Agricultural Land Tenancy in Rural Bangladesh: Productivity Impact and Process of Contract Choice

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"He grants wisdom to whom He pleases; and he to whom wisdom is granted receives indeed a benefit overflowing; but none will grasp the Message but men of understanding." (Al-Qur'an; 2: 269)

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Abbreviations

ADB	Asian Development Bank
AHM	Agricultural Household Model
BBS	Bangladesh Bureau of Statistics
BOI	Board of Investment
CDF	Cumulative Distribution Function
FIML	Full Information Maximum Likelihood
GDP	Gross Domestic Product
GNP	Gross National Product
HH	Household
IMR	Inverse Mills Ratio
IRRI	International Rice Research Institute
IV	Instrumental Variable
LDCs	Least Developed Countries
LR	Likelihood Ratio
MDGs	Millennium Development Goals
MoA	Ministry of Agriculture
PRSP	Poverty Reduction Strategy Paper
Tk	Taka
WB	World Bank
WFP	World Food Programme

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Abstract

Land is a prime factor of production for an agricultural country like Bangladesh and access to land has been the major source of livelihood of farmers living in rural Bangladesh. However, access to land is governed by informal tenure arrangements which in turn affect the productivity of the farm. This thesis looks at the consequences of different contract choices relating to land tenancy arrangements in rural Bangladesh. It consists of three core chapters (Chapter 4, 5 and 6) which include: an analysis of the productivity impacts of sharecropping; an examination of the conditions under which a sharecropping contract is chosen over a fixed-rent contract; and an examination of sources of incentives whereby particular types of tenants end up contracting with particular types of landlords or choosing particular crop practices. Empirical investigations presented in this thesis add to our understanding of the nature of contructual relationships within agricultural land tenancy markets.

The first academic contribution of this thesis lies in the comparison of conventional and non-conventional econometric methodologies. Particular emphasis is given to the problems of sample-selection bias and endogeneity in the contract choice that very often plague the estimation results. It is important to have an appropriate measure which controls for the biases in the econometric analysis that arise from the observability problem of certain theoretically important factors such as risk preferences, moral hazard problem which affect impact of tenure arrangements, participation decision as well as motivation for matching. This is crucial because how much certain characteristics affect the contract choice system can provide information about the functioning of a micro-economy.

The works discussed herein are mostly econometric analysis, although the thesis has attempted to locate the most relevant theoretical models to explain

the econometric outcomes in each chapter. The literature review chapter (Chapter 3) also has a detail explanation of the revelant theoretical models. A two-year household-level panel data set of rice farmers from rural Bangladesh is used to illustrate different corollaries of tenancy contracts.

The first core chapter (Chapter 4) attempts to analyse the impact of sharecropping compared with that of owner cultivation. It illustrates the productivity differentials with special focus on the hypothesis of 'Marshallian inefficiency', i.e. lower efficiency on sharecropped as compared to owned plots. The main contribution of this chapter is the use of a unique regression model to evaluate the potential impact of adoption of sharecropping measured by the impact on the household's output. A household's decision to enter into a crop-share contract is endogenous and may affect his productivity. Therefore, a simultaneous equation model with endogenous switching regression is developed. This method enables us to estimate the causal impact of choosing sharecropping and helps to capture the treatment-effect of sharecropping by controlling for the impact of the selection problem on productivity and the adoption decision.

This chapter includes preliminary results from the random-effect, the fixed-effect and the treatment-effect models to evaluate the consistency of estimation results. Our analysis reveals that in rural Bangladesh, the threat of eviction effect[1] dominates the Marshallian inefficiency and sharecroppers are no less productive compared with the owner cultivators.

This chapter contributes to an understanding of the factors which generate differences in input and output intensities across two comparative tenure regimes: mixed tenant and pure tenant. Results do not find any strong support for the idea that cropping intensity is relatively higher among pure sharecrop-

[1] Threat of eviction hypothesis: Uncertainty about contract renewal creates incentives to increase output (and therefore input use) on sharecropping plots in order to qualify for contract renewal. Testable implications would be highr or not significantly lower output on sharecropped plots than on own cultivated plots.

pers compared to mixed sharecroppers. The overall empirical results imply that due to non-availability of off-farm jobs, share tenants employ their optimal effort in crop production.

The second core chapter (Chapter 5) attempts to identify the determinants of the choice of contracts between a crop-share contract and a fixed-rent contract. The modelling focuses on estimating how heterogeneous risk preferences and the moral hazard problem affect the choice of contracts among the participants in the land-lease market. The analysis draws from the principal-agent model where both parties are assumed to be risk averse. Though sharecropping remains widespread, its determinants are still poorly understood and the debate over the extent of risk preferences and moral hazard are far from settled. The present study jointly determines the socio-economic factors underlying the decision to rent-in/out land and the choice of tenancy contract between a crop-share contract and a fixed-rent contract using a two-stage modified Heckman selection model. The first set of results reveal that a number of socio-economic factors affect a farmer's participation in the land-rental market and work in opposite directions regarding the decision to rent-in or rent-out land. The likelihood of renting-in land is higher for farmers with insufficient cultivable land but with higher numbers of male agricultural labourers in the household. On the other hand, the likelihood of renting-out land is higher among farmers with higher levels of cultivable land but with lower numbers of male agricultural labourers in the household. Among the households, who participate in the land-lease market as tenants, the results do not support the risk-sharing hypothesis of the agency theory as a motivation for contract choice, while there is some support that the monitoring problem affects the contract choice. The monitoring capacity of the landlord household is an important factor in choosing a particular tenancy contract.

The third core chapter (Chapter 6) extends the analysis of the second core chapter with particular focus on the incentives for matching. It studies the presence of potential bias in estimated coefficients of contract choice equations arising from multiple sources of endogenous matching among the landlords, the tenants and the activities and its implications on the contract choice equation. The study finds support for the incentives for endogenous matching in two sources. These are: tenant's observable proxies for risk aversion impacting the decision of choosing a particular crop practice; and the landlord's observable risk preferences are significantly related to the tenant's characteristics although there is no evidence of observed landlord characteristics impacting on the tenant's proxies of risk aversion. Econometrically the presence of matching biases the results due to the omitted variable problem, which if not controlled for will cause an inconsistent estimation of the contract choice equation. In fact, this chapter reveals that without controlling for matching the risk-sharing is an important determinant of contract choice. However, after controlling for possible sources of matching, risk-sharing is found not to have any significant influence on choosing a particular tenancy contract.

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Declaration

I, Sharmina AHMED, certify that this work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

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Sharmina Ahmed

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1 Chapter One: Introduction

1.1 Introduction

Acute poverty, economic alienation and severe vulnerability to natural factors often characterise rural households in low income countries, which mainly derive their livelihood from agriculture. This thesis explores the economic choices the farming households make in agricultural land market and their impact where the production environment is uncertain, market opportunities are limited and underlying institutional settings are either imperfect or missing. Particular focus is placed on rural Bangladesh, a country where the majority (80 percent) of the population were living in rural areas in 2007/08 (World Bank, 2008).

Land for the people of Bangladesh (like many developing countries) is the single most important asset. The majority of households in Bangladesh largely depend on land-based activities, especially agriculture-related activities for their livelihoods. As almost 65 percent of the total population (and above 80 percent of the rural population) were dependent on agriculture, the failure of agriculture in 2009/10 to provide for a secure livelihood is considered to be a major factor contributing to rural poverty. In 2009/10 about 41 percent of the total population were living below the poverty line (World Bank, 2010). 80 percent of the people in Bangladesh live in rural areas which is where the incidence of poverty is worst.

In Bangladesh poverty is concentrated mostly in households which do not own assets. The incidence of poverty in 2006 was 80 percent among the rural households with no cultivated land, 60 percent among those who had up to 0.2ha land and close to zero among households owning more than 1.0ha of land (Hossain, 2006).

During periods when there is a shortage of off-farm employment agricul-

tural tenancy markets are commonly used in rural Bangladesh, especially during the cropping seasons. The contemporary agricultural land tenure system in Bangladesh is still deeply influenced by the practices of British colonial administrators. However, functioning of the agricultural tenancy market has not been thoroughly explored with respect to Bangladesh. Moreover, to date no land reform or tenancy reform policies have been successfully implemented in Bangladesh.

The current broad agricultural policies are focused on economic restructuring, liberalization and privatization of different relevant markets. This provide the rationale for this research to revisit the issue of land and livelihoods in agricultural areas of rural Bangladesh. It is important to note that livelihood strategies among farmers in rural Bangladesh are influenced by the land tenure rules which are informal. Thus, knowledge of how informal tenure rules interact and their impacts are important because it assists in identifying constraints and opportunities for intervention in the land tenure markets.

This study looks at the rice farmers in rural Bangladesh and it takes into account the socio-economic differences between individual farming households in relation to access to land and the choice of tenancy contract. The study focuses on the rice farmers in empirical analysis since this is the dominant agricultural production process. Rice farmers provide nearly 48 percent of rural employment. Rice provides about two-thirds of total calorie supply and about one-half of the total protein intake of an average person in the country. The rice sector contributes one-half of the agricultural GDP and one-sixth of the national income in Bangladesh (Bangladesh Bureau of Statistics, BBS, 2009). About 75 percent of the total cropped area was planted to rice in the year 2008. Thus, rice plays a vital role in the livelihood of the people of Bangladesh.

1.2 Overview of the Thesis

The historical and recent background relating to the Bangladesh economy and land issues are reviewed in Chapter 2. This chapter provides an overview of the agricultural production system in Bangladesh focusing on the rice farmers. These background information is important to fully understand and interpret the results from the empirical models in Chapter 4 to Chapter 6.

Several studies, both theoretical and empirical, are reviewed in Chapter 3. This involves the understanding of how the contemporary theories deal with different propositions. There are large numbers of theoretical models of the agricultural land tenancy in the literature. A number of theoretical models specifically deal with the issue of efficiency impacts relating to share tenancy. Many of these models can be applied to test different hypotheses of risk sharing and moral hazard as the determinants of the agricultural land contract choice. The literature which proposes and discusses these models, as well as the vast array of empirical works, are reviewed in Chapter 3. In particular, a detailed review of the empirical findings on the agricultural tenancy is provided in the second part of this chapter. Results of empirical works are found to be mixed and plagued by issues relating to sample selection bias and endogeneity. This thesis develops an understanding of the role of sample selection and endogeneity issues in the determination of the efficiency impact of sharecropping and of choosing a crop-share tenancy. Only a small number of studies provide an empirical analysis of production between sharecroppers and owner cultivators and sample selection issues of the contract choice between the tenants and the landlords separately. These issues are thoroughly investigated and analysed empirically.

This thesis identifies and improves upon particular deficiencies in the literature and also recognizes the importance of country specific analysis in policy

formulation. In the light of this, the focus of this dissertation is a critical assessment of the productivity and welfare implications of the land tenancy market and it examines to what extent the government can intervene through land policy reforms by examining the determinants of contract choices. In order to have a better understanding of the functioning of the agricultural land tenancy market The main research questions are as follows:

- How efficient is the tenancy market in terms of productivity and is there any difference in productivity between pure sharecroppers and mixed sharecroppers[2]? (Chapter 4)
- What factors determine the participation of households in the land rental market and their choice of a particular contract? (Chapter 5)
- Are there any incentives whereby particular types of landlords (or tenants) look for particular types of tenants (or landlords) in the informal tenancy market? (Chapter 6)

1.2.1 Outline of Empirical Methodologies

In agricultural sectors, land is a key productive asset and source of income. The nature of the land rental market is a key consideration, affecting agricultural productivity. It is therefore important to look at the productivity differences arising due to variations in contract design in the land rental market.

In Chapter 4, the author applies a switching regression model for empirical analysis. It also compares the results of a random-effect model and a fixed-effect model which are also run using the same dataset. The use of the switching regression model allows one to relax the assumption that the set of

[2]Pure sharecroppers are those farmers who do not have any cultivable agricultural land and mixed share-croppers are those farmers who own some cultivable land and also rent-in land from the landlord.

covariates that affect the outcome have the same impact for owner cultivators and tenant cultivators. As a result, this model is able to control for self-selection and endogeneity due to unobservable household characteristics and plot-level characteristics. Correlation coefficient results from the production functions of the switching regression model demonstrate which group between the share tenants and the owner cultivators have better productivity efficiency. These econometric techniques are used to analyse, compare and contrast data to assess the efficiency impact of sharecropping as a key contractual arrangement in the land markets, while controlling for other relevant risk factors.

A well functioning land rental market can play an important role in improving agricultural productivity and household income (especially for marginal farmers)3 because households that rent-in land have a higher marginal [3] product from that land (Deininger and Jin, 2002). However, land market activities in rural Bangladesh like many other developing countries are generally informal, short term and under a crop-share contract rather than fixed-rent contract. Thus, households cropping under share tenancy are subject to tenure insecurity which may distort outcomes in the presence of missing/imperfect markets. Assessing the efficiency of sharecropping contractual arrangements in this context requires a careful investigation into the effect of share tenancy on agricultural production and net crop income. By allowing endogeneity of choosing a crop-share tenancy contract and by distinguishing households according to land market participation regimes, a simultaneous equation model with endogenous switching is developed to evaluate allocative efficiency for different agricultural land participation regimes in rural Bangladesh. The effects on productivity of both groups of households who cultivate on their own or under share tenancy can be identified. This chapter also compares the productivity differences between the pure landless sharecroppers and the mixed

[3]Marginal farmer: A cultivator with a land holding of 1 hectare or less (2.5 acres).

sharecroppers.

Chapter 5 explores the determinants of entering into the land market and choosing between a crop-share contract and a fixed-rent contract for cultivation using the non-separable modified Heckman model (Heckman, 1979). Heckman (1979) corrects for the bias caused by the sample selection using the control function approach, namely, the inverse Mill's ratio. Imperfections in factor markets are a typical feature of the rural economy in many developing parts of the world. Exchange of land by different parties and engagement in crop cultivation processes in different ways are two major decisions faced by rural households. A typical approach to analysing data on social position (e.g. owner, tenant or landlord) and determinants of contract choices is covariance analysis which deals with these two issues separately. However there is no reason to assume that the decisions to enter into the land tenancy market and then to choose a certain contract are independent especially in the tenancy market (like many other markets) with asymmetrical information where individuals choose their position based on the expected outcome from the choice of contracts. Thus the two decisions are simultaneously related. When land and labour market imperfections exist, decisions about entering this market and choosing a particular contract are made jointly and therefore need to be analysed within a non-separability framework. The modified Heckman selection model provides consistent, asymptotically efficient estimates for all the parameters. This model would be identified by the exclusion of one or more instrumental variables in the outcome equation which is assumed to have a direct effect on the selection equation.

With respect to land rental markets, this study divides households into those that rent out their own land – the landlords and those that rent-in – the tenants. In addition, the chapter tests two alternative hypotheses based

on basic theoretical models of contract farming: risk sharing and moral hazard hypotheses. In particular it deals with the question: what are the most important factors determining differences in decision-making regarding land market participation and choosing a tenancy contract. From the policy point of view the fact that both participation in the land rental market and the choice of a crop-share tenancy over fixed-rent tenancy have been growing in recent years in rural Bangladesh (also in developing countries), means that it is important to investigate the determinants while also considering the simultaneity of the two decisions.

Chapter 4 looked at the productivity differences between the owner cultivators and the crop-share tenant farmers. Chapter 5 looks at how imperfect markets and obvious heterogeneities among the landlords and the tenants interact to determine a tenancy contract. However, recent arguments on unobserved production risk and risk sharing are critical to the issue of the presence of incentives which induce endogenous matching between the tenants and the landlords or the tenants and the activities he has to perform for cultivation. Chapter 6 examines this endogenous matching issue among the rice farmers in rural Bangladesh. Following Ackerberg and Botticini (2002), it is likely that if matching persists, this leads to biased coefficient estimates in the contract choice models. This is because in the estimation of determinants of contract choice (as also discussed in Chapter 5) researchers very often have to rely on the proxies for risk aversion of the tenants and the landlords, because direct measures of risk attitudes are nearly impossible to measure. In order to identify whether there is endogenous matching between the tenants and the landlords or the tenants and the cultivation activities, the tenant (the landlord) proxies of risk aversion within the household are regressed on the landlord (the tenant) characteristics. Similarly, a separate regression relates the tenant's proxies of

risk aversion to the cultivation activities. After finding the possible sources of matching, Chapter 6 re-estimates the contract choice equation using the fixed-effect instrumental variable model controlling for all endogenous matching variables.

Finally, Chapter 7 concludes, providing a summary of the key original contributions of this thesis and ideas for future work.

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2 Chapter Two: Agricultural Land Issues in Bangladesh

2.1 Introduction

Bangladesh is an ideal case to study how informal tenancy contracts in the agricultural sector can affect the welfare of its population without any government intervention to date and how government can think about contributing to this process. For most rural households land is a very important asset. It is a source of regular income, a security against famine, and the foundation of livelihood. Therefore, in rural areas the traditional value system puts a high premium on the ownership of land. A question arises regarding the capacity of the prevailing informal situation in the land market to eradicate poverty and inequality in rural Bangladesh. As a major focus of this thesis is the functioning of the agricultural land rental market among rice farmers in rural Bangladesh, this chapter reviews some background information about agriculture in rural Bangladesh, and the contribution and importance of rice farmers, including definitions of different contracts and their prevalence. It is important to consider why and when transactions through the informal agricultural land rental market should be regarded as an effective tool for enhancing the welfare of the farmers and what way (if any) government can intervene. This issue is discussed in conjunction with a review of the related literature as it is considered an integral topic for this thesis.

The remaining sections of this chapter are devoted to defining and assessing the various institutional and mechanical elements of the land management system in Bangladesh. These have significant impacts on the functioning of tenancy contracts. The subsequent empirical work builds upon the relationship between particular characteristics of the tenant farmers and the landlord farmers in rural Bangladesh and this is presented in Chapters 4 to 6.

2.2 The Bangladeshi Economy

Bangladesh is a low-lying, country located in South Asia. Formed by a deltaic plain at the confluence of the Ganges (Padma), Brahmaputra (Jamuna), and Meghna rivers and their tributaries, Bangladesh's alluvial soil is highly fertile but vulnerable to flood and drought. Straddling the Tropic of Cancer, Bangladesh has a subtropical monsoonal climate characterized by heavy seasonal rainfall, moderately warm temperatures, and high humidity. Natural calamities, such as floods, tropical cyclones, tornadoes, and tidal bores affect the country almost every year. Bangladesh is affected by major cyclones on average 16 times a decade. In 2010, Bangladesh was the seventh largest country in the world in terms of population with 148.7 million people. The population is still growing at a high rate and the growth rate of population is still 1.2 percent in 2010, as shown in Table 2.1. The population density was more than 1,229 people per square kilometre.

Table 2.1 Macro indicators of Bangladesh (2010)

	Score
Population, total (million)	148.7
Population ages 0-14: 15-64: 65+ (% of total)	32.0: 64.1 :3.8
Population growth (annual %)	1.2
Rural population (% of total population)	72.9
Population density (people per sq. km)	1,229.2
Literacy rate, adult total (% of people aged 15 and above)	56
Land area: surface area (sq. km)	130,170: 144,000
Arable land (% of land area)	61.1
Agricultural land (% of land area)	69.2
Permanent cropland (% of land area)	3.5
Irrigated land (% of cropland)	56.1
Forest area (% of land area)	6.7
Nationally protected areas (% of total land area)	0.7
Renewable internal freshwater resources per capita (cubic metres)	665.6
Crop production index (1999-2001 = 100)	111.1
Livestock production index (1999-2001 = 100)	105.1
GDP (current US$ billions)	30.1
GDP growth (annual %)	4.8
Agriculture: manufacturing: services, value added (% of GDP)	30.3: 21.5: 48.3
Ores and metals exports: imports (% of merchandise exports: imports)	0.3: 3.2
Aid (% of GNI)	2.0

Source: World Bank, 2010

As evident from other South Asian countries, agriculture plays a dominant part in the overall economy (Table 2.2). According to the World Bank report in 2008, it accounted for between 30 to 60 percent of the gross domestic product (GDP) among these countries; employed more people than any other sector (as much as 70 percent in most cases); represented a major source of foreign exchange; supplied the bulk of basic food; and provided subsistence and other income to more than half of the population.

Table 2.2 Land and population dynamics in South Asia

Country	Land (mill. ha)	Agri. Land (%)	Population (1999) (mill.)	Employment			Land per capita 1990 (ha)
				Agriculture %	Industry %	Service %	
Nepal	13.7	19	24	93.4	0	6.4	0.26
Pakistan	77.1	27	138	45.5	21.5	33.0	0.40
India	297.3	57	1014	60.1	18.1	21.8	0.34
Bangladesh	13.0	70	129	65.1	19.8	15.1	0.12
Sri Lanka	6.46	29	19	46.3	22.9	30.8	0.26
Bhutan	4.70	3	2.1	94.0	0.5	5.5	0.29
Maldives	na	na	0.3	20.2	32.7	48.1	na
Regional	412.3	-	1326	60.0	16.7	23.3	0.28

Source: FAO STAT (1990, 2001)

Table 2.3 shows the changes in occupation of the people of Bangladesh from 1987 to 2007. In terms of employment, agricultural sector has consistently been central to the Bangladeshi economy. There was a gradual increase in employment in the service sector. However, most of the employment in the service sector includes daily labourers and hawkers which are very seasonal and low-paid workers. Because of the dominance of agriculture in employment, Bangladesh is categorized as an agrarian economy. Agriculture also plays a key role in Bangladesh by contributing 24 percent of its exports, 29 percent of its GDP and employing more than 65 percent of its labour force in 2008 (World Bank, 2008).

The country's main endowments include its vast human resource base, rich agricultural land, relatively abundant water, and substantial reserves of natural gas. However, population pressure continues to place a severe burden on productive capacity, creating a food deficit, especially of rice and wheat. Foreign assistance and commercial imports fill the gap. Underemployment is a serious problem, and a growing concern for Bangladesh's agricultural sector will be its ability to absorb additional manpower. Finding alternative sources of

employment will continue to be a daunting problem for future governments, particularly with the increasing numbers of landless peasants who already account for about half the rural labour force.

Table 2.3 Changes in the occupation of workers, 1987 to 2007 (percent of all workers)

Source: Hossain, 2009

2.3 Land Use and Land Distribution in Bangladesh

Table 2.4 shows changes in the use of land area from 1920 to 2001. Agricultural land made up 73 percent of land area in 2001 (cultivated land plus wet lands, as shown in Table 2.4), while urban land accounted for 12 percent. Approximately 7 percent of Bangladesh's territory was forested, and the average annual rate of deforestation was 0.3 percent over the period 1920 to 2001. Protected areas made up 0.7 percent of Bangladesh's land area (World Bank, 2009). According to Asian Development Bank's (ADB) calculation in 2004 only rice was grown in 80 percent of the total cultivable land, of which 50 percent was dedicated to high yielding modern varieties. Bangladesh is prone to annual flooding, with 80 percent of the country's land area within floodplains. The remaining area consists of hills (12 percent) and terraces (8 percent). High-intensity cropping

techniques, soil and riverbank erosion, and loss of wetlands resulting from flood control, drainage and irrigation projects are causing substantial land degradation (ADB 2004b).

Table 2.4 Population and land use history of Bangladesh from 1920- 2001

	1920	1950	1980	2001
Population (millions)	33.43	41.88	86.97	124.35
Population density (person/sq.km.)	226	283	588	843
Total cultivated + settled area	7.82	8.89	9.24	9.80
(million/ha)	(53)	(60)	(62)	(66)
Total wetland area	3.38	2.88	2.65	2.25
(million/ha)	(23)	(19)	(18)	(15)
Total forest-woodland area	1.47	1.41	1.01	0.95
(million/ha)	(10)	(10)	(7)	(7)
Other areas	2.13	1.62	1.90	1.80
(million/ha)	(14)	(11)	(13)	(12)

*values in the parenthesis show the percentage to the total areas
Source: (compiled from Flint and Richards (1991), BBS (2001).

Bangladesh has a long history of inequitable access to land. In rural areas, in 2005, 1 percent of landowners owned more than 7.5 acres each (indicated as large farmers in Figure 2.1). Ten percent of landowners owned between 2.5 and 7.5 acres (medium farmers). The remaining 89 percent of landowners owned less than 2.5 acres (marginal farmers). 39 percent had less than 0.5 acres. This inequity exists despite a series of land reforms in the 1950s and 1960s that included tenancy reforms, imposed ceilings on landholdings, and provided for the distribution of public land to the landless (BBS, 2008; Uddin and Haque, 2009).

Figure 2.1 Changes in the land ownership distribution, 1984-2005 (percentage)

Source: BBS Agricultural Census, 2005.

Moreover, as shown in Figure 2.1, in 2005 13 percent of rural households in Bangladesh owned absolutely no type of land (landless), including for housing, and the number of landless households had grown since 1984. Thirty-one percent of rural households relied on agricultural land as their main source of income.

Land-poor farmers cultivate others people's land only. Land is a prerequisite for social, economic and political power in Bangladesh. Because land is scarce, establishing ownership rights is highly competitive. The three most common private tenure types in Bangladesh are: owner cultivation; farmers who cultivate their own land but also lease-in land (hence mixed tenant); and pure landless tenants who only cultivate other people's land. The distribution of these three types of tenure relationship is illustrated in Figure 2.2. The number of tenant households gradually increase in rural Bangladesh from 29 percent to 36 percent between 1985 and 2004. In rural Bangladesh the majority of the tenants and

the landlords are relatively small landowners.

Figure 2.2 Percentage distributions of farm holdings and area by type of tenure

Source: BBS Agricultural census, 2005.

From 1996 to 2005, the total number of tenants increased by 22 percent from 4.6 million in 1996 to 5.5 million in 2005, while the area available for tenancy remained stagnant at 1.9 million ha (BBS, 1999). This indicates increased competition in later years. According to the recent agricultural census carried out by the BBS in 2008, the number of absolute landless farmers in Bangladesh was 4.48 million. In addition, there were 7.96 million tenants living in rural areas and the majority of them were farmers who lease additional lands for

farming activities. Therefore, land leasing is an important feature of agriculture in Bangladesh. About 23 percent of the total cultivated land was farmed under various tenurial arrangements in 2005. The most common tenancy arrangement was sharecropping, which accounted for nearly 90 percent of the total leased land.

Leases for the agricultural land include both cash and sharecropping arrangements (Shafi and Payne, 2007). About one-third of all rural households lease-in land, with sharecropping constituting the most common arrangement. Most commonly, in rural Bangladesh, the sharecropper and the landowner each receive one-third of the crop; the remaining third is allocated based on each party's share of the costs. The sharecropper has a right of first refusal to purchase the sharecropped land at market price, if the landowner decides to sell it (argued by Uddin and Haque, 2009; Shafi and Payne, 2007; and Anwar, 2006).

As well as Bangladesh having a large number of landless farmers, both rural and urban land is scarce in Bangladesh, and land prices are rising. Under formal law, land sales, leases of a year or more, and land received through inheritance must be registered. As mentioned by Uddin and Haque (2009); Khan (2009); Shafi and Payne (2007); and World Bank (2009b) land registration requires eight procedures and an average of 245 days to complete. The total cost of the transaction averages 10.4 percent of the value of the property in 2005. As government approvals are necessary at various levels, those seeking such approvals are subject to demands for bribes. The time and cost required to participate in the formal land market drive most land transactions into the informal sector . The Board of Investment (BOI) of the Government of Bangladesh estimated the average price of developed land in industrial belts to be between US$10 and $15 per square metre, depending on location. The average cost of construction on this land was between US$100 and $125 per square metre (Government of

Bangladesh-BOI 2010).

The Government of Bangladesh, in its poverty-reduction strategy paper for the International Monetary Fund (IMF) (PRSP, 2005), recognized the need to reduce incidences of land-grabbing in rural Bangladesh. The government issued a Land Use Policy in 2001, through which it intended to: reform the system of land administration and related laws; preserve and optimize the use of the agricultural land; make suitable government-owned land available for development projects; reduce soil degradation; and establish a data bank for various categories of land. However, to date in Bangladesh no land reform policies have been implemented successfully and have been abandoned. The next section deals with the history of actions to implement land reforms since 1950.

Figure 2.3 Land tenancy distribution in Bangladesh, 1996/97

Source: BBS, 2000

2.4 Land Reform in Bangladesh

"Land reform, like all public policy, is in part a shadow play involving the manipulation of symbols; the actual policy demonstrably reflects considerations more pressing and mundane than abstract details of social justice or economic rationability." (Herring, 1983)

Land reform (also agrarian reform, though that can have a broader meaning) – involves the changing of laws, regulations or customs regarding land ownership. Land reform may consist of government initiated or government-backed property redistribution, generally of agricultural land. Land reform can be a powerful strategy for promoting both economic development and environmental quality (i.e. soil quality). Although land reform appeared to be important to the Government of Bangladesh, little has been done. Over the last few hundred years the labourers have repeatedly tried to build movements to overthrow the landowners, which have ended mostly in defeat. Access to land by the vast majority of the landless rural population in developing countries gives rise to issues of social justice and basic human rights; it relates to the right to feed oneself, the right to adequate shelter and the right to employment. Although many national and international institutions agree on the need for agrarian reform in order to reduce poverty and hunger, experiences in many developing countries suggest that little progress has been made under existing land reforms (Table 2.5). Moreover, the number of landless people exerting pressure on land as a limited resource is increasing around the world. In most developing countries tenancy reform policies are a major part of land reform policies. However, in most countries the reforms failed to meet the targeted objectives so far.

Table 2.5 Land regulation in various countries

Source: Faruqee and Kavin (1999)

In the case of Bangladesh, relative to the land area, the population is huge and the vast majority live in poverty. The low level of industrialization has kept nearly 90 percent of the people in the countryside, where lack of infrastructure of all kinds means everyday existence is a struggle. Since 2000, there has been much talk about improving the equity regarding the distribution of government-owned land, increasing land productivity, implementation of the Settlement Act, acquisition of excess land (subject to a ceiling), recovering ab-

sentee ownership land, modernization of land administration, and improving land management, but in reality very little has changed. Although some work has been done under government projects here and there, that has been no visible impact on the standard of living of people in rural Bangladesh. Instead some rules and regulations have caused further complications.

After the independence of Bangladesh in 1971, the first initiative towards land reform was taken in 1972 (Table 2.6). The notable aspects of the proposed reform were: (a) reducing the maximum limit of land ownership to 100 bighas per family; (b) distributing khas[4] land among the landless farmers; and (c) tax exemption for small land owners. Although under this policy, it was proposed to introduce the Ceiling Act, the ruling political party backed off from doing so on political and social grounds. In 1984, the Land Reform Ordinance was issued. Matters like contract agreement and reducing the ceiling on ownership of the agricultural land were addressed under this ordinance. However, little was implemented in reality and the marginal farmers did not benefit significantly from these policies.

[4]Government-owned land

Table 2.6 Land policy, administration time line and problems in Pakistan period (1950-1971) to Bangladesh period (1971-1998)

Source: CARE Rural Livelihood Programme Report, 2003

Land reform has important socio-economic implications. The disparity that exists among the people of Bangladesh makes it a serious issue. Land is the main component of crop production, but in order to serve the growing masses dependent on the land, there is little scope of bringing more land under cultivation. In order to change the standard of life of the poor farmers, it requires a thorough review of land issues, and a review of non-functional laws and land use rules. Land must be managed with the aim of ensuring the welfare of the majority of the population, in an ecologically sustainable way. More research

is needed to find out whether the present informal tenancy contracts maximize the productivity and the income of the farmers.

Given the paucity of land, its intense utilization and the predominance of small-holders, classical views of land reform based on large-scale land redistribution are not realistic policy options in Bangladesh. There has been a growing realization within the government that the critical policy issues pertaining to land have to do with land administration reform. In the context of the agricultural production and the optimum utilization of the agricultural land, the system of land tenure needs to be streamlined. To reinforce this realization this dissertation is a critical assessment of the productivity and welfare implications of the land tenancy market in Bangladesh and it examines to what extent the government can intervene through land policy reforms by examining the determinants of contract choices. Securitization of tenurial cultivation by adopting and implementing unified rules will help to increase output, provide income support to marginal farmers and will alleviate poverty by way of providing a kind of safety net for the landless farmers.

2.5 Rice Farming in Rural Bangladesh

The data set used for this thesis was collected from the rice-farming households and hence, this study looks into the different aspects of tenancy farming of the rice producers in rural Bangladesh. The country has very little scope to increase the supply of land to meet the growing demand for rice, which is the staple food, for its ever-increasing population (Figure 2.4). Since land is scarce, the way to maximize output would be through intensive cultivation together with the use of modern technology. As is widely argued, one alleged obstacle to agricultural development is the agricultural land tenure system which is seen as inequitable and inefficient. In order to have a better understanding of the

functioning of the agricultural land tenancy market in rural Bangladesh this thesis asks questions about how efficient the tenancy market is in terms of productivity and how the land rental market affects the income of the poor and vulnerable sharecroppers and what factors determine the participation of households in the land rental market and their choice of a particular contract.

Figure 2.4 Dominance of rice production in Bangladesh

Source: BBS, 2005

Figure 2.5 Population growth and rice production in Bangladesh, 1970-2005

Source: BBS, 2005

About 80 percent of the tenant farmers in rural Bangladesh grow mostly rice. Here farmers grow three types of rice - Aus, Aman and Boro. Among these three types, Aman and Boro are the major crops which can grow all over

Bangladesh, while Aus is usually grown only in hilly areas. Apart from rice, the other two major crops in Bangladesh are jute and tea.

According to the BBS, the cost of tillage and material inputs increased by almost 5 percent and 10 percent respectively between 1981 and 1999 although the cost of land decrease by almost 10 percent. Akanda and Shoichi (2004), found that the returns from the production of rice did not increase as rapidly as the cost over the time period, even though Bangladesh observed a steady increase in the rice yield. Figure 2.6 explained that the tenant farmers also faced a loan repayment or rent burden paying approximately 33 percent of the harvest yield.

Figure 2.6 Share of receipts among the rice farming tenants and landlords

source: Alanda and Shoichi (2004)

2.6 Conclusion

With the growing need to enhance the agricultural productivity the economics of sharecropping tenancy arrangements has become an agrarian issue in recent years. However, the landholding system in Bangladesh like most developing countries is not purely an economic affair. It is very much associated with people's culture and identity. That is partly why land-related issues usually generate intense emotional reactions particularly in rural areas. The size of the land they own, the feeling of security that they have on their holdings, and the process through which land disputes are adjudicated all affect the households' income, their incentive to work and invest, their desire to use their land in a sustainable manner, and even their social and economic status in their respective communities. In predominantly agrarian societies, all these factors combine to affect the agricultural output and productivity. Furthermore, it affects the socio-economic welfare of its citizens. Therefore it is equally important to know about the underlying economics of contracts and the tenancy system both theoretically and empirically. Chapter 3 of this thesis deals with a review of a number of theoretical concepts and empirical findings on the agricultural land tenancy in different economies. This will provide a solid foundation for the analysis of the tenancy system among the rice farmers in rural Bangladesh in Chapters 4 to 6.

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3 Chapter Three: Literature Review

3.1 Introduction

This chapter underpins the analysis in later chapters and reviews a number of aspects of literature that are relevant. The literature surveys include diverse areas such as efficiency and impact of share tenancy, determinants of contract choice and the endogenous matching problem in land rental markets, since the agricultural land rental market is a multidisciplinary research area (Otsuka and Murakami, 2007). It is not asserted that the literature presented here is a comprehensive survey of any of these areas, but rather provides the key foundations in the literature for the original work presented in this thesis.

Theoretical models of determinants of contract choice are presented that are most relevant to the pros and cons of participating in the land rental market and choosing a particular type of contract. Building on this basis, models that are more explicitly tied to the agricultural rental market are reviewed, as well as providing a detailed review of empirical analyses regarding these issues. At this point the evidence is discussed around a number of variables that are mostly relevant to the prevailing situation in developing countries. The discussion of theory as well as empirical evidence of relationships between particular variables and contract choice is important for the model specifications used in the later chapters of this thesis.

An important factor often overlooked in the literature about the agricultural land rental market is the impact of share tenancy, which is the second best choice for a tenant farmer after full ownership because the tenant farmer has to share his marginal productivity of labour with the landlord. This is very important particularly for an economy where the rental market is totally unregulated. Theoretical and empirical works on these issues where some regulations

are present are discussed here.

The remaining sections of this chapter are devoted to the relationship between particular characteristics of the tenant farmers and the landlord farmers. This is a relatively recent area that is considered in the literature both from the theoretical and empirical angles. The evidence of both sides is reviewed, providing input for the original empirical work in this thesis. These reviews of theories and empirical works support and inspire the works in this thesis in Chapters 4 to 6.

3.2 Economic Models of Sharecropping

3.2.1 Sharecropping With No Risk

"Sharecropping has existed in various times and places in various forms. It has disappeared over time and reappeared. Sometimes the tenant's share is one-half, sometimes it is not. Sometimes the output share equals the cost-share; sometimes it does not. Sometimes productivity is higher on sharecropped land than on other types of tenancy or with self-cultivation; sometimes it is not. Sometimes sharecroppers are poor; sometimes they are prosperous. Sometimes sharecroppers produce risky cash crops; sometimes they produce for subsistence." (Otsuka and Murakami, 2007)

In the literature, sharecropping is defined as a contract where the landlord supplies the land, the tenant supplies the labour and non-labour inputs and they share the output. In the real world contracts similar to sharecropping are still common. Examples include: agriculture in Least Developed Countries (LDCs), strawberry farms in California (Wells, 1996), franchise contracts in risky neighbours (McDonald's, gas stations), jeepney drivers in the Philippines on more risky routes (Otsuka, 1998), and pooling of catch among Japanese fisherman (Platteau, 2000).

The puzzle of sharecropping starts where output sharing implies a disincentive to provide inputs which are not shared. The classical view of sharecropping was first introduced by Adam Smith (1776). In the first volume of the *The Wealth of Nations*, Smith discussed the issues surrounding incentives inherent-in the sharecropping system. Later, in line with Adam Smith, Alfred Marshall (1890) formalized the efficiency implications of share versus fixed-rent contracts. The basic problem with the Marshallian model is that the tenant taking the share as given will demand land up to the point where its marginal product is zero, whatever the share. Therefore, in general there will be no equilibrium share that clears the market of land. The Marshallian model assumes that there is a perfect labour market with exogenous wage w per unit of time worked and no risk in crop cultivation. Therefore, if r is the landlord's output share and $(1-r)$ is the tenant's output share and R is the fixed-rent, then the contract specializes to:

Share rent if $1 > r > 0$ and $R >= 0$

Fixed rent if $r = 0$ and $R < 0$

A wage contract if $r = 1$ and $R < 0$

The tenant's production function is $f = f(q_l, q_x, \overline{A})$ and depends on land rented in $\overline{A}$, effective labour input q_l and non-labour input q_x.

Share tenants maximize their income (y) where,

$$y = (1-r)f(q_l, q_x, \overline{A}) + w(1-n_l) \tag{1}$$

where $(1-n_l)$ is the unit of labour at the tenants' disposal.

Thus solving the problem,

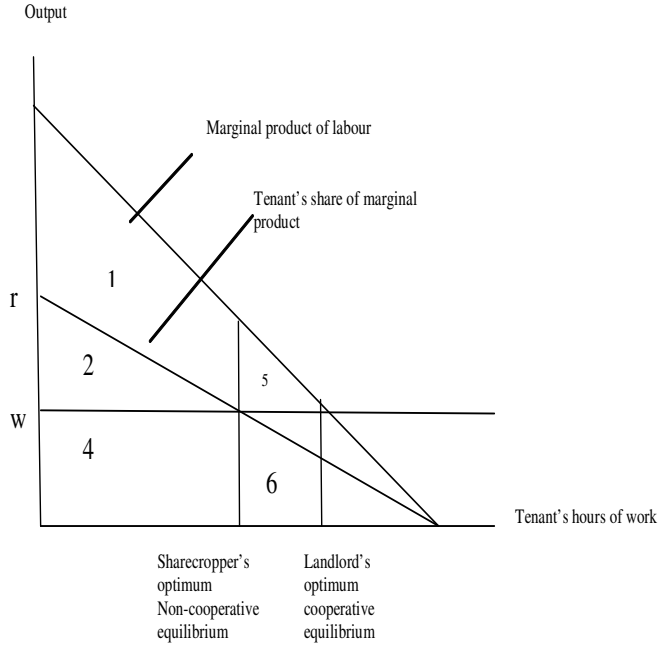
$$(1-r)f_2 = w \quad (2)$$

$$(1-r)f_1 = 0 \quad (3)$$

From the above two conditions, the first condition implies that the equilibrium marginal product of labour is a multiple of the wage rate and the second equation implies that the productivity of land becomes zero. As Quibria and Rashid (1984), Taslim (1992) and Otsuka and Hayami (1988) explain in their papers, this implies that, if the tenant also chooses the amount of rental land, the additional first order condition would be equation (3). Marshall (1890) and subsequently the authors listed above, argue in their papers that, since the cost of renting additional land is essentially zero, the marginal product of the land is driven to zero. Gale Johnson (1950) noted this condition of the 'Marshall' model with considerable scepticism. He found the requirement that the marginal productivity of land under sharecropping be driven down to zero to be particularly strict.

In fact, in the Marshall model, equation (2) is more important as it is in contrast to the standard competitive situation where a competitive firm hires up to the point where the marginal product of labour is equal to the wage rate. Thus equation (2) embodies the famous Marshallian paradigm of inefficiency of sharecropping.where the market is never cleared as in a competitive market.

Figure 3.1 Marshallian inefficiency of sharecropping



This can be interpreted geometrically in Figure 3.1. In this figure the landlord's rent under a fixed-rent contract = area 1+2+ 5 where, area 5 is the deadweight loss area. The landlord's rent under a sharecropping contract = area 1. Hence, the landlord loses area 2 +5: 2 is lost to the tenant and 5 is a deadweight loss.

The result is an excess supply of the tenants. However, the landlord could do better by offering a fixed-rent contract, thus eliminating the deadweight loss. Hence, Marshall argued that the sharecropping contract should never been observed under the first best condition. This implies looking for other reasons why a sharecropping contract still prevails.

If effort is contractible, the landlord can force the share tenants to work by specifying the level of effort in the contract.

Bell and Zusman (1976) proposed a model whereby a landlord and a tenant each calculate their gains from a leased plot at the rate r_s when assuming that

all other tenants keep their rate at $\overline{r}$. The outcomes from a contract are y_l and y_s for a landlord and a tenant respectively. If one assumes that the gains from a wage labour is $\overline{y_s}$ for a tenant and the gains from own cultivation of land is $\overline{y_l}$ for a landlord, then the equilibrium is given by maximizing the Nash formula, z, where

$$z = (y_l - \overline{y_l})\ (y_s - \overline{y_s}) \tag{4}$$

The value obtained by this procedure is then set to equal $\overline{r}$, because of symmetry considerations. The landlord, who usually has the bargaining power, can then extract the entire additional surplus by appropriately determining the rent. The difficulty with the Bell and Zusman model is that how does not define $\overline{r}$ and it does not calculate r_s.

Therefore the wide prevalence of the sharecropping has remained a puzzle. Over several decades several theories are put forward to explain the existence and increasing trend of sharecropping around the world.

As Ray (2008) summarizes in his book *Development Economics*, there are three basic reasons why sharecropping is still popular in many economies:

"First, if we do not observe sharecropping where theory tells us there should be none, then there is something wrong with the theory. At any rate, the theory needs to be argued by a fuller description of reality... Second, at a more practical level, if sharecropping still exists, it suggests that there are other compensating factors that necessitate such an arrangement. If these factors can be corrected by appropriate policy, the sharecropping will decline... Third, these contractual relationships may have implications for other kinds of the landlord and the tenant behaviour, such as the provision of credit to the tenant, contracting parties risk preferences, the tendency to evict the tenants and the incentives to make long-run improvements in cultivation." (Ray, 2008)

The Marshallian tradition was built on the implicit assumption that the share contract refers to only one variable, share of output. However, as pointed out by Gale Johnson, and subsequently developed by Cheung (1968) and other authors, a contract need not contain only one variable. Cheung (1968) begins his analysis by arguing that many real-world contracts (he draws support for his argument from Taiwan) specify through a set of items such as the amount of land to be cultivated, non-labour inputs to be supplied, etc., in addition to the rental-share. By incorporating this new feature in his model, Cheung is able to show the Pareto efficiency of sharecropping. However, unlike traditional analysis, he views the problem from the landlord's side.

Bardhan and Srinivasan (197 1) were the first to extend the conventional unilateral maximization approach to a general equilibrium approach using same set of transaction items as Cheung (1968). They allow both landlord and tenant influence in determination of the share-rental, while retaining the perfectly competitive labour market assumption of Cheung and Marshall. The share tenant in the Bardhan-Srinivasan model has the option of leasing in land to cultivate with his own labour or working as wage labour in some alternative employment. The tenant is assumed to maximize his utility defined in terms of income and leisure. However, Bardhan and Srinivasan do not provide any proof of the existence of equilibrium, while they claim that the price of land is not zero because additional land would provide additional utility.

Perhaps the most common answer given for the existence of agricultural tenancy is the existence of agricultural risk. Tenancy contracts terms are build upon the magnitude of these predicted and unpredicted risks. The Sharecropping is seen as a device to share such risk between landlord and tenant. A number of scholars have attempted to provide a rigorous formulation of this and related problems for example, Stiglitz (1974), Holmstrom (1979), Gross-

man and Hart (1983), and Holmstrom and Milgrom (1987), etc.

The analyses of sharecropping under uncertainty thus provide one with the following rationale for the existence of the institution: first, as a risk-sharing device; secondly, as providing incentives to the tenant; thirdly, as economizing on information or moral hazard problem; fourthly as a means of screening workers of different capabilities and finally, as a tool for threat of eviction. Major theories on these four broad points are discussed in sections 3.2.2 to 3.2.6.

3.2.2 Sharecropping and Risk Sharing

In 1979 Newbery and Stiglitz looked more closely at the question of prevalence of sharecropping and enriched the environment where there are uncertainties in production. They assumed that both output and product price may be risky (denoted by Newbery and Stiglitz in Table 3.1). By sharing output, sharecropping also shares risk between the landlord and the tenant; the rent paid varies with the level of output achieved. Hence, the rent is adjusted ex-post to the realization of risk. If the tenant is risk averse, reducing risk will increase work effort. Thus, the crop-share contract may be better than a fixed-rent contract for the risk-averse tenant and a wage contract for the landlord if he is also risk averse.

However, by reducing the risk of a tenant farmer by increasing the landlord's share also increases the Marshallian disincentive to work. Hence, there is only one instrument, r, which is available to achieve two objectives: reducing risk which increase the tenant's effort and extracting rent which reduces the incentive to work. If the landlord increases r to absorb more risk, he must decrease R to satisfy the tenant's participation constraint.

Table 3.1: Summary of the findings of Newbery and Stiglitz (1979)

Newbery and Stiglitz showed that choice of contracts eliminates market failure due to the absence of insurance against unobserved risk. However, it is argued by these authors that in the presence of transaction costs in contracting or economies of scale due to indivisibility of inputs, risk sharing is still insufficient to explain the occurrence of sharecropping. Pant (1983) considered a model with non-tradable inputs, but without uncertainty. In the absence of uncertainty, fixed-rent contracts, which would then be optimal, are arbitrarily ruled out. Bell (1986) used a bargaining model with uncertainty and argued that risk-sharing might be improved with share contracts in addition to wage and fixed-rent contracts. His intuition was that risk-averse tenant households can use their endowments of non-tradables in crop-share contracts without being exposed to greater risk of fixed-rent contracts.

The recent literature on contracting proposes four major hypotheses which explain the choice of crop-share contracts over cash-rent contracts in agriculture. These are: optimal incentive and risk sharing; moral hazard due to the monitoring problem; and screening or self-selection. Some of the notable literature on these topics is dealt with in the following sub-sections.

3.2.3 Sharecropping and Input Incentives

On the sharing of risk, Hurwicz and Shapiro (1978) and Shetty (1988) focused on the wealth or income constraints of the tenant which drives the choice of crop-share contracts. Through their models, they showed that richer tenants will get a fixed-rent contract and earn higher profits than the poorer tenants who get crop-share contracts. Shetty was the first to consider potential tenants with different wealth levels but with identical reservation utilities. Wealth is observable and the landlords compete for wealthier tenants. Therefore, poorer tenants who may default will receive crop-share contracts. This model has an important realistic assumption such as heterogeneous tenants and with a characterization of the monopolistically competitive equilibrium. All of these are useful features. A final rationale for sharecropping in the context of risk-sharing relies on providing incentives for work effort.

The literature which deals with the incentive problem and presence of sharecropping assumes that the tenants are risk averse and there is no insurance market. The landlord therefore provides both land and insurance against risk. Hence, for a landlord, the optimal contract involves a trade-off between incentive provision and insurance provision. This model was first introduced by Stiglitz (1974). Shetty (1988) focused on a similar type of model with capital market imperfections. Assume there is only one landlord and one tenant. The tenant has a utility function of $U(y) - l$ where y is income and l is labour input. The tenant's reservation utility is $\overline{y}$. If the production function is $f = \theta q(l)$ then income from the fixed-rent contract of the tenant would be $y = \theta q(l) - r$ and income from a pure share contract would be $y = \alpha\theta q(l)$, where r is the rental payment and α is the tenant's share. The argument here is that a crop-share contract provides some risk as well as reduces some risk.

Using the notation used above, the landlord's problem is

$$\max_{\alpha,l} E_\theta\{(1-\alpha)\theta q(l) - c\}$$

$$s.t. E_\theta\{\alpha\theta q(l) + c\} - l \geqslant \overline{y} \text{ and}$$

$$E_\theta[U'\{\alpha\theta q(l) + c\}\alpha\theta q'(l)] - 1 = 0 \tag{5}$$

Here c can be either cost-sharing arrangements or consumption loans offered by the landlord. The first constraint is the tenant's acceptance condition and the second constraint is the tenant's first-order condition for the labour input choice. From the first order condition of the landlord, one can find that the optimal share becomes

$$\alpha = 1 - \frac{q - c_\alpha}{q' l_\alpha} \tag{6}$$

Hence, whether α is less than one, depends on the sign of l_α. This model, however, gives no prediction of the size of share and does not answer the question why one can observe 50:50 output share to be highly prevalent in the crop-share system around the world. Building upon this methodology, Huffman and Just (2004) showed why share tenancy is a robust contract in a variety of economic environments and why share contracts tend to dominate in developing countries, whereas cash-rent contracts tend to dominate in developed countries. Radner (1981), Bardhan (1984) and Holmstrom and Milgrom (1987) considered a dynamic framework of the incentive and risk-sharing model.

3.2.4 Sharecropping and Moral Hazard

Eswaran and Kotwal (1985) described a model where both the landlord and the tenant provide different types of labour inputs which are not observable. In Asian tenancy markets both the landlord and the tenant are actively involved

in the cultivation process as this is their main occupation. In their model there is one landlord and one tenant. Both of them are risk neutral, so insurance or risk sharing are not relevant. The production function in their model takes the form of $q = q(t, s, L, M, \overline{A})$ where t and s are management and supervision respectively which is measured in time, L and M are labour with wage w and other inputs with price p_M respectively. $\overline{A}$ is the amount of land transacted, which is a fixed factor. The assumptions here are that there are no markets for t and s, although there are markets for L and M. The optimum levels of L and M are jointly decided for profit maximization, with sharing of cost equal to sharing of input. Hence, these two inputs will be optimally applied while there is moral hazard in the provision of management and supervision by both the landlord and the tenant. Relative efficiencies of the landlord and the tenant are summarized by Table 3.2.

Table 3.2: Relative efficiencies of the landlord and the tenant in management and supervision, Eswaran and Kotwal (1985)

Under the fixed-rent contract, the tenant's problem becomes:

$$\max_{t_2, s_2, M, L} \Pi_2^r = [pq(\mu_2, t_2, s_2, M, L, \overline{A}) - p_M M - wL] + (1 - t_2 - s_2)u \qquad (7)$$

and the landlord's problem is:

$$\text{choose the level of rent } R \text{ for } Y_2^r = u,\ i.e.,\ R = \max(0, \Pi_2^r - u) \qquad (8)$$

where

u= tenant's reservation income

v= landlord's opportunity cost per unit of time

Y_1^r= landlord's income

Y_2^r= tenant's income

Therefore, the landlord's income, $Y_1^r = R + v$ and tenant's income, $Y_1^r = \Pi_2^r - R = u$

Under the crop-share contract, the landlord does the management and the tenant does the supervision, both with a Marshallian disincentive to provision.

Tenant chooses s_2 :

$$\max_{s_2}(1-\alpha)\Pi(t_1, s_2) + (1 - s_2)u, 0 \leqslant s_2 \leqslant 1$$

$$\text{decision rule: } (1-\alpha)\Pi'_{s_2} = u \text{ (implies Marshallian inefficiency)} \qquad (9)$$

Landlord chooses, t_1 :

$$\max_{t_1} \alpha\Pi(t_1, s_2) + (1 - t_1)v,$$

$$\text{decision rule: } \alpha\Pi'_{t_1} = v \text{ (implies Marshallian inefficiency)} \qquad (10)$$

The landlord as principal chooses α^* that maximizes his income subject to the tenant's reservation utility.

To test the theory, Eswaran and Kotwal performed numerical simulations to see how varying the parameters affects contractual choice. For example, they found that, if both t and s are low, sharecropping is preferable to the landlord but if t is high then a fixed-rent contract is best; if s is high, a fixed-wage contract is best. The important findings of this theory is the coexistence of different contracts in an economy because in the real world as well one would observe several types of tenancy contract existing simultaneously.

3.2.5 Sharecropping and Self-Selection

Allen and Lueck (1992, 1993 and 1999) and Prendergast (2002) have argued against the risk-sharing hypothesis and put emphasis on the screening hypothesis. The basic assumption of self-selection or the screening model is that asymmetric information between the landlord and the tenant. The tenant chooses among contract alternatives to maximize returns from his entrepreneurial ability. As pointed out by Singh (1991), the screening model has several important features in terms of the stylized facts. First, it explains the coexistence of sharecropping with fixed-rent contracts. Second, it fits with observations that share tenancy is often associated with lower productivity than owner cultivation and/or cultivation under fixed-rent contract. This is because the model predicts that more able tenants will choose fixed-rent contracts. Third, the model seems to agree with the agricultural ladder hypothesis that, as the agricultural workers gain physical and human capital, they progress from sharecropping to renting and finally owner-operation (Spillman, 1919; Cox, 1944).

Hallagan (1978) and Newbery and Stiglitz (1979) independently formulated similar models on self-selection. Allen (1982) extended the basic model to allow for heterogeneous landlords. In 2002 Allen further broadened his model by having default possibilities and more than one time period. In Hallagan's

basic model there are several potential tenants, of whom one has higher ability than the rest. He wants to maximize his return Y from his entrepreneurial ability, e. In this model:

$\overline{A}$ is the fixed land area

$\overline{L}$ the fixed quantity of land

R is the fixed rent per unit of area

and $F = F(e, \overline{L}, \overline{A})$, production function

If only the tenant decides (self-selection) on the choice of contract, he will choose the contract that yields him the highest income among the three alternative contracts, as illustrated in Figure 3.2.

fixed wage: $Y = w\overline{L}$;

share contract: $Y = (1 - \alpha)F$

fixed-rent: $Y = F - R\overline{A}$

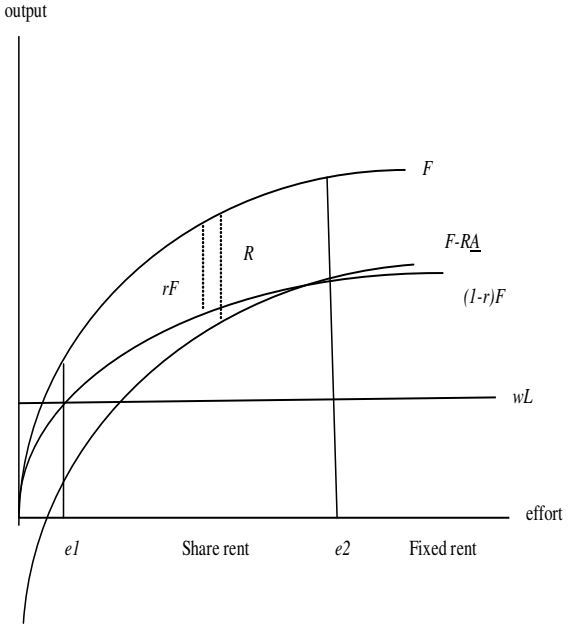
Hence, if his entrepreneurial ability is in the interval $(0, e_1)$, he chooses a wage contract;

If his entrepreneurial ability is in the interval (e_1, e_2), he chooses a share contract; and

If his entrepreneurial ability is greater than e_2, he chooses a fixed-rent contract.

Thus, sharecropping could be seen as a transitional contract between wage and fixed-rent contract if the tenant's ability increases over time by learning-by-doing.

Figure 3.2 Tenant self-selection model (Hallagen, 1978)



The self-selection model however does not explain sharecropping under uncertainty. Allen (1982) allowed for competition among the landlords. Allen also assumed a competitive market for labour. While Allen's formulation was more general, the assumption of price-taking behaviour by all market participants seems unrealistic especially for a developing economy with many poor farmers.

A strong criticism of self-selection models emerges from a consideration of what happens over time. In the screening model, the ability of the tenant will be revealed sooner or later. Singh (1991) argues that, in the real world, one would expect such knowledge to be gained gradually by direct observation. Once this happens, screening is unnecessary and only wage and fixed-rent contracts will exist. Allen (1985) designed a model with more than one period and a continuum of ability levels. Its important predictions depend on the initial lack of information about potential tenants' abilities and the resulting screening. There is an infinite number of discrete production periods and contracts are agreed in each period. Each person knows his own ability, but this cannot be known by anybody else until he has been seen to produce for one period.

Allen's model with these predictions focuses on some important features of the institutional setup in less developed countries. However, this model does not give clear-cut predictions about the variation of contract type with ability.

It is evident from the above discussion on various models of sharecropping that sharecropping itself is a diverse phenomenon. Therefore, explanations of sharecropping are also very diverse. One common theme of all these models is that a different contract choice is a response to uncertainty (observable or unobservable) and asymmetries in information. Moreover, these uncertainties and asymmetries in information differ significantly from one economy to another. Therefore, empirical analysis also plays an important role in the choice of realistic policies from a menu of such policies. Hence, this thesis identifies the productivity and welfare implications of the land tenancy market and examines the determinants of contract choices. Some of the earlier empirical works are also discussed in the following section.

3.2.6 Sharecropping and Threat of Eviction

In recent years a small number of theorists have developed models that take account of the importance of the threat of eviction on the efficiency of sharecropping. Kassie and Holden in their 2007 paper stated that:

"... The effectiveness of eviction threats depends on the tenant's concern about his future utility on rented plots, earnings from outside farming activities and availability of farmlands in the village... When the opportunity cost of alternative employment is higher than the benefits that will be obtained from rented land and land is not scarce, the tenant would not care about contract insecurity... If there is rationing of land such that it is not easy for a tenant who has lost his contract to find another landlord from which to obtain land, the threat of eviction is real and has a cost."

In rural Bangladesh, like many other developing countries the amount of land per household is very small and there is a shortage of non-farm employment opportunities. In such circumstances, the threat of eviction may play a vital role in the efficiency of sharecropping. Before Kassie and Holden, Banerjee and Ghatak (2004) developed a two period principal-agent model to show how the threat of eviction upon unsatisfactory performance of the tenant increased the incentive to work hard in the first period. The effectiveness of eviction threats depends on the tenant's concern about his future utility on rented plots, earnings from outside activities and availability of farmlands. When the opportunity cost of alternative employment is higher than the benefits that will be obtained from the tenancy contract and land is not scarce, the tenant would not be concerned about contract insecurity, since he can easily move to other alternative employment. However, with scarce land and outside employment opportunities, the threat of eviction is real and has a cost. Their model is summarized below.

Suppose a plot is assumed to be owned by an infinitely living landlord who in each period employs one tenant to crop the land. There is a large population of infinitely living tenants whose reservation payoff is normalized to $'0'$. The landlord and the tenant share the same discount factor $\delta > 1$.

Assume the output has two values, *zero* and *one* and the probability of high output depends on the investment effort in the last period. Thus at period t high output represents as

$$\widetilde{p}(k_{t-1}) = p + k_{t-1}, p \in (1/2, 1) \tag{11}$$

where k_{t-1} is the investment effort of period $t-1$ which has three values: zero (0), low (x) and high $(2x)$.

The cost of supplying effort $c = c(k_{t-1})$;and $c(0) = 0$; $c(x) = c > 0$ and

$c(2x) = \tau c$, where $\tau \geqslant 2$.

To ensure that the probability of high output is less than one, they assumed $p + 2x < 1$; thus $x < 1 - p/2$.

Banerjee and Ghatak showed that in the case of equilibrium with no eviction threat, the situation at which the tenant prefers to choose the high level to low level effort is

$$\delta(p + 2x)h - \tau c > \delta(p + x)h - c \tag{12}$$

where h is the share of output. From the above equation

$$h \geqslant (\tau - 1)c/2x \equiv \overline{h} \tag{13}$$

Similarly the share h at which the tenant prefers to choose a low level of effort is

$$\delta(p + x)h - c > \delta ph \tag{14}$$

$$\text{and } h > c/2x \equiv \underline{h} \tag{15}$$

at $\tau \geqslant 2$; $\overline{h} \geqslant \underline{h}$.

Since giving the tenant a share of output is costly for the landlord, it may not always be optimal for him to extract high effort in the second best world with moral hazard. Therefore, in the presence of moral hazard, for the wealthy tenant, the landlord can offer a fixed-rent contract. If the tenant is poor, the only way the landlord can give him incentives is by giving him a high share of output. However, when the reservation utility of the tenant farmer is close to zero and when he values the future tenancy contract to maintain his subsistence income, if $V(k_t)$ denotes the lifetime expected utility of a tenant at point t, then

if the tenant chooses the high investment level ($\overline{V}$),

$$\overline{V} = \frac{(p+2x)h - \tau c}{1 - \delta(p+2x)} \tag{16}$$

The success share of the tenant, such that he is indifferent between choosing the high and low level of effort on the equilibrium path, is:

$$\delta(p+2x)^2(h+\delta\overline{V}) - \tau c \geqslant \delta(p+2x)(p+x)(h+\delta\overline{V}) - c \tag{17}$$

Similarly, Banerjee and Ghatak showed that the landlord needs to offer a minimum share to obtain desirable effort from the tenant farmer. Now

$$\underline{V} = \frac{(p+x)h - c}{1 - \delta(p+x)} \tag{18}$$

Banerjee and Ghatak (2004) argued through their model that, if eviction threats are used which reduces the tenant's effective discount factor, this also reduces the incentive to invest effort. If eviction threats are not used, the tenant enjoys the share irrespective of whether output is high or low. This in turn increases the effort investment. The source of inefficiency in this model is that if the tenant has no wealth, the only way the landlord can extract some surplus from him is to take a share of output, but this diminishes investment incentives. Therefore, a policy that not only restricts eviction but also puts a ceiling on the share of output that the landlord can claim as rent, would help promote investment.

3.3 Empirical Analysis of Sharecropping

Empirical research on contract choice has always been proved to be quite challenging for a number of reasons. Firstly, it is difficult to find appropriate empirical measures of theoretical variables, such as risk attitudes of the contracting

parties, monitoring, enforcement and other transaction costs. Secondly, all the hypotheses that have been commonly used in the theoretical papers cannot be tested at the same time. This section focuses on the recent empirical contributions regarding two particular aspects of debates on sharecropping: (1) efficiency and impact of sharecropping; and (2) determinants of contract choice.

3.3.1 Efficiency and Impact of Sharecropping

This subsection studies the effects of different contracts on farm productivity. Rao in 1971, investigated the productivity difference between owner-operated farms and share-rented farms. He used farm-level data from India which included 137 observations from two different cropping years, 1957 and 1958, in 10 villages. Rao estimated the effect of the contract on the average per acre output at each farm-size level and found that the productivity was higher in sharecropped lands than in owner-cultivated lands. Shaban (1987) tested two theoretical models of sharecropping: the Marshallian approach versus the monitoring approach. The Marshallian approach assumes an incentive problem with share tenancy and the monitoring approach theorizes that if landlords have an monitoring technology, there would be no misallocation associated with sharecropping. Shaban also used farm-level data from India and compared the average per acre values of the output produced and the different inputs used across owned and sharecropped lands of the same household. He found that controlling for irrigation, plot value and observed soil characteristics, farmers are more productive and use inputs more intensively on their own lands. This suggests the existence of an incentive problem in share tenancy.

Laffont and Matoussi (1995) developed and empirically tested a model where the presence of financial constraints limits the tenant's ability to pay up-front rents. Therefore, poor tenants choose a share tenancy which provides effort

incentives and solves financial constraints. They use data from a village in Tunisia. The empirical part focused on two issues: productivity across contracts and determinants of contract design. In the estimation of productivity, the authors used a log-linear production function using output per hectare as a dependent variable. They acknowledged the fact that the dummy variable for contract choice is endogenous and controlled for this endogeneity by using instrumental variables. They argued that the crop type, the tenant's wealth and number of active members in the family are good instruments for the contractual characteristics. They found that a sharecropper's productivity is less than that of fixed-rent tenants. Hence, they suggested that sharecroppers exert less effort than fixed-rent tenants since the coefficients of the contract dummies measure the impact of each contract on expected output.

Allen and Lueck (1992, 1993), Dubois (2002) and Braido (2004) looked at the efficiency problem from a different perspective. They claimed that the incentive problems measured by comparing land productivity and input use across farms under different contracts can be biased by land-quality heterogeneity. In situations where land quality is not distributed randomly across different cultivation processes, one must be careful when interpreting differences in the per acre value of each input used and output produced. Land leased out to tenants might be of lower quality than that cultivated by owner farmers. Hence, it may be optimal to use inputs less intensively on lands with lower quality. To avoid such non-randomness, Braido using data from India, tested the effect of contract choice on productivity when land quality and input choices are used as control variables. The results show that the productivity gap across contracts can be explained by differences in input choices.

Empirically it is difficult to find a truly exogenous instrumental variable to test the productivity differentials across different contract types. Braido

(2004) used a structural economic theory to derive a testable prediction free of the endogeneity problem. However, a structural test depends on parametric assumptions of the production function. There is an intense debate in economics regarding the use of the reduced-form model with instruments versus the use of tests based on structural economic models. In order to achieve a meaningful explanation, recent works thus increasingly focus on selection issues. Pender and Fafchamps (2006) developed a theoretical model of tenant and landlord behaviour taking transaction costs, Marshallian inefficiency, and monitoring costs into account, and tested the model empirically. They demonstrated that positive monitoring costs will cause the landlord to restrict the area rented to tenants such that the tenant's yield on the leased-in plot should be higher than the landlord's yield on his own plot. In their empirical analysis using a self-selection model they failed to find evidence of this, however, this was possibly due to the small sample size which would have required the yield difference to be as high as 40 percent. Similarly, they also failed to find evidence of Marshallian inefficiency when comparing input levels and output values of owner-operated and rented-in plots of tenant households, using household fixed-effects to control for unobservable household characteristics.

Using a stochastic frontier approach with the same data set, Ahmed (2002) found significant inefficiency on sharecropped land but not so on land under fixed-rent contracts. This demonstrates that different methods applied to the same data set has led to different conclusions. In Eritrea, Tikabo and Holden (2004) found land productivity to be significantly higher for owner-tenants than for pure owner-operators and owner-landlords showing that land is transferred from less efficient to more efficient land users.

Among the existing literature there is little evidence on the consequences of participating in land rental markets, especially for poor and/or highly land

constrained households with limited off-farm employment opportunities. These knowledge gaps are addressed elaborately in the present study. The impact of tenancy is particularly important for developing countries as issues of land access and international investment in land become increasingly prominent in the international policy agenda (for example, U.N.'s Millennium Development Project 2005 and the World Bank's Report 2008). Jin and Jayne (2011) used data from Kenya to focus on the impacts of land rental markets on rural poverty in Kenya. Their findings from dynamic panel income regression suggest that the overall income gains to the smallest farms from increased access to land through land rental markets are remarkable. They found that renting land would lead to an increase in per capita total net income and per capita net crop income by 6.6 and 25.1 percent respectively.

In an earlier work Acharya (1999) looked into the same problem, comparing the impact of share tenancy between mixed tenants and pure tenants. Like Bangladesh, Nepalese share tenants come from two different economic classes– mixed share tenants, who operate their own farm and rent-in additional land to supplement their income and landless pure share tenants. Their findings supported the arguments that mixed share tenants are in a better position in terms of net return from share tenancy than pure share tenants. Deininger et al., (2004), Swinnen and Vranken, (2006) and Jin and Deininger et al., (2008) studied both the efficiency and impact of share tenancy in the presence of transaction costs. These studies generally found that land rental markets enhance productivity and equity even in the presence of transaction costs. In spite of this evidence, there remain quite well-established perceptions that the existence of land rental markets may lead to land concentration and increased poverty and thus, close government control over land rental is necessary (Deininger et al., 2004; and Masterson ,2007). To evaluate the impact of share tenancy, Carter

and Yao (2002) and Deininger et al. (2008) assumed that a rural household's decision to participate in the informal land rental market as a share tenant is made in order to maximize total household income by optimally reallocating its endowed productive resources. This research also used the same hypothesis to test the impact of share tenancy on net crop income.

3.3.2 Determinants of Contract Choice

This subsection reviews the recent debate on the reasons why a farming household chooses between two alternative choices of the agricultural tenancy contracts: fixed-rent tenancy versus crop-share tenancy.

Hoffman (1984) used a logit model to estimate the determinants of contract choice. His logit estimates showed that distant lands and less risky crops are more likely to be rented under fixed-rent contracts compared to sharecropping contracts.

Allen and Lueck produced several empirical works to find the determinants of contract choice. Their 1992 work stressed aspects related to soil exploitation and costs of monitoring the tenant. They argued that due to insecurity of tenure, the tenants have incentives to overuse the land. Under this argument, sharecropping is expected to occur where there are high possibilities for soil exploitation and where the cost of dividing the output is low. The authors used data from the US to test this theory. They also used a logit model and the results support the underlying theory. However, their results do not support the risk-sharing hypothesis commonly associated with sharecropping. In their second work of 1993, they extended the previous analysis. In this paper they tried to understand not only the share rate, but also the share of input costs borne by the landlord. From the theory one should expect sharecropping to be associated with lower costs of measuring output and high possibility of soil

exploitation. Furthermore, sharecropping landlords would share costs at a rate equal to the crop-share rate. The results from the logit estimates showed that tenants retain a higher share of the output when they bear input costs alone. Moreover, the probability of having an input being shared is negatively affected by the land's value, which is a proxy for soil exploitation. In their 1999 paper they test the risk-sharing hypothesis. Their logit analysis showed that risk does not have a positive impact on the probability of choosing a crop-share tenancy contract. Their Tobit regression also indicated that, in general, in the US, the tenant's share rate does not decrease with risk. Following their works several notable empirical papers focused on this issue.

In 2002, Dubois' paper found similar results. He developed a dynamic principal-agent model for the agricultural tenancy where the optimal contract balances the risk sharing, effort incentives and concerns about the land quality. Results from the farmers in Philippines rejected the pure risk-sharing hypothesis and the pure transaction cost approach. In the decision to lease out a plot, landlords care about the value of the plots and cropping pattern. Chaudhuri and Maitra (2002) also showed that among the tenants, sharecropping is positively correlated to the value of the plot. They used data from India.

There are a number of papers which cannot reject the risk-sharing hypothesis unlike the papers mentioned above. Among these, Dubois and Mimeo (2001) used data from Pakistan and assessed the risk-sharing properties of household consumption. The author showed that the more risk-averse tenants are more likely to choose share contracts. Bandiera and Mimeo (2003) studied the determinants of contract choice using historical data from Italy. They found that tenant's wealth and female landlords are positively related with the incidence of fixed-rent contracts. The uniqueness of this paper is that it analyses different elements of contract choice rather than focusing only on the incentive-power

dimension.

Unlike most of the empirical studies on finding the determinants of contract choice, this dissertation uses attributes of both the landlord and the tenant farming households. As far as the author is aware, Canjels (1998), Huffman and Just (2004) and Rainey et al. (2005) are the only empirical studies providing some evidence that the attributes of both parties affect the contract choice. Canjels used very few attributes. Huffman and Just's paper implied that both the landlord's and the tenant's attributes are key determinants of optimal contract choice. Rainey et al. used survey data obtained from Arkansas districts in the US and reported results showing that a landlord's attributes significantly affect contract choice.

3.4 Conclusion

The scope of this thesis falls within the area of the economics of contracts and the economics of the agricultural tenancy markets. A review of existing literature has provided information on how different aspects of contracting parties and unobservable production risks may affect the final outcome and shape the tenancy contracts. Many challenges remain. In addition to some empirical issues, there has been an unsolved puzzle whereby the results on the association between the risk attitudes of the tenants and the landlords and the outcomes depends on the characteristics which cannot clearly be observed. Moreover, these attitudes differ from one economy to other. This requires further analysis as to how the informal tenancy market in a particular economy may benefit both contracting parties and whether there is a need to intervene. Therefore, in order to have a better understanding of functioning of agricultural land tenancy market the research questions asked in this thesis are: How efficient is the tenancy market in terms of productivity and how does the land rental market affect

the income of the poor and vulnerable sharecroppers? What factors determine the participation of households in the land rental market and their choice of a particular contract? Are there any incentives whereby particular types of landlords (or tenants) look for particular types of tenants (or landlords) in the informal tenancy market?

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4 Chapter Four: Efficiency Impact of Sharecropping in Rural Bangladesh

4.1 Introduction

The efficiency of share tenancy plays a crucial role in increasing total production and ensuring economic efficiency in many developing countries including Bangladesh, where the agricultural land and power are distributed in a very unequal fashion. There are two main hypotheses that can be tested empirically: Marshallian inefficiency and threat of eviction hypothesis. This chapter tested these two hypotheses having opposite effects on land productivity on sharecropped lands compared with owner-operated land. The Marshallian theory, which deals with the economics of sharecropping, asserts that the sharing arrangement is inefficient because tenants receive only a part of marginal product of labour. It is predicted therefore that yield would be lower under the share contract than under the owner-farming system. On the other hand, in the presence of abundant labour, the threat of eviction may induce a higher level of overall input use and get higher yield compensating for inherent Marshallian inefficiencies. In situations, like in rural Bangladesh where the agricultural land and power are distributed in a very unequal fashion, mechanisms like an informal land rental market will have a crucial role in increasing total production and ensuring economic efficiency.

There have been many empirical studies to test the efficiency of sharecropping (such as Jacoby et al., 2002, and Otsuka, 2007). The available empirical evidence on the efficiency of sharecropping is mixed. Shaban (1987) found that in India, share tenancy was associated with an average loss of productivity of 16 percent. Several other studies have also found evidence supporting the Marshallian perspective, such as Laffont and Matoussi (1995) and Chunrong et al. (1996). Jacoby and Mansuri's more recent study (2006), however did not find any evidence of inefficiency of sharecropping using the data from rural Pakistan. Kassie and Holden (2007) found a significantly higher output value per hectare

on sharecropped plots than on owner-cultivated plots. The empirical evidence relating to the efficiency of share tenancy in Bangladesh is very limited and far from inclusive. Taslim (1993) in his review paper listed some studies according to their findings: Mandal (1980), Talukder (1980) and Bhuiyan (1987) find presence of the Marshallian inefficiency among share tenants, while Shagidand (1982), Taslim (1989) and Hossain (2001) found no conclusive evidence to support the Marshallian inefficiency among the crop-share tenant farmers.

Recently, there also has been considerable debate that a household's decision to enter into the tenancy market is endogenous and may affect the productivity levels (Arimoto et al., 2010). Most empirical studies comparing the efficiency of sharecroppers with owner operators also have failed to control for the differences in production functions between the two groups depending on the choices they make. Given this backdrop, the present study sets out to simultaneously analyse two key issues: (a) examination of factors affecting the decision to cultivate as share tenants, (b) estimation of production efficiency in terms of yield/ha with or without a crop-share contract while taking into account the self-selective nature of the choice between cultivating as a share tenant or as a owner operator. This study focuses primarily on the sharecroppers among the rice farmers of rural Bangladesh by addressing the following question: What is the significance of crop-share tenancy on households' productivity in an environment with imperfect land and labour markets?

For empirical analysis, the paper applies a switching regression model for empirical analysis, although it also compares the results of a random-effect model and a fixed-effect model. The use of the switching regression model allows one to relax the assumption that the set of covariates that affect the outcome have the same impact for owner cultivators and tenant cultivators. As a result, this model is able to control for self-selection and endogeneity due to

unobservable household characteristics and plot-level characteristics. Correlation coefficients results from the production functions of the switching regression model demonstrate which group between the share tenants and the owner cultivators have better productivity efficiency than the other group.

The main findings of this paper are as follows: First, the impact of a crop-share contract on productivity is not significantly lower than that of own cultivation. This leads to a rejection of the hypothesis that crop-share contracts are affected by Marshallian inefficiency. However, this finding is consistent with the threat of eviction hypothesis (Kassie and Holden, 2007) with several imperfect or missing markets. Secondly, there is evidence of differences in the production function coefficients between the tenant and the owner households. For instance in the production function, among the share tenant farmers, output per hectare significantly increases with the number of bullocks in the family and significantly decreases with the number of female agricultural labourers in the family. However, for the owner farmers, the size of the household and the number of male agricultural labourers in the family decreases the crop output per hectare, while the experienced household head significantly contributes to increasing the productivity. Credit access from informal sources increases the productivity of the owner cultivators although the coefficient for this variable has no significant effect on the productivity among the share tenants. These differences indicate that the coefficients of production factors have differential effects on the agricultural productivity for households who cultivate under a sharecropping contract compared to households who cultivated their own land. Therefore, empirical analysis using a pool sample of both parties to estimate production functions may suffer from inconsistency.

An additional contribution of this study is that it assesses the efficiency of sharecropping between the mixed-share tenants and the pure-share tenants.

The results do not find any significant productivity difference between the mixed-share tenants and the pure-share tenants.

To analyse this more a number of well-executed empirical studies have been developed by comparing average intensities of output and inputs for sharecroppers and non-tenants. Following Shaban (1987), Acharya (1998) and Braido (2003), this study extends their empirical method for testing the relative efficiency of the mixed-share tenants versus the pure-share tenants. Here in addition to the traditional variables the analysis includes important variables related to developing countries such as: dummies for soil type, ecosystem type and crop variety. These variables are used to measure input-output intensity differences on rural Bangladesh paddy farms. The study finds that although ecosystems do not have any significant impact on output differences between the mixed- and the pure-share tenants, type of soil and method of irrigation used by a household have significant impacts.

The rest of this chapter is presented as follows: section 4.2 gives information about the conceptual framework and objectives of this analysis. Section 4.3 describes the empirical methodology and section 4.4 illustrates the data. Section 4.5 explains the non-parametric estimation. Section 4.6 illustrates the results and section 4.7 interprets predictive statistics from the endogenous switching regression model. Section 4.8 deals with the problem of differentiation between mixed sharecroppers and pure sharecroppers and lastly, section 4.9 concludes the chapter.

4.2 Conceptual Framework

To motivate the analysis, this chapter highlights the key features of land tenure in rural Bangladesh, in particular the relative scarcity of land, large number of farmers and the high risk associated with agricultural production. The concep-

tual model for this study focuses on a basic model of the agricultural household in developing countries where one or more related markets are either missing or imperfect. The model follows from Hallagan (1978). The production function of a typical agricultural household can be represented as:

$$F = F(e, \overline{L}, \overline{A}) \tag{19}$$

where e is the entrepreneurial input of the household, $\overline{L}$ and $\overline{A}$ are fixed land area and fixed quantity of work. Thus, the production function is treated as a function of entrepreneurial inputs of the tenant farmer. It also assumes that $\overline{L}$ and $\overline{A}$ are equal among the tenants. Therefore, with asymmetrical information, the tenant chooses among contract alternatives to maximize the return Y (output and income) from his e.

Three options that a farmer faces are:

(1) to earn a fixed wage income;

$$Y = wL \tag{20}$$

(2) to earn a share of output as a share tenant;

$$Y = (1 - r)F \tag{21}$$

(3) to choose the fixed-rent contract and receive a surplus of output from rent;

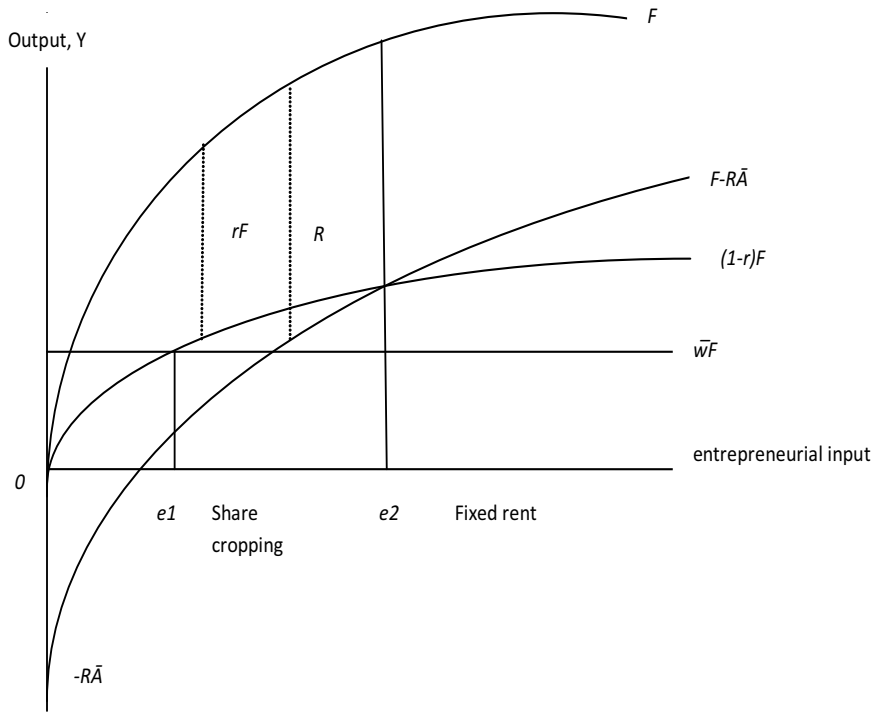
$$Y = F - RA \tag{22}$$

where $(1 - r)$ is the tenant's output share and R is a fixed rent.

These relations can be illustrated in Figure 4.1 (from Hallagan, 1978 and Otsuka et al., 1992) with horizontal axis measuring the farmer's entrepreneur-

ial input and the vertical axis measuring his income and output from crop cultivation.

Figure 4.1 Tenant self-selection model (Hallagen, 1978)

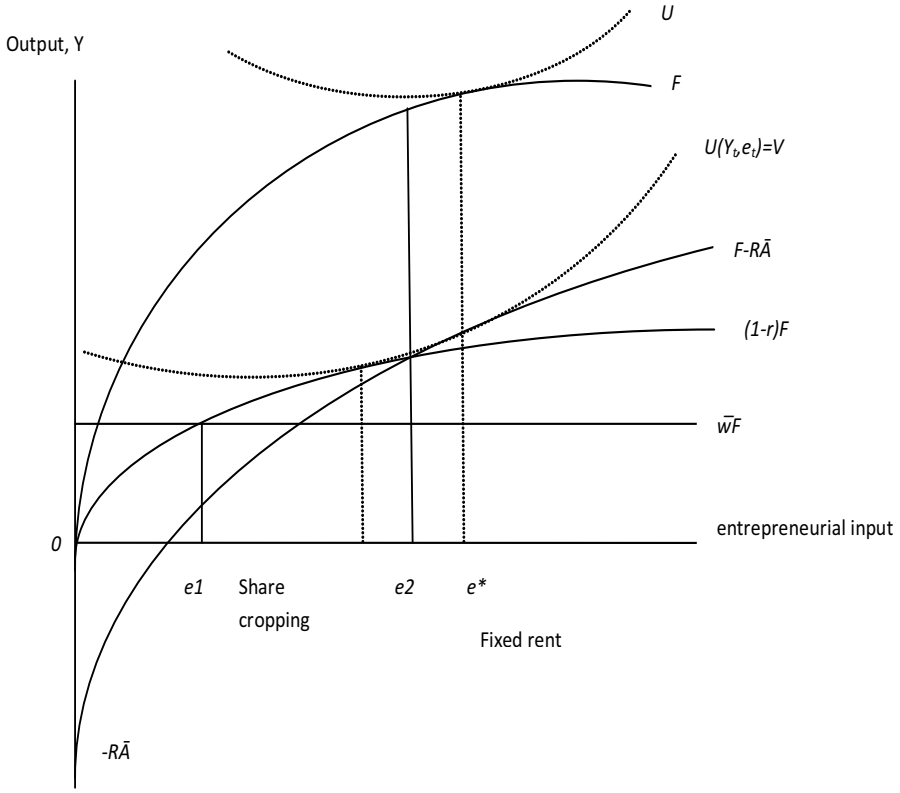


It is evident from Figure 4.1 that if the tenant has ability higher than $e2$ he would prefer a fixed-rent contract as it yields a higher income than the other two options. However, if his ability lies between $e1$ and $e2$ his output will be maximized if he chooses the share contract, while if it falls below $e1$ the tenant would be better off to leave tenancy and take up wage employment.

In order to test empirically the Hallagen model with output as a function of entrepreneurial input, one needs to have data on actual output/labour hours. Unfortunately, the data set used for this analysis has the information on yield/ha but not on the actual output/labour hours. With the yield data one can calculate the efficiency as a measure of yield/ha using utility from the

production function[5]. Figure 4.2 shows the Hallagen model using the utility functions under Marshallian theory from different types of cultivation process. The figure applies the standard theory of contract choice where each type of tenant farmer has to offer at least his reservation utility V in order to accept a particular type of contract.

Figure 4.2 Productivity and utility maximization from different tenancy contracts



In the Figure 4.2 as before $(1-r)F$ represents the minimum reward function for the share tenants. At this level their utility would be equal to the reservation utility thus, $U(Y_t, e_t) = V$. The share of output given to the landlord is measured by vertical distance between F *and* $U(Y_t, e_t)$. However, the utility of the landlord is not maximized with the share-cropping contract but with

[5]There are several authors who also use as crop/ha as the dependent variable such as: Arimoto (2005), Banerjee and Ghatak (2002), Bezabih (2007), Deininger (2008), Pender and Fafchamps (2001), Singh and Singh (1982).

the fixed-rent contract. The slopes of F *and* $U(Y_t, e_t)$ are equal is at point e^*. Moreover, for the share tenants with the same utility function, the gain from share tenancy is lower than that of fixed-rent tenancy. Higher output is attainable if the farmers cultivate with a fixed-rent contract. Therefore, according to the Marshallian analysis, output sharing discourages entrepreneurial effort.

However, the Hallagan model has a limitation that it only considers the farmer's optimization problem and ignores the landlord's optimization problem. Allen (1985) reexplained Hallagan's model using the threat of eviction hypothesis. After Allen the model was extended by Banerjee and Ghatak (2004) and Kassie and Holden (2007). These models showed that the threat of eviction may induce higher levels of overall input use compensating for inherent Marshallian inefficiencies. Rahmato (1984) in his study on Ethiopian farmers stated that

"... the threat of eviction was a potent weapon in the hands of the landlord and the tenant over whom the danger of unemployment and destitution hung like the sword of Damocles, had no alternative but to accommodate all the demands of his landlord...."

Banerjee and Ghatak's (2004) paper was the first to focus on the threat of eviction when there is an abundant supply of tenant farmers with insufficient non-farm employment opportunities. They argue that the threat of eviction may induce higher levels of overall input use compensating for inherent Marshallian inefficiencies. Their model was discussed in detail in Chapter 3.

Therefore, the testable implications would be that sharecroppers are at least productive as farmers under fixed-rent contract and/or owner operators. Imperfections in the factor markets create a potential for land markets to play a role to enhance production efficiency in order to equalize factor ratios across farms. However, in the absence of perfect insurance and credit markets, pro-

duction efficiency does not ensure a farmer's subsistence income from crop cultivation. Moreover, empirical studies that found sharecropping to be inefficient are usually in the situation when policy limits the contract choice in some way (Otsuka, 2002). The study area which is considered in this analysis is characterized by land scarcity due to high population density, surplus labour due to poor access to non-farm income and no policy intervention by the government or non-government organizations.

The effectiveness of the eviction threat depends on the tenant's future utility and availability of farm land and other jobs in the locality. In rural Bangladesh, for more than half of the population agricultural activities are the major source of income. There is a predominance of land scarcity due to high population density and surplus labour due to poor access to non-farm income.

Another important point that is needed to be considered in terms of the policy perspective is that there are many empirical studies on how different contracts may affect productivity but there are very few studies that consider the productivity of sharecropped vs. owner-operated land.[6] Theoretically and also reflected in Figure 4.2 farmers under fixed-rent contracts should behave the same as owner operators because their utility is maximized at the same point, e^*. In addition, most of the empirical evidences on sharecropping efficiency in Asia did not use household fixed-effects to control for unobservable household differences and did not explicitly compare owner-operated and sharecropped plots considering different production functions which may arise due to differences in the entrepreneurial abilities. However, from the future land redistributive policy perspective it is important to know what is the efficiency consequence of the land rental market. This question has been analysed in this chapter.

[6] According to Marshall which is also reflected in Figure 4.2, the farmers under share tenancy would have lower productivity than the owner cultivator.

Andy (2010) pointed out that the key issues in the agricultural sector in developing countries is the imperfect nature of the labour and land markets. In order to compensate for these issues, informal institutions emerge. For example, uncertainty, stemming from deviations from perfect markets influence the creation of informal land rentals and variations in ownership of the agricultural inputs. The function of these informal institutions cannot be fully explained by the theoretical models. One of the main reasons is that in these informal markets decisions of the contracting parties largely depend on their risk attitudes and transaction costs involved. While productivity efficiency of the tenant farmers is explained theoretically by Marshall's model and many other subsequent models (these models are summarized in Chapter 3), almost all of these models assume perfect market conditions. Thus under incomplete markets, whether the tenants are less productive than the owner cultivators or not depends on the degree of threat of eviction.

In this study, results should somewhat reflect the evidence of restricted off-farm labour employment in rural Bangladesh which may compensate for inherent Marshallian inefficiencies. Imperfections in the labour market increase the threat of eviction among the tenants and are expected to be reflected through the productivity of sharecroppers. This includes crop-share tenant households with abundant labour which should be more productive or at least as productive as owner cultivators.

It is well recognized in the crop-sharing literature that in developing countries short term leasing is an effective method of imposing some discipline on the tenants' cultivation where work monitoring is costly. Tenancy in rural Bangladesh also does not vary much from this situation. The contracts which are mostly verbal and informal are usually offered for one single cropping season. This threat of eviction among the poor vulnerable tenants might also have

exactly the opposite effect on productivity as argued in Marshallian inefficiency. The objectives of this research thus to find out the productivity inefficiency (if any) among the crop-share tenants.

4.3 Empirical Methodology

The analysis starts by comparing the presence of Marshallian inefficiency hypothesis versus the threat of eviction hypothesis of sharecropping based on the fact that sharecropped lands are less productive and employ inputs less intensively than owner-operated plots.[7] By contrast, the threat of eviction hypothesis formulates that uncertainty about contract renewal creates incentives to increase output by share contract tenants. According to Kassie and Holden's (2007) these two hypotheses can be outlined as follows:

Marshallian inefficiency hypothesis: Sharing of the output reduces incentives to apply inputs on sharecropped plots and this causes output on sharecropped land to be lower than on owner cultivated plots.

Threat of eviction hypothesis: Uncertainty about contract renewal creates incentives to increase output (and therefore input use) on sharecropping plots in order to qualify for contract renewal.

Threat of eviction hypothesis is said to be complementary to Marshallian hypothesis because is explains several influenceson contract choice that can be seen in the real world. Some of these issues are as follows and they are addressed in turn below:

- Mutual trust among contracting parties;
- The length of contract terms;

[7]There are a number of existing literatures which compare Marshallian inefficiency between sharecroppers and owner cultivators. Some of the examples of literatures are: Pender and Fafchamps (2001), Bezabih (2007), Chaudhuri and Maitra (2001), Kassie and Holden (2007), Jacoby and Mansuri (2008), Jin and Jayne (2011), etc..

- Landlord's high monitoring ability.

According to existing literature, mutual trust among the contracting parties is a part of the threat of eviction hypothesis. This is related to the possibility that a tenancy contract may or may not be renewed. If the contracting parties have mutual trust this may reduce the chance of non-renewal. In the absence of mutual trust, non-renewal or eviction an additional instrument available to the landlord.

Bhandari's (2007) paper on social distance and trust among contracting parties argued that the enforcement of the tenant's labour effort level can be virtually costless when there is trust between the landlord and the tenant. However, it may be difficult to find a variable which represents mutual trust although it is explained by the eviction or non-renewal.

The length of the contract is directly related to eviction and thus with the threat of eviction hypothesis. For example, a contract for just one cropping season has a higher likelihood of eviction after this period than if a contract is for say several cropping seasons. In that case the tenant has a lower threat of eviction for that period. Banerjee and Ghatak (2004) argued that if a tenant is offered a sharecropping contract for one or two cropping seasons, to some extent, the problem of Marshallian inefficiency might be overcome by threatening to evict the tenant in case of poor performance. Due to several factors such as an abundance of land-poor farmers, absence of off-farm employment opportunities and absence of formal contract and/or land reform policy, in rural Bangladesh, there is evidence that tenancy contracts are usually for one or two cropping seasons only (Rahman and Rahman, 2009).

Ray (2008) explains the link between the monitoring ability of the landlord and threat of eviction. According to his book, depending on the level of monitoring ability of the landlord, the landlord can gather a collection of verifiable

and non-verifiable information about the tenant. Although verifiable information can be used to design a formal contract, the non-verifiable information cannot be used. On the other hand, as Ray mentioned, such information can be taken into account in the decision to renew a contract. Therefore, this information which largely depends on the monitoring ability of the landlord is potentially valuable for contractual efficiency.

4.3.1 Existence of Productivity Between Owner Cultivators and Crop-Share Cultivators

To evaluate the efficiency of sharecropping through productivity of a tenant (as explained in section 4.2), the analysis will estimate a production function by using a sample of household level data from 2000 and 2004.

Hypothesis: This study tests an empirical model with the Marshallian inefficiency versus the threat of eviction hypotheses having opposite effects on household productivity as a sharecropper. The study assumes that imperfect labour and credit markets may eliminate or reduce the Marshallian inefficiency.

As per standard productivity analysis, a farmer's productivity is determined by household level characteristics and plot level characteristics. In the production function, lease status is included as an additional determinant because this analysis focuses on the productivity differentials between crop-share tenants versus owner operators, thus:

$$y_{it} = \alpha_i + \beta_1 s_{it} + \beta_2 h_{it} + \gamma x_{it} + \theta c_i + u_{it}, t = 1, 2 \qquad (23)$$

where,

i denotes household and t denotes year 2000 and 2004

α_i = unobserved time-invarient individual effect

y_{it} = output of the household in kg/ha at year t

s_{it} = dummy for either owner cultivator or crop-share tenant at year t

h_{it} = exogenous key variable inputs (such as family labour, non-labour inputs used per ha by household h at year t)

x_{it} = exogenous plot characteristics and other time-varying such as whether the plot is irrigated or not at year t average rainfall in 2000 and 2004

c_i = observed time-invariant factors that affect y_{it} (e.g. soil quality, topography dummies and district dummies)

u_{it} = accounts for all unobserved household-specific time-varying errors such as managerial ability or other unobserved measures of risk aversion that affect production function decisions

If one believes that contract choice status has only an intercept effect on productivity (i.e. results in a parallel shift up or down for various productivity profiles), then the model can include a contract choice dummy as a right-hand-side variable and pool the entire sample of tenant farmers. Since the entire sample is used, there are no sample selection issues. One can then use ordinary least squares (OLS) to estimate a typical productivity equation. If one believes that contract status is endogenous then one can use an instrument for the contract choice dummy without concern for sample-selection bias. In the above model the analysis ruled out the possibility that the dependent variable is observed only for a restricted non-random sample. With this view equation (1) is estimated first without instrumenting the contract choice dummy then in the next step the research uses the instrumental variable approach with the household fixed-effect model using panel data for 2000 and 2004.

However, differences in risk-sharing attitudes and enforcement ability should lead to differences in land-leasing behaviour and eventually to differences in tenants' effort (productivity). Therefore if one believes that contract choice status has not only an intercept effect but also a slope effect (i.e. coefficients differ

according to contract choice as well), then a sample selection with endogeneity on contract choice is called for. This paper focuses on the use of an endogenous switching model that sorts individuals over two different states (with one regime observed). The econometric problem of estimating a model with endogenous switching arises in a variety of settings in labour economics.

4.3.2 Switching Regression Model for Measuring Production Efficiency with Self-Selectivity: A Two Stage Estimation Procedure

When estimating the impact of a sharecropping contract on productivity, two issues come up. They are as follows.

- The first issue is the assumption that the social position due to lease status is endogenous to productivity. Moreover, some unobserved characteristics that influence the probability to choose a particular contract could also influence the productivity of a farmer. Neglecting these endogeneity and selectivity effects is likely to give a biased picture of the relative productivity both under a share-cropping contract and a fixed-rent contract.

- The second issue is that the effect of the agricultural productivity may not be independent of leasing behaviour. Factors of production may have differential effects on the agricultural productivity for households who cultivate under a sharecropping contract compared to households who cultivated their own land. Therefore, estimation methods (as in most of the literature) that pool all sampled observations to estimate production/ output functions with contract choice as an input or a determinant may not be appropriate. Separate functions for both contract types should be examined.

Therefore, in order to avoid inconsistent estimates of the effect of tenancy positions one needs a joint determination of a discrete outcome, which denotes the individual statuses and another outcome (either discrete or continuous) that may be affected by the status. This model is called the "endogenous switching regression model" (Maddala, 1983). The switching regression model enables one to: (1) model both the allocation of farmers to positions and the effects of positions on other outcomes; (2) estimate the degree to which common, unmeasured variables affect both the outcomes and the classification variables; (3) obtain estimates of the effects of other variables *within* levels of the classification variables that take account of potential selection biases and (4) estimate the impact of the classification regime by simulating how individuals would behave had they entered different positions from those that they in fact occupy (Mare and Christopher, 1987). This model uses full information maximum likelihood (FIML) estimation and in the first stage estimates a probit model which is used to predict the probability of contract choice and in the second stage, the inverse Mills ratio (which is used as an instrument in the second stage to control for endogeneity) is included as a regressor.

First, a probit model is applied in the first stage to determine the relationship between a household's tenurial status and a number of socio-economic variables. The choice of sharecropping contract by the ith household is described by h_i^* , that is a function of a vector of explanatory variables:

$$h_i^* = \alpha z_i + u_i \tag{24}$$

where z is vector of exogenous variables, α is a vector of parameters and u_i is a random disturbance. The function that indicates a household's contract choice status can be specified by

$$
\begin{aligned}
h_i &= 1 \; iff \; \alpha z_i + u_i > 0 \\
h_i &= 0 \; iff \; \alpha z_i + u_i \leq 0
\end{aligned} \tag{25}
$$

The switching regression model assumes that a farming household, given a set of characteristics represented by z, makes a decision to cultivate under a particular tenure status. The farming household adopts a specific production function to produce output, and the production function differs due to the differences in operating conditions. The parameters of the production function will provide information about the sources of productivity difference.

Therefore, in the second stage, separate regression equations are used to model the productivity of the household conditional on a specific contract choice status. We assume a Cobb-Douglas production function in estimating the switching regression model:

$$
\begin{aligned}
y_{is} &= \alpha_{is} + \beta_1 x_{is} + \beta_2 k_{is} + \beta_3 m_{is} + \varepsilon_{is} \; iff \; h_i = 1 \\
y_{io} &= \alpha_{io} + \beta_1 x_{io} + \beta_2 k_{io} + \beta_3 m_{io} + \varepsilon_{io} \; iff \; h_i = 0
\end{aligned} \tag{26}
$$

where y_{is} and y_{io} are the productivity of household under cropping under sharecropping contract and subscripts denote tenure status (i/o) and the x, k, m are natural log of number of employees, value of fixed capital, and value of input (raw materials and others) respectively., β_1 β_2 and β_3 are vectors of parameters and ε_{is} and $\varepsilon_{io}$are random disturbance terms respectively.

The Cobb-Douglas production function helps one determine what happens to the output. We are interested in determining whether the function exhibits constant returns to scale and test against the alternative that the returns are

not constant (i.e. $H_0 : \beta_1 + \beta_2 + \beta_3 = 1$ vs. $H_1 : \beta_1 + \beta_2 + \beta_3 \neq 1$). In the estimation of economies of scale, parametric approaches assess the functions of frontier production,or of more flexible forms such as translog function. The study uses a translog function however, it is meaningful to explain economies of scale here because the estimation of production function includes yield/ha as the dependent variable and not a measure of Total Factor Productivity. As Boussard (1990) argued, the question of whether there are economies of scale in agriculture is the subject of a long standing debate. This debate surrounds the question of the functional form to model farm technologies. The estimation of the Cobb-Douglas production functions generally leads to increasing returns to scale. However, according to Kislev and Petterson's synthesis (1996), increasing returns to scale are not always realised because of two reasons. First, in agriculture it is difficult to breakdown of farm efficiency into technical efficiency and second, it is common on agriculture to be unforseen events relating to weather, disease, etc. that impact significantly on productivity. Therefore, this study does not estimate returns of scale and focus only on the productivity difference between the owner cultivators and the tenant farmers.

The intercept term is the productivity parameter, and it measures the level of total factor productivity. If $\alpha_{is} < \alpha_{io}$, then we will conclude that households under crop-share contract are more productive. Here u_i, ε_{is} and ε_{io} are assumed to have a tri-variate normal distribution with mean 0 and the covariance matrix as follows:

$$\Omega = \begin{bmatrix} \sigma_{is}^2 & . & \sigma_{isu} \\ . & \sigma_{io}^2 & \sigma_{ifu} \\ . & . & \sigma_u^2 \end{bmatrix} \tag{27}$$

where σ_u^2 is the variance of the error term in the selection equation, (which can be assumed to be equal to one since the coefficients are estimable only up to a scale factor), σ_{is}^2 and σ_{if}^2 are the variances of the error terms in the production function and σ_{isu} and σ_{iou} represent the covariance of u_i, ε_{is} and ε_{io} Since, y_{is} and y_{io} are not observed simultaneously the covariance between ε_{is} and ε_{io} is not defined (Maddala, 1983). An important implication of the error structure is that because the error term of the selection equation u_i is correlated with the error terms of the production function ε_{is} and ε_{io} , the expected values of ε_{is} and ε_{io} conditional on the sample selection are non-zero.

To estimate the endogenous switching regression model more efficiently and with no strict assumptions, FIML is preferable (Green, 2000; Lokshin and Sajais, 2004).The FIML model method simultaneously estimates the probit equation and the regression equations to yield consistent standard errors. The log likelihood function for this model is

$$\begin{aligned} InL(\beta_1, \beta_2, \beta_3, \sigma_{is}^2, \sigma_{io}^2, \sigma_{isu}, \sigma_{iou}) = \sum_i (H_i[In\{F(\frac{\alpha X_i + \rho_1 \varepsilon_{is}/\sigma_{isu})}{\sqrt{(1-\rho_1^2)}})\} \\ + In\{f(\varepsilon_{is}/\sigma_{is})/\sigma_{is}\}] \\ + (1-H_i)[In\{1 - F(\frac{\alpha X_i + \rho_2 \varepsilon_{io}/\sigma_{iou})}{\sqrt{(1-\rho_2^2)}})\} + In\{f(\varepsilon_{io}/\sigma_{io})/\sigma_{io}\}] \end{aligned} \tag{28}$$

where F is a cumulative distribution function, f is a normal density distribution function, $\rho_1 = \sigma_{isu}/\sigma_u\sigma_{is}$ is the correlation coefficient between u_i and ε_{is} and $\rho_2 = \sigma_{iou}/\sigma_u\sigma_{io}$ is the correlation coefficient between u_i and $\varepsilon_{io.}$ Only the value of y, y_{is} or y_{io} is actually observed for any given household depending upon which regime that particular household is in, cultivating under a share-cropping contract or fixed-rent contract. Therefore, σ_{iso} does not occur in the likelihood function and it is not estimable.

After the parameters are estimated, one can calculate

$$\begin{aligned} xb_{1i} &= E(y_{is}|x_{1i}) \\ xb_{0i} &= E(y_{io}|x_{0i}) \\ yc_{1\_1i} &= E(y_{is}|h_i = 1, x_{1i}) = x_{1i}\beta_1 + \sigma_{isu} \end{aligned} \tag{29}$$

4.3.3 Switching Regression Model for Measuring Production Efficiency with Self-Selectivity: A Three Stage Estimation Procedure (considering stochastic production frontier)

To further investigate whether the presence of inefficiency (if any) comes from the available technical efficiency for two different contract types, a three-stage switching regression model is applied. The first stage would be a probit model like equation (28) which is used to determine factors affecting the decision to choose a cropshare contract rather than a fixed-rent contract. From the first stage estimated values of α are obtained. By substituting the estimated values of α, it is possible to estimate two inverse Mills ratios.

In the second stage, separate regressions like equation (29) are used to model the production behaviour of groups of farmers conditional on a specified criterion function of contract type selection using two inverse Mills ratios as instruments.

In the third stage, separate stochastic profit functions with inefficiency effects models were proposed using transformed variables from the second stage that takes into account the self-selectivity decision as well. To estimate the production frontiers to measure the presence of technical efficiency, the equation may be expressed as follows:

$$
\begin{aligned}
y_{is} &= \beta_1 x_{is} + v_{is} - \theta_{is} \; iff \; h_i = 1 \\
y_{io} &= \beta_2 x_{io} + v_{io} - \theta_{io} \; iff \; h_i = 0
\end{aligned} \tag{30}
$$

where v_{is} and v_{io} have normal distribution with variance σ^2_{is} and σ^2_{io} captures random variation in output due to factors beyond the control of farms and component θ_{is} and θ_{io} is a non-negative one-sided error term that captures the technical inefficiency in production specified by

$\theta_{is} = z_{is} + w_{is}$ and $\theta_{io} = \gamma z_{io} + w_{io}$ for z is a vector of explanatory variables and w a random variable such that θ is obtained by a non-negative truncation of $N(z\gamma, \sigma^2_i)$

These equations will be estimated by a stochastic production frontier with inefficiency effects model first proposed by Battesse and Coelli (1995) in a single step. Therefore, in the third stage, to obtain household specific production efficiency scores, two stochastic production functions will be calculated for the crop-share contract and fixed-rent contract using two inverse Mills ratios from the second stage using the Weighted Least Square (WLS) method.

4.4 Data and Summary Statistics

Data for the analysis are drawn from a repeat survey of a nationally representative sample of rural households conducted to assess changes in rural livelihood systems. The first round of this survey conducted by International Rice Research Institute (IRRI) was done in 2000. Using the same households and additional households the survey was again conducted in 2004. The survey includes owner farmers, who lease-in land, the tenant farmers and farmers who lease out land and the landlord farmers. In the combined panel data set of

2000 and 2004 there are 1,845 observations from farming households. Among them, 47.91 percent are owner farmers, 32.74 percent are the landlord farmers, 15.01 percent crop-share tenant farmers and only 60 farmers were tenant farmers cropping under a fixed-rent contract. For this analysis the study takes the sub-sample of owner farmers and tenants under a crop-share contract. Table 4.1 presents the definitions of variables of interest and control variables.

Table 4.2 presents the preliminary comparative statistics of owner cultivator and tenant farmers. On average, tenant farmers had higher productivity from tenancy but lower incomes from the crops they grow, compared to owner farmers. Tenants' owned average cultivated land area was much lower than that of owner farmers. Among the non-tenant households (owner cultivators) the number of healthy people in the household, number of bullocks, active labour force in the household and both pre-capital variables (income from goat and poultry rearing and income from trees) had higher mean values than those of the tenant household, indicating that non-tenant households were better off than the tenant households although the tenant households had better productivity than the non-tenant households. On average tenant farmers existed in relatively poor economic conditions. They tended to own less land and fewer livestock. Their overall health and education condition was worse than that of owner farmers. They also had lower levels of capital stock and that explains their higher burden of credit from formal and informal sources. Overall the owner cultivators were significantly distinguishable in terms of welfare.

Table 4.1: Variable definitions

Variable	Description
	dependent variables
log_output_ha	log of rice output per hectre
	independent variables
share	= 1 if hh cultivate under share tenancy contract, 0 if hh cultivate his own land
	HH characteristics variables
hhsize	household (HH) size (number) (proxy for subsistence pressure)
male_agri_labour	total male agri worker (number)
female_agri_labour	total female agri worker (number)
	socio- economic variables
ngom	= 1 if the hh has membership with any local NGO; 0 otherwise
edu_head	education of HH head ; =1 if completed primary education; =0 otherwise
healthyp	no. of healthy population in a HH
femaleh	sex of HH; = 1 if HH head is female; =0 if male
age_head	age of head (number)
prim_occu_head	= 1 if the primary occupation of the head of HH is agriculture; =0 otherwise
cow_no	number of bullocks used in cultivation
active_labour_force	number of active labour force in the hh
Irri_access	=0 if no irrigation; 1= pump; 2= tubewell; 3= govt.system
	land type variables of the HH
grplo	land ownership group: 1 if absolute landless or functionally landless(<=0.20ha); 2 if marginal or small landowner (0.21-1.00) ; 3 if lower or upper medium landowner (1.01-3.00) ; 4 if large landowner (> 3.00)
homestead_land	ownland: homestead (ha)
Cult_own_land	ownland: cultivable (ha)
	capital variables of the HH
goat_ poultry _inc	annual income from goat and poultry rearing (tk.)
Income_tree	annual income from tree, other plants (tk.)
	access to credit
credit_formal	amount of credit from formal institutions (tk.)
credit_informal	amount of credit from informal institutions (tk.)
	instrumental variables
experience	=1 if rent in land under share tenancy last year; 0 otherwise
imprv_share	=1 if economic status improved last year due to additional rent in land; 0 otherwise
	control variables
fp	flood plane
dp	drought prone
fv	favourable environment
s	submergence
loamy_soil	=1 of the soil is loamy; 0 otherwise
clay_soil	=1 of the soil is clay type; 0 otherwise
rainfall	average rainfall of 54 districts in year 2000 and 2004
year	=1 if year 2000; 0 otherwise

Table 4.2: Differences in farm endowment, socio-economic characteristics and extent of land transaction by participation status

Variables	Participating households				All farming households	
	Crop-share tenant		Owner cultivator			
Percentage of transacting households	22.20		77.80			
	mean	SD	mean	SD	mean	SD
rice_ha	3.19	1.39	3.7	1.8	3.18	1.75
hhsize	5.31	2.35	5.74	2.48	5.64	2.45
total_agri_male	1.16	0.725	1.29	0.84	1.26	0.82
total_agri_female	0.02	0.104	0.019	0.13	0.017	0.13
ngom	0.38	0.48	0.25	0.43	0.28	0.45
edu_head	0.36	0.63	0.01	0.82	0.71	0.81
healthyp	4.90	2.29	5.21	2.44	5.14	2.41
femaleh	0.02	0.14	0.03	0.17	0.031	0.17
age_head	44.08	12.33	46.32	12.59	45.82	12.56
prim_occu_head	0.69	0.46	0.71	0.45	0.70	0.46
cow_no	1.31	1.46	2.06	2.22	1.89	2.10
active_labour	2.95	1.48	3.33	1.58	3.24	1.57
grplo	1.11	0.36	2.03	0.79	1.82	0.81
cultivated_land	0.003	0.031	0.51	0.78	0.39	0.72
goat_ poultry _inc	750.73	1,221.30	1,075.39	1,399.56	1,003.30	1,368.19
Income_tree	987.26	2,247.96	3,153.38	9,744.59	2,672.41	8,705.48
credit_formal	2,759.12	8,415.05	2,713.45	8,502.01	2,723.59	8,479.39
credit_informal	645.62	3,520.74	400.73	3,003.96	455.10	3,126.24

4.5 Non-Parametric Estimation

Figures 4.3 and 4.4 show the non-parametric distribution of log_rice/ha and $log\_crop\_income/adulthh$ among crop-share tenants and owner cultivators.

Figure 4.3: The estimated density of log_rice/ha among share tenants and owner cultivators

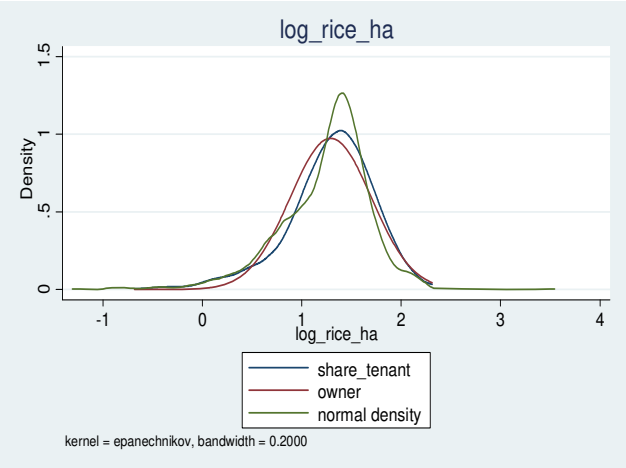
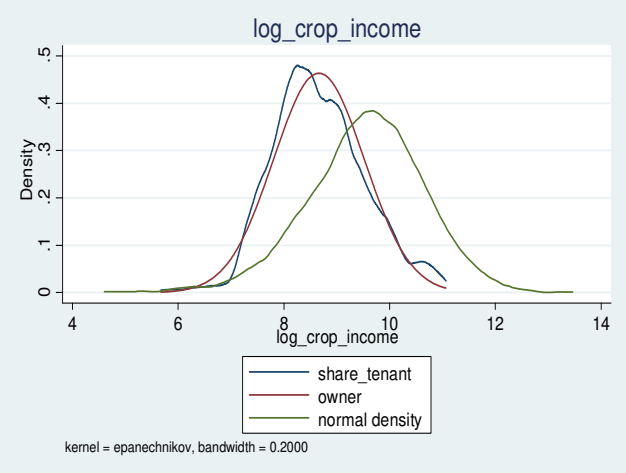


Figure 4.4: The estimated density of log_crop_income/adult among share tenants and owner cultivators



The estimated densities show that although there is not much difference in the productivity and crop income between tenants and non-tenants, the crop income per adult household is moderately skewed to the left compared to the normal density. This indicates that there are more exceptionally small than exceptionally large values. Those exceptional values will impact the mean and pull it to the left, so that the mean will be greater than the median. Therefore on average the crop incomes for both groups are smaller than the normal distribution value. In the subsequent part of the chapter, a rigorous analytical model is estimated to verify whether these differences in mean crop

production and crop income remain unchanged after controlling for observed and unobserved confounding factors.

4.6 Results

To analyse the correlation of crop production, the study includes a broad set of explanatory variables including household demographic factors, specific individual/household head's characteristics and asset holdings, district level factors which change over time, variant factors and time invariant factors.

In this study dependent variables as well as numerical independent variables are transformed into log values of absolute frequency. In the estimation of the production function in the agricultural sector and the literature that has been reviewed for this thesis use both absolute value and relative frequency. Some of the examples in the literature which use absolute values are Arcand et al. (2007), Banerjee and Ghatak (2002), Bellemare (2010), and Tikabo and Holden (2004). Similarly some of the examples in the literature which use relative frequencies are Allen and Lueck (1992), Arimoto (2010) and Materson (2007).

According to Hron and Filzmoser (2010) *"As far as response variable y carries absolute information, the absolute values of the explanatory variables can be used directly as long as outliers in the data set are identified and removed beforehand." They also mentioned that "However, in many practical situations the information is not absolute but relative, often expressed in proportions or percentages. Examples of relative information are the unemployment rate in selected countries, proportions of people working in agriculture, percentages of inhabitants with tertiary education, or proportions of the household budget spent on foodstuff. Here the usual model assumptions fail because the values of the response variable are bounded in a certain interval, e.g. in (0, 100) in case of percentages, and the assumption of normal distribution is thus not meaningful.*

However, the problem is in fact a conceptual one and it is inherent to the nature of the data."

For consistency in the modelling, it is important that all of the variable (the dependent and explanatory variables) are in one format, i.e. all in relative frequency or absolute value. Woolridge (2009) and Hron and Filzmoser (2010) state that the best transformation for both theoretical and for practical reasons is the logarithmic transformation.

Following Tikabo and Holden (2004), Arcand et al. (2007), Braido (2008) and Deininger et al. (2007) and due to data limitations In the estimation of productive efficiency the study includes variables such as $hhsize$; $male\_agri\_labour$; $female\_agri\_labour$; $active\_labour\_force$ in a household which represent the quantity of labour. In order to check whether there is a multicollinearity problem among these variables, a correlation coefficient matrix is presented in the Appendix as Figure A2. Correlations measure the strength and direction of the linear relationship between the two variables. The correlation coefficient can range from -1 to +1, with -1 indicating a perfect negative correlation, +1 indicating a perfect positive correlation, and 0 indicating no correlation at all. Figure A2 in the Appendix shows that none of the correlation coefficients are very large. This implies that these variables are not highly correlated with each other.

This variable is a ranked variable which defines 4 types of farmers depending on their land ownership. Thus, this variable does not affected by other numerical variable such as cultivated own land. Cultivated own land variable includes information of a household about how much own land they cultivate in a particular year regardless of how much other kinds of uncultivated land a farmer has. On the other hand, grplo variable ranks the farmers according to their ownership of any land irrespective of the land use for cultivation or not.

If grplo is a numerical variable then there may be an issue of multicollinearity.

4.6.1 Random-Effect, Fixed-Effect and Treatment-Effect Models

The correlation between choice of tenancy and farm households' performance outcomes is theoretically complex and there are further empirical pitfalls regarding the impact evaluation problem. Using unbalanced panel household level data for 2000 and 2004, Table 4.3 present the results from the random-effect, fixed-effect and treatment-effect models where production functions are considered using equation (26). Thus the dependent variable is log_rice_ha for Table 4.3. All three models also use time constant variables such as soil type dummies (loamy and clay), location/ecosystem dummies (flood plain, submergence, drought plain and irrigated plain), and time-varying variables such as annual district rainfall and a year dummy as control variables. Among the few studies on sharecropping which also take account of the impacts on land quality, Ai et al. (1996) and Shaban (1987) include soil type and irrigation characteristics as explanatory variables to control for heterogeneity stemming from different land quality. Dubois (2002) includes land fertility in his empirical model of sharecropping. All of the above authors assess the relationship between land quality and contract type, looking at two or more crops cultivated. Dubois (2002) argues that heterogeneity in the cultivation process and soil utilization in the production of different crops can have an impact on land productivity and contract choice.

In this thesis, following Allen and Lueck (1992, 1993 and 1996) the empirical studies focus on only one crop, namely rice, and thus soil fertility variables are not used as variables of interest. However, in order to control for any variations in the productivity or contract choice due to soil fertility all empirical models use time constant variables such as soil type dummies (loamy and clay),

location/ecosystem dummies (flood plain, submergence, drought plain and irrigated plain), and time-varying variables such as annual district rainfall and a year dummy as control variables.

As argued in sections 4.3.1 and 4.3.2 using a contract choice dummy in the production function leads to biased and inconsistent results since the tenancy choice variables are correlated with the unobservable reflected in the error term. Instrumenting for the share tenancy choice dummy variable requires that a separate tenancy choice equation be estimated as explained by one or more instrumental variables and other variables. Here the study uses membership with any non-government organization (NGO) ($ngom$) as an instrument which equals one if the household is a member of any local NGO and zero if the household is not a member of any local NGO.

Validity of the instrumental variable:

- Arimoto (2010) use credit-cooperative and rice bank variables as instruments. He argues that link with at least one of these would enable tenants to adopt riskier contracts. Baindiera (2007) studies tenancy contracts in Italy and finds that choice of contract length is driven by access to credit and membership with co-operative. Bizimana (2011) uses dichotomous co-operative variable as instrument and argues that if a household has membership with co-operative, the household may opt for acquiring riskier contracts. Deininger et al. (2008) use distance to bank from the tenant household as instrumental variable based on the similar intuition. As in rural Bangladesh NGOs plays a vital role to form informal co-operatives among the faming households, following above references, the thesis use NGO membership ($ngom$) as instrumental variable.

- The assumption for including $ngom$ as an instrumental variable (also tested through regression) is that this exogenous measure of $ngom$ is

uncorrelated with the error term in the production function and that the excluded instrument is correctly excluded from the estimated equation. Membership with any local NGO is also an indicator of social connection.

- In rural Bangladesh most of the landlords are also small or marginal farmers. Income from the rented land is the main source of income for them. Therefore, in order to reduce the monitoring problem and ensure supervision enforceability, landlords would prefer to look for the tenant farmers who have some kind of social recognition. Hence, the expected sign for ngom is positive and significant for the contract choice equation. The OLS results from the tenancy contract equation of the IV regression for both functions show that the coefficient for ngom is positive and significant (results are provided in Appendix A1).

- The F-statistic in the table is a test for a weak instrument. This is a test on just ngom and F-statistic is simply the square of the t-statistic of estimates from the first stage regression. The F-statistic of 11.67 is larger than the rule of thumb value of 10 which is suggested by Durbin-Wu-Hussman. Thus, ngom does not seem to be a weak instrument.

Columns (a) to (d) of Tables 4.3 present the results from the random-effect model and fixed-effect model with and without the instrumental variable. Because of the debate around the exogeneity of the contract choice dummy using pooled random- and fixed-effect models, the discussion mainly focuses on the estimated results of random- and fixed-effect models with the instrumental variable (in column (c) and (d) in Table 4.3).

In the literature there are arguments about which method is better– random-effect model or fixed-effect model. Variations in the data may come from two sources

- inter-household (across household) variations in the average productivity from one household to another; and

- intra-household (within household) variation within each household over time.

A regression relying on inter-household variation is problematic due to potential omitted variable bias. The solution is to focus on intra-household variation which can be captured by the fixed-effect model. The intuition behind this model is that it deals with within-household variation. By including fixed-effects (control variable for time trend such as– year or rainfall) one can control for the average differences across households in any observable and unobservable predictors. The fixed-effect coefficients soak up all the across-group action. What is left is the within-group action, which is what we want where the threat of omitted variable bias is greatly reduced.

At the end of Table 4.3 test results for the validity of the fixed-effect model over random-effect model are presented. For models without IV, the Hausman test for comparing fixed-effect versus random-effect does not allow one to use the cluster-robust standard error. In such cases using *xtoverid* with cluster *id* gives a P-value of 0.010 from the modified Hausman test suggests the rejection of the null hypothesis that the random-effect model provides consistent estimates. The statistic reported by *xtoverid* is numerically equal to the test statistic reported by Hausman.[8].

Again for the model with IV, STATA command *xtivreg* does not support producing the cluster-robust standard errors. Hence, the standard Hausman test would give an inconsistent result. Alternatively, in order to avoid this, the study uses the *xtivreg*2 command of STATA, which provides IV estimation with cluster-robust standard error. After doing so, the Hausman test has been done to compare the random- and fixed-effect model with IV under the null

[8]Schaffer, M. E., 2010

hypothesis that the random-effect model gives consistent results. However, probability chi^2 of the Hausman test for IV models has the value of 0.007. This again leads to rejection of the null hypothesis that random-effect provides consistent estimates.

The IV regression results (Table 4.3) for the production function equations show that the coefficient for share tenancy choice is negative but not significant, indicating that crop-share tenant households do no better or worse than an owner-cultivator household. Hence, for the production function the results do not support the presence of Marshallian inefficiency among the tenant farmers. The F-statistics in the models are quite large, so one can conclude that the regression model for predicting dependent variable with the set of independent variable is better than just using the mean.

Column (e) of Table 4.3 presents results from the treatment-effect model. For the production function the share dummy variable is positive and significant. This is opposite to the Marshallian hypothesis. Comparing the fixed-effect model and treatment-effect model, as mentioned by Cameron and Trivedi (2009): " The treatment-effect model imposes more structure. The benefit may be increased precision of estimation. The cost is a greater chance of misspecification error." Therefore, if the errors are heteroscedastic, as they are (see Appendix A1 and A2), the IV estimator remains consistent but the treatment-effects estimator becomes inconsistent. Hence, to check the robustness of the results, the study needs further investigation.

Table 4.3 Productivity efficiency of sharecropping: Random effect, fixed effect model (with and without IV) and treatment effect model

Variables	Dependent variable: log_rice_ha				
	Random effect model	Fixed effect model	Model with instrumental variable relation with any NGO: ngom		
			Random effect model	Fixed effect model	Treatment effect model
	(a)	(b)	(c)	(d)	(e)
First stage					
ngom			0.080**	0.090**	0.270**
			(0.026)	(0.020)	(0.159)
Production function					
share	0.023	0.013	0.277	-0.836	0.064**
	(0.028)	(0.077)	(0.291)	(1.326)	(0.030)
imprv	0.042	-0.019	0.015	0.023	0.038
	(0.028)	(0.055)	(0.045)	(0.133)	(0.031)
hhsize	-0.031*	-0.037	-0.036*	0.029	-0.031*
	(0.017)	(0.034)	(0.018)	(0.123)	(0.016)
ageh	0.015**	0.028**	0.017**	-0.005	0.016**
	(0.005)	(0.013)	(0.006)	(0.058)	(0.005)
$ageh^2$	-0.0002**	-0.0003**	-0.0002**	0.00004	-0.0002**
	(0.00005)	(0.0001)	(0.00006)	(0.0005)	(0.00005)
eduhead	-0.021	0.006	-0.014	-0.044	-0.022
	(0.020)	(0.057)	(0.022)	(0.106)	(0.019)
femaleh	0.083	-0.224	0.073	0.177	0.083
	(0.080)	(0.187)	(0.094)	(0.721)	(0.089)
prim_oocu_head	-0.034	-0.066	-0.038	-0.154	-0.035
	(0.033)	(0.086)	(0.037)	(0.198)	(0.035)
grplo	-0.022	0.206	-0.118	0.849	-0.039
	(0.074)	(0.237)	(0.134)	(1.087)	(0.077)
healthyp	0.012	0.031	0.018	-0.070	0.013
	(0.017)	(0.040)	(0.018)	(0.170)	(0.016)
male_agri_labour	0.030*	0.107**	-0.029	0.181	-0.032*
	(0.018)	(0.042)	(0.019)	(0.139)	(0.018)
female_agri_labour	0.009	0.385*	0.047	-0.180	0.012
	(0.117)	(0.199)	(0.119)	(1.006)	(0.104)
active_labour_force	0.0001	0.011	-0.004	0.005	-0.00008
	(0.016)	(0.035)	(0.018)	(0.069)	(0.016)
clvt_own_land	-0.008	-0.073	0.020	-0.223	-0.004
	(0.014)	(0.047)	(0.037)	(0.249)	(0.017)
homestead_land	0.006	-0.377	0.181	-0.095	0.060
	(0.168)	(0.317)	(0.265)	(0.808)	(0.200)
cow_no	0.002	0.006	0.003	0.021	0.002
	(0.006)	(0.018)	(0.006)	(0.035)	(0.006)
irri_access	-0.064	0.090	-0.057*	0.093	-0.064**
	(0.042)	(0.103)	(0.031)	(0.112)	(0.028)
income_goat_poul	3.06e-06	-7.17e-06	3.15e-06	-0.00003	3.31e-06
	(5.26e-06)	(0.00001)	(6.49e-06)	(0.00005)	(6.17e-06)
income_trees	-2.50e-06	-6.66e-06**	-1.72e-06	-9.45e-06*	-2.34e-06
	(2.21e-06)	(2.66e-06)	(1.82e-06)	(6.59e-06)	(1.53e-06)
credit_formal	-2.21e-06	9.27e-06*	-2.46e-06**	9.56e-06	-2.24e-06*
	(1.42e-06)	(5.26e-06)	(1.37e-06)	(7.99e-06)	(1.27e-06)
credit_informal	-2.74e-06	-7.70e-06	-4.75e-06	-3.64e-06	-3.07e-06
	(3.02e-06)	(0.00002)	(4.42e-06)	(0.00002)	(3.61e-06)
log_non_agri_income	-0.022**	-0.061*	-0.021*	-0.051	-0.022*
	(0.012)	(0.033)	(0.012)	(0.059)	(0.012)
constant	1.078**	0.129	1.031	1.151	1.076**
	(0.212)	(0.549)	(0.201)	(1.817)	(0.182)
N	1014	1014	1014	1014	1014
F (30, 937)		3.06			
Wald chi2(30)	111.67		107.20	10416.6	
modified Hausman stat.	50.78				
P- value	0.010				
Hausman test, prob<chi^2			0.007		
LR test of independent equation; prob.>chi2					0.013

** significant in 5% level, * significant in 10% level

Note: all equations control for average rainfall in different districts (64 districts) in 2000 and 2004, dummies for soil type and dummies for ecosystem: fp- flood prone, dp- draught prone, fav-favourable, ir- irrigated. The estimation also check with random effect model and compare random effect vs. fixed effect using Sargan-Hansen stat. for model without IV and Huasman test for the models with IV.

4.6.2 Endogenous Switching Regression Model

To check the robustness of IV estimation, this study used endogenous switching regression that can control both for unobserved selection bias and endogeneity. As mentioned in the previous section, for the switching regression model apart from the endogeneity of contract status, the model relaxes the restriction that all the covariates of production and income functions have the same effect on tenant and non-tenant farmers. For instance, differences in risk-sharing attitudes and enforcement ability (partly unobserved) should lead to differences in land-leasing behaviour and also performance (observed through productivity and net crop income).

The FIML estimates of the endogenous switching regression model are reported in Table 4.4. Column (a) presents the estimated coefficients of selection equations on choosing share tenancy and columns (b) and (c) present the productivity function for tenant farm household and non-tenant farm households.

The differences in the production function coefficients between the tenant and the owner households illustrate the presence of heterogeneity in the sample. For instance in the production function, among the share tenant farmers, output per hectare significantly increases with the number of bullocks in the family (cow_no) and significantly decreases with the number of female agricultural labourers in the family ($female\_agri\_labour$). However, for the owner farmers, the size of the household ($hhsize$) and number of male agricultural labourers in the family ($male\_agri\_labour$) decreases the crop output per hectare, while the experienced household head significantly contributes to increase the productivity ($ageh$). Credit access from informal sources increases the productivity of the owner cultivators although the coefficient for this variable has no significant effect on the productivity among the share tenants. Without a minimum amount of collateral it is difficult to get access to any type

of credit in rural Bangladesh like many other developing countries in the world. The insignificance of the credit variable affecting productivity indicates credit constraints among the share-tenant farmers.

Correlation coefficients results from the production functions show that the rho_1 and rho_0 are positive and negative for owner cultivators and for share tenant farmers respectively, although none of them are significant. Since rho_1 and rho_0 are not significantly different from zero it suggests that in the data set those who cultivate their own land or cultivate under share tenancy have productivity no better or less than that of a random farming household. Therefore, the switching regression model does not support the presence of Marshallian inefficiency which is also consistent with the results of the fixed-effect IV model.

Table 4.4 Full information maximum likelihood estimates of the switching regression model: log_rice_ha

Variables	log_rice_ha		
	Selection function	Production function	
		Crop-share tenant	Own cultivator
	(a)	(b)	(c)
ngom	0.282**		
	(0.136)		
hhsize	-0.261	-0.092	-0.139**
	(0.408)	(0.117)	(0.061)
ageh	-0.054	0.013	0.014**
	(0.034)	(0.009)	(0.005)
eduhead	-0.190*	0.033	-0.018
	(0.116)	(0.096)	(0.018)
femaleh	-0.029	0.157	0.031
	(0.340)	(0.136)	(0.061)
prim_oocu_head	-0.275*	-0.072	-0.002
	(0.162)	(0.047)	(0.027)
healthyp	-0.004	-0.007	-0.005
	(0.049)	(0.014)	(0.007)
male_agri_labour	0.126	0.041	-0.031*
	(0.104)	(0.032)	(0.016)
female_agri_labour	-0.877*	-0.286*	0.050
	(0.481)	(0.100)	(0.088)
Ave. price_mv_2000			
Ave. price_mv_2004			
Ave. price_tv_2000			
Ave. price_tv_2004			
active_labour_hat	0.050	0.004	-0.019
	(0.099)	(0.026)	(0.016)
clvt_own_land	-14.789**	-0.039	-0.022
	(1.485)	(1.091)	(0.013)
homestead_land	-2.528	-0.925	0.144
	(2.527)	(0.909)	(0.185)
cow_no	-0.016	0.036**	0.002
	(0.044)	(0.013)	(0.006)
irri_access	-0.362**	0.031	-0.105**
	(0.145)	(0.045)	(0.025)
income_goat_poul	-0.00009	7.87e-06	9.62e-06
	(0.00004)	(0.00001)	(6.21e-06)
income_trees	-2.62e-06	-1.61e-06	-4.50e-06**
	(0.00002)	(4.11e-06)	(1.23e-06)
credit_formal	2.46e-06	-2.01e-06	-6.33e-06
	(9.02e-06)	(2.08e-06)	(7.00e-06)
credit_informal	0.00001	1.01e-06	4.72e-06*
	(0.00002)	(4.37e-06)	(2.78e-06)
Imprv_share	0.191	0.015	
	(0.175)	(0.044)	
constant	-128.84**	-26.365*	47.51**
	(67.355)	(20.088)	(11.062)
N	1507		
LR test of independent equation; prob.>chi2	0.000		
sigma		0.290**	0.349**
		(0.012)	(0.007)
rho		-0.092	0.103
		(0.306)	(0.142)

** significant in 5% level, * significant in 10% level

Note: all equations control for average rainfall in different districts (64 districts) in 2000 and 2004, dummies for soil type and dummies for ecosystem: fp- flood prone, dp- draught prone, fav-favourable, ir- irrigated.

Sigma1 and sigma2 are the square-roots of the variance of the residuals of the regression part of the model

The likelihood ratio test for joint independence of the three equations is 0.000. This leads to string rejection of the null hypothesis that independent estimates provides consistent estimates.

4.7 Estimation and Interpretations of the Predictive Statistics from the Endogenous Switching Regression Model

Table 4.5 Definition of expected outcome and treatment effect parameters

Sub-samples	Conditional prediction: expected value on the dependent variable being observed/not being observed		Treatment effects
	Crop-share tenant	Owner cultivator	
Crop-share tenant	$E[Y_{1i}\|X,H=1]$	$E[Y_{0i}\|X,H=1]$	TT
Owner cultivator	$E[Y_{1i}\|X,H=0]$	$E[Y_{0i}\|X,H=0]$	TU
Heterogeneity effects	BH_1	BH_2	TH

Table 4.5 shows the expected values for output/ha and the treatment-effect relationships that can be identified in a split of tenant sub-samples and the owner cultivator sub-samples. The diagonal cells are the expectations that are actually observed in a sample. For example, $E[Y_{1i}|X, H = 1]$ is the expected output/ha of a crop-share tenant sample group. The expected output/ha without a contract for this tenant group would be a counterfactual outcome.[9] The same logic would describe the actual and counterfactual output/ha for the group of owner cultivators.

The expectations in Table 4.5 can be used to estimate expected differences in consumption between a tenant and an owner farmer. These differences could reflect the actual effect of crop-share contract or simply differences in unobserved heterogeneity.

The effect of the contract on performance (hence output/ha) for those who cultivate under a share contract is the effect of the treatment on the treated

[9]Expressing what has not happened but could, would, or might under differing conditions

(TT):

$$TT = E[Y_{1i}|X, H = 1] - E[Y_{0i}|X, H = 1] \tag{31}$$

where Y_{1i} and Y_{0i} are defined in Table 4.6 as the output/ha (or net crop income/adult) with or without a contract respectively and $H = 1$ denotes those in the sample who cultivate under a crop-share contract and zero otherwise. The effect of the treatment on the untreated (TU) can be similarly defined for those who are owner cultivators but could also be contracted for farming.

$$TU = E[Y_{0i}|X, H = 0] - E[Y_{1i}|X, H = 0] \tag{32}$$

The TT and TU parameters give the expected performance effect of a randomly chosen household from the groups who are tenants and who are non-tenants, respectively. These are policy relevant treatment-effect variables (Heckman and Vytlacil, 2001).

The policy relevant treatment-effects can also be distinguished from the heterogeneity effect in Table 4.5. First, tenant farmers may have different productivity regardless of the incentive problem due to other endogenous determinants of household demand. This "base heterogeneity effect" (BH) is given for the two states of nature:

$$\begin{aligned} BH_1 &= E[Y_{1i}|X, H = 1] - E[Y_{1i}|X, H = 0] \\ BH_0 &= E[Y_{0i}|X, H = 0] - E[Y_{0i}|X, H = 1] \end{aligned} \tag{33}$$

where BH_1 and BH_0 are the differences in output/ha (or net crop income/adult) between the tenant and non-tenant farmers respectively. Second, a "transitional heterogeneity" (TH) can also be calculated. This is the dif-

ference of output/ha between the tenants and non-tenants ($TT - TU$) and is due to variations in the expected net output/ha (or net crop income/adult) of methods of crop cultivation.

These measures can be estimated from the endogenous switching regression model. They are necessary to understand inherent differences in productivity between the two groups and to properly anticipate potential responses to changes in land reform policy. The estimated values of the treatment-effects and the heterogeneity effect are as illustrated in Table 4.6.

Table 4.6 Expected outcome and treatment effect parameters: log output/ha and log crop income/adult hh

Sub-samples	Conditional prediction: expected value on the dependent variable being observed/not being observed		Treatment effects
	Crop-share tenant	Owner cultivator	
(a) Log crop output/ha			
Crop-share tenant	($Yc_{1\text{-}1}$) =observed expected output by tenant	($Yc_{0\text{-}1}$) = counterfactual output of tenant act as a owner	($Yc_{1\text{-}1} - Yc_{0\text{-}1}$) = farmer i's expected output under tenancy minus his expected output without tenancy (sample contract farmers' average outcomes under tenancy): effect of treatment on the treated (TT)
Owner cultivator	($Yc_{1\text{-}0}$)= counterfactual output of owner act as a tenant	($Yc_{0\text{-}0}$) =observed expected output by owner	($Yc_{1\text{-}0} - Yc_{0\text{-}0}$)= non-tenant farmers expected income without tenancy minus his expected income without tenancy (sample owner farmers' average crop income from joining the tenancy) : effect of treatment on the untreated (TU)
Heterogeneity effects	($Yc_{1\text{-}1}$ - $Yc_{1\text{-}0}$)= differences in output between tenant and non-tenant group (BH_1)	($Yc_{0\text{-}1}$ - $Yc_{0\text{-}0}$)= differences in output between tenant and non-tenant group (BH_0)	TH = difference between the effect of tenancy on output for the tenant and non-tenant groups

Tables 4.7 presents the expected productivity under actual and counterfactual conditions for rural Bangladesh.

Expected Output/ha and treatment-effect Parameters Looking at Table 4.7 considering first the observed differences in output/ha between two groups of farming households in the shaded cells along the diagonal, it can be seen that the non-tenant farmers' output/ha was 0.018kg/ha less (1.398-1.370) than that of the share tenants. This simple comparison is misleading as it does not account for other unobserved factors that may have influenced output. The last row adjusts for this heterogeneity and shows the difference in expected output/ha. With the counterfactual condition, the non-tenants cultivating under a crop-share contract, the average outcome would be increased by 0.011 kg/ha (1.409-1.398). By contrast, with the counterfactual condition that the tenant farmers cultivate as a non-tenant their expected output would be 0.037 kg/ha less (1.407-1.370) in a cropping season. Under both counterfactual conditions, the tenant farmers seem to be more productive than owner farmers. Therefore the results do not support the Marshallian inefficiency hypothesis.

Table 4.7: Average expected crop output/ha for tenants and non-tenants in rural Bangladesh

Sub-samples	Conditional prediction: expected value on the dependent variable being observed/not being observed		Treatment effects
	Crop-share tenant	Owner cultivator	
(a) Log crop output/ha			
Crop-share tenant	1.398 ($Yc_{1\text{-}1}$)	1.407 ($Yc_{0\text{-}1}$)	-0.011(0.008) ($Yc_{1\text{-}1} - Yc_{0\text{-}1}$)
Owner cultivator	1.409 ($Yc_{1\text{-}0}$)	1.370 ($Yc_{0\text{-}0}$)	-0.039(0.005)* ($Yc_{0\text{-}0} - Yc_{1\text{-}0}$)
Heterogeneity effects	0.011 ($Yc_{1\text{-}0} - Yc_{1\text{-}1}$)	-0.037 ($Yc_{0\text{-}1} - Yc_{0\text{-}0}$)	0.028*

The last column in the Table 4.7 shows the treatment-effects of the performance as the expected change in output for randomly selected households in each group. For the tenant group that would have cropped under owner cultivation the mean effect of the tenancy is to decrease output by -0.011kg/ha. How-

ever, for the non-tenant farmers that would have cropped under tenancy, the mean effect of having no contract decreases output by 0.039kg/ha. The effect of tenancy on output is larger than that of owner cultivators (TH). The estimated treatment-effects indicate that cropping under tenancy results in higher output than cropping under own cultivation.

Hence, the estimated treatment-effects indicate that cropping under tenancy may have a higher outcome than cropping under own cultivation. This result is consistent with the findings from the fixed-effect models (section 4.6.1) and endogenous switching regression models (section 4.6.2).

Taslim (1999); Arkand (2004); and Rahman (2008) argued that poor farmers in rural Bangladesh seek credit from different sources at the beginning of the cropping season which must be repaid after the season Like tenancy contracts, these loans are short term, usually given for one cropping season. For owner farmers since they do not have to share any output with others, if they take out a loan it is much easier to repay. It is very often the opposite case for share tenant farmers who are already fighting for their subsistence living and only get a certain share of the total crop output, so the loans are difficult for them to repay. As for alternative wage employment, Taslim (1992, 1999), Reisen (2004) and some other authors stated that in rural Bangladesh working as a wage labourer usually means being socially degraded to the bottom rung. A farmer possessing some land will not normally take up wage employment. He may however, lease-in land under crop-share or other arrangements in order to employ any excess family labour. It would therefore be inappropriate to regard wage employment as an acceptable alternative to tenancy for all farmers.

On the other hand one should not forget that agriculture in Bangladesh already employs and supports far too many people. This is evident from the regression results that in the case of production the active labour force is not

a significant coefficient and for the crop income function it in fact supports diminishing marginal returns to labour with a negative and significant coefficient. All of these factors collectively reduce the net crop income of the tenant farmers although threat of eviction from the landlord forces the tenant to cultivate crop-share land with efficiency at least sufficient to secure a renewal of the lease.

4.7.1 Robustness Check for Endogenous Switching Regression Model

To check for robustness of the results from the endogenous switching regression model this study further estimates production efficiency while taking into account the decision to choose a crop-share tenancy. This requires an additional stage so it is referred to as a three-stage estimation procedure. In the third stage of the usual switching regression model the study uses stochastic production frontier regression for tenants and non-tenants groups. Stochastic frontier analysis assumes that each farm household produces less than it might due to a degree of inefficiency. The results from the third-stage frontier model are presented in Table 4.8.

This stage includes instruments from the first-stage (Inverse Mills Ratios) selection equation and predicted productivity variable from the second-stage of the endogenous switching regression model. At the bottom of Table 4.8 results from the output frontier model are reported which shows that that there is no technical inefficiency component in the model. This is the test of null hypothesis $H0 : sigma2 = 0$ against the alternative hypothesis $H1 : sigma2 > 0$. If the null hypothesis is true, the stochastic frontier model reduces to an OLS model with normal errors and the earlier two-stage switching regression model should give a consistent result. For this study, for the tenant farmers the output shows LR= 14.65 with a $P - value$ of 0.00, and for the owner cultivator, LR = 51.28

with P-value of 0.00. Therefore, the results can lead us to reject the alternative hypothesis and the two-stage endogenous switching regression model should predict a consistent result.

Table 4.8: Third stage estimation of the transformed stochastic production frontier with adjusted for self-selective choice decision

	Stochastic production frontier	
Variables	Crop-share tenant	Own cultivator
IMR (instrument for self selectivity)	0.664	-0.009
	(0.502)	(0.094)
pro_expected (pro_hate from 2nd stage)	0.664*	-0.073*
	(0.350)	(0.042)
ngom	0.085	0.055
	(0.044)	(0.036)
hhsize	-0.166	-0.101
	(0.134)	(0.094)
ageh	0.023**	0.018**
	(0.010)	(0.007)
eduhead	0.055	0.009
	(0.039)	(0.021)
femaleh	0.365**	0.068
	(0.149)	(0.101)
prim_oocu_head	0.003	0.031
	(0.049)	(0.036)
grplo	0.027	-0.060*
	(0.077)	(0.036)
healthyp	-0.012	0.009
	(0.017)	(0.012)
male_agri_labour	0.009	-0.042*
	(0.035)	(0.021)
female_agri_labour	-0.404**	0.341**
	(0.211)	(0.171)
active_labour_hat	-0.029	-0.003
	(0.035)	(0.023)
clvt_own_land	-7.583**	1.161*
	(3.168)	(0.637)
homestead_land	-0.093	0.694**
	(1.042)	(0.348)
cow_no	-0.040**	0.0001
	(0.015)	(0.0008)
irri_access	0.053	-0.118**
	(0.059)	(0.043)
income_goat_poul	-7.14e-06	0.00002*
	(0.00001)	(0.00001)
income_trees	-0.00001	-1.13e-06
	(9.43e-06)	(2.19e-06)
credit_formal	-3.30e-06	-1.31e-06
	(2.38e-06)	(1.49e-06)
credit_informal	2.30e-06	4.49e-06
	(6.20e-06)	(4.31e-06)
Imprv_share	0.003	
	(0.046)	
constant	0.040	1.607**
	(0.598)	(0.309)
N	297	629
Wald chi2 (30)	77.63	103.18
Log likelihood	-13.59	-266.614
chibar2(01)	14.65	51.28
Prob> chibar2	0.00	0.00

* significant in 5% level, ** significant in 10% level

Note: all equations control for average rainfall in different districts (64 districts) in 2000 and 2004, dummies for soil type and dummies for ecosystem: fp- flood prone, dp- draught prone, fav-favourable, ir- irrigated.

4.8 Mixed tenant vs. Pure tenant

4.8.1 OLS and IV model

A mixed-share tenant is a household owning and sharecropping land in the same year and season. It has been argued that differing opportunity costs are faced by owner-cultivators and crop-share tenants in developing countries. A difference in opportunity costs may also apply as well to mixed-share tenants and pure-share tenants. In rural Bangladesh, the ownership of any kind of land is a primary form of wealth. If the landlords are risk averse and look for less risk averse (that is, more wealthy) tenants, then, a mixed-share tenant is in a better position to obtain a tenancy contract with more flexible conditions compared to a pure-share tenant. If this is the case more output will be produced by pure-tenants compared with mixed-tenants. Table 4.9 presents results from OLS and IV where production function is considered. The dependent variables and the set of covariates are the same as in the earlier sections.

The OLS results in crop output has no significant coefficients for the mixed-share tenant dummy. This suggests that there is no statistically significant variation in productivity between mixed tenants and pure tenants. However, to check for consistency of the OLS results this study assumes that there are some unobserved factors which affect both the performance of a tenant farmer and his decision to choose a particular type of tenancy. Thus apart from using control variables the estimation needs to control for endogeneity of tenancy choice.

In the instrumental variable model the study includes the amount of homestead land as an instrument for acting as a mixed tenant or a pure tenant. The intuition behind this is that, although the amount of own-cultivated land defines a farmer as a mixed tenant, it also affects the productivity. Therefore, the amount of own-cultivated land cannot be used as an instrument for the mixed-

tenant dummy. As mentioned earlier, owning any kind of land may influence a landlord to offer a tenancy contract. Ownership of a homestead does not affect the productivity of rice as the farmers do not cultivate rice on such land. However, this ownership enables a farmer to be selected for contract farming more easily and that may influence the tenancy pattern. Tenants in rural Bangladesh are drawn mainly from this group of farmers possessing some land of their own (mentioned in Hartman and Boyce, 1983; Jansen, 1986; Rahman, 1986; Ahmed and Taslim, 1992). The estimation also checked for the robustness (through using the F-statistic) of this instrument and found that the variable homestead land cannot be considered as a weak instrument for mixed-tenant choice.

The IV results have no significant differences in the productivity function between mixed tenants and pure tenants. The variables in the IV are almost the same as using the OLS although the standard error for the mixed-tenant dummy is larger than that of OLS. Among other variables, output increases significantly for the modern variety of rice and decreases significantly for the traditional variety rice. As in the previous section, the household's subsistence pressure reduces output/ha.

Table 4.9 OLS and IV model: log_rice_ha
(Variable of interest : mixed = 1 if the share tenant is mixed tenant; 0 if pure tenant)

Variables	log_rice_ha	
	OLS (a)	IV (b)
first stage : share		
homes_land		5.808**
		(1.227)
Robust F (1,169)		22.390
Prob > chi2		
mixed	0.057	0.024
	(0.070)	(0.172)
ngom	0.019	0.020
	(0.043)	(0.039)
rice_m	0.332 **	0.332**
	(0.181)	(0.168)
rice_t	-0.164**	-0.165**
	(0.046)	(0.043)
hhsize	-0.058**	-0.059**
	(0.033)	(0.030)
ageh	0.013	0.014
	(0.008)	(0.009)
eduhead	0.068**	0.068**
	(0.034)	(0.031)
femaleh	0.168	0.168**
	(0.105)	(0.096)
prim_oocu_head	-0.014	-0.017
	(0.060)	(0.060)
grplo	-0.011	-0.011
	(0.086)	(0.079)
clvt_own	-0.728	-0.728**
	(0.281)	(0.260)
healthyp	0.035	0.036
	(0.030)	(0.029)
male_agri_labour	0.016	0.017
	(0.033)	(0.126)
female_agri_labour	-0.025	-0.024
	(0.111)	(0.103)
cow_no	-0.031**	-0.031**
	(0.017)	(0.015)
irri_access	0.082	0.081
	(0.067)	(0.062)
income_goat_poul	0.00001	0.00001
	(9.40e-06)	(9.01e-06)
income_trees	-2.60e-06 (7.17e-06)	-2.24e-06
		(6.96e-06)
credit_formal	-2.25e-06	-2.24e-06
	(1.78e-06)	(1.63e-06)
credit_informal	1.07e-06	1.06e-06
	(4.14e-06)	(3.79e-06)
constant	0.503	0.488
	(0.437)	(0.397)
N	199	199
R-sq	0.316	0.315
Wald chi2		(28) 160.12

** significant in 5% level, * significant in 10% level
Note: all equations control for average rainfall in different districts (64 districts) in 2000 and 2004,
dummies for soil type and dummies for ecosystem: fp- flood prone, dp- draught prone, fav-favourable, ir- irrigated.

4.8.2 Difference in Output-Input Intensities: Location Level Inference

Although the estimations in sections 4.6 and 4.8.1 do not provide significant support either for Marshallian inefficiency or lower opportunity cost among the pure and mixed-share tenants, following Braido (2003) and Acharya (1998) this

analysis compares output and input differences of the two groups of tenant. The objectives behind this estimation are, firstly, to check the robustness of the pervious estimation and secondly by comparing the output between two groups of share tenant households, one accounts for the existence of missing incentives and ability bias. Let M_h and P_h be the mixed- and pure-share tenant households, respectively. Thus the difference between output and inputs between these two types of tenants will be

$$\Delta_h \ln(y) = \beta_1 + \sum_{k=1}^{K} \beta_k \Delta_h \ln(x_k) + \Delta_h u \tag{34}$$

$$\Delta_h \ln(x_j) = \gamma_1 + \Delta_h v_j, \text{ for all } j \in \{1, 2\} \tag{35}$$

However, one could argue that contract designs are affected by location or crop type and are homogeneous inside a location or for a particular crop type. To know whether there are significant effects of location in the estimation, this study follows Braido's (2003) method of replacing the constant terms by location (ecosystem) dummies. These dummies capture the mean difference of the dependent variables between mixed- and pure-share tenants of the respective location. The error terms in equations (34) and (35) are assumed to have zero mean and finite variance. Under this assumption equation (34) which includes log output as dependent variable requires joint estimation. Similarly equation (35) which includes labour and non-labour inputs requires joint estimation too. Thus, these two sets of equations are estimated jointly using Zellner's iterative method of estimating seemingly unrelated regressions.

Table 4.10: Regression of output and family owned input differences of mixed sharecroppers versus pure sharecroppers

variable	diff_log_rice/ha	diff_labour	diff_bullock
flood prone	0.134	0.673	0.404
(51 observations)	(0.155)	(0.437)	(0.714)
drought prone	-0.051	0.258	0.955
(46 observations)	(0.155)	(0.431)	(0.704)
favourable	0.161	0.754	0.701
(95 observations)	(0.144)	(0.423)	(0.691)
irrigated	0.060	0.476	0.958
(55 observations)	(0.152)	(0.434)	(0.709)
loamy_soil	0.507**	-0.225	-0.398
	(0.186)	(0.480)	(0.784)
clay_soil	0.463**	0.028	0.145
	(0.180)	(0.469)	(0.767)
irri_access	0.125**	0.133	0.209
	(0.052)	(0.148)	(0.242)
rice_m	0.597**	0.044	-0.222
	(0.098)	(0.283)	(0.462)
rice_t	-0.071	-0.081	0.271
	(0.054)	(0.151)	(0.246)
rainfall	0.00003	0.00009	0.00004
	(0.00004)	(0.0001)	(0.0002)
diff_cul_area	-0.062		
	(0.094)		
diff_labour	0.030		
	(0.035)		
diff_bullock	-0.045**		
	(0.018)		
N	182	182	
p-value	0.0000	0.0000	

** significant in 5% level, * significant in 10% level

Note: all equations control for average rainfall in different districts (64 districts) in 2000 and 2004, dummies for soil type and dummies for ecosystem: fp- flood prone, dp- draught prone, fav-favourable, ir- irrigated.

The likelihood ratio test for joint independence of the three equations is 0.000. This leads to string rejection of the null hypothesis that independent estimates provides consistent estimates

Regression results from the estimation are shown in Table 4.10. The vector of mean difference of intercept dummies is not statistically significant for either the output equation or input equation. This indicates that for all locations, the hypothesis that there are no missing incentives cannot be rejected. However, unlike the findings of Acharya (1998) using Nepalese data, variables representing soil quality and types of irrigation access are jointly significant. Therefore, these variables appear to be important for explaining the presence of any difference of output between the pure tenant and the mixed tenant. The cultivation of modern rice variety is proved to be an important factor in explaining output intensity variation between pure and mixed sharecropping households. For

labour and non-labour inputs none of the variables are significant indicating that the crop-share tenant farmers are cropping under such contracts only to maintain a subsistence living and without any incentive to improve their effort.

4.9 Conclusion

There are two main hypotheses that can be tested empirically: Marshallian inefficiency and the threat of eviction hypothesis. This chapter tested these two hypotheses having opposite effects on land productivity on sharecropped lands compare with owner-operated land. The overall results indicate that in rural Bangladesh the share tenants are no less efficient than the owner cultivators. However, these are not unexpected findings from a subsistence economy where a large number of small farm families are competing for tenancy contract to supplement income from their own farm.

There is considerable controversy but a scarcity of empirical evidence in Asia concerning the impact of land rental markets on the agricultural productivity. However, the absence of Marshallian inefficiency in share tenancy does not necessarily imply that the share contract can be enforced costlessly in general. In rural Bangladesh like many other developing countries, with abundant agricultural labours looking for a farming contract, it is usually because those particular landlords who adopt the share contract tend to be those equipped with a mechanism of contract enforcement.

This study also considers different production functions for two different groups of farmers: owner cultivators and share tenants due to self selection. The differences in the production function coefficients between the tenant and the owner households illustrate the presence of heterogeneity in the sample. For instance in the production function, among the share tenant farmers, output per hectare significantly increases with the number of bullocks in the family

and significantly decreases with the number of female agricultural labourers in the family. However, for the owner farmers, the size of the household and number of male agricultural labourers in the family decreases the crop output per hectare, while the experienced household head significantly contributes to increases the productivity. Credit access from informal sources increases the productivity of the owner cultivators although the coefficient for this variable has no significant effect on the productivity among the share tenants. These differences indicate that the factors of production have differential effects on the agricultural productivity for households who cultivate under a sharecropping contract compared to households who cultivated their own land. Therefore, empirical analysis using a pool sample of both parties to estimate production functions may suffer from inconsistency.

Another contribution of this study is that it assesses the efficiency of sharecropping between the mixed-share tenants and the pure-share tenants. The results do not find any significant productivity difference between the mixed-share tenants and the pure-share tenants.

This paper also evaluates the presence of input and output differences between the pure-share tenants and the mixed-share tenants. The paper contributes to an understanding of the factors which generate differences in input and output intensities across two comparative tenure regimes. The cultivation of modern rice variety is proved to be important in explaining output intensity variation between pure and mixed sharecropping households. For labour and non-labour inputs none of the variables are significant indicating that the crop-share tenant farmers are cropping under such contracts only to maintain a subsistence living and without any incentive to improve their effort.

These results contain, with appropriate caveats, some implications for policy relating to tenure systems. When crop-sharing is such a versatile productive

arrangement to overcome many market failures, the efficacy of land redistribution programmes, recommended so often in many developing countries, including Bangladesh, must be viewed with much caution. However, any tenancy reform policy in the direction of ensuring tenure security, making financial and other markets more competitive, and/or providing for more and larger peasant proprietorships in Bangladesh may have the potential for increasing output, income generation, and overall economic development Future research to identify the determinants of a functioning land market under different contracts and to understand how to better leverage the potential for the rental market for the rural poor could contribute meaningfully to the design of the future land and tenancy reform policies.

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5 Chapter Five: Participation and Contract Choice in the Agricultural Tenancy Market: Evidence from Rural Bangladesh

5.1 Introduction

The informal transfer of agricultural land via tenancy, either by fixed-rent or sharecropping arrangements, is a common institution spreading in many parts of the world, especially in developing countries. Although a large number of authors have sought to explain it in the theoretical literature, there have only been a few empirical works that attempt critically to estimate and to understand the generality of the theoretical results.

Empirical literature on finding the determinants of contract choice in the agricultural markets has generally used a single equation model with contract choice variable, whereas optimizing operational farm size through the informal tenancy market in the presence of imperfect/missing markets has been analysed separately. Dubois (2002) first argued that there is no reason to think that the decisions to enter into the tenancy market and choose a particular contract are independent. Despite the importance of this issue of simultaneous decisions, no studies provide in-depth empirical evidence on the simultaneity of participation and the contract choice decision. To fill this empirical research gap, this study provides a joint analysis of optimizing operational land through participation in the lease market, and of choosing a particular contract depending on the risk sharing problem and moral hazard problem. The joint estimation method has an important econometric contribution. Through this, the sample selection bias due to the non-randomness nature of the decisions that plagues studies on tenancy choice very often can be avoided.

The recent theoretical literature on contract farming proposes several factors that explain the choice of a specific contract (studied by Allen and Lueck, 2003; and Fukunaga and Huffman, 2009). Among these factors this chapter analyses

the problems of risk sharing and moral hazard. Given a risk-averse tenant and the costly monitoring of effort, sharecropping might dominate fixed-rent contracts because of the risk-pooling advantage (as argued by Stiglitz, 1974; and Matsen and Saussier, 2002). As theory suggests, although it is overlooked by empirical studies, this research focuses on testing the risk sharing and moral hazard problems in choosing tenancy contracts separately for both groups: the tenants and the landlords.

The aim of this study is to analyse the land rental markets in rural Bangladesh by examining the factors that influence the participation decision in the tenancy market together with testing the risk-sharing and moral hazard problems in choosing a specific contract between sharecropping and fixed rent. This is done first by looking at the opportunity costs of leasing-in and leasing-out land in the presence of imperfect/missing markets. Second, using several measures of a household's risk-sharing abilities and the monitoring abilities of the landlord and the tenant, the research assesses the extent to which risk averseness among the participating farmers affects the contract choice among participating households using a Heckman selection model (Heckman, 1978). For the risk-sharing problem, the focus is on evaluating the importance of possession of land assets, working capital, credit and social connections in a locality in determining the choice of contract. For the moral hazard problem, the focus is on the landlord's and the tenant household's monitoring abilities.

Although the Heckman selection model is widely used in labour economics to determine the optimal wage, it also offers interesting insight into the underlying mechanism of the agricultural lease market. For example, the modified Heckman model used in this study is helpful to compare the heterogeneity between the tenants and the landlords in rural Bangladesh. This paper can be viewed as bridging the gap between two strands of literature to get the full

picture. Moreover, although tenancy cultivation is a very common feature of the Bangladeshi agricultural sector, there has been only a limited amount of empirical work which has focused on contract choices in rural Bangladesh, and this kind of empirical analysis is important in providing evidence to inform any policy formulation.

The main findings suggest that in rural Bangladesh, the extent of availability of family labour and possession of land assets largely affects the tenant farmer's decision to enter into the agricultural tenancy market. A tenant's risk averseness in relation to contract choice is reflected only through his own economic evaluation (poor, middle income or rich) rather than his possession of other types of land asset and available working capital or credit facilities (i.e. actual wealth). Similarly, the landlords increase the amount of land to lease-out if they have abundant land and scarcity of available family labour. These results draw attention to two issues: first, they support the labour-intensive nature of the agricultural system in rural Bangladesh like many other developing countries; and second, they point towards a missing market for waged agricultural labour. On the choice of contract, a landlord's proxies for risk averseness are insignificant suggesting that they are more or less risk neutral.

The landlords and the tenants in this analysis face significant monitoring problems. The variables used to measure the monitoring problems are the gender of the head of the household, the number of male agricultural labourers and the number of healthy people in the household. Results show that if the household has fewer male labourers or is headed by a female, then the probability of offering a fixed-rent contract increases. By contrast, the analysis finds that tenant households headed by a female and the households with fewer healthy people prefer share tenancy rather than fixed-rent tenancy.

Finally, empirical analyses also report the estimated correlation coefficient

(Rho). The value of rho provides evidence on the correlation between the unobserved explanatory variables of both participation and contract choice equations. If $rho = 0$ then participation in the tenancy market equation is exogenous for the contract choice equation. The estimates of rho for both the tenants' and the landlords' sub-sample are greater than 0. These findings do not contradict the idea that the decision to participate in tenancy market and the choice of a particular contract between sharecropping contract and fixed-rent contract are correlated in the underlying model and thus have to estimate simultaneously.

The remainder of the paper is organized as follows: the next section outlines a simple principal-agent model of contract choice. Section 5.2 outlines the theoretical basis for the estimation. Section 5.3 deals with the key concepts of the model and section 5.4 deals with the econometric methodology together with identification strategy. Section 5.5 presents results of the empirical analysis along with description of the data and preliminary evidence from the data. Section 5.6 present discussions on extension of econometric model and section 5.7 concludes.

5.2 Conceptual Framework

5.2.1 Model

Hallagan (1978) uses a self-selection model where in the presence of asymmetric information, the tenant chooses among the contract alternatives to maximize output. According to his model, if the tenant has high entrepreneurial ability and ability to pay the rent up-front, he would prefer a fixed-rent contract as it yields a higher income than the crop-share tenancy or wage labour. However, if his entrepreneurial ability lies in a certain range his output will be maximized if he chooses the share contract, while if it falls below that range the tenant would be better off to leave tenancy and take up waged employment.

Hallagen's model has been explained in detail in Chapter 4. This tenant self-selection model does not explain sharecropping under certainty since it should never be offered by the landlord. Moreover, in an economy, it might be the landlord who ultimately decides on the choice of contract, and the tenant's risk-sharing attitudes would not show any significant role in his choice of contract. After Hallagen, Allen (1985) developed a model where he incorporated the landlord's optimization behaviours. In his model, workers' self-selection among contractual options is used by the landlord as a device to offer a particular contract. However, Allen's model failed to give a reason for the existence of share tenancy.

Another line of approach to find a rationale for the existence of share tenancy is to consider the optimizing behaviours of both the tenants and the landlords. This section summarizes a simple principal-agent model based on the models of Cheung (1969) and Janvry (2004) where the landlord is the principal and the tenant is the agent and both parties are assumed to be risk averse.

Assume that the production function of a cultivable plot is

$$q = \theta q(L, \overline{A}) \;\; ; \; q_L^{'} > 0, q_L^{''} < 0, q(0) = 0 \tag{36}$$

where L = tenant's effort, $\overline{A}$ = fixed land area, θ is the random term $\tilde{}(1, \sigma^2)$, ex-post relative to decision on L (price and output risk)

Landlord's income (Y) is defined as in (37):

$$Y = rq(L)\theta + R \tag{37}$$

Tenant's income (y) is defined as in (38)

$$y = (1 - r)q(L)\theta - R \tag{38}$$

where r= landlord's output share, $(1-r)$= tenant's output share, R= fixed-rent, hence the contract specialized to share if $1 > r > 0$ and $R = 0$; fixed-rent if $r = 0$ and $R > 0$ and a wage contract if $r = 1$ and $R < 0$ Two decisions come from this system — effort L decided by the tenant; and contract term (r, R) decided by the landlord.

If the landlord and the tenant are both assumed to be risk averse and concerned about the moral hazard problem,[10] then the tenant's problem becomes:

$$\max_{L} U_T = EU(y, L) = EU[(1-r)\theta q - R, L] \tag{39}$$

and the landlord's problem becomes

$$\max U_F = EV[rq(L)\theta + R] \tag{40}$$

$s.t. \max U_T = EU[(1-r)\theta q - R, L]$ and $U_T \geqslant \overline{U_T}$ where $\overline{U_T}$ is tenant's reservation utility

Solving the tenant's problem gives:

$$q_L^{'} = -\frac{EU_L^{'}}{(1-r)EU_y^{'}\theta} \tag{41}$$

if $EU_L^{'} = U_L^{'}$ = marginal utility of leisure which is not stochastic and with no risk $EU_y^{'} = U_y^{'}$ = marginal utility of income.

To analyse the role of risk on L, one can compare $U_y^{'}$ and $EU_y^{'}\theta$. We know that, $cov(x, y) = E(x - \overline{x})(y - \overline{y}) = Exy - \overline{xy}$. Hence, $cov(U_y^{'}, \theta) = EU_y^{'}\theta - EU_y^{'}E\theta$, hence with no risk $EU_y^{'}\theta < EU_y^{'} = U_y^{'}$

[10] For the landlord the moral hazard problem arises in the tenant's behaviour and for the tenant household the moral hazard problem arises on level of trust among the family labourers.

Solving the landlord's problem gives:

$$r = -q\frac{1 - \frac{EU_y^{'}\theta}{EU_y^{'}} / \frac{EV^{'}\theta}{EV^{'}}}{q_L^{'}\frac{dL}{dR}} \tag{42}$$

In order to approximate $V^{'}, V^{'}\theta, U_y^{'}\theta, U_y^{'}$ (that is the tenant's and the landlord's choice of contract under uncertainty) as a function of r, σ^2 the level of risk aversion and moral hazard problem of the tenants and the landlords need to be considered. Hence the landlord's share depends on his own risk aversion and his disincentive due to the moral hazard problem as well as the tenant's risk aversion. For the risk neutral tenant and landlord, $r = 0$ and $R > 0$, thus both the parties would choose a fixed-rent contract. The value of r increases with the level of risk aversion of the tenant and the landlord. If the contract terms are always chosen by the landlord, depending on his level of risk aversion and moral hazard of unobserved effort, a mixed contract with both the share- and fixed-rent component is possible. However, it is clear from equation (41) that the tenant also maximizes his returns from the choice of contract depending on his own level of risk aversion, $EU_y^{'}$ and his output share $(1 - r)$. The tenant's output share again depends on the landlord's problem which is solved in equation (42). Therefore, the tenant can also self-select in the tenancy market because the outcomes of the two tenancy contracts are different.

Comparing the basic principal-agent model and the model with self-selection in order to be acquainted with the actual mechanism of the tenancy market and the choice of contracts, one needs to analyse the model with both parties' perspective included. The empirical analysis in this study investigates the significance of unobserved risk and effort on the choice of contracts using two sub-samples:- one for the tenant household and another for the landlord household. The puzzle with these kinds of standard principal-agent models is

that key parameters for risk aversion are not directly observable such as levels of wealth and working capital, experience, credit access, etc. The empirical literature uses proxy variables for various parameters of these equations.

The next section summarizes three key concepts that will be tested through empirical models: opportunity costs to participate (reflected through the reservation utility), moral hazard and risk averseness.

5.3 Key Concepts from the Model:

5.3.1 Participation: Opportunity Costs and Market Imperfections

In well-functioning land markets farmers with higher agricultural ability who do not join the off-farm labour force should gain access to additional land, to use their factors of production, to increase their operational farm size and thus to increase their income. Participation in informal land rental markets in many countries clearly indicates that the amount of land they wish to cultivate is not equal to the amount of land they own (or not own). Many authors, (e.g. Bliss and Stern, 1982; Binswagner and Rosenweig, 1984; Deininger and Jin, 2009) have shown that with perfect markets 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 and few off-farm employment opportunities, 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. Participation in the land lease market becomes more difficult when the farmers who participate are mostly poor as seen in rural Bangladesh. These farmers have to balance their reservation income (U_T in the model) from the off-farm activities and their income (U_F and U_T in the model) from participating in the land tenancy market either as a landlord or as a tenant.

5.3.2 Risk Aversion and Moral Hazard

Existing literature on tenancy contracts armed with the theory of contracts usually addresses two aspects: risk averseness and moral hazard. 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 the reputation of the farmer as a tenant. These are characterized by his possession of sources of wealth, working capital and other characteristics 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 more risk-averse tenants thus prefer an output-share contract to a fixed-rent contract. With a sharecropping contract the tenant can share the production risk with the landlord.[11]

Similarly, a landlord can suffer from moral hazard problem in which they cannot monitor or verify the farmers' actions. From the landlord's side as the theory shows, it is always preferable to offer a fixed-rent contract rather than a sharecropping contract. This is because output sharing (share-tenancy) causes the land market not to clear. The share paid by the landlord to the tenant does not always work in 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, drought, pest infestation etc. Therefore, when the plot is under the sharecropping system, the low output may be from unobservable effects of nature or from low effort of the tenant farmers. However, for the landlord it is not always possible to offer a fixed-rent contract to all of the tenants, especially in an economy where most of the tenant farmers are poor and unable to pay up-front fixed rent.

[11] Theoretically, the landlord can mix these methods by offering a share tenancy with some fixed rent component, but in rural Bangladesh we do not see many mixed contracts (Rahman and Rahman, 2009).

This implies that decisions taken by the landlord and the tenant may be different. Moreover, given participation as a tenant or as a landlord, it is still possible that there may be considerable variations in the factors between these two groups in choosing either a sharecropping contract or fixed-rent contract. The theoretical approach of risk-sharing and testing the presence of moral hazard proposes a couple of predictions that are subject to empirical testing. Firstly, because share tenancy cannot 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 and lower moral hazard problem. Theoretically income, assets and tolerance to risk affect the tenant's risk aversion. Practically, the tenants are thought to be more risk averse if they have lower wealth.[12] In this sense, having more opportunities of stable employment strengthens the tenant's tolerance to risk and choosing a fixed-rent contract. Secondly, the landlord will consider his capacity to monitor the tenant when he chooses to offer a particular contract. This study thus empirically examines the following hypotheses using data from rural Bangladesh:

(i) opportunity cost and factor market imperfection: the higher the opportunity cost (represented by the reservation income) of participating in the 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. By contrast, the more risk averse a landlord is, the lower the likelihood that a crop-share contract will be chosen.

(iii) moral hazard: the higher the marginal cost of evaluating the effort devoted by the tenant to production by a landlord, the larger the probability that fixed-rent contracts are offered since they offer more incentive from the landlord's point of view. It should have the opposite effect for the tenant farmers

[12] See Binswanger, (1981); Rosenweig and Binswanger, (1993).

who largely rely on the available family labour for the cultivation process.

5.4 Empirical Methodology

The research focuses on the determinants of the decision to enter into the tenancy market and of the choice between fixed-rent and sharecropping contracts. In rural Bangladesh (as elsewhere) social concerns and influences shape economic decisions including participation in the informal land tenancy market. Due to this social and economic complexity, it would be very difficult to estimate a truly structural model of contract choice determination. In order to test the three competing hypotheses for participation and contract choice, this research relies on a reduced form approach involving estimation of the modified Heckman selection model.[13] The decision to lease-in to lease-out land is represented by the amount of land that is leased. Conditional on these decisions relating to the types of rental contracts chosen are defined as dichotomous latent variables. From equation (6) and (7) both groups want to maximize their utility from participating in the lease market. An important assumption here is that these two groups of farmers are distinctly different with respect to their socio-economic circumstances.[14] The following sub-sections discuss the details of the econometric model and the identification strategy.

5.4.1 Econometric Models

Rationale for Simultaneous Choice to Participate and to Choose a Contract

A typical approach to analysing data on social position (e.g. owner, tenant

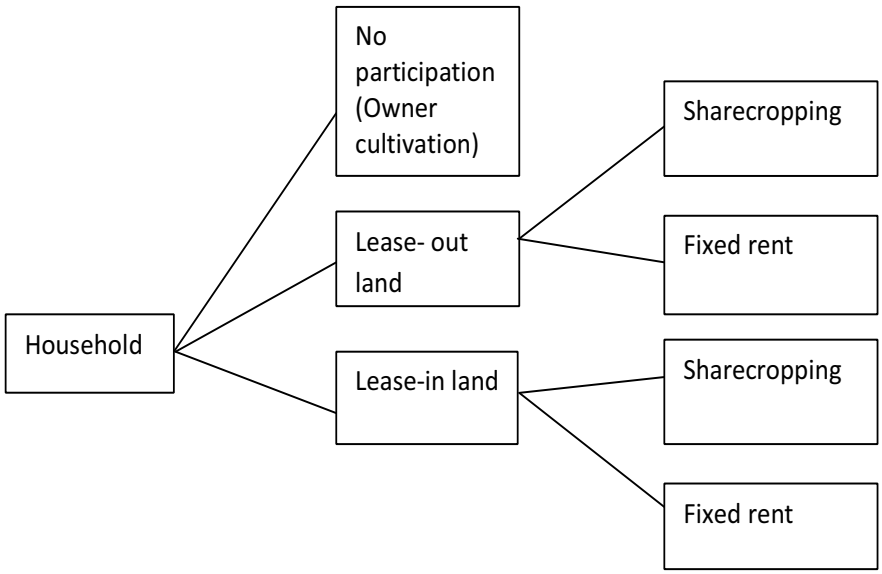
[13]The modified Heckman model was first used by Plumper et al. (2005) followed by Clatworth et al. (2009) and Tauchman (2010).

[14]Most of the literature examining the determinants of land market transactions (e.g. Deininger et al., 2003; Teklu and Lemi, 2004;Tikabo et al., 2004 and Masterson, 2007) also implicitly assumed that the decision to lease-in and lease-out land are independent of each other.

or landlord) and determinants of contract choices is covariance analysis. This approach, based on the theoretical model explained in section 5.2, assumes that, once other measured variables that affect the contract choice dummy are taken into account, the process by which individuals are sorted into positions is independent of the factors influencing the outcome itself. Such strong assumptions are often untenable, however there is no reason to assume that the decisions to enter into the land tenancy market and then to choose a certain contract are independent especially in the tenancy market (like many other markets) with asymmetrical information where individuals choose their position based on the expected outcome from the choice of contracts. Thus the two decisions are simultaneously related.

While theoretically it is difficult to design, empirically it is possible to account for this simultaneity. This analysis therefore uses a two-stage model based on a tree structure of choice of tenancy contract path, as shown in Figure 5.1. Farmers at the beginning of the cropping season are assumed to follow two sequential decisions. The first decision is whether he chooses to enter into the lease market or not. If he chooses to participate in the lease market a household then can either lease-in land (termed as a tenant) or lease-out land (termed as a landlord) land. The second decision, depending on the outcome of the first stage relates to what type of contract a farmer would choose, i.e. if a farmer wants to lease-in some land, then he has to choose between a sharecropping contract and fixed-rent contract. Similarly, if the farmer decides to lease-out some land, then he has to choose a contract between sharecropping and fixed-rent. There may be also some farmers who both lease-in and lease-out land in the same cropping season. However, in the data set and also in rural Bangladesh, this phenomenon is not commonly observed.

Figure. 5.1 Tree for two stages model



There are some decision variables which are specific to each stage and some variables are likely to affect both stages. Moreover, some unobservable variables may affect both decisions. Farmers may also choose not to participate when their reservation income/utility is greater than the expected share/expected outcome. A solution of this problem can be identified if there are one or more variables that strongly affect the chances for participation (e.g. reservation income) but not the outcome under study (contract chosen). In these circumstances, the bivariate probit with selection model provides consistent, asymptotically efficient estimates for all the parameters in such a model.[15] The first stage regresses the choice between leasing-out (or leasing-in) versus not participating, which allows us to study the determinants of the landowner's decision to lease-out (or lease-in) land. The second stage regresses the choice between a sharecropping and a fixed-rent contract conditional upon having decided to participate and allows studying the determinants of the farmers' contract choice.

[15] Andrews (1989)

Finally, to provide additional insight into the nature of the joint choices made by individuals,we estimate the marginal effects of covariates on the probabilities of each combination of alternatives. The marginal effects allows us to understand changes in socio-economic characteristics which may affect the final four choices.

5.4.2 Identification Strategy

From the data one can observe more than in the partial observability model but less than in the full model. In the case of the effects of risk averseness and moral hazard problems on tenancy, contract choice, we assume that there is an underlying regression relationship, so that:

$$contract_j = \beta \mathbf{x}_j \ + \ \mu_{1j} \qquad\qquad outcome\ equation \qquad (43)$$

where $contract_j$ is a dichotomous variable and is equal to one if the share contract is chosen and zero if the fixed-rent contract is chosen; $\mathbf{x}_j$ denotes the observable proxies for risk attitudes of the person who decides the contract as well as of the other party and moral hazard of the contractor. This dependent variable, however, is not always observed. Rather, the dependent variable for observation j is observed if the farmer chooses to participate in the land market. Hence j is observed if

$$participation_j = \gamma \mathbf{z}_j \ + \ \mu_{2j} \qquad\qquad selection\ equation \qquad (44)$$

The participation variable is the amount of land a participant leases in the tenancy market (hence a tenant or a landlord depending upon the decision to lease-in or lease-out, respectively) and zero if he is an owner cultivator.

Where

$$\mu_1 \backsim N(0, \sigma)$$
$$\mu_2 \backsim N(0, 1)$$
$$corr(\mu_1, \mu_2) = \rho \tag{45}$$

Therefore, $participation_j$ variable is measured by a truncated Tobit equation where the latent variable cannot always be observed while the independent variables are observable.

Note that a selection problem does not exist in two types of situations (Achen, 1986, 1978-1979). First, it might be the case that the unmeasured factors influencing the selection equation are uncorrelated with the unmeasured factors influencing the outcome equation. Second, there is no selection problem if every variable influencing selection is controlled in the outcome equation. The problem is that most selection processes are complex and the complete list of variables influencing selection are often not measured, cannot be measured, or are unknown. If these two types of situation do not occur, then we have a selection bias problem.

Thus, when $\rho \neq 0$, standard regression techniques to the first equation may yield biased results. There are three types of observations in a sample with the following probability:

$$\begin{aligned} \Pr(participation &= 0) \\ \Pr(participation &> 0, contract_j = 0) \\ \Pr(participation &> 0, contract_j = 1) \end{aligned} \tag{46}$$

This is equivalent to Heckman's selection model except that the problem has

a discrete choice variable (choice of tenancy contract) in the outcome equation and a discrete variable (amount of land leased-in or leased-out) in the selection equation. The modified Heckman selection model[16] provides consistent, asymptotically efficient estimates for all the parameters. This model would be identified by the exclusion of one or more instrumental variable in the outcome equation which is assumed to have a direct effect on the selection equation. The following section has detailed discussions on this and other variables of interest.

5.4.3 Testable Implications: Variables of Interest

This section focuses on developing a set of intuitions about the coefficients of explanatory variables in both stages. It emphasizes both opportunity costs and risk-sharing incentives.

Selection Equation

In the first stage the study assumes that land tenancy market participation is driven by access to opportunities outside the farm sector and by ability.[17] In order to participate in the land tenancy market the landlord has to offer at least as much as the tenant's reservation utility. Hence, farmers may choose not to participate when their reservation income/utility is greater than the expected share/expected outcome.

(1) Reservation income/utility of the farmers: proxied by income from trade and income from service, i.e. non-agricultural incomes, credit from the formal sources such as banks, Grameen Bank and cooperatives, and credit from informal sources such as loans from money lenders, traders, friends and relatives. The framework assumes that the tenant farmers possessing higher reservation income would have a lower likelihood of participating in the land market because of high opportunity costs in the tenancy contract. For landlords, as their

[16] Clatworth et al. (2009); Tauchmann (2010)
[17] Deininger and Jin (2005)

utility maximization problem includes the net benefit from renting out the land together with the contract shape, the higher the non-agricultural income may facilitate their shifting from the agricultural sector to the non-agricultural sector, thus decreasing the probability of participating in the land tenancy market.

(2) Factor market imperfections: household characteristics such as the dependency ratio(i.e. the number of dependents in the household relative to the other members of the household), male and female agricultural labour and bullock power are used to test for the presence of imperfections in the factor markets. Intuition here is that if the household has more competent agricultural labour and bullock power the likelihood of participating in the land market will increase for tenant farmers and decrease for landlord farmers. On the other hand, a higher ratio of female labourers and a high dependency ratio should have the opposite effect. This is because these characteristics may increase the managerial cost of participation due to the moral hazard problem.

(3) Identification: the selection equation in this study is identified by the inclusion of an electricity dummy variable for the access to electricity by a farming household during 2000-04. Availability of electricity identifies the economic status of a rural household. It is rational to assume for rural Bangladesh that access to electricity affects the participation in the land lease market but not the contract choice decision. This variable is assumed to have a negative significant effect on the selection equation for both the tenant and the landlord but for different reasons. The tenant farmer adheres to the belief that poor tenants (thus with no electricity access) will lease-in more land and landlords and rich farmers (with access to electricity) will shift from agriculture and decrease the scale of participation in the land-lease market.

Outcome Equation

The outcome or contract choice equation includes only those farmers who

enter into the land tenancy market. Here the analysis aims to prove the risk-sharing and moral hazard hypotheses. The estimated model examines how differing risk perceptions by both the landlord and the tenant affect contract type selection.

(1) Risk averseness of the tenant and the landlord have been tested through two models in this study: In model 1 risk averseness is proxied by wealth (amount of land assets owned), working capital (income from trees, goat and poultry rearing, etc.), non-agricultural income, self economic assessment and social connection (NGO membership). Here following Deininger (2008) non-agricultural income is assumed to be exogenous. This is a sensible assumption for many agricultural developing countries where the scope of off-farm employment opportunity is very small.

Intuition: This approach says that for the tenant the probability of choosing a crop-share contract increases with the tenant's own financial weakness and the landlord's financial strength. For the landlord farmer the intuition would be the opposite.

The more non-agricultural income a tenant has the less risk averse he is which would increase the likelihood of choosing a sharecropping contract.

In order to test the risk-sharing hypothesis, model 2 uses three new proxies which are all weighted values of farmers' wealth, working capital and income. These variables are: farmers' debt to capital ratio, debt to income ratio, and assets per capita (assets are defined as the amount of all types of land assets a farming household has). The intuition here is that for the tenant farmers, the probability of choosing a crop-share contract should increase with the tenant's own debt burden and the landlord's financial strength. However, more assets per capita should have the opposite effect.

(2) Presence of moral hazard: An alternative model emphasizing the agency

theory or moral hazard problem is estimated. With this approach, each contract may have unique opportunities for morally hazardous behaviour, i.e. the tenant farmers may take advantage of the landlord without detection. Variables describing the experience and managerial abilities are utilized to test the agency problem hypothesis. Among households the following variables are used as proxy variables to test for moral hazard hypothesis: dependency ratio, number of healthy people, experience and female headed households. Intuition behind using such proxies are: for a landlord, the more dependent members there are in a household or if the household head is female, that landlord would prefer a fixed-rent contract because of higher monitoring costs. The opposite intuition applies for a tenant farmer because a higher dependency ratio would make the tenant farmer more risk averse. By contrast, as the number of adult members increases in a household, that would decrease the magnitude of the moral hazard problem. This should then lead to the landlord offering a crop-share contract and to the tenant choosing a fixed-rent contract. The tenants with better production backgrounds (proxied by age) are thought to be better managers and to be more able to negotiate better contract terms. Therefore, this will decrease the likelihood of taking a crop-share contract. By contrast, the landlord with more production expertise is more likely to prefer more involvement in the production process which will increase the probability of him choosing a crop-share contract The higher the social connection a farmer has within his locality increases the monitoring ability and decreases the moral hazard problem. This would again increase the likelihood of offering a share-cropping contract by the landlords and the preference for fixed-rent contract by the tenant farmers.

In both stages dummies for different geographical ecosystems such as flood prone, drought prone, favourable environment, irrigated and submergence area,

soil types, time dummies, and average rainfall variations among the districts and between years are used as control variables.

5.5 Empirical Findings

5.5.1 Data and Descriptive Statistics

The data for the analysis are drawn from a repeat survey of a nationally representative sample of households of rural Bangladesh collected by IRRI. The benchmark survey was implemented in 2000-01 for a study of the impact of rice research on poverty reduction in rural Bangladesh sponsored by the International Food Policy Research Institute. A multi-stage random sampling method was followed for sample selection from 62 unions[18] in 57 districts (out of 64 districts, omitting urban districts). Then one village was selected 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 sample of 30 to 31 households from each of the 62 villages (1880 households) was drawn using the stratified random sampling method. At this stage two villages were dropped because of the logistical problems of implementing the survey. The 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 the wealth ranking technique of the participatory rural appraisal (PRA) method.

The second wave was conducted by IRRI in 2003-04 following the households included in the first wave and their descendents. The sample size of households rose to 1,927 in the last wave. For each selected household, plot-, household-

[18] A union usually consists of 15-20 villages.

and contract-level data were collected. Definitions of important variables taken from the survey data and are used in the estimation and are reported in Table 5.1. Summary statistics of the variables are given in Table 5.2. The sample unit used in the analysis is individual farmer level data. Therefore, the unbalanced panel data of 2000 and 2004 consists of multiple observations for the same households.

Table 5.1 Variable definitions

Variable	Description
	Selection model dependent variables
d_leasein	Amount of land (ha) lease-in by a HH
d_leaseout	Amount of land (ha) lease-out by a HH
	Full model dependent variables
contract_leasein	= 1 if HH sharecropping in the plot; = 0 if HH fixed rent in the plot
contract_leaseout	= 1 if HH sharecropping out the plot; = 0 if HH fixed rent out the plot
	Independent variables
	HH characteristics variables
selfeco	Compare to the others households 1 =rich; 2= high middle; 3= lower middle; 4=
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)
	Socio- economic variables
edu_head	Education of HH head ; =1 if completed primary education; =0 otherwise
healthyp	No. of healthy people in a HH
femaleh	Sex of HH; = 1 if HH head is female; =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
	Proxies for risk sharing
credit_formal	Amount of credit from formal institutions (tk.)
credit_informal	Amount of credit from informal institutions (tk.)
asset/ wealth	Amount of own cultivable land + homestead and other types of land (ha)
working capital	Income from trees + fruits + fisheries
non-agri_ income	Income from trade and service (tk.)
debt_income	liquidity constraint/ per capita income
debt_capital	liquidity constraint/ working capital
asset_per_capita	Amount of all land/ no. of adult members in a HH

Table 5.2 Means and standard deviation

Variable	Mean	Standard deviation	Min.	Max.
hhsize	5.53	2.22	2	26
active_labour	3.19	1.51	0	14
healthy population	5.14	2.14	0	24
total_agri_male	1.12	0.81	0	6
total_agri_female	0.017	0.13	0	1
cow_no.	1.84	1.91	0	14
own cultivable land	0.35	0.78	0	15.43
rent in	0.34	0.42	0.012	4.37
rent out	0.05	0.64	0	14.82
asset(land)_per capita	0.18	0.32	0	3.17
working capital	52,485.65	10,6088.7	0	1,6,01500
per_capita income	11,806.99	13,800.09	933.19	21,0252.4

Figure 5.2 distribution of land ownership group (data from 2000)

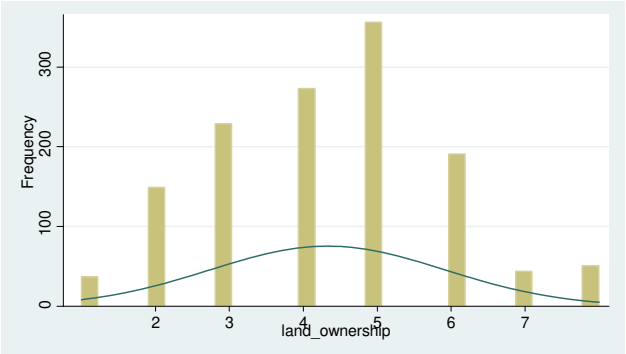
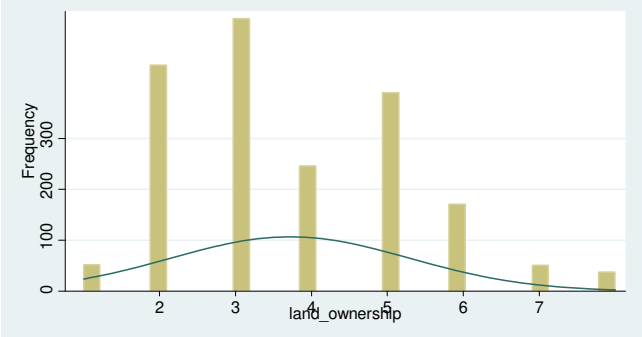


Figure 5.3 distribution of land ownership group (data from 2004)



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)

Figures 5.2 and 5.3 illustrate the distribution of land among the households

for the survey data in 2000 and 2004, respectively. Figures indicate that the amount of land owned by the households shrank between 2000 and 2004. This may be due the splitting of assets motivated by the Inheritance Law.

5.5.2 Preliminary Evidence from Data

Table 5.3 presents an initial comparative study of the three groups of farmers: non-participating owner farmers, the landlords and the tenants. From the table, 39.5 percent of the households lease-in land and 14.7 percent of the household lease-out land. Nearly 55 percent of the households take part in some kind of land transaction through land rental markets. Therefore approximately 46 percent of the households are not participating in the land rental market. One of the explanations for 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 the benefits of tenancy as a landlord and as a tenant. Non-participation of 46 percent 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 households have a perfect combination of land and non-land factors for crop cultivation.

Table 5.3 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	5.53	2.21	5.51	2.69	5.3	2.42
Healthy population in a HH(no.)	5.13	2.14	4.97	2.67	4.9	2.34
Age of head (year)	45.61	12.36	49.63	14.39	45.62	13.06
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.)	1.21	0.81	0.77	0.88	1.3	0.87
Total female agri .worker in HH (no.)	0.02	0.12	0.03	0.19	0.03	0.17
Cow (no.)	1.84	1.90	1.45	2.54	1.26	1.81
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)	0.34	0.78	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	18040.4	1848.45	3551.37
Loan amount from formal lending institutions (tk.)	3,183.37	8,433.59	3,520.4	12009.5	2,807.7	14,095.3
Loan amount from informal landing source (tk.)	1,188.94	9,062.04	1997.7	12560.7	1665	14,128.72
Per capita income (tk.)	1,1806.9	13,800.1	15978.5	20821.7	11911.5	10,952.7
Annual agri. income (tk.)	3,4231.2	40664.2	36300.6	52891.7	24182.7	29,268.9
Annual agri. wage income (tk.)	3,939.2	7,848.7	1,388.3	5,330.8	3,740.8	10,034.7

The summary statistics from the data presented in Table 5.3 somewhat confirms the accumulated evidence of the prevalence of imperfections in markets for labour and non-labour endowments. In rural Bangladesh, the market for hired labour for the agricultural activities is largely missing which is evident from the very low mean of the agricultural wage income variable. This may be due to the extreme seasonality of demand for agricultural labour. Among the three groups per capita income is lowest among the tenant farmers. The farmers relying on hired labour may not have a guaranteed supply of sufficient

Figure 5.4 Correlations between household income and tenancy status

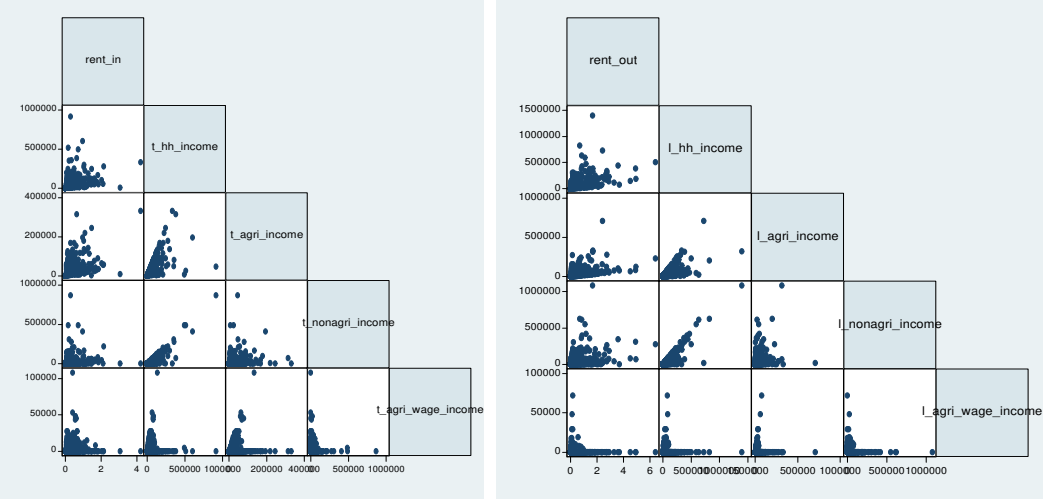
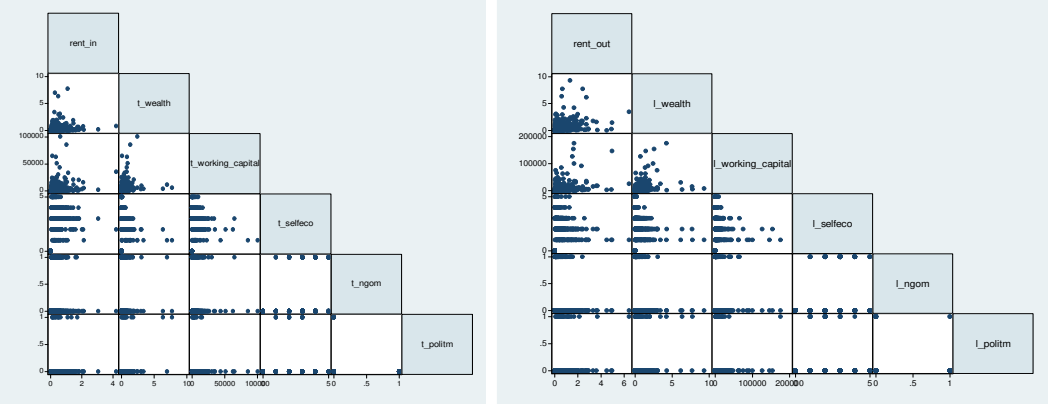


Figure 5.5 Correlations between household wealth, working capital and social connections and tenancy status



labour during peak season in the absence of sufficient off-farm labour opportunities. The same explanation is also applicable for non-labour inputs especially, bullock power. Thus, for rural Bangladesh, two inputs other than land that are essential for cultivation are family labour and draft power. Summary of data also shows that marginal/small landowners rent-in land from large landowners. This contradicts the findings of Fujita (2010) who studied land mortgages in the Tangail district in Bangladesh and found that marginal/small landowners rent land to medium landowners.

Figures 5.4 and 5.5 present the distribution of different households' wealth and off-farm incomes among the tenants and the landlords and their correlations. Correlations clearly show that tenant's income increases with renting land. For both the tenant and the landlord household, the agricultural wage income has a positive relationship with household income. However, there are no significant correlations between wealth and social connection (t_ngom, t_politm, l_ngom, l_politm) variables and participation in the tenancy market by the tenant or the landlord. It is thus interesting to find whether this association holds through the econometric models.

Before setting off to estimate the modified Heckman selection model it is worth looking at the distribution of two types of contracts (sharecropping and fixed-rent) in rural Bangladesh, represented by the survey data used here. These distributions are shown in Figure 5.6.

Figure 5.6 Distribution of different contract choice between tenants and landlords

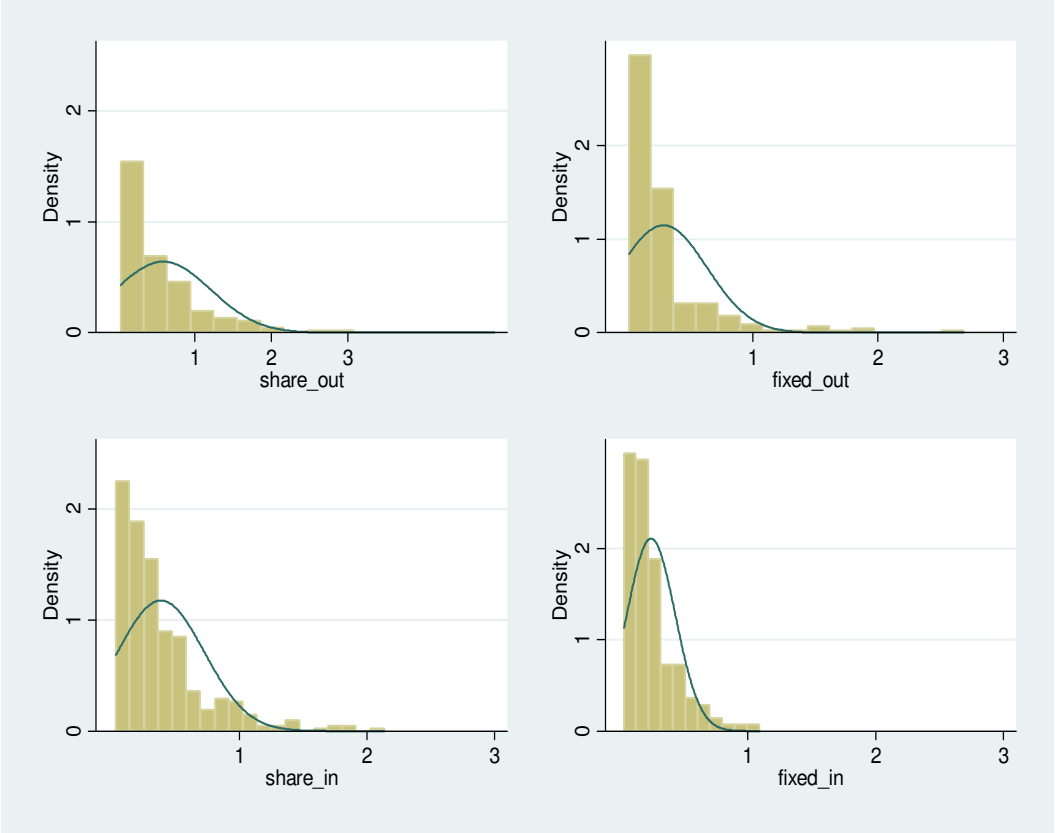


Figure 5.6 reveals that, like most of developing countries, land transactions through the tenancy market in rural Bangladesh are very much skewed. Small pieces of land are cultivated through the tenancy mechanism. The landlords are offered almost the same size of land for both contracts, while for the tenant farmers the average size of land chosen for the fixed-rent contract is smaller than that for the sharecropping contract. Moreover, the average amount of land that a landlord rented out under a sharecropping or fixed-rent contract is higher than the average amount of land that a tenant rents under either arrangement. The implication is that the land rental markets do not serve well as a mechanism to allocate factors at the farmlevel to maximize welfare (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 and

the landlord may choose more than one tenant farmer to cultivate his land.

5.6 Results

5.6.1 Risk-Sharing Model

This section presents the estimated results using the household-level unbalanced panel data for 2000 and 2004. To investigate the risk-sharing hypothesis, two models have been used. Model 1 includes all direct measures of the tenants' and the landlords' credit, wealth and working capital measures. Model 2 focuses more on indirect calculated measures of credit, wealth and working capital of the two groups.

Tenant's Sub-Sample

Tables 5.4 and 5.5 report the results of the modified Heckman model which deals with the tenant household's decision to participate and choose a specific contract, respectively.

The estimated results of the first stage (Table 5.4) reveal that the farmers' likelihood of participating in the land tenancy market decreases with the amount of any kind of land asset they own. This supports the fact that in rural Bangladesh like elsewhere for farmers with no access to land, the motivation to participate is simply to acquire land for cultivation in the absence of a functional land sales market. None of the proxies for reservation income has any significant impact on the participation decision. This might be an indication of the presence of insufficient sources of wage labour and non-agricultural employment opportunities for the large farming population in rural Bangladesh.

The other three variables that have a significant impact on the amount of land a tenant farmer leases-in are household size, number of male agricultural workers in the family, and access to electricity. Among these three variables, the first two have a positive impact and the last one has a negative impact

as expected. Therefore, a tenant household with more members and more male agricultural workers will lease-in more land than the household that has fewer members or male workers, denoting the labour-intensive nature of the agricultural sector in Bangladesh. As the level of social welfare increases, which is characterized by access to electricity, the tenant significantly reduces his rate of participation in the land-lease market.

Table 5.4: Stage 1: Estimated risk sharing model: Selection equation (tenant sub-sample)

variables	*HH decision of leasing in land*	
	Model 1	Model 2
credit_formal	0.00002	
	(0.00001)	
credit_informal	-2.09e-06	
	(9.92e-06)	
assest	-22.414*	
	(1.689)	
working capital	3.46e-06	0.00001**
	(5.41e-06)	(8.21e-06)
non-agri_income	-1.47e-06	
	(2.06e-06)	
debt_capital		2.33e-06
		(0.00001)
asset_percapita		-38.283*
		(5.489)
hhsize	0.189*	0.098
	(0.075)	(0.102)
selfeco	-0.141	-0.213
	(0.135)	(0.214)
depen_ratio	-0.902	-1.611
	(0.591)	(1.169)
agri_labour_male	0.498*	1.116*
	(0.141)	(0.247)
agri_labour_female	-1.545*	-5.135
	(0.696)	(21.830)
bullock	0.00004	-1.35e-06
	(0.00002)	(0.00003)
electricity	-0.469*	-0.686*
	(0.214)	(0.278)

* : significance in 95% confidence interval ; ** significance in 90% confidence interval
The regression also include average rainfall in different year and different districts and dummies for different ecosystem (flood prone, draught prone, irrigated, favourable)and soil type (loamy and clay) as control variables; S.E. are in parenthesis

Table 5.5 deals only with the tenant farmers who choose to participate in the land-lease market and choose between crop-share contracts versus fixed-rent contracts. Similar to the selection equation, for the estimation of the contract choice or outcome equation this study presents two models to observe

the effects of proxies of risk averseness on contract choice. As equation (6) illustrated, the tenant's optimization problem involves the marginal utility of income from contract farming which depends not only on his own financial strength but also the landlord's financial strength where there is a issue of cost share and cropshare.

The coefficients of the variables representing these two models give some contradictory findings. Model 1 which employs all direct measures of credit, wealth and working capital does not show any significant impact of these proxies for risk aversion on the choice of contract. In model 2 as anticipated, moving from rich to poor ($selfeco$) increases the prevalence of choice towards crop-share contracts. Thus, more risk-averse tenants choose more share tenancy contracts. However, contrary to the hypothesized outcome, strengthening the tenants' position in terms of assets per capita, also makes a crop-share contract more likely. This may be due to the fact that farmers who have some land but still choose to participate in the land-lease market need to employ their available workers to farm their own land. At the same time they choose to exploit other people's land to optimize their operational land size. This may increase their perception of risks involved with contract farming, and so sharecropping cultivation becomes their primary choice of farming. Note that none of the landlord's financial strength variables are significant for any model. It again suggests that when the tenant farmers are deciding over a tenancy contract, risk-sharing between the tenant and the landlord does not play a significant role.

Table 5.5 Stage 2: Estimated risk sharing model: Outcome equation (tenant sub-sample)

variables	*Tenant farming households*	
	Contract choice: 1 if share contract, 0 if fixed rent contract	Contract choice: 1 if share contract, 0 if fixed rent contract
	Model 1	Model 2
t_credit_formal	5.21e-06	
	(5.46e-06)	
t_credit_informal	0.00001	
	(0.00001)	
t_assest	1.607	
	(1.089)	
t_working capital	4.54e-06	
	(2.14e-06)	
t_non-agri_income	-5.21e-07	
	(4.50e-06)	
t_debt_capital		-0.010
		(0.024)
t_debt_income		0.029
		(0.028)
t_asset_percapita		3.084**
		(1.764)
t_hhsize	0.005	0.017
	(0.015)	(0.018)
t_selfeco	0.034	0.072**
	(0.035)	(0.043)
t_depen_ratio	-0.019	0.064
	(0.137)	(0.281)
l_credit_formal	-1.55e-06	
	(7.07e-06)	
l_credit_informal	-7.63e-07	
	(0.00001)	
l_assest	0.346	
	(1.464)	
l_ working capital	-6.25e-06	
	(3.26e-06)	
l_non-agri_income	-9.38e-06	
	(2.42e-06)	
l_debt_capital		-0.059
		(0.123)
l_debt_income		0.075
		(0.076)
l_asset_percapita		-1.390
		(2.074)
Inverse Mills ratio		
rho	-0.095	-0.142
sigma	-0.300	-0.461
Wald chi2	0.319	0.308
No of observations	1557.29 (25)	791.33 (20)

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

The regression also includes male, female agricultural labour force information, bullock power variable, average rainfall in different year and different districts and dummies for different ecosystem (flood prone, draught prone, irrigated, favourable)and soil type (loamy and clay) as control variables; S.E. are in parenthesis

In addition to the two equations, the Heckman model estimates rho (shown in the lower part of Table 5.5). This is the correlations of the residuals and sigma (the log of sigma) and the standard error of the residuals of the outcome equation. The inverse Mills ratio is the $rho * sigma$. For the tenant sub-sample

as it is evident from the Table 5.5 that for both model rho is different from zero indicates the presence of sample selection bias in the data set. Therefore, for the tenant sub-sample the two decisions, to participate in the tenancy market as a tenant farmer and then to choose a contract between the sharecropping contract and the fixed-rent contract are taken simultaneously in the real world.

Landlord's Sub-Sample

Table 5.6 shows results from the first stage of the Heckman two-stage model where the amount of land leased out is a continuous variable. Controlling for other explanatory variables, in model 1, land leased out is positively related to the total land asset owned and the number of female agricultural labourers in a household. By contrast, it is negatively related to the non-agricultural income and their self economic evaluation. This result may suggest that land poor farmers and farmers with the capability of shifting to the non-agricultural sector face high opportunity cost to participate in the tenancy market. Model 2 which includes indirect measures of wealth and working capital shows that, as anticipated, farmers with large households (thus with high opportunity cost in participating) and with more male agricultural workers (thus with low opportunity cost) lease-out a lesser amount of land to others. In model 2 the opportunity cost hypothesis is also supported by the negative significant effect of the landlord's debt to capital ratio on the decision to participate, although the coefficient is very small supporting the fact that most of the landlords in rural Bangladesh may not be very capital rich.

Table 5.6 Stage 1: Estimated risk sharing model: Selection equation (landlord sub-sample)

variables	*HH decision of leasing out land*	
	Model 1	Model 2
credit_formal	-2.93e-06	
	(3.85e-06)	
credit_informal	-1.90e-06	
	(2.83e-06)	
assest	0.145*	
	(0.061)	
working capital	7.93e-06	-1.06e-06
	(5.18e-06)	(9.88e-06)
non-agri_income	-1.13e-06*	
	(5.72e-06)	
debt_capital		-0.00001*
		(3.95e-06)
asset_percapita		-2.184*
		(0.239)
hhsize	-0.013	-0.116*
	(0.022)	(0.035)
selfeco	-0.570*	-0.288*
	(0.043)	(0.069)
depen_ratio	-0.147	0.256
	(0.172)	(0.372)
agri_labour_male	-0.202*	-0.399*
	(0.048)	(0.079)
agri_labour_female	0.498*	-0.046
	(0.166)	(0.263)
bullock	-0.00002*	-0.00001
	(5.29e-06)	(8.74e-06)
electricity	-0.197*	-0.209**
	(0.071)	(0.104)

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

The regression also include average rainfall in different years and different districts and dummies for different ecosystems (flood prone, drought prone, irrigated, favourable) and soil type (loamy and clay) as control variables; S.E. are in parenthesis

Similar to the finding for the tenant farmers, the second stages of models 1 and 2 focusing on the landlord's contract choice problem do not have much support for the risk-sharing hypothesis (Table 5.7). Results suggest that among the farmers who do participate, the probability of choosing a share contract decreases with their own economic evaluation as being poor which should also make them more risk averse. In model 1 the tenant's access to credit from informal sources has a significant positive effect on the likelihood of offering a

fixed-rent contract. The value of the coefficient is very small suggesting that only few tenants have access to a sufficient amount of credit from informal sources that is needed for the cultivation process. Apart from these two variables none of the coefficients of the proxies for risk averseness or risk-sharing variables have any significant effect on the decision to choose a particular contract. Therefore, even for the landlords' in rural Bangladesh, risk-sharing may not be an important issue when at the beginning of the cropping season they offer a particular contract to the tenant farmers.

Table 5.7 Stage 2: Estimated risk sharing model: Outcome equation (landlord sub-sample)

variables	*landlord farming households*	
	Contract choice: 1 if share contract, 0 if fixed rent contract	Contract choice: 1 if share contract, 0 if fixed rent contract
	Model 1	Model 2
l_credit_formal	8.35e-06	
	(2.48e-06)	
l_credit_informal	2.33e-06	
	(1.86e-06)	
l_assest	-0.023	
	(0.039)	
l_working capital	3.79e-06	
	(3.05e-06)	
l_non-agri_income	-3.85e-07	
	(3.49e-06)	
l_debt_capital		0.002
		(0.002)
l_debt_income		0.004
		(0.029)
l_asset_percapita		0.025
		(0.043)
l_hhsize	-0.002	0.011
	(0.010)	(0.014)
l_selfeco	-0.068	-0.071**
	(0.094)	(0.040)
l_depen_ratio	0.041	0.245
	(0.095)	(0.180)
l_agi_male	-0.090*	-0.125*
	(0.040)	(0.042)
t_credit_formal	-1.20e-06	
	(4.58e-06)	
t_credit_informal	-8.86e-07**	
	(5.47e-06)	
t_assest	-0.083	
	(0.075)	
t_ working capital	-3.62e-06	
	(7.28e-06)	
t_non-agri_income	1.85e-06	
	(1.33e-06)	
t_debt_capital		0.079
		(0.128)
t_debt_income		-0.076
		(0.056)
t_asset_percapita		-0.122
		(0.079)
Inverse Mills ratio	-0.044	-0.020
rho	-0.098	-0.046
sigma	0.449	0.436
Wald chi2	274.02 (25)	223.83 (20)
No of observations	526	526

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

The regression also include male, female agricultural labour force information, bullock power variable, average rainfall in different year and different districts and dummies for different ecosystem (flood prone, drought prone, irrigated, favourable) and soil type (loamy and clay) as control variables; S.E. are in parenthesis

The correlation coefficient (rho) for the landlord group is also different from zero and negative suggesting that for the landlord sub-sample the two decisions, to participate in the tenancy market and then to offer a contract between the sharecropping contract and the fixed-rent contract are taken simultaneously

(Table 5.7).

5.6.2 Monitoring Problem/Moral Hazard Model

Tables 5.8 to 5.11 report the coefficient estimates for the moral hazard model with asymptotic standard errors reported in the parentheses. Household-specific variables are utilized to test the moral hazard problem.

Tenant's Sub-Sample

From the participation equation (Table 5.8), it is evident that the age of the people in the household has a significant non-linear relation with the decision to participate. The negative effect of age and a positive effect on age squared means that as tenant farmers get older the effect of age on participation is lessened. The presence of social connection (ngo_membership) has a positive significant effect on the amount of land are tenants willing to lease-in, as it is assumed that any social connection will reduce the opportunity cost and moral hazard problem. Furthermore, like the risk-sharing model, a higher number of female agricultural workers compared with the number of male workers in a household decrease the amount of land a household wants to lease-in, thereby reflecting the gender discrimination in the agricultural land tenancy market.

Table 5.8 Stage 1: Moral hazard model: Selection equation (tenant sub-sample)

variables	*HH decision of leasing in land*
	Model 1
age_head	-0.057*
	(0.019)
age_head2	0.0006*
	(0.0002)
female_head	-0.101
	(0.221)
healthy_popu	0.076
	(0.059)
primary_occup_head	0.091
	(0.106)
edu_active_labour	-0.006
	(0.005)
ngo_membership	0.283*
	(0.086)
hhsize	0.004
	(0.061)
selfeco	0.018
	(0.063)
depen_ratio	-0.204
	(0.252)
agri_labour_male	0.065
	(0.072)
agri_labour_female	-0.785*
	(0.386)
bullock	0.00001
	(5.17e-06)
electricity	-0.141**
	(0.087)

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

The regression also include average rainfall in different years and different districts and dummies for different ecosystem (flood prone, draught prone, irrigated, favourable)and soil type (loamy and clay) as control variables; S.E. are in parenthesis

Stage 2 (Table 5.9) of the outcome equation dealing with choice of contract by the tenant farmers shows strong support for the presence of the moral hazard problem. As predicted, from Table 5.9 it is evident that a household with a female head faces the moral hazard problem, which decreases the likelihood of choosing a sharecropping contract. Opposite significant effects are evident for the size of the household and number of healthy people in the household. Both of these characteristics reduce the moral hazard problem within a tenant household.

Table 5.9 Stage 2: Moral hazard model: Outcome equation (tenant sub-sample)

variables	*Tenant farming households*
	Contract choice: 1 if share contract, 0 if fixed rent contract
t_age_head	0.013
	(0.008)
t_age_head2	-0.0001
	(0.00009)
t_female_head	-0.344*
	(0.134)
t_healthy_popu	-0.046**
	(0.026)
t_primary_occup_head	0.054
	(0.047)
t_edu_active_labour	-0.002
	(0.002)
t_ngo_membership	-0.021
	(0.037)
t_hhsize	0.043**
	(0.026)
t_depen_ratio	0.077
	(0.111)
l_age_head	-0.007
	(0.009)
l_age_head2	0.00007
	(0.0001)
l_female_head	0.443
	(0.293)
l_healthy_popu	0.192*
	(0.106)
l_primary_occup_head	0.633
	(0.161)
l_hhsize	-0.159
	(0.101)
Inverse Mills ratio	0.034
rho	0.079
sigma	0.429
Wald chi2	958.53 (26)
No. of observations	595

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

The regression also include male, female agricultural labour force information, bullock power variable, average rainfall in different years and different districts and dummies for different ecosystem (flood prone, drought prone, irrigated, favourable)and soil type (loamy and clay) as control variables; S.E. are in parenthesis

Landlord's Sub-Sample

Table 5.10 deals with the monitoring problem of farmers who wish to participate in the land market through leasing out land. Participation in the informal land market is positively correlated with female headed households. In most of the developing countries the agricultural occupations are male-dominated. Thus, it is predicted that a household primarily run by a female would face a monitoring problem with managing family labour in farming. This would enhance the rate of land leased out to others for cultivation.

The amount of land leased out decreases with the increasing number of educated, healthy people in the household, together with the increasing number of agricultural male members and bullocks used in crop cultivation. The signs of the coefficients are consistent with what we expect. Farm households in rural Bangladesh are more likely to transact in the land market where they are not able to operate it by themselves. In addition Table 5.10 shows that land-rich farmers are joining in the land-lease market more than the land-poor farmers. Therefore, it can be said that in rural Bangladesh land-poor farmers optimize their amount of land for cultivation through leasing in land where land-rich farmers optimize their amount of cultivable land by leasing out the rest.

Table 5.10 Stage 1: Moral hazard model: Selection equation (landlord sub-sample)

variables	*HH decision of leasing out land*
	Model 1
age_head	0.016
	(0.017)
age_head2	-0.00008
	(0.0002)
female_head	0.087*
	(0.038)
healthy_popu	-0.104*
	(0.034)
primary_occup_head	0.048
	(0.091)
edu_active_labour	-0.154*
	(0.052)
ngo_membership	-0.109
	(0.084)
selfeco	-0.254*
	(0.049)
depen_ratio	-0.335**
	(0.196)
agri_labour_male	-0.142*
	(0.059)
agri_labour_female	0.074
	(0.201)
bullock	-0.00002*
	(4.36e-06)
electricity	-0.176*
	(0.075)

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

The regression also include average rainfall in different years and different districts and dummies for different ecosystems (flood prone, drought prone, irrigated, favourable)and soil type (loamy and clay) as control variables; S.E. are in parenthesis

The results of the contract choice decision focused on the moral hazard problem of the landlord farmers are presented in Table 5.11. Keeping other factors constant, the landlords whose primary occupation is not agriculture are more likely to offer fixed-rent contracts. As the household's head primary occupation shifts from agriculture to non-agriculture, the monitoring cost tends to increase. This increases the incentive for the landlords to offer fixed-rent contracts where there is no such monitoring costs involved.

The only other factor that significantly increases the probability of offering a fixed-rent contract is the increasing number of male agricultural workers in the household. The sign of this coefficient is unexpected. It is predicted that increasing the number of male workers will increase the monitoring ability which in turn should have a positive effect on offering crop-share contracts. However, put another way, farming households with surplus male agricultural workers are more likely to opt for better-paying non-agricultural activity which in turn increases the monitoring cost.

Table 5.11 Stage 2: Moral hazard model: Outcome equation (landlord sub-sample)

variables	*Landlord farming households*
	Contract choice: 1 if share contract, 0 if fixed rent contract
l_age_head	-0.012
	(0.008)
l_age_head2	0.0001
	(0.00007)
l_female_head	-0.075
	(0.079)
l_healthy_popu	-0.003
	(0.019)
l_primary_occup_head	-0.121*
	(0.056)
l_edu_active_labour	0.0005
	(0.002)
l_ngo_membership	-0.073
	(0.050)
l_hhsize	-0.006
	(0.020)
l_depen_ratio	0.080
	(0.095)
l_agri_male	-0.056*
	(0.332)
t_age_head	-0.002
	(0.006)
t_age_head2	0.00005
	(0.00009)
t_female_head	0.182
	(0.258)
t_healthy_popu	-0.056
	(0.051)
t_primary_occup_head	-0.025
	(0.120)
t_hhsize	0.049
	(0.049)
Inverse Mills ratio	-0.228
rho	-0.504
sigma	0.452
Wald chi2	609.25 (29)
No. of observations	526

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

The regression also include male, female agricultural labour force information, bullock power variable, average rainfall in different years and different districts and dummies for different ecosystem (flood prone, drought prone, irrigated, favourable)and soil type (loamy and clay) as control variables; S.E. are in parenthesis

In summary, for both the tenant and the landlord farming households, the moral hazard problem plays a vital role in the decision of whether to enter into

the informal lease market rather than after entering choosing a particular contract. Nevertheless, a tenant farmer faces a more habitual monitoring problem for controlling his workers in crop cultivation than a landlord.

5.7 Conclusion

This study aims to contribute to the empirical literature about agrarian tenancy contracts and the landlord-tenant relationship. It provides evidence from rural Bangladesh by comprehensively considering the effects of opportunity costs of entering into the tenancy market and the risk-sharing and moral hazard problems in choosing a specific contract.

In particular, results from the preliminary studies on the data set show that in rural Bangladesh, 46 percent of the farmers do not participate in the informal land market. Substantial non-participation in the land rental market indicates the presence of considerable opportunity costs in this market. Results also showed that land rental transactions are motivated by the need to adjust land area cultivated to the size and signifiantly depend on the extent of availability of family labour and possession of land assets.

A tenant's risk averseness on contract choice is reflected only through his own economic evaluation (poor, middle class or rich) rather than his possession of other types of land asset and available working capital or credit facilities. Similarly, the landlords increase the amount of land to lease-out if they have abundant land and scarcity of available family labour. These results draw attention to two issues: first, it supports the labour-intensive nature of the agriculture system in rural Bangladesh like many other developing countries. Second, it points towards a missing market for the agricultural waged labour. On the choice of contract, a landlord's proxies for risk averseness are insignificant suggesting that they are more or less risk neutral. These results draw

attention to two issues: first, it supports the labour-intensive nature of the agriculture system in rural Bangladesh like many other developing countries. Second, it points towards a missing market for the agricultural waged labour.

Between the risk-sharing hypothesis and moral hazard hypothesis, the presence of the moral hazard due to the monitoring problem is supported for both groups. The landlords and the tenants in this analysis face significant monitoring problems. Estimates from selection models support the presence of the moral hazard problem for the landlord explained by the monitoring problem. These models show that if the household has fewer agricultural male labourers or is headed by a female, then the probability of offering a fixed-rent contract increases. Hence, the monitoring capacity of the landlord is an important factor in choosing a particular contract offered to the tenants in rural Bangladesh. The landlords are concerned about their valuable asset, whereby they lease-out land and participate in the land rental market when they can ensure a minimum level of monitoring capacity. Therefore, a landlord household with less subsistence pressure and more female labour tends to offer fixed-rent contracts. At the same time, a landlord will offer a sharecropping contract only when he has sufficient other land assets, irrigation facilities in his land for lease and the capacity to monitor tenant farmers.

The analysis of this paper is a stepping stone to understand the mechanism of the informal land tenancy market. However more comprehensive analysis is still needed in future due to the fact that this paper does not focus on the issue of possible non-random matching between the tenant and the landlord or the crop choice. It may be important for rural Bangladesh where internal migration is not very popular, particularly in rural areas.

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6 Chapter Six: Endogenous Matching and the Agricultural Contractual Choice among Rice Farmers in Rural Bangladesh

6.1 Introduction

Hypotheses about contract choice are hard to test for several reasons. Researchers often have difficulty in finding appropriate empirical measures for risk attitudes of the contracting parties and of monitoring and other transaction costs. Most of these theoretically important variables are either not observed or only observed partially. Given this problem, a common methodology is to regress contract choice on a range of proxies relating to the characteristics of the contracting parties and the crops. Furthermore the vast majority of the empirical literature using contract choice theory overlooks an important point. The data come from the market that consists of heterogeneous principals and agents. Hence, analyses which ignore the possibility of the presence of endogenous matching between these two parties and/or their activities are often plagued with inconsistency. In recent years it has been recognized that the empirical work should also consider the presence of one or more sources of incentives whereby particular types of landlords (or tenants) looking for particular types of tenants (or landlords) or particular types of tenants choose particular types of crop practices (i.e. the matching process) (Aggarwal, 2007). The central message of this study is that there are many sources of matching between the landlord and the tenant farmers. When the landlords are heterogeneous with respect to the riskiness of their assets and the tenants likewise with respect to their degree of risk aversion coming from the unobserved risk of the agricultural production, then both of the contracting parties may have incentives to match with each other.

Ackerberg and Botticini (2002) were among the first authors to point out the importance of accounting for endogenous matching when analysing the

functions of the land rental markets. According to them:

"The problem is that endogenous matching generates correlation between observable characteristics of one party and proxy errors of the other party, causing biases in many or all coefficients in interest."

There are mixed results in the literature in this issue. Ackerberg and Botticini's study focused on the land tenure contracts in Renaissance Tuscany. Thus, they accounted for matching along one trait and instrument using regional differences reflecting the context. They found that tenants with relatively low wealth (and hence more risk averse) were employed to cultivate vines which have higher risk, while less volatile cereal crops were contracted out to wealthier tenants who are less risk averse. As Serfes (2005) pointed out, this positive assortative relationship[19] between the degree of risk aversion of a tenant and the riskiness of a crop is counter-intuitive. Another recent empirical paper on this issue which plays a significant role is that of Aggarwal (2007). He used data from western India where he had information on actual matched partners for groundwater contracts. He used a pseudo fixed-effect model to control for the omitted variable bias. Contrary to the findings of Ackerberg and Botticini (2002) he did not find risk-sharing to be significant in any of the fixed-effect models. Dubois (2002) on the other hand used the over-identifying test to find out whether there is omitted variable bias. Using the test he showed that if the crop types are truly statistically exogenous in the contract equation, distance variables do not suffer from omitted variable bias in the contract choice equation. Of course, this part of his test assumed either that the bivariate probit discrete choice is correctly identified (normality of error terms leading to erroneously accept exogeneity) or that some exogenous variables are excluded

[19] Assortative matching: Primarily used in reference to evolution, assortative mating refers to animals and people tending to mate with others with similiar traits regarding age, intelligence, education, wealth, ethnic origin, height, occupation, religion, place of birth, and race.

from at least one equation (which is not testable without relying on normality but is considered to provide a more robust identification of the bivariate probit model). Relatively little empirical work has been done on matching accounting for more than one trait at the individual household level. The present study contributes to the literature by investigating determinants of the agricultural tenancy contract, specifically controlling for all possible channels of endogenous matching of the principals, the agents and the activities. This analysis finds sufficient conditions for the existence of more than one source of matching. In the contract choice equation, when controlling for channels of matching, the analysis finds that risk attitude does not play a major role in contract design.

The underlying theoretical model for this analysis is a standard principal-agent frame work which predicts a negative relationship between risk and performance pay. Here the landlords are considered as the principals and the tenants are considered as the agents. In the presence of risk aversion and limited liability all channels that affect contract choice by the landlord, the tenant and the crop practice on the tenure status is theoretically ambiguous. Which effect prevails is ultimately an empirical question.

The remainder of the paper is organized as follows. Section 6.2 illustrates the conceptual model and logic behind using such an empirical strategy. Section 6.3 describes data and summary statistics. Section 6.4 describes the empirical methodology, section 6.5 explains results and intuition behind explaining the results. Section 6.5 concludes.

6.2 Conceptual Model

A simple contract choice equation would be of the following nature:

$$c = \beta_t t + \beta_l l + \beta_r r + \varepsilon \tag{47}$$

where c is a binary contract choice variable which is equal to one if a share contract is observed and zero if a fixed payment contract is observed.

t , l and r are the characteristics of the tenant farmer, the landlord farmer and the crop variety which according to the theory determine contract choice.

β_t, β_l and β_r are the corresponding vectors of unknown coefficients. ε is assumed to be the random error term that is distributed independently and identically with mean zero and variance σ^2. If all the characteristics of the tenant, the landlord and the crop variety are fully observed and are uncorrected with ε , then a binary choice regression of (47) would give consistent estimates.

A fundamental problem with econometric estimation of equation (47) arises when the tenant farmer's (agent in principal-agent theory) characteristics are partially observed or may not be observed at all. For example, risk preferences of the tenant and the landlord are crucial determinants of the contract attributes, but such preferences are typically observed in the data. However, it is common in the empirical work on contractual choice to use proxies (o) for such unobserved characteristics. Following Ackerberg and Botticini (2002), the proxy equation can be written as (48) and estimate regression (49) instead

$$t = \alpha_o o + \varepsilon_t \tag{48}$$

$$c = \gamma_o o + \beta_l l + \beta_r r + \varepsilon_o \tag{49}$$

where $\gamma_o = \alpha_o \beta_t$ and $\varepsilon_o = \varepsilon_t \beta_t + \varepsilon$ For example income, wealth, age, off-farm income and debt-to-asset ratio are often used as proxies for risk aversion.[20]

Another problem with estimating equation (49) by means of the standard method is that the coefficients become biased if the agents endogenously match with observed and unobserved activities and/or principals. If such endogenous

[20] Aggarwal (2007), Huffman and Just (2004), Allen and Lueck (1999).

matching exists, omitted variable bias in the coefficients arises because of the correlation between the regressors in (49) and the residuals ε_o. This is because agents with certain characteristics tend to select principals and activities with specific features.

Another source of matching can be the association between crop types and the agents is presented by the matching equation (50)

$$r = \alpha_t t + \varepsilon_r \tag{50}$$

$$r = \alpha_t \alpha_o o + \alpha_t \varepsilon_t + \varepsilon_r \tag{51}$$

Here ε_r is the matching error and equation (51) follows from (50). Because of matching, some activities such as choice of crop practice r may be correlated with the unobserved component of the agent's characteristics ε_t. Thus, estimation by means of standard methods will yield biased estimates for such a regression (Greene, 2003, p.75). The same argument can be given if the agents are endogenously matched with certain characteristics of the principal.

To control for the potential omitted variable bias stimulated by matching, Ackerberg and Botticini (2002) argued that the preferred solution to the problem is to find suitable instrumental variables that affect the matching equation but do not affect the contract choice equation or the proxy equation. They used region dummies as instrumental variables under the assumption that the observations came from different geographical regions with different population distributions of the tenants or the landlords. On the other hand, Aggarwal (2007) used a fixed-effect model to control for the unobserved characteristics of trading partners that determine the matching process. The within-group estimator would be a better choice if the data set has a unique tenant-landlord

configuration as a group which Aggarwal's data set had. Bellemare (2006) on the other hand, regressed the landlord (tenant) levels of assets per capita within the household on the tenant (landlord) characteristics for the sub-sample of cases where the contract is not signed between them. After finding out the possible channel, he followed Ackerberg and Boticcini's method and used geographical dummies as instruments.

Therefore, the initial task is to test whether there is an endogenous matching between the landlords and tenants and/or the activities and what may be the channel to this matching which is overlooked by most literature. The analysis uses data from the rice farmers in rural Bangladesh. However, the data set does not have complete information on actual matching between the tenants and the landlords. To solve this problem the study follows the methodology of Bellemare's (2006) paper. In order to estimate the presence of incentives for matching this analysis uses a sub-sample of the tenant farmers who take loans from their landlords. Using this sub-sample of the landlords and the tenants, the study regressed the landlord (tenant) levels of asset and social connections within a household on the tenant (landlord) characteristics.

In addition, the analysis is focused on the possible matching between cropping intensity and the agents' behaviour. Rice farmers in rural Bangladesh essentially cultivate three different types of rice namely Aus, Aman and Boro. In terms of cropping intensity, each farming household can be grouped as a mono-cropping, a bi-cropping or a tri-cropping household, with the household cultivating one crop in a cropping year or twice or thrice, respectively. A farmer's decision regarding which set of crop(s) to grow in a given year is generally quite complex. Most theoretical as well as empirical models assume crop choice to be exogenous. However, in rural Bangladesh, like many other parts of the world, proper sequencing of crops across seasons is a very important deci-

sion taken by the farmers actively involved in the cultivation process. Although output would be higher for bi-cropping and tri-cropping, it would also be more expensive and effort intensive. Since the importance of both risk aversion and limited liability depends on the risk preferences of the tenant, the theory predicts that the tenants' risk attitude determines incentive costs of the output and hence the equilibrium choice of effort and techniques. Therefore, by regressing cropping intensity on farming household risk preferences, this may indicate the presence of potential matching (if any) between the crop and the farmer's level of risk aversion.

As mentioned earlier Ackerberg and Botticini (2002) pointed out that if the observations can be separated into geographical regions (representing isolated markets), then the matching equation is likely to differ across these regions. One can then use these geographical dummies related to crop intensity/crop practice or tenant characteristics as instruments which only indirectly affect the contract choice equation. However, in the agricultural production, ecological and environmental factors may also affect the final output. Moreover, theoretically, these factors affect the reservation utility of an agent, which is likely to affect not only who is matched with whom but also the choice of tenancy contract. Therefore, in choosing instruments one needs to be careful about the distinction from pure geographical distribution representing different markets with ecological distribution. With this view, this analysis uses rainfall variations, soil type dummies and dummies for different ecosystems as control variables in all equations. Dummies for administrative divisions and a dummy for household's access to electricity are used as instruments. Unlike Ackerberg and Botticini (2002) who used a two-stage IV method, this research uses a household year fixed-effect IV model. The argument behind using a fixed-effect model is that there may be some time-constant unobserved factors (such as

unobserved inherent heterogeneity) that affect contract choice dummies. Thus, models using only simple two-stage methods may suffer from this heterogeneity bias.

6.3 Data and Summary Statistics

6.3.1 Data

The data for the analysis are drawn from a repeat survey of a nationally representative sample of rice farmers in rural Bangladesh conducted to assess changes in rural livelihood systems. The benchmark survey was implemented in 2000-01 by IRRI with 1,880 rural households from 62 villages in 57 out of 64 districts in Bangladesh, for a study of the impact of rice research on poverty reduction in Bangladesh sponsored by the International Food Policy Research Institute (Hossain et al., 2003). The sample was drawn by using a multistage random sampling method. In the first stage, 64 unions were randomly selected from a list of all unions in the country. In the second stage one village was selected from each union that best represented the union with regard to the size of land holding and literacy rate. A census of all the households in the selected villages was conducted to stratify the households by the size of land ownership and land tenure. A random sample of 20 households was drawn from each village such that each stratum is representative of its probability proportion. The final wave was conducted by IRRI in 2003–04 following the households present in the first two waves and their descendants. The sample size of households rose to 1,927 in the last wave.

Among the characteristics of the sample households the average size of cultivated land per household decreased over time from 0.53ha in 2000 to 0.48ha in 2004 - this was attributable to the division of land with the splitting of households over time. By tenancy status, owner farmers constituted the largest group

of households. Over 2000–04, the proportion of owned farms declined substantially from 37 percent to 26 percent, while the proportion of pure-tenant farmers increased from 9 percent to 17 percent. The area under tenancy increased from 33 percent in 2000, and further to 40 percent in 2004. There was also a considerable increase in the proportion of non-farm households resulting from increased landlessness and growing popularization of the peasantry due to the growing population pressure on the limited land resources.

6.3.2 Summary Statistics

The data set for the analysis consists of information on the owner farmers, the landlords and the tenant farmers. It contains information on demographic characteristics of the household as well as characteristics of the plots that they own or rent from others. The variables that are used in the estimations are the following:

- The landlord's and the tenant's productive characteristics and assets are the age, education and primary occupation of the household head, health status of the household members, number of adult and dependent household members, and the number of male and female agricultural labourers in the household. In addition, the analysis uses household wealth as measured by all land properties owned by a household, household's debt-to-capital ratio and household's debt-to-per-capita income ratio. Finally, a dummy variable is used in which households assess their own economic evaluation according to their living standard categories: rich, middle class, poor and very poor.

- Plot level characteristics that affect production are the plot size, dummy for whether the plot has irrigation and dummies for soil types.

- Ecosystem variables that affect the outcome which are dummy variables for flood prone, drought prone, favourable and irrigated plots.
- Average rainfall which differs both by year and among the districts.

Table 6.1 presents the summary statistics of some of the important variables that are used in the estimation. From this table it is observed that tenant farmers have more debt-to-capital burden and debt-to-income burden than the landlord farmers and their overall wealth is lower than that of the landlord farmers.

Table 6.1 Summary statistics

Variable	Description	Mean	Standard deviation
tenant	If rent in >0	0.401	0.407
landlord	If rent out >0	0.487	0.658
share	=1 if share cropping in	0.739	0.438
crop_practice	=0 if mono crop; 1 if bi crop; 2 if tri crop	0.671	0.581
mono cropping	=1 if mono crop	0.386	0.487
bi cropping	=1 if bi crop	0.554	0.497
tri croppimg	=1 if tri crop	0.058	0.234
t_debt_capital	tenant's liquidity constraint/ tenant's working capital	0.448	3.790
l_debt_capital	tenant's liquidity constraint/ tenant's working capital	0.126	1.471
t_wealth	tenant's own cultivated land + homestead and other land	0.159	0.512
l_wealth	landlord's own cultivated land + homestead and other land	0.248	0.764
t_debt_income	landlord's liquidity constraint/ landlord's per capita income	0.251	0.788
l_debt_income	landlord's liquidity constraint/ landlord's per capita income	0.100	0.516

Table 6.2 presents some cross tabulations of three variables for the aggregate and for the seven major divisions individually. The variables used in the cross tabulations are crop practice among the tenant farmers who cultivate under

two major types of tenancy contracts: sharecropping contract and fixed-rent contract and the level of their debt-to-capital ratio. Crop practice is equal to zero for mono-cropping if a farming household cultivates only one rice crop during a cropping year; one for bi-cropping if a household cultivates two rice crops during a cropping year and two for tri-cropping if the number of cultivates rice crops are three.

Table 6.2: Distribution of crop practice, electricity and contract

	Contract (%)		
Crop practice	Share = 1	Fixed = 0	Total
Whole sample			
Mono-cropping	55.24	42.75	44.23
	(2.359)	(1.253)	(2.080)
Bi-cropping	51.66	54.35	52.36
	(0.589)	(0.376)	(0.535)
Tri-cropping	3.58	2.90	3.40
	(0.093)	(0.627)	(0.216)
Dhaka			
Mono-cropping	39.84	54.17	42.18
Bi-cropping	56.10	45.83	54.42
Tri-cropping	4.07	0.00	3.40
Chittagong			
Mono-cropping	40.98	21.43	37.33
Bi-cropping	54.10	64.29	56.00
Tri-cropping	4.92	14.29	6.67
Barisal			
Mono-cropping	36.36	42.86	38.30
Bi-cropping	57.58	42.89	53.19
Tri-cropping	6.06	14.29	8.51
Rajshahi			
Mono-cropping	47.92	32.35	41.46
Bi-cropping	50.00	67.65	57.32
Tri-cropping	2.08	0.00	1.22
Khulna			
Mono-cropping	53.09	56.52	53.85
Bi-cropping	44.44	43.48	44.23
Tri-cropping	2.47	0.00	1.92
Rangpur			
Mono-cropping	48.57	40.74	45.16
Bi-cropping	51.43	59.26	54.84
Tri-cropping	0.00	0.00	0.00
Sylhet			
Mono-cropping	60.00	100.00	66.67
Bi-cropping	30.00	0.00	25.00
Tri-cropping	10.00	0.00	8.33
Electricity			
0	49.87	29.71	44.61
1	50.13	70.29	55.39

Note- the figures in the parentheses are the mean debt-to-capital ratio of the tenants in that cell.

A few interesting correlations can be interpreted from Table 6.2. First, the practice of mono-cropping is more associated with share contracts than fixed-rent contracts where as bi-cropping is most favoured for tenant households who cultivate under fixed-rent contracts. Second, as one looks across contracts for a given crop practice, the mean tenant's debt-to-capital ratio is higher under crop-share contracts than under fixed-rent contracts (mean of tenant's debt-to-capital ratio are in the parentheses). These correlations indicate that poorer tenants primarily cultivate under share contracts and choose mono-cropping. Tenants with less debt burden choose more bi-cropping than mono-cropping and cultivate under fixed-rent contracts. This correlation suggests the presence of some possible matching between crop practice and the tenant's degree of risk aversion.[21] Third, there are variations in the crop practice among the seven administrative divisions in Bangladesh. This supports the fact that there are differences in the market distribution among these divisions as well.

The data set does not have information on actual matching between the tenants and the landlords. In order to estimate the presence of incentive for matching this analysis uses a sub-sample of the tenant farmers who take loans from their landlords.

6.4 Econometric Methodology

From equation (47) c is a binary variable that can have only two possible outcomes which is one if share contract is chosen and zero if the fixed-rent contract is chosen. For econometric estimation equation (47) can be rewritten as equation (52)

$$\Pr(c_i = 1|\mathbf{x}_i) = \phi(\mathbf{x}_i'.\beta) \tag{52}$$

[21] Ackerberg and Botticini (2002) found similar correlation between tenant's wealth and crop type.

where Pr denotes probability, $\mathbf{x}_i$ denotes the observable vector of regressors including proxies for risk attitudes of the person who decides the contract as well as of the other party and moral hazard of the contractor which are assumed to influence the outcome c_i.and ϕ is the Cumulative Distribution Function (CDF) of the standard normal distribution. The parameters β are typically estimated by maximum likelihood. It is also possible to motivate the probit model as a latent variable model. Suppose there exists an auxiliary random variable

$$c_i^* = \mathbf{x}_i'.\beta \ + \ \mu_i \tag{53}$$

where

$\mu_i \backsim N(0,1)$. Then c_i^* can be viewed as an indicator for whether this latent variable is positive:

$$c = \begin{Bmatrix} 1 \ if \ c_i^* > 0 \ i.e. - \mu_i < \mathbf{x}_i'.\beta \\ 0 \ otherwise \end{Bmatrix} \tag{54}$$

6.4.1 Maximum Likelihood Estimation

The data set used here contains n independent statistical units corresponding to the model above. Then their joint log-likelihood function is

$$In \ \mathcal{L}(\beta) = \sum_{i=1}^{n} (c_i \ In\phi(\mathbf{x}_i'.\beta) + (1 - c_i) \ In(1 - \mathbf{x}_i'.\beta)) \tag{55}$$

The estimator which maximizes this function will be consistent, asymptotically normal and efficient provided that $E[\mathbf{xx\prime}]$exists and is not singular. It can be shown that this log-likelihood function is globally concave in β, and therefore standard numerical algorithms for optimization will converge rapidly to the unique maximum.

6.5 Results and Discussions

The analysis presents two sets of empirical results to identify the existence of possible assortative matching in the choice of a tenancy contract. The first results focus on the presence of matching between tenant farmers and crop intensity. The second results include matching between the landlord (the tenant) and the tenant (the landlord). The analysis then turns to the contract choice equation where it represents both results from a naive contract choice equation without controlling for possible matching and the results which consider the presence of such matching.

6.5.1 Crop Practice and the Tenant's Characteristics

As suggested above, the first step toward reviewing potential matching problems is to check correlations between observable crop practice and agent characteristics (equation 47). Table 6.3 addresses this question by regressing the choice of crop practice on tenant's observable risk preferences. The regressions are also controlled for ecosystem, rainfall and soil dummies. The results confirm a significant and negative relationship between choice of crop practice and tenant's debt-to-capital ratio, which is also a proxy for the tenant's degree of risk aversion. It indicates that less wealthy tenants (that is more risk-averse tenants) appear to choose the mono-cropping pattern.

Table 6.3: Estimation results for crop practice

Dependent variable: 0 if mono crop, 1 if bi crop and 2 in tri crop

Variables	Fixed effect model	Probit model
t_debt_capital	-0.013**	-0.047**
	(0.003)	(0.022)
t_agri_male	-0.015	0.090
	(0.053)	(0.101)
t_agri_female	-0.192	0.358
	(0.246)	(0.553)
t_age_head	-0.021	-0.027
	(0.027)	(0.032)
t_age_head2	0.0003	0.003
	(0.0003)	(0.003)
t_prim_occupation	-0.044**	0.042
	(0.008)	(0.161)
t_cow_pp	6.00e-06	6.44e-06
	(3.5e-06)	(6.31e-06)
t_hhsize	0.068	0.067
	(0.048)	(0.086)
t_healthy_population	-0.045	-0.065
	(0.046)	(0.086)
t_depen-ratio	0.170	0.948*
	(0.236)	(0.373)
t_edu_active_labour	-0.004	0.011**
	(0.003)	(0.005)
constant	0.363*	0.415
	(0.208)	(0.903)
N	1174	1174
Wald chi 2 (19)		
F(18,999)	303.72	
LR chi2 (19)		62.62

** significant in 5% level, * significant in 10% level

Note: all equations control for average rainfall in different districts (64 districts) in 2000 and 2004, dummies for soil type and dummies for ecosystem: fp- flood prone, dp- drought prone, fav-favourable, ir- irrigated. The estimation also checks with random effect model and compare random effect vs. fixed effect using Hausman test. Hausman test shows that fixed effect model estimations are consistent over random effect model.

To investigate this channel of possible matching the analysis first estimates two models: the random-effect model and household-year fixed-effect model. The analysis then compares the results of the random-effect model and fixed-effect models using the Hausman test. The results of the Hausman testshow that the fixed-effect model gives more consistent results than the random-effect model. In the table therefore, only results from the fixed-effect model are given. Moreover, as crop practice is a discrete choice variable, the same regression was also tested with a probit model. The results of the probit model are similar to the results from other two models. The estimated results of the marginal

effects of the probit model are included in the Appendix (Table A 3).

The regression results in all three models suggests that the tenant household's observable degree of risk aversion determines the type of crop practice. The explanations behind this relationship are fairly intuitive. In the absence of any insurance market against loss from crop cultivation, farmers are concerned with unobserved output losses due to environmental factors such as flood or drought under all crop practices. Therefore, even if multi-cropping increases the outcomes, it also involves high unobserved risk. However, as Ackerberg and Botticini (2002) mentioned, it does not tell us why there is such matching. It can be interpreted as, if unobservable production risks are very important then the more risk-averse tenant will choose mono-cropping. A second implication one can make from such estimation is the direction of the biases in the contract choice equation. Since cropping practice is negatively related with the observed proxies for risk aversion, it may also be correlated with unobserved component of risk aversion. This indicates negative bias of the crop practice coefficient.

6.5.2 Landlord's (Tenant's) Risk Preferences on Tenant's (Landlord's) Characteristics

Following Bellemare (2006), it may be possible that the landlords and the tenants match with each other, and that more than one possible channel of matching exists in the decision to choose a particular tenancy contract. To facilitate identification of whether there is endogenous matching between the landlord and the tenant farmer in the survey data, the research regressed two proxies of landlord's (tenant's) risk aversion on the tenant's (landlord's) characteristics and the results are shown in Table 6.4. For the landlord farmer these two proxies are landlord's debt-to-income ratio (l_debt_income) and landlord's wealth as represented by all types of land asset that his household owns (l_wealth).

Similarly, for the tenant farmer the proxies for risk aversion used in the regression are tenant's debt-to-capital ratio ($t\_debt\_capital$) and tenant's level of wealth (t_wealth) as shown in Table 6.5.

Table 6.4: Estimation results for Landlord's risk preferences on tenant's characteristics (fixed-effect model)
Dependent variable: l_debt_income and l_wealth

Variables	l_debt_income	l_wealth
t_debt_capital	0.003	-0.001
	(0.004)	(0.003)
t_ngom	0.090	0.103
	(0.057)	(0.077)
t_offfarm_income	5.04e-06	7.17e-06
	(6.69e-06)	(7.96e-06)
t_hhsize	0.043	0.116**
	(0.032)	(0.036)
t_depen-ratio	-0.082	-0.174
	(0.181)	(0.195)
t_age_head	-0.008*	-0.019*
	(0.003)	(0.005)
t_age_head2	0.0001**	0.0002*
	(0.00005)	(0.00006)
t_edu_active_labour	0.0009	-0.0008
	(0.0002)	(0.004)
t_healthy_population	-0.057	-0.113*
	(0.037)	(0.035)
constant	0.384**	0.739**
	(0.210)	(0.201)
N	205	205
F(18,1528)	101.25	104.35

** significant in 5% level, * significant in 10% level

Note: all equations control for average rainfall in different districts (64 districts) in 2000 and 2004, dummies for soil type and dummies for ecosystem: fp- flood prone, dp- drought prone, fav-favourable, ir- irrigated. The estimation also checks with random effect model and compare random effect vs. fixed effect using Hausman test. Hausman test shows that fixed effect model estimations are consistent over random effect model.

Table 6.5: Estimation results for Tenant's risk preferences on landlord's characteristics (fixed-effect model)
Dependent variable: t_debt_capital and t_wealth

Variables	t_debt_capital	t_wealth
l_debt_capital	0.125	-0.014
	(0.080)	(0.017)
l_debt_income	0.222	0.024
	(0.145)	(0.043)
l_ngom	0.247	0.060
	(0.399)	(0.080)
l_offfarm_income	4.38e-06	-6.80e-06
	(2.84e-06)	(4.42e-06)
l_hhsize	-0.224	0.017
	(0.268)	(0.039)
l_depen-ratio	-0.316	0.168
	(0.639)	(0.195)
l_age_head	-0.023	-0.002
	(0.019)	(0.004)
l_age_head2	0.0002	8.31e-06
	(0.016)	(0.00004)
l_edu_active_labour	0.002	0.002
	(0.016)	(0.003)
l_healthy_population	0.222	0.023
	(0.302)	(0.043)
constant	0.818**	0.164**
	(0.477)	(0.126)
N	205	205
F(18,1525)	120.95	153.77

** significant in 5% level, * significant in 10% level

Note: all equations control for average rainfall in different districts (64 districts) in 2000 and 2004, dummies for soil type and dummies for ecosystem: fp- flood prone, dp- drought prone, fav-favourable, ir- irrigated. The estimation also checks with random effect model and compare random effect vs. fixed effect using Hausman test. Hausman test shows that fixed effect model estimations are consistent over random effect model.

Tables 6.4 and 6.5 present the results of the regression using fixed-effect models. The estimated coefficients show that the landlord's degree of risk aversion is significantly correlated with the tenant's age (t_age) and number of healthy people in the household ($t\_healthypp$). Thus, it appears that less risk averse landlord tends to match with young tenant households and the households that has fewer healthy members. It indicates a possible negative assortative matching between the landlord's risk preferences and the tenant's observable and unobservable characteristics. Under the standard principal agent model, a less risk-averse landlord may choose a more risk-averse tenant because

then the landlord can offer a contract with a lower incentive package and can reduce the cost of his contract. Again this would be possible because more risk-averse tenants have low reservation utility.

By contrast, the estimated results between the tenant's risk preferences and the landlord's characteristics show no significant relationship. These results can be interpreted in such a way that in rural Bangladesh, with the availability of abundant tenant farmers especially during the peak cropping season, the landlord chooses his tenant farmer(s) according to his own risk preferences. As labourers are abundant, the tenant farmers have little choice over their landlord. As mentioned in the previous section, the landlord's risk preferences may be correlated with some unobserved characteristics of the tenant which is crucial for a tenancy contract. Therefore, in order to reduce the potential bias in the contract choice equation, one needs to control for the endogeneity of the landlord's risk preferences.

6.5.3 Selecting Instruments

From above two sub-sections it is obvious of the presence of some possible assortative matching. This analysis finds at least two sources: crop practice and the landlord's level to risk attitudes. To control for the potential bias/biases induced by the endogenous matching process, Ackerberg and Botticini (2002) proposed a two-stage estimation approach to account for endogeneity. More specifically, their approach was to replace the actual values of potentially endogenous activity with their respective estimated values. In the choice of proper instruments, however, as discussed above, to control for other biases in estimation, the analysis uses the fixed-effect instrumental variable model.

From Table 6.3 the study finds possible endogeneity in the choice of cropping pattern during a cropping year. A farmer's decision regarding which set of crops

to grow in a year which does not affect his contract choice is generally quite complex and it is difficult to find instruments that can identify this decision only. In the choice of instruments, therefore, this study follows Ackerberg and Botticini's 2002 prescription and uses non-overlapping geographical distribution to achieve such identification. The estimation includes divisional dummies as instruments which represent different market facilities. Moreover, it includes a dummy for access to electricity in the villages from 1987 to 2004 and another dummy for access to electricity by the landlord households.

The intuition behind using electricity as an instrument comes from the fact that access to electricity in rural Bangladesh represents socio-economic development. In Bangladesh, being a developing country, the importance of power especially in rural areas cannot be over-emphasized. It has been argued that, a lack of access to electricity is one of the major impediments to growth and development. Several studies, such as Burnes et al. (2010) found that electrification has a significant positive impact on a household's social status, income and educational outcome. In the survey data the households are asked if they have access to electricity from 1984 to 2004. This study assumes that access to electricity affects tenancy contract choice only through its direct effect on a household's risk preferences.

6.5.4 Contract Choice Equation

Table 6.6 shows the estimated results of the contract choice equation using a fixed-effect model where the dependent variable is equal to one if the tenant farming households cultivate under a share contract and zero if they cultivate under a fixed-rent contract. The table presents two results, with and without controlling for endogenous matching and shows the difference in coefficients between these two models. The endogenous variables are: crop practice,

l_debt_income and l_wealth.

Estimation results in Table 6.6 show that a number of factors determine whether a tenant farmer chooses a sharecropping contract over a fixed-rent contract Without controlling for endogenous matching the analysis finds a strong trade-off between the landlord's proxies of risk attitudes and contract choice. The fact that a number of coefficients in the equation for the sharecropping contract are statistically significant is an indication that the landlords and the tenants are risk averse and that monitoring costs matter. Moreover, the perception that the landlord's wealth attributes are largely unimportant when a tenant chooses a particular contract is rejected.

The following conclusions can be drawn from column 2 in Table 6.6: (1) Poor, aged tenant farmers and thus more risk-averse tenants prefer crop-share contracts. (2) The probability of choosing a fixed-rent contract increases if the tenant farmers have more healthy people in a household which ideally reduces the management problem of the family labour. (3) The estimated coefficient for the landlords being debt-free with respect to capital is positive, indicating that crop-share is more likely to be chosen. These results support risk-sharing between the two groups. However, the estimated coefficient of the landlords' wealth and debt-to-income ratio are negative, implying that crop-share contract is less likely to be chosen if the landlords are wealthy thus less risk averse. These results are unclear and not easy to interpret.

Column 3 of Table 6.6 presents the results of the restricted model where crop practice, the landlords debt-to-income ratio and landlords wealth are all considered as an endogeneity problem and are controlled by instruments. Here, the model has strong support for the presence of a monitoring problem among the tenant farmers but does not show much support for the risk-sharing hypothesis. In the restricted model poor and aged tenants thus more risk-averse tenants,

choose a sharecropping contract as before. Conversely, unlike the uncontrolled model none of the landlords' proxies for risk attitude have any significant effect on the likelihood of the tenant farmers choosing a crop-share contract. This implies that if one overlooks the presence of assortative matching the survey data allow us to accept the risk-sharing hypothesis. While allowing for matching we cannot accept the risk-sharing hypothesis.

Summing the findings of the contract choice equation which accounts for endogenous matching suggests that at the beginning of the cropping season when the tenant farmers have to choose, between two alternative choices of tenancy contract, they are more concerned about their own experience and managerial ability than risks involved in the production process. These findings are opposite to the findings of Ackerberg and Botticini (2002) who used data from Renaissance Tuscany, but similar results were found by Bellemare (2006) using data from Madagascar. In fact, empirical evidence of the choice of sharecropping compared with other forms of tenancy contracts tends to give different results depending on the region being studied.

In the case of rural Bangladesh the incompleteness of the labour market may explain the expansion of sharecropping. The empirical analysis also shows that in rural Bangladesh poor, aged tenants (hence more risk averse) are more likely to choose crop-share contracts than a fixed-rent contract. Among other characteristics, tenants are more likely to choose a fixed-rent contract if the farming households have more educated and healthy members. This is consistent with that fact that a tenant's own ability and availability of useful family labour play a vital role in choosing a particular contract. Thus in rural Bangladesh farmers' own degree of ability is more important than risk-sharing opportunities during the production process.

Table 6.6: Estimation results tenancy contract choice

Dependent variable: 0 if fixed-rent contract, 1 if sharecropping contract

Variables	Fixed effect without IV	Fixed effect with IV
t_debt_capital	-0.009	-0.011
	(0.042)	(0.054)
t_selfeco	0.268**	0.235*
	(0.102)	(0.138)
t_hhsize	0.097	0.138
	(0.075)	(0.102)
t_femaleh	0.514	0.210
	(0.422)	(0.572)
t_depen_ratio	-0.605*	-0.386
	(0.369)	(0.533)
t_agehead	0.106*	0.122*
	(0.063)	(0.084)
t_agehead2	-0.001**	-0.001*
	(0.0006)	(0.0009)
t_agri_male	0.243**	0.229
	(0.125)	(0.158)
t_agri_female	0.517	0.561
	(0.558)	(0.689)
t_cowpp	5.54e-06	1.60e-06
	(0.00001)	(0.00002)
t_primary_occu	0.158	0.182
	(0.171)	(0.212)
t_edu_active_labour	0.023**	0.018*
	(0.008)	(0.010)
t_healthy_popu	-0.132**	-0.152*
	(0.062)	(0.081)
l_own_land	2.648	1.576
	(1.939)	(3.393)
l_agehead	-0.012	-0.014
	(0.013)	(0.018)
l_debt_capital	0.912*	0.711
	(0.555)	(0.855)
l_healthy_popu	0.242**	0.120
	(0.109)	(0.216)
l_debt_income	-2.021*	-0.960
	(1.121)	(2.460)
l_wealth	-12.693**	-2.082
	(5.502)	(15.133)
crop_inten	0.491**	0.303
	(0.117)	(0.214)
constant	-2.903**	-3.011
	(1.714)	(2.173)
N	506	506
F(464,14)	123.36	222.20
Prob>F	0.0009	0.0051

** significant in 5% level, * significant in 10% level

Note: all equations control for average rainfall in different districts (64 districts) in 2000 and 2004, dummies for soil type and dummies for ecosystem: fp- flood prone, dp- drought prone, fav-favourable, ir- irrigated. The estimation also checks with random effect model and compare random effect vs. fixed effect using Hausman test. Hausman test shows that fixed effect model estimations are consistent over random effect model

6.6 Conclusion

The hypothesis for standard contract theories is that there is a link between characteristics of the contracting parties and the activities. This is called matching and when there are econometrically unobserved or partially observed characteristics, empirical analysis that do not control for such matching may face omitted variable bias. However, it has been difficult to find all paths of such relationships through empirical studies. This analysis adds to the existing and limited empirical literature on the agricultural tenancy contracts by applying the econometric method proposed by Ackerberg and Botticini (2002) to IRRI survey data for rice farmers of rural Bangladesh during 2000 and 2004. The method identifies the potential sources of matching between the principals, the agents and the activities on the estimated results. The procedure is to first, search for possible channels of the presence of endogenous matching. After finding evidence of matching, the contract choice equation is then estimated using instrumental variables to correct for its impact of endogenous matching.

The study finds that tenant's risk aversion affects the decision to grow one or more crops during a cropping year under formal contract agreements. This result is consistent with expectations and theory. For example, farmers who have a higher debt-to-capital burden are more likely to choose mono-cropping. While cultivating more than one crop could be profit maximizing, there are risks in this type of cultivation. Furthermore, this study finds that the landlord's observable risk averseness is significantly related with the tenant's characteristics. This implies that in rural Bangladesh where there is abundant agricultural labour, the landlords with specific characteristics look for the tenants with matching characteristics. This is consistent with the predictions of the theoretical literature, where the landlord maximizes his income from the tenancy market depending on his own distinct characteristics and that of the

tenant's. However, the analysis finds that the tenant's observable risk averseness is not significantly related with the landlord's characteristics. It appears that the tenant farmers do not look for a particular type of landlord before choosing between the fixed-rent contract and the crop-share contract.

These results should be interpreted with care due to the data limitations. In particular, endogenous matching can be understood more clearly if the data sets have full information on actual matching partners between two contracting parties. In addition, the lack of information about the actual value from a specific contract makes it difficult to separate the effects of compensation of the landlords and the tenants. Consequently, the explanatory power of this study relies largely on how well the observed variables proxy the true unobserved characteristics. After controlling for matching, the analysis finds no significant evidence of risk-sharing. For choosing a particular contract type for crop cultivation, the tenant farmer largely depends on his own ability and own degrees of risk aversion.

In spite of the aforementioned prerequisites, the findings of this study have important implications in the context of most developing countries. One of the things holding back agriculture in developing countries is the unwillingness of farmers to invest in better inputs. This is understandable when in the absence of an insurance market, the tenant farmers do not want to take risk in the crop production process. However, in 2010, a new micro-insurance scheme introduced in Kenya, Africa (Kilimo Salama Programme) using mobile phone technology has enabled more than 9,000 farmers to insure their harvests against drought. Mobile phone technology is involved in all stages of the insurance process: taking out a policy, checking the payout threshold criteria and payment of the indemnity. Such innovation is a clear indication that farmers are always look for better opportunity either from the government sources or from the non-

government sources. This kind of strategy has the potential to be economically viable as long as it is affordable and attractive to the smallholder farmers.

Another finding from the empirical analysis is that more risk-averse landlords search for less risk-averse tenants. Greater security of property rights would increase access to land for the poor and their share of the land rental market. Results also show that participation in the land rental market for the tenant farmer is constrained by lack of experience and number of healthy people in the household. Therefore, training and improved health status can have substantial benefits not only for the tenants, but also for those with whom they might interact in the rental markets. As many developing countries around the world have some similar attributes, the findings of this study can give important insight into current policy debates on the role of agrarian arrangements and potential for government intervention in these countries.

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7 Chapter Seven: Conclusion

7.1 Introduction

This study deals with the consequences of different arrangements for agricultural land tenancy in rural Bangladesh. In rural Bangladesh, land is one of the essential assets for people to overcome poverty. Land also ensures health and social security by generating employment, investment, social capital and collateral. Agricultural land refers to the share of land area that is arable under permanent crops and pastures. Secured access to land is vital for diverse land-based livelihoods, sustainable agriculture, economic growth, poverty reduction and equity. In Bangladesh, virtually all arable land is generally used for agricultural production and almost two-thirds is used for rice production. It is estimated that the country has approximately 9 million hectares of cultivated land but population pressure suggests that by 2025 as much as 50 percent of that land will be taken over by human settlement (SAMATA, 2006).

Coupled with limited and declining agricultural resources, Bangladesh also has limited opportunities for alternative employment. The majority of the households are small farming households and ownership of land is skewed where the country has few farmers with large amount of farmlands. Moreover, informal land tenancy contracts are very popular among the farming households. However, so far, a number of constraints make land reform unlikely. These include the lack of an in-depth analysis of the current situation in the informal tenancy market; farmers lacking sufficient information to enable them to optimize agricultural production processes; and the lack of clarity about the social and political objectives of land reforms. There is also an ongoing debate on whether land reform is necessary to increase productivity. With a large rural population, a high degree of landlessness and a very large labour force, the sig-

nificance of land for the poor in improving income and livelihood opportunities has led to a broader emphasis on ways of improving land access and securing land rights. In order to get better social inclusion and protection of vulnerable groups, land must be managed in such a way that the welfare of the majority of the population can be ensured in an ecologically sustainable way. This thesis, therefore, is an attempt to examine land tenancy issues central to the livelihoods of people living in rural Bangladesh.

From Chapter 4 to Chapter 6 using empirical evidence, the study explores how land resources are accessed, used and managed through the informal tenure system. Household level data from 2000 and 2004 have been used to illustrate above issues. The microeconomic foundation of this thesis is mainly the theory of household choices in the presence of incomplete and imperfect markets.

7.2 Main Findings

This thesis has analysed the efficiency impact of share tenancy and the determinants of tenancy contract choice. The main focus is on the execution of the agricultural tenancy market in the absence of any formal policy or intervention from any sources other than contracting parties. The following six points are the key findings from this thesis:

1. Based on 2000 and 2004 survey data from rice farmers in rural Bangladesh, after controlling for weather, soil and topographic characteristics, the share tenants are found to be as productive in terms of output/ha as the owner cultivators. There are theoretical reasons to believe that the share tenants are not as productive as the owner cultivators, due to what is known as Marshallian inefficiency. In contrast to much of the empirical literature, using a treatment-effect model, the results in Chapter 4 do not demonstrate any evidence of the presence of Marshallian inefficiency among the crop-share tenant farmers.

2. Secondly, there are evidence of differences in the production function coefficients between the tenant and the owner households. For instance in the production function, among the share tenant farmers, output per hectare significantly increases with the number of bullocks in the family and significantly decreases with the number of female agricultural labourers in the family. However, for the owner farmers, the size of the household and number of male agricultural labourers in the family decreases the crop output per hectare, while the experienced household head significantly contributes to increase the productivity. Credit access from informal sources increases the productivity of the owner cultivators although the coefficient for this variable has no significant effect on the productivity among the share tenants. These differences indicate that the coefficients of production functions have differential effects on the agricultural productivity for households who cultivate under a sharecropping contract compared to households who cultivated their own land. Therefore, empirical analysis using a pool sample of both parties to estimate production functions may suffer from inconsistency.

3. Throughout the analysis of Chapter 5, the principal focus is on the determinants of the simultaneous decision to (1) enter into the tenancy market and (2) to choose between share tenancy and fixed-rent tenancy. The data set is divided into two sub-samples: one for the tenant farmers and the other for the landlords. For the participation in the tenancy market, results support the notion that land-poor farmers enter into the informal tenancy markets as the tenant and land-rich farmers play their part as the landlords. It is likely that these findings are simply due to the relatively poor availability of off-farm alternative employment in rural Bangladesh.

4. In the choice of tenancy contract, risk sharing hypothesis in this thesis is proxied by amount of land assets owned, working capital, non-agricultural

income, self economic evaluation and social connection. Holding landlords' risk aversion constant, the risk-sharing model using the tenant sub-sample illustrates that the ownership of land assets is a significant factor to gauge their risk averseness. Oppositely holding tenants' risk aversion constant, the risk-sharing model using the landlord sub-sample illustrates that for the landlord sub-sample apart from land assets, the number of agricultural labourers within the family is also an important factor. This may suggest that land-poor farmers in Bangladesh are too vulnerable to unobservable production risk and that they do not have sufficient access to either working capital or credit facilities necessary to avoid such risks.

5. While the main questions of interest in Chapter 5 related to the determinants and joint relationships between the decision to enter the land-lease market and choose a tenancy contract, it is also necessary to test both the risk-sharing and monitoring problem hypotheses assumed in the theories. The presence of the moral hazard due to the monitoring problem is supported for both groups. The landlords and the tenants in this analysis face significant monitoring problems. Estimates from selection models support the presence of the moral hazard problem for the landlord explained by the monitoring problem. These models show that if the household has fewer agricultural male labourers or is headed by a female, then the probability of offering a fixed-rent contract increases. Hence, the monitoring capacity of the landlord is an important factor in choosing a particular contract offered to the tenants in rural Bangladesh. The landlords are concerned about their valuable asset, whereby they lease-out land and participate in the land rental market when they can ensure a minimum level of monitoring capacity. Therefore, a landlord household with less subsistence pressure and more female labour tends to offer fixed-rent contracts. At the same time, a landlord will offer a sharecropping contract only

when he has sufficient other land assets, irrigation facilities in his land for lease and the capacity to monitor tenant farmers.

6. Chapter 6 took a different approach to deal with the same problem as Chapter 5 by analysing the presence of endogenous matching between the tenants and the landlords or the tenants and cultivation activities arises from unobservability of certain theoretically important variables and due to incentive problem. The results demonstrate some evidence of the presence of matching between crop practice and the tenant's characteristics, and the landlord's risk preference variable and the tenant's characteristics. This again supports the tenant's susceptibility to unobserved production risk. A naïve single equation approach without controlling for such matching does find significant effects of these factors over the choice of contract. However, after controlling for matching using instrumental variables, these factors lose their significance over the choice of tenancy contract.

7.3 Implications for Tenancy Reform Policies in Bangladesh

Two of the major constraints of tenancy contracts in Bangladesh are that there is no written agreement on the conditions of a contract and most of the tenancy contracts are for a very short period. In fact, the 1984 Land Ordinance gives the sharecropper the right to have a written contract for five years with the landlord for sharecropping. The ordinance also applies to the selling of land to non-family member of the sharecroppers. However, the law remains on paper so far and at the time of writing was yet to be implemented.

There are some lessons to be learned for the agricultural tenancy market in Bangladesh. First, this thesis has shown that the sharecroppers are as productive as owner cultivators. The main debate on land reform in Bangladesh like many developing countries, according to available literature, is hovering

around the question of redistribution of farm lands (as mentioned in the report of Arkand and Haque, 2008). However, following the findings of this thesis in a country like Bangladesh, with a large rural population, a high degree of share tenancy, and small farm size, redistributive land reform policy should be considered with the utmost care. For example, Rahman and Rahman (2009) noted that the redistribution of land from large farmers to marginal and landless farmers would leave each landless household with only 0.21ha of land, which is unviable as a livelihood resource.

The second lesson is that findings from previous chapters confirm the presence of imperfect markets for credit, insurance and property rights for marginal farmers. In Chapters 4 to 6 of the this thesis, reservation income/utility of the farmers in empirical analysis of the thesis is proxied by income from trade and income from services, i.e. non-agricultural incomes, credit from the formal sources such as banks, Grameen Bank and cooperatives, and credit from informal sources such as loans from money lenders, traders, friends and relatives. Empirical findings in Chapter 4 show that credit access from informal sources increases the productivity of the owner cultivators although the coefficient for this variable shows that there is no significant effect on the productivity among the share tenants. Additionally, empirical findings in Chapter 5 show that the tenant's access to credit from informal sources has a significant positive effect on the likelihood of offering a fixed-rent contract. However, the value of the coefficient is very small suggesting that only few tenants have access to a sufficient amount of credit from informal sources that is needed for the cultivation process. Arcand (2004), Chaudhury and Maitra (2006) and Rahman (2008) also argued in their papers that over time, increasing modernization of agriculture and the introduction of new technologies and a simultaneous reduction in the inherent risk through greater availability of credit which also acts as insurance,

the poor tenant will become better off.

Although Bangladesh is notable for micro-finance activities in rural areas, only 2 percent of the total micro-credit projects are offered for the agricultural sector. Land reform policies which focus on land rights and credit facilities may improve this condition. Secure land rights that are transferable require a predictable market value and the ability to be used as collateral or passed on as wealth to the next generation. Therefore, by strengthening land rights, governments can create wealth for the poor and bring "dead capital" to life (Prosterman and Hanstad, 2006).

Empirical findings of Chapter 6 demonstrate that greater security of property rights would increase access to land for the poor and their share of the crop they receive according to the sharecropping contract. Moreover, empirical findings of Chapters 4 and 5 emphasize the significant effects of the number of male and female labourers and the number of bullocks in a household. The data set of rice farmers from 200 to 2004 that has been used for the empirical analyses on this thesis show that (explained in Table 4.2) on an average although tenant farmers has higher productivity than owner cultivators, but has lower income from the crops they grow. The Table 4.2 also estimate that among the non-tenant household, the number of healthy people in the household and pre-capital variables (income from goat and poultry rearing and income from trees) have higher mean values than those of the tenant household. On average tenant farmers tended to own fewer livestock and their overall health and education condition is found worse than that of owner farmers. They also had lower levels of capital stock. Thus, Government policy has an important role to play in improving the factor equalization role of the land rental markets because farming is still dominant as a source of livelihood in Bangladesh.

Land is not the only key factors required in order to sustain livelihoods

from farming. Other key factors (e.g. livestock resources and farm capital assets) which are also unequally distributed among the farming population are essential in farming too which is explained in Chapter 2. Therefore, the key policy thrust would be to facilitate operation of the land rental markets, as well as to improve equality in ownership of the non-land resources. Results of this thesis clearly demonstrate that a rational approach, therefore, would be to invest in micro-credit programmes, agricultural extension services, and rural infrastructure, as well as the livestock sector. All these investment areas also have a synergistic role in improving production efficiency of Bangladeshi farmers (Rahman and Rahman, 2009 and Rahman and Hasan, 2008) which, in turn, would improve the overall livelihoods of these farm households.

The third lesson is that there is a lack of data available for Bangladesh, particularly recent socio-economic information and analysis of the tenancy market. In order to design rational land and tenancy reform policies, it is vital to collect, monitor and analyse data during all phases of the programme. For example, there is no reliable data source on the amount of the crop that the share tenant gets at the end of the cropping season. Before implementing the policies, policy-makers should collect overall data regarding the number and composition of landless and land-poor families, distribution and concentration of land ownership, as well as production, share, rent and income from the land. In addition, after implementation, in order to avoid the failures of the past, it is important to conduct regular monitoring to evaluate both the progress and the impact of the reforms. Such systematic monitoring and evaluation is vital for identifying problems and providing information necessary for programme refinement.

7.4 Future Research

This thesis has provided a formulation and has tried to fill the gap for the analysis of consequences of the agricultural tenancy market in rural Bangladesh, but there are obviously several areas where further research is required. In general, given the empirical nature of this thesis, how well the models can identify the significance of variables of interest relies on how potential sources of bias can be controlled. Multiple year panel data are definitely desirable in order to capture the dynamic effects of tenant farming. Some model and data-set-specific recommendations have been provided at the end of each core chapter. The following parts deals with some related areas which deserve attention.

Firstly, in the context of share tenancy in rural Bangladesh it is important to know the distribution of share of output between the tenant and the landlord. This thesis explicitly assumes that the share of output is 50:50. Although 50:50 sharing is the most common and easiest method of sharing, there may also be differences between locations. The data set used for this study does not have any information on the distribution of different methods of output share. The nature of share of output is important to know as it reflects the extent of exploitative behaviour of the landlords over poor tenant farmers.

Secondly, it might be important to further explore the substitutability between large state or collective farms and individual family farms in the context of the Bangladeshi economy. Unfortunately, the present study could not collect detailed information on these two forms of land administration. This may be a vital point for formulating new policies.

Another aspect not clearly analysed in this thesis is the role of tenancy as a foundation for economic growth. The analysis does not specifically focus on the dynamic family farming sector that might have significant forward and backward linkages to broaden social development. One should test whether a

broad-based distribution of land assets not only benefits the poor but becomes a solid basis for sustained and inclusive economic growth.

In many developing countries, tenancy reforms have reduced inequality and enhanced sustainable farming practices by eliminating basic grievances arising from the relationship between the tenants and the landlords. However, classic civil wars in Mexico, Spain, China and Vietnam were catalysed largely by land-based problems. Due to data limitations, unfortunately, this thesis has not thoroughly covered the issues on the equality impacts of the potential interventions through policies. Two important aspects that should be analysed in future work are: inequality of the agricultural tenancy, and costs and benefits of the reform policies.

Lastly, this thesis does not focus on the gender issues that might be vital for any reform policies where almost half of the population are female. The share of women in labour use ranges between 11-18 percent in food grain (rice and wheat) and 14-48 percent in non-cereal production (Rahman, 2000). It is also believed that women's labour accounts for at least 25 percent of the value added from sowing to post-harvest operation in rice production. Therefore, women should receive at least equal rights in the tenancy market. Although the data set used in this thesis has information about female participation, their education level and health status, more information is required to analyse the role of women in the agricultural tenancy market. The data set does not allow such analysis. In order to get the full benefit from the tenancy market, future study should also focus on women's employment in the Bangladeshi agricultural tenancy market.

With two years data, the analysis presented in this thesis may seem to be partial. However, this thesis contributes to and complements the existing literature regarding the important role of socio-economic conditions and risk

attitudes of the contracting parties as a determinant of the tenancy contract choice. The findings of this thesis contribute to the understanding of the decisions that lead to various productivity and income differences from the crop production under various contractual arrangements. By doing so, they can provide useful insights into questions regarding whether public policy should intervene in these decisions, and how interventions should be constructed to align with individuals' incentives. Moreover, in understanding different aspects of the agricultural tenancy market issues in Bangladesh and in many similar developing countries, one may come closer to such understanding of the economy as a whole. Particular policy suggestions are beyond the direct scope of this thesis, but are certainly promising areas for further research based on the robust basis of the analysis in this thesis.

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Appendix

Table A.1 Productivity efficiency of sharecropping: checking validity of instrument (*ngom*)

variables	Dependent variable: share dummy	Dependent variable: log_rice_ha
	(a)	(b)
ngom	0.081**	0.029
	(0.026)	(0.023)
hhsize	0.016	-0.029*
	(0.018)	(0.016)
ageh	-0.011**	0.015**
	(0.005)	(0.005)
$ageh^2$	0.0001*	-0.0001**
	(0.00005)	(0.00005)
eduhead	-0.032	-0.026
	(0.021)	(0.019)
femaleh	0.021	0.073
	(0.094)	(0.082)
prim_oocu_head	0.023	-0.036
	(0.038)	(0.035)
grplo	0.391**	-0.005
	(0.082)	(0.075)
healthyp	-0.014	0.012
	(0.017)	(0.016)
male_agri_labour	-0.011	-0.029*
	(0.019)	(0.017)
female_agri_labour	-0.162	0.001
	(0.112)	(0.100)
active_labour_force	0.017	-0.017
	(0.018)	(0.016)
clvt_own_land	-0.119**	-0.013
	(0.017)	(0.016)
homestead_land	-0.580**	0.026
	(0.216)	(0.198)
cow_no	-0.004	0.0005
	(0.006)	(0.006)
irri_access	-0.039	-0.064
	(0.030)	(0.027)
income_goat_poul	3.89e-06	2.52e-06
	(6.71e-06)	(6.13e-06)
income_trees	-3.29e-06**	-2.46e-06
	(1.68e-06)	(1.54e-06)
credit_formal	-3.21e-06	2.33e-06*
	(1.41e-06)	(1.29e-06)
credit_informal	-6.88e-06*	-2.54e-06
	(3.86e-06)	(3.60e-06)
log_non_agri_income	-0.004	-0.021*
	(0.012)	(0.012)
constant	0.369*	0.977**
	(0.113)	(0.210)
N	1043	1071
R2	0.145	0.114

** significant in 5% level, * significant in 10% level

Note: all equations control for average rainfall in different districts (64 districts) in 2000 and 2004, dummies for soil type and dummies for ecosystem: fp- flood prone, dp- draught prone, fav-favourable, ir- irrigated.

Table A2: Estimation results of marginal effect for crop practice

Dependent variable: 0 if monocrop, 1 if bicrop and 2 in tricrop

Variables	Marginal effect
t_debt_capital	-0.012**
	(0.005)
t_agri_male	0.020
	(0.023)
t_agri_female	0.089
	(0.113)
t_age_head	-0.006**
	(0.002)
t_age_head2	0.00005**
	(0.0003)
t_prim_occupation	-0.005
	(0.037)
t_cow_pp	1.68e-06
	(0.0000)
t_hhsize	0.015
	(0.020)
t_healthy_population	-0.013
	(0.021)
t_depen-ratio	0.217**
	(0.087)
t_edu_active_labour	-0.002
	(0.013)
Prob (y)	0.619

** significant in 5% level, * significant in 10% level

Fig. A1 : checking heteroscedasticity: plot res log_rice_ha

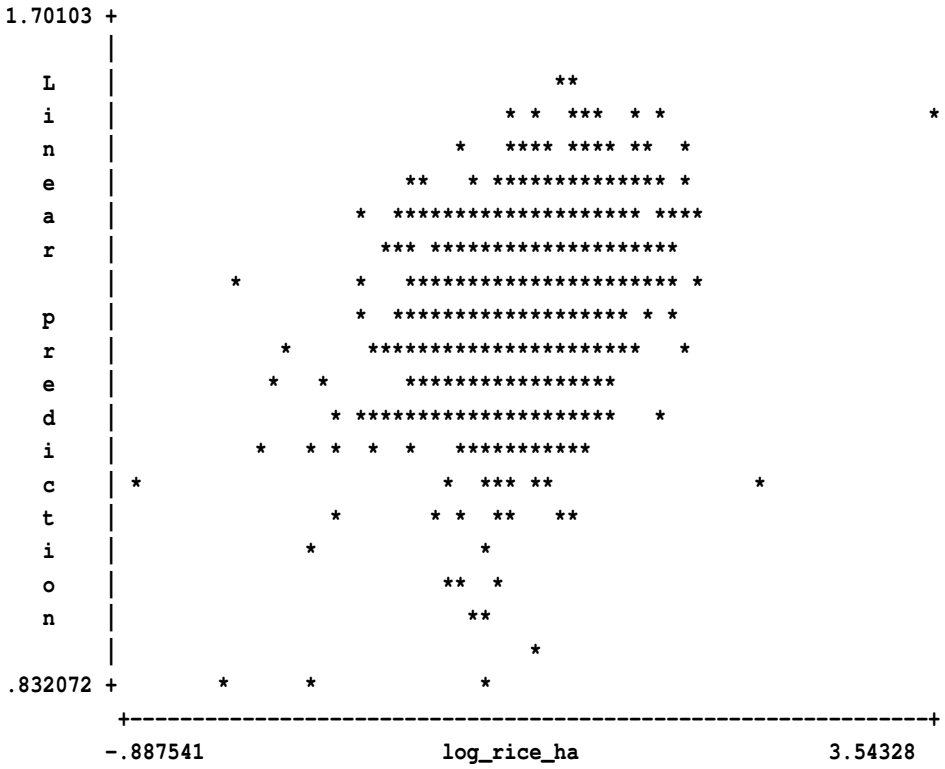

Fig A2: Checking correlation among labour variables
(hhsize= household size; wrkmag= male_agri_labour;
wrkfag= female_agri_labour; actvlf= active_labour_force)

```
. corr  hhsize    wrkmag wrkfag actvlf
(obs=3215)

      hhsize   wrkmag   wrkfag      actvlf

hhsize      1.0000
wrkmag      0.2806   1.0000
wrkfag      -0.1082  -0.0961   1.0000
actvlf      0.0621   0.1367  -0.1208      1.0000
```