH fixed rent out		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Homestead land	1.662	1.578		3.848*	3.464**	
	(1.148)	(1.161)		(1.961)	(1.935)	
Garden & fruit land	2.137	2.829**		4.625*	4.474*	
	(1.669)	(1.606)		(1.522)	(1.481)	
Pond land	-0.606	-0.126		2.526	2.517	
	(2.453)	(2.525)		(1.789)	(1.683)	
Own cultivated land	0.106	0.120		-0.109	-0.099	
	(0.369)	(0.345)		(0.184)	(0.188)	
Wealth			0.334			0.164
			(0.343))			(0.160)
Amount of loan from formal source	2.72e-06			4.92e-06		
	(5.5e-06)			(8.6e-06)		
Amount of loan from informal source	9.88e-06			0.00001**		
	(0.00002)			(8.04e-06)		
Monthly income from goat	0.009*			0.005*		
	(0.0005)			(0.0004)		
Monthly income from poultry	0.0002			-0.00005		
	(0.0001)			(0.0002)		
Income from tree & plant	4.49e-06			-0.00002		
	(0.00002)			(0.00001)		
Working capital		-4.16e-06	4.66e-06		-0.00001	0.00001*
		(0.00001)	(9.78e-06)		(0.00001)	(6.21e-06)
Primary occu. head	0.037	0.037	0.467	0.058	0.071	0.075
	(0.053)	(0.053)	(0.052)	(0.055)	(0.054)	(0.052)
Leased high land	0.464*	0.445*	0.488*	0.402*	0.368*	0.547*
	(0.222)	(0.224)	(0.222)	(0.254)	(0.254)	(0.242)
Soil type	0.075	0.087	0.094	-0.437**	-0.485**	-0.432**
	(0.207)	(0.208)	(0.207)	(0.245)	(0.243)	(0.231)
Leased irrigated land	-0.558	-0.561	-0.602	0.285*	0.275**	0.270**
	(0.369)	(0.350)	(0.386)	(0.139)	(0.133)	(0.133)
Rice plot	-0.052	-0.069	-0.060	-0.064	-0.095	-0.134
	(0.173)	(0.173)	(0.167)	(0.185)	(0.188)	(0.184)
Total worker in a HH	0.264	0.252	0.300	-0.039	-0.066	0.073
	(0.215)	(0.213)	(0.211)	(0.248)	(0.242)	(0.239)
Male agricultural labour	-0.251	-0.286	-0.307	-0.235	-0.186	-0.313
	(0.219)	(0.217)	(0.220)	(0.248)	(0.236)	(0.220)
female agricultural labour	0.222	0.333	0.254	-7.256*	-7.008*	-5.936*
	(0.643)	(0.659)	(0.675)	(0.576)	(0.571)	(0.442)
Non agricultural labour male	-0.453*	-0.448*	-0.442*	0.149	0.156	0.313
	(0.166)	(0.168)	(0.167)	(0.189)	(0.186)	(0.220)
Non agricultural labour female	-0.233	-0.186	-0.253	-0.213	-0.171	-0.220
	(0.378)	(0.362)	(0.359)	(0.377)	(0.352)	(0.345)
Value of bullocks own	-4.76e-06	-1.93e-06	-6.38e-06	-7.25e-06	8.22e-06	-1.43e-06
	(7.7e-06)	(9.10e-06)	(8.6e-06)	(0.00001)	(0.00001)	(0.00001)
HH size	0.048	0.065	0.051	-0.085*	-0.073*	-0.084**
	(0.050)	(0.042)	(0.039)	(0.044)	(0.044)	(0.043)
Age of head	0.015**	0.017*	0.017*	-0.003	-0.004	0.0002
	(0.009)	(0.009)	(0.008)	(0.008)	(0.008)	(0.007)
N	261	261	261	225	225	225
Log likelihood	-274.42	-275.94	-277.99	-231.137	-233.14	-243.46
ρ	0.027	0.035	-0.027	0.176	0.173	0.266
	(0.131)	(0.131)	(0.130)	(0.13)	(0.129)	(0.13)
Wald ^{2}	(34)	(30)	(27)	(34)	(30)	(27)
	541.07	75.97	62.11	2415.66	912.73	1043.92
Wald test for = 0 ; $^2(1)$	0.044	0.071	0.044	1.164	1.727	3.58

* : significance in 95% confidence interval ; ** significance in 90% confidence interval

6 Model Extension: Analysis of endogeneity in choice of contacts

6.1 Endogeneity in contract choice

In this study I also try the potential solution for endogenous matching between the tenant and the landlord (explained in introduction) suggested by Ackerberg and Botticini. Their suggestion is to use topographical or geographical based instruments that can affect the matching, together with the tenants and the landlord's attributes together in one equation. The study estimates first the correlation between the tenant's characteristics and plot characteristics and then a probit model which includes the landlords, the tenants and plot characteristics to check for endogeneity.

A different approach most literatures in this field is taken that considering a situation where the tenant and the landlord have already decided to participate in the rental market and finally decide over the contract chosen. I also revisit this methodology with data from rural Bangladesh. This estimation also helps one to focus on any endogenous matching problem, if there is any, between the land lord and the tenant. The effect of explanatory variables on contract choice is estimating on the basis of the effect of variables on the probability of choosing a particular contract. Thus, contract choice is a latent variable ,C_{ij}, for contract type and have the following economic relationship:

$$C_{ij} = a' \, x_i + b' \, y_j + p' \, z_{ij} + \varepsilon'_{ij} \tag{5}$$

Where x_i denote a vector of tenant i's attributes, y_j denotes a vector of land lord j's attributes and z_{ij} denotes the vector of plot level attributes. The random disturbance ε'_{ij} reflects the fact that this model contains proxies in xs, ys and zs and hence contains approximation error. I assume that error term follows a normal distribution with a zero mean and a variance of one.

The binary variable that is the outcome of interest, say, chosen sharecropping contract is determined by C_{ij} . Thus the observed dependent variable is

$$C^*_{ij} = \begin{Bmatrix} 1, \; if \; contract \; is \; a \; crop \; share \\ 0, \; if \; contract \; is \; a \; fixed \; rent \end{Bmatrix} \tag{6}$$

The likelihood of contract chosen becomes (from (5) and (6))

$$\pi_{ij}\ F\ (a^{'}\ x_i + b^{'}\ y_j + p^{'}\ z_{ij} + \varepsilon_{ij}^{'})^{C_{ij}}\ .\{\ (1-F)((a^{'}\ x_i + b^{'}\ y_j + p^{'}\ z_{ij} + \varepsilon_{ij}^{'})\}^{1-C_{ij}} \tag{7}$$

Where $F()$ follows a cumulative normal distribution function giving the probability of a crop share contract being chosen, conditional on the covariates. Therefore, when estimating using a probit model, an increase of an explanatory variable with a positive sign raises the probability that a crop share contract is chosen. I consider the same hypotheses that has been considered for the bivariate model.

Table 6.1: distribution of land type, soil type, contract and tenant's wealth

Land type	Contract	
	Share	Fixed rent
Highland	0.088	0.012
	(319)	(134)
Lowland	0.074	0.121
	(126)	(149)
Loamy soil	0.084	0.086
	(214)	(198)
Sandy soil	0.138	0.069
	(75)	(101)

Note: the first element in each cell is the mean wealth of the tenant and the second element (in parentheses) is the number of observations (ref. Ackerberg and Botticini, 2002)

The cross tabulations in table 6.1 show two correlations. First, highland plots appear to be associated with share contracts, whereas lowland plots are most often leased out under fixed rent contract. Out of 728 total observations, 445 highland plots are sharecropped and 283 lowland plots are under fixed rent contract. Second, as for lowland plots, the mean tenant's wealth is higher under fixed rent contract than under share cropping contracts. Though there are no significant correlations between soil type and contract chosen. Moreover, from the table it is obvious that there are no such correlations between the tenant's wealth and type of plot they leased in. Therefore, the next step toward assessing potential

matching problems (suggested by Ackerberg and Botticini, 2002) is to examine the correlations between observable the tenant's characteristics and plot characteristics. To address matching problem the observed correlation between the land type and the tenant's wealth and working capital variables inform us about the direction of the unobserved correlations between the land type and the tenant's other unobserved variables. Table 6.2 addresses this question by regressing plot type on the tenant's wealth. The results reveal that there is no significant relations among three variables.

Table 6.2: Matching equation : dependent variable ploy type

highland	Coefficient	Std. Err.	t
wealth_t	0.0973457	0.164897	0.59
workc_t	1.07e-06	3.52e-06	0.30
_cons	0.7588444	0.0208043	36.48

These non- significant correlations may suggest that, there may be no matching or may the estimation miss some important instruments. However, to make sure about endogenous matching one has to then estimate a regression which includes both the principal's and the agent's characteristics together with plot level characteristics.

6.2 Empirical Results: probit model

Table 6.3 below reports results of probit regression. Without controlling for matching (without the land type and soil type variables), One can find little, if any, effect of the tenant's and the landlord's wealth and working capital strength on the contract choice. after controlling for biases due to matching, however, empirical results show significant effects of the above mentioned variables. As anticipated, strengthening land lord's financial condition (represented by wealth_l and loan_l) makes the share contract more likely. Also, as predicted increasing the tenant's financial strength (represented by workc_t) makes fixed rent contract more likely though the value of the coefficient is very small. The land lord's financial condition is the more statistically significant variable. Focusing on other variables, if agriculture is the primary occupation of a tenant farmer (prim_occu_t) is increase the likelihood of the share contract. This supports the moral hazard hypothesis in which agriculture as the primary occupation of the tenant somewhat guarantee

increased labour effort in the leased land. On the other hand, similar to earlier model plot level characteristics such as irrigated land and high land ensure a positive outcome and thus, increase the likelihood of share contract.

As noted earlier, Ackerberg and Botticini (2009) in their paper mentioned about the endogenous matching problem between a tenant and a landlord. Probit results in this study suggest that these may be matching between the principals and the agents. It does not tell why there is such matching. One inference can be drawn that, under the share contract the income of the tenant moves in proportion with the output realized. Crops grow in high land have higher output realized than crops grow in low land due to the occurrence of seasonal flood. Therefore, risky crop outcome is associated with fixed rent contract, whereas, the less risky crops would be associated with share contracts. Interestingly, there are a number of studies on contract choice that have found little or no risk sharing effects or endogenous matching effects in various places and eras (Allen and Lueck, 1999; Ackerberg and Botticini, 2000; Fukunaga and Huffman, 2009).

Table 6.3: Probit model: estimated coefficients for wealth effects

variables	Dependent variable : 1 if contract is sharecropping, 0 if contract is fixed rent			
	Model with land type and soil type		Model without land type and soil type	
	coefficient	SE	coefficient	SE
Wealth_l	7.996*	3.164	2.669	3.705
Loan_l	0.00002*	-7.10e-06	8.94e-06	-8.81e-06
Workc_t	-0.0002**	0.0001	-0.0001	0.00009
Own_cul_land_t	0.375	0.928	0.298	0.883
Age_t	0.026	0.054	0.004	0.034
Hhsize_t	-0.398	0.341	-0.328	0.214
Primary_occup_t	1.429*	0.450	0.507*	0.257
Edu_head_t	-0.168	0.149	0.028	0.093
Cul_irri_area_l	5.669*	2.555	1.971	1.777
riceplot	0.281	0.695	0.247	0.639
highland	2.385*	0.719		
Soil_type	-3.114*	1.111		
C	-0.059	2.650	1.876	2.354
Log pseudolikelihood	-9.553		-15.747	
Prob > χ^2	0.0007		0.058	
Pseudo R^2	0.650		0.423	

Model also control for agricultural male and female labourers and also for non agricultural male and female labourers in a household

* : significance in 95% confidence interval ; ** significance in 90% confidence interval

7 Conclusion

Through this study, I intend to contribute to the literature of agrarian tenancy contract and landlord-tenant relationship with evidence from rural Bangladesh by comprehensively considering the effects of transaction costs, risk sharing and moral hazard problem. There has been a great deal of recent empirical work looking at such issues jointly or separately in a wide range of countries: from historical data, to agriculture in developing countries, to franchising and agriculture in developed countries like United States and France.

Results from the preliminary studies shows that in rural Bangladesh, although more than 80% of the farmers line below poverty line, 46% of the farmers don not participate in the informal land market. Substantial non-participation in the land rental market indicates that there are considerable transaction costs in those market. Results of empirical analysis showed that land rental transactions are motivated by need to adjust land area cultivated to the size and number of healthy population in the household.

Between risk sharing hypothesis and moral hazard hypothesis, estimates form bivariate probit model strongly support moral hazard problem of the landlord. Hence, monitoring capacity of the landlord are important factors to choose a particular contract offered to the tenants in rural Bangladesh agriculture. The landlords concern about their valuable asset, lease out land and participate in land rental market when he can ensure a minimum level of monitoring capacity. Therefore, household with more female labour tend to offer fixed rent contract. At the same time, a landlord will offer a share cropping contract only when he has sufficient other land assets, irrigation facilities in his lease out land and capacity to monitor tenant farmers.

However, there is no such significant empirical support that risk sharing hypothesis through wealth effect from the tenant side . Poorer and likely more risk averse tenants do not necessarily work under share tenancy arrangements. The empirical evidences from different countries, though, suggest both similar and different conclusions. As noted before, Allen and Leuck (1999, 2000) in their works also find no significant relation between tenant's wealth and contract choice in case of U.S. tenant farmers. Comparisons of their results to my results give some contrasting conclusion. In rural Bangladesh, output from cultivation is largely depend on favorable environmental , soil and land conditions. High unstable yields, lack of income diversification and extreme poverty among farmers naturally make them risk averse. Thus, when they decide between two contracts; share tenancy and fixed rent tenancy, its their labour supply capacity and type of plot determines the choice of contracts. Results also find some confirmation of this from the preliminary evidence as explained in the paper. Their major income and welfare depends on the leased in land. Therefore, they may little option to choose a particular contract rather than to accept whatever contract and the terms the landlord offers them. That is why, some degree of risk averseness among the tenants are reflected through their age, non agricultural income and type of rented land in the empirical analysis. Furthermore, I do have some supports over potential matching of heterogeneous tenants and land lords. Estimates ignoring this matching can

give misleading results. In the analysis, controlling for matching gives a significant estimates for risk sharing hypothesis.

I believe that these preliminary studies and empirical results are important because there are evidence of the presence of imperfections in some markets in agriculture sector in Bangladesh. The fairly high degree of non-participation in the land rental market may indicate that there is room for policy intervention to improve the markets and efficiency of resource allocation. As a result, the finding of this study may provide insights into issues currently debated in Bangladesh (also in many other developing countries) over the function of informal lease market in substituting for imperfect credit, insurance and capital market. The land rental market in rural Bangladesh is completely informal and has not been so far stimulated by any policy. The analysis of this paper is still somewhat preliminary in nature due to the fact that here I do not focus into that productive efficiency from a leased plot compare to an own cultivating plot or from a sharecropping plot compare to a fixed rent plot. For a rural agricultural household in Bangladesh, the final output of crop production which is also their main source of income, is the main concern. This issue is missing from the analysis in this paper and will be looked after in detail in future.

Appendix

Table A.1: Marginal effect: bivariate model: leased_in vs. leased_out

variables	Dependent variable : 1 if HH share in plot, 0 HH fixed rent in			Dependent variable : 1 if HH share out plot, 0 HH fixed rent out		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Edu_head	0.025	0.248	0.025	0.032	0.031	0.024
	(0.029)	(0.029)	(0.029)	(0.025)	(0.026)	(0.025)
Healthy_p	0.046*	0.046*	0.046*	0.021	0.021	0.019
	(0.016)	(0.016)	(0.016)	(0.012)	(0.013)	(0.012)
Age_head	0.002	0.002	0.002	0.00008	0.0002	0.00006
	(0.003)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)
Sex_head	0.116	0.116	0.116	-0.069	-0.069	0.069
	(0.091)	(0.090)	(0.091)	(0.059)	(0.059)	(0.056)
Primary occup_ head	0.010	0.010	0.013	0.013	0.016	0.019
	(0.014)	(0.015)	(0.014)	(0.011)	(0.011)	(0.013)
hhsize	-0.045*	-0.039*	-0.044*	-0.043*	-0.041*	-0.044*
	(0.019)	(0.018)	(0.018)	(0.015)	(0.015)	(0.016)
ownland	-0.044*	-0.044*	-0.044*	0.018	0.018	0.017
	(0.022)	(0.022)	(0.022)	(0.013)	(0.012)	(0.012)
Total worker	0.133	0.110	0.125**	0.031	0.024	0.054
	(0.069)	(0.069)	(0.069)	(0.064)	(0.064)	(0.069)
Total agri. male	-0.055	0.065	0.072	-0.080	-0.070	-0.105**
	(0.072)	(0.073)	(0.073)	(0.062)	(0.060)	(0.062)
Total agri. female	0.109	0.141	0.012	-1.722*	-1.679*	-1.617*
	(0.175)	(0.194)	(0.195)	(0.175)	(0.170)	(0.164)
Total nonagri. male	-0.159*	-0.159*	-0.159*	-0.012	-0.009	-0.026
	(0.052)	(0.053)	(0.053)	(0.048)	(0.048)	(0.055)
Total nonagri. female	-0.166	-0.154	-0.173	-0.073	-0.064	-0.079
	(0.112)	(0.116)	(0.117)	(0.091)	(0.089)	(0.095)
Value_ bullock	2.02e-06	9.81e-07	2.82e-06	-6.74e-07	4.27e-07	2.45e-06
	(2.8e-06)	(2.99e-06)	(2.92e-06)	(2.56e-06)	(2.69e-06)	(2.89e-06)
Homestead land	0.460	0.441		0.839*	0.770*	
	(0.317)	(0.325)		(0.425)	(0.427)	
Garden and fruit land	0.592	0.791**		1.009*	0.995*	
	(0.459)	(0.442)		(0.312)	(0.442)	
Pond area	-0.167	-0.035		0.558	0.559	
	(0.679)	(0.706)		(0.381)	(0.365)	
wealth			0.094			0.041
			(0.096)			(0.039)
Formal loan	7.5e-07			7.5e-07		
	(1.53e-06)			(1.53e-06)		
Informal loan	2.7e-06			2.7e-06		
	(4.6e-06)			(4.6e-06)		
Income from goat	0.002*			0.002*		
	(0.00002)			(0.00002)		
Income from poultry	0.00005			0.00005		
	(0.00003)			(0.00003)		
Income from trees	1.24e-06			1.24e-06		
	(4.41e-06)			(4.41e-06)		
Working capital		-1.16e-06	-1.32e-06		-3.46e-06	-3.12e-06
		(3.08e-06)	(2.76e-06)		(2.19e-06)	(1.54e-06)
Leased high land	0.129*	0.125*	0.138*	0.087	0.082	0.136*
	(0.061)	(0.622)	(0.062)	(0.054)	(0.055)	(0.058)
Leased irrigated land	-0.155	-0.157	-0.170	0.062*	0.061*	0.067*
	(0.101)	(0.097)	(0.108)	(0.028)	(0.027)	(0.037)
Soil type	0.021	0.024	0.026	-0.095**	-0.107*	-0.106*
	(0.057)	(0.058)	(0.058)	(0.053)	(0.053)	(0.055)
Rice plot	-0.014	-0.019	-0.017	-0.014	-0.021	-0.033
	(0.048)	(0.048)	(0.474)	(0.040)	(0.041)	(0.045)