

Access to Information and Factor Market Participation: Adjustments of Land and Labour Margins of Agricultural Households in Bangladesh

Shyamal K Chowdhury
ZEF, Bonn University
Walter-Flex-Str. 3, D-53113
Bonn, Germany
Email: schowdhury@gdnet.org

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Abstract: This paper assesses the impact of access to information on farm household's factor market participation. The paper tries to answer two questions. First, does use of telephone have any impact on farm household's factor market participation decision? Second, correcting for market participation, does use of telephone have any impact on the type of factor adjustment decision? For the first question, the paper uses a bivariate probit to correct for omitted variable bias and for the second question, the paper uses a two stage probit. Empirical findings of this paper suggest that access to information in the form of use of telephone has significant positive impact on factor market participation. The difference in market participation between telephone users and nonusers is around 14 percent. However, once a household participate in the market, the use of telephone does not have any impact on specific factor market participation.

JEL classification: C35, D13, D23, D83.

Key words: information, transaction costs, farm households, factor markets, Bangladesh, bivariate probit, two-stage probit.

1 Introduction

This paper examines the impact of access to information on factor market participation of farm households in Bangladesh. While the critical role of information as a cause of market imperfection in developing countries has become axiomatic, the theory is backed by little empirical evidence on the magnitude of the problem. The present study asks whether access to information through access to telecommunications brings any discrete change in a farm household's land and labour market participation decisions. More specifically it asks two questions. First, does the use of a telephone have any impact on a farm household's factor market participation decision? Second, correcting for market participation, does the use of a telephone have any impact on the type of factor adjustment decision?

In most developing countries, agriculture remains a major contributor to GDP in general, and it remains the prime source of livelihood of rural people in particular.¹ Despite different policy interventions, the sector has remained semicommercialized, dominated by self-sufficient family farms.² Many markets, particularly future markets for risks and capital are either absent or extremely limited, small and illiquid. Even when a market exists, its use is not universal. An analysis of the participation decision is important as understanding of the household's participation decision increases the available set of policy instruments that can influence the household's behaviour. As market participation is assumed to increase efficiency in resource allocation, understanding of the factors that influence the participation decision can help to design policy aimed at improving household welfare.

Land and labour transactions usually increase resource allocation efficiency as agents with high expected marginal productivity of land acquire land and vice versa, and agents with high expected

¹ In the case of least developed countries, agriculture value added as a percentage of GDP was 37% in 1997. Least developed countries (UN classification) include 47 economies. Source, World Development Indicators, World Bank.

² As of 1981, the percentage of owner-cultivated farms was 79% of total farms. See, United Nations Food and Agriculture Organization (1981) cited in Otsuka *et al* (1992), p. 1971.

productivity of labour hire labour and vice versa. In this way, a downward (upward) adjustment of labour or an upward (downward) adjustment of land are the alternative means of exploiting resource endowments in agrarian economies. However, though beneficial, not all households participate in such factor adjustments. Among many reasons that might cause selective market participation, market imperfection due to information imperfection is one of the prominent ones. The present study thinks transaction cost as a cause of selective factor market participation and considers information cost as a part of transaction cost.

Transaction cost is a widely used approach to explain the observed market failures and self-sufficiency in agriculture in developing countries.³ One fundamental source of transaction cost is information cost. When information is not costless, this has important implications in present and future contracts and transactions. Transactions and contracts, which could be feasible in the presence of perfect information, may not occur.⁴ The existence of transaction cost generates a wedge between a household's buying and selling price,⁵ i.e., once adjusted for transaction costs, the rental price of land and labour can be different depending on whether the household is on the demand or on the supply side of the market. As a result, transaction costs reduce the market size and, in extreme cases, when transaction costs are very high, the market may fail.

The strand of economic literature that recognizes the possibility of market imperfections usually identifies asymmetries of information and problems of moral hazard as the primary reasons for market failure in agriculture in developing countries.⁶ In many instances, agrarian institutions that govern the transactions of land and labour are endogenous as they adapt to reflect information costs.⁷ For example, in the absence of perfect information, sharecropping is a rational response to overcome incentive problems caused by informational imperfections where an agent's effort cannot be directly monitored by the principal.⁸ However, if land and labour markets do not function properly only because of costly and imperfect information, then an increase in information availability may change the functioning of markets.

The present study has taken the use of the telephone as a proxy for access to information, and has assumed a positive relationship between availability of information and market participation. Recent expansion of telecommunications services to rural areas in Bangladesh has increased the access of rural households to information.⁹ If availability of information increases market participation, then the use of the telephone may increase market participation because the use of the telephone provides increased access to information and hence its use reduces information imperfection. Access to telecommunications has potentials to overcome limitations associated with

³ See Key *et al* (2000) for a theoretical analysis and empirical evidence.

⁴ See Akerlof (1970).

⁵ See Hirshleifer (1984), pp. 421-23.

⁶ See for example, Binswanger and Rosenzweig (1984), Stiglitz (1988), Bardhan (1989), and Otsuka *et al* (1992).

⁷ See Stiglitz (1988), p. 100.

⁸ See Stiglitz (1974) that assumes that a landlord cannot monitor the effort of labour. In addition, this principal-agent paradigm comprises a large body of literature. For a recent application in an agrarian context, see Otsuka *et al* (1992).

⁹ See Chowdhury (2002) on the rural telecommunications project in Bangladesh.

information imperfection, and to reduce transaction costs. ‘Two key determinants of market emergence are the costs associated with acquiring information, and the cost of negotiating transactions’,¹⁰ and the spread of telecommunications is expected to reduce both acquiring and negotiation costs. With this background, the present study examines the impact of transaction costs on a farm household’s factor market participation where search and information cost is a part of transaction costs.

Though selective, adjustments of land and labour margins of agricultural households in Bangladesh are not uncommon. In the case of land, observations show that there are both short-term adjustments through the transfers of user-rights, such as renting out or sharecropping, and long-term adjustments through the transfer of ownership such as selling. Similarly, adjustments of labour margins in the form of temporary, seasonal and permanent contracts can also be found. The observed market participation behaviour of households complies with the view that market participation is household specific, as argued by de Janvry *et al* (1991), and participation is not factor specific. Markets for factors exist, but not all farm households utilize them.

Table-1 shows the observed factor adjustment of agricultural households in Bangladesh and table-2 reports the market participation behaviour of households for telephone users and nonusers. The figures are generated from a primary survey conducted in Bangladesh in the year 2001. The survey methods and coverage will be discussed in section-4. Among the surveyed households, more than 62 percent of them adjust land through the market, and more than 64 percent of them adjust labour through the market.

[Table-1 here]

Turning to the effect of telephone use, one can find that the raw difference in factor market participation rate between households that use a telephone and households that do not use a telephone is about 14 percent (table-2). The last row of table-2 presents the mean of participation and for users and nonusers of telephones and their difference where the difference is significant at the level of one percent. Examining the patterns of market participation rates for households with respect to telephone use, it appears that the use of a telephone has had an important effect on market participation behaviour.

[Table-2 here]

This study contributes to the existing literature in two ways: first, it estimates empirically the impact of access to information in the form of the use of a telephone on a farm household’s market participation behaviour. In doing so, it controls for the possible self-selection bias by jointly estimating both the propensity of a household to participate in the market and the match of households to telephone use. Second, the study estimates empirically the impact of access to information on specific factor adjustment. At this stage, it estimates a farm household’s probability

¹⁰ See Leff (1984).

to participate in a specific market correcting for participation. The remainder of the paper proceeds as follows: section 2 provides a descriptive review of land and labour adjustment patterns of farm households in Bangladesh and relates the observed pattern with the telephone use; section 3 constructs a framework that provides a theoretical basis for market participation decisions; section 4 describes the data collection methods and descriptive statistics; section 5 provides the empirical estimation; and section 6 concludes.

2 Land and Labour Adjustments: An Overview

This section starts with examining the relationship between a household's factor endowments and factor market participation. It also examines the simultaneousness of adjustments of land and labour. Later, it relates factor market participation to the use of the telephone.

Table-3 reports the availability of family labour and adjustments of labour margins, and table-4 reports the availability of family land and adjustments of land of the surveyed farm households in Bangladesh. It seems that a household's labour adjustments, either hired-in or hired-out, do not depend on the availability of family labour. In contrast to labour, households that lease-out land are mostly big farmers and households that lease-in land are small farmers; while it is only about 10 percent of the small farm households that adjust land downwards, it is about 43 percent of the large farmers that adjust land downwards. This observed relationship between farm size and input adjustment direction is further reinforced by observations on upward adjustment, which are in fact the mirror image of downward adjustment (table-4).

[Table-3 here]

[Table-4 here]

Factor adjustment decisions are not independent as a labour adjustment decision is not independent of land adjustment decisions and vice versa. As a result, land market constraints can affect labour market participation and vice versa. For instance, the presence of potential supervision and monitoring constraints on hired labour can limit the upward adjustments of land. Similarly, the presence of potentially binding constraints on off-farm works can limit the downward adjustments of land. In the absence of any constraints, the factor adjustment decision should be independent of its own factor endowments.

Table-5 combines both land and labour adjustments. The observed patterns show that about 85 percent of the households adjust at least one of the factor margins, and the remaining 15 percent do not make any factor adjustments. About 20 percent of the households adjust their land margin only, and about 22 percent of the households adjust their labour margin only. About 13 percent of the households adjust both land and labour margins upwards, while none of the households adjust both margins downwards. Note that the observed factor adjustments reported in table-5 are for a cropping season for land and for a year for labour. As a result, these adjustments are essentially short term in nature. Households that have not adjusted in the present sample in the short run

might already have adjusted in the long run through mechanisms like migration and land selling and have achieved desired factor ratios. To account for such adjustments, migration and land buying/selling will be taken in to consideration.

[Table-5 here]

To examine the relationship between adjustments of two margins, the study looks at the conditional probabilities given by table-6. The conditional adjustment probabilities show that households unable to adjust one margin are more likely to adjust in the other margin; households that have not adjusted land margins are likely to adjust in the labour margin and vice versa. In addition to this substitutability between adjustments in either of the margins, the probabilities of simultaneous adjustment are also high; given that a household has adjusted its land margin, it is more likely that it will adjust its labour margin as well.

[Table-6 here]

Table-7 shows the probabilities of market participation, given telephone use. The probability that a household uses a telephone and does not participate in the market is very low compared to the probability that a household does not use telephone and does not participate in the market. The probability of participating in the labour market conditional on telephone use is 0.128 while the probability of participating in the land market conditional on telephone use is 0.326. With the exception of labour market participation, it seems from table-7 that households that use a telephone have a higher probability to participate in the market than households that do not use a telephone.

[Table-7 here]

The explorative type of analysis of this section suggests that, though selective, farm households in Bangladesh participate in land and labour markets and adjust their factor endowments. However, there exists simultaneity in factor adjustments behaviour among the participating households. In addition, the use of a telephone might have some relationship with the farm household market participating behaviour as households that use a telephone have a higher probability to participate in the market than the households that do not use a telephone.

3 Theoretical Framework

Household-farm models usually maintain a common framework where a household maximises its utility function under production, time and budget constraints.¹¹ Under the presence of transaction costs, henceforth TC, a household's market participation depends on comparison between two utility levels: the utility level that the household can attain when it participates in the factor market net of transaction costs, and the utility level it attains when the household remains in autarky. In the second case, the household does not incur any transaction costs.

¹¹ See Strauss (1984).

Two types of transaction costs are proportional transaction cost (PTC) and fixed transaction cost (FTC). The first one, PTC, depends on the volume of trade, which means TC is incurred in each unit of trade. In comparison with PTC, FTC is specific to the frequency of trade, which means TC is incurred in each trading. In reality, a single trade can be subject to both types of TCs and, despite this distinction, both play the same role: by widening the price gap between buyers and sellers, they (PTC and FTC) reduce exchange. However, the distinction is important in respect of market participation decisions for farm households; while PTC influences the amount to be supplied in the market once a farm household is already in the market, FTC influences whether a farm household participates in the market or not.

Information cost can be viewed as a form of fixed transaction cost. It does not change the unit price that a farm household receives as a supplier or pays as a buyer; it is fixed and equally incurred by households that supply land and/or labour and households that demand land and/or labour. As a fixed cost, it delays a household's market participation decision and, in extreme cases, when the problem of information is widespread, a market could be completely missing.

Following Key *et al* (2000), it is possible to write the household's indirect utility V as a function of market prices, (w, r) , the household's income before incurring transaction costs, y , and the household's exogenous utility shifters, Z_h :

$$V = V(w, r, y, Z_h) \quad (1)$$

The utility levels to be compared are when the household adjusts its land and/or labour margins in any direction (buyer or supplier), and when the household remains in autarky. That means

$$V^m = V(w, r, y - tc, Z_h) \quad (2)$$

$$V^a = V(\tilde{w}, \tilde{r}, \tilde{y}, Z_h) \quad (3)$$

Where V^m and V^a are two respective utility levels when the household adjusts its margin or remains in autarky, and \tilde{w} , \tilde{r} and \tilde{y} are the autarkic wage, rent, and income respectively. Intuitively, a household will participate in the market when $V^m \geq V^a$, or in other words, $y - tc \geq \tilde{y}$.

4 Data Collection Methods and Descriptions

The study uses data from the household survey conducted in six different regions of Bangladesh during the months of January and February of the year 2001. The survey is described in Chowdhury (2002) in details. In the survey, households were stratified on the basis of the ease of access to telecommunication infrastructure, where access was defined in terms of distance that needs to be travelled to access telephone services. The survey contained questions on the

households' production and factor market participation behaviour, and the variables related to access to and use of telecommunications. In addition, the survey also collected respondents' personal and family characteristics. Table-8 provides summary statistics of the variables relevant for the present study. For ease of discussion, variables are arranged under three categories: a household's characteristics, a household's factor endowments, and information availability.

In the case of household characteristics, age is measured in years and education is measured in intervals and has been recorded in seven different categories. Among the head of the households, about 43 percent of them are functionally illiterate and about 7 percent of them have studied at tertiary level. The modal occupation of the head of the households is agriculture (35.92 percent), followed by business/trade (19.01 percent). The total yearly household expenditure is measured in local currency. Table-8a and table-8b show the descriptive statistics about education and occupation of the head of the households respectively.

[Table-8 here]

[Table-8a here]

[Table-8b here]

In the case of factor endowments, farm size is the amount of land a household owned; it is measured in decimals. A household's labour supply consists of the number of persons per household between the ages of 14 and 60 years. As both females and males participate in agriculture in one way or another, the present study has not excluded female members of the household in aggregating the household's total labour supply. The average price of land is the average price of farmland and consists of the prices of best and worst land at village level. Similarly, the average wage is the village level agricultural wage per day per person. Both prices are measured in local currency. Among the respondent households, migration to a city or abroad is a visible characteristic. Out of 284 households, 13.03 percent and 17.96 percent of the households have one of or more family members migrated to city or abroad respectively (table-8c).

[Table-8c here]

In the case of information availability, telephone use status measures whether any member of the household uses a public or a private telephone. The survey contained questions about present as well as past telephone use status. The distance to the nearest telephone is measured in kilometres, and the telephone user as a percentage of sample size is the number of telephone users in a village as a percentage of the number of respondents from that village. The village type is a dummy variable and is one for a village with a telephone and zero otherwise.

5 Empirical Estimation

In the empirical estimation, the present study employs two basic measures of factor market participation. The first one is the factor market participation status that equals 1 if a household has adjusted any of its factor endowments in the last growing season. The second measure is the type of factor adjustment correcting for market participation. At this stage, it considers three possibilities that a household faces: adjust land only, adjust labour only, and adjust both land and labour. In order to be more tractable it discusses them under two different subsections. As usual, it starts each subsection with an empirical specification followed by the estimation and results.

5.1 Factor Market Participation Status

For market participation, here, the approach is to augment a standard cross-sectional market participation function to include a dummy indicating whether a household uses a telephone or not. Let T_i represent a dummy variable that equals 1 if the i th household uses a telephone, and zero otherwise. Household i 's market participation decision is assumed to depend on T_i , and a vector of observed characteristics X_i , and can be described by the latent variable model:

$$M_i^* = \alpha T_i + \beta X_i + \varepsilon_{1i} \quad (4)$$

where M_i^* is the expected utility level that a household attains from market participation, ε_{1i} is a normally distributed error term with mean zero and unit variance, and α and β are parameters to be estimated.

However, one cannot observe the expected utility level; what one rather observes is whether or not a household participates in factor markets. Assume for each household i a dummy variable M_i that expresses the bivariate state of a household's market participation. The conditional probability that for household i given T_i and X_i , one observes $M_i = 1$, (participate in factor market) is given by

$$P(M_i = 1 | T_i, X_i) = P(\alpha T_i + \beta X_i + \varepsilon_{1i} \geq 0) = F\left(\frac{\alpha T_i + \beta X_i}{\sigma_1}\right) \quad (5)$$

The study estimates the probabilities of market participation given T_i and X_i , where T_i and X_i include a household's telephone use status and characteristics, respectively. Table-9 reports the normalized probit coefficients estimated with varying sets of covariates. In the first column, telephone use is the only explanatory variable along with a constant term. The raw difference in factor market participation rate between households that use a telephone and households that do not use a telephone is about 14 percent (marginal coefficient of telephone). In column 2, in addition to telephone use, household characteristics have been added as additional covariates. Inclusion of household characteristics reduces the difference between users and non-users to around 11 percent. Even after controlling for additional covariates, the telephone dummy variable

continues to have a sizeable impact on a household's factor market participation. Column 3 includes a household's factor endowments. The difference reduces further to 6 percent once controlled for a household's factor endowments in addition to the household characteristics. However, inclusion of these factors does not alter the significance of telephone use.

[Table-9 here]

Correction for possible omitted variable bias: The estimation results suggest that the use of a telephone has a significant positive impact on a household's factor market participation. However, the extent of the effect of telephones on participation decreases as the estimation controls for households' observed characteristics and factor endowments. Since the use of a telephone is correlated with a household's observed characteristics, it seems plausible that it is also correlated with the unobserved characteristics of households that may be correlated with the market participation of households. So, if a household's unobserved propensity to participate in the market is correlated with telephone use, then the single equation estimate is subject to an omitted variable bias.

If the households that are most likely to use telephones are also those most likely to adopt measures that reduce transaction costs, then the single equation estimation would overestimate the impact. However, it is also possible that households with the highest information/TC use a telephone. In such cases, the use of a telephone might not be able to bring down the transaction costs sufficiently enough to participate in the market. In this case, the single equation model would underestimate the benefit of telephone use.

To address the issue of an omitted variables bias, the estimation allows for the possibility that a household's telephone use and market participation are correlated. Since two variables of interest, use of a telephone and factor market participation, are both discrete, the appropriate simultaneous equation model in this context is a bivariate probit.¹²

A household will use a telephone if the net benefits of telephone use are positive. Similar to market participation given by equation (4), the net benefits of telephone use, T_i^* , can be modelled as a latent variable being determined by the following linear equation:

$$T_i^* = \eta'Z_i + \varepsilon_{2i} \quad (6)$$

where Z_i is a vector of covariates that capture a household's demand for information and other attributes related to information availability, ε_{2i} is a normally distributed error term with mean zero and unit variance. The conditional probability that for household i given Z_i , one observes $T_i = 1$, (use telephone) is given by

¹² See Evans *et al* (1999).

$$P(T_i = 1|Z_i) = P(\eta'Z_i + \varepsilon_{2i} \geq 0) = F\left(\frac{\eta'Z_i}{\sigma_2}\right) \quad (7)$$

To allow for the possibility that unobserved characteristics of a household's decision to participate in the factor market and a household's preference for telephone use are correlated, it is assumed that ε_{1i} and ε_{2i} are distributed according to a bivariate distribution with $E(\varepsilon_{1i}) = E(\varepsilon_{2i}) = 0$, $\text{var}(\varepsilon_{1i}) = \text{var}(\varepsilon_{2i}) = 1$ and $\text{cov}(\varepsilon_{1i}, \varepsilon_{2i}) = \rho$. Given that both the decision to participate in the factor market and the decision to use a telephone are dichotomous, the likelihood function is a bivariate normal probit.

Assuming that a telephone is a normal good, the use of a telephone is determined by the price of the telephone and its alternative and a household's income. In addition to that, there are two sources, a household's characteristics and information availability at village/community level that determine the demand for information and hence telephone use. The study has estimated the probabilities of telephone use given Z_i , where Z_i includes variables related to information availability, such as distance to the nearest telephone, and the number of telephone users in a village as a percentage of sample size, as described in section-4. The other set of variables that Z_i includes are household characteristics such as income and migration.

Table-10 reports the coefficients of determinants of telephone use estimated by standard probit method and table-11 reports the coefficients of the market participation estimated by bivariate probit that corrects for the omitted variables bias. Note that all the reported coefficients are normalized probit coefficients. Identification of the bivariate probit model requires that at least one covariate in X_i is not included in Z_i .¹³ For this reason, a household's characteristics that have been included in X_i have not been considered in Z_i and vice versa. The covariance between ε_{1i} and ε_{2i} , ρ is equal to -0.0502 with a level of significance of 0.4010. Results reported in table-9 and table-11 are comparable up to a certain extent. As can be seen from table-11, the bivariate probit results are similar to single equation probit estimation; the difference in factor market participation rate between households that use a telephone and households that do not use a telephone is significant and remained at around 8 percent (column three, table-11) or more.

[Table-10 here]

[Table-11 here]

5.2 *Type of Factor Adjustment, Correcting for Participation*

Once a household participates in factor market(s), does the use of a telephone have any impact on which specific factor market the household participates in? It has been seen in section-2 that households that participate in factor markets do not participate in the same way. Among the

households that participate in factor markets, in general, 22 percent of them participate in the labour market only, 20 percent of them participate in the land market only, and 13 percent of them participate in both land and labour markets. For the households who have crossed the participation threshold, what are the characteristics that determine the participation in the labour market or in the land market or in both markets? And does the use of a telephone play any role at this stage?

Equation (4) describes a household's market participation M_i^* as a function of a household's telephone use and observed characteristics. Similar to that, one can define for each household i , the net benefit of participating in a particular market denoted by K_{ij} as a function of information availability and other characteristics denoted by Y_i , and this can be described by the latent variable model:

$$K_{ij}^* = \gamma Y_i + \varepsilon_{3i} \quad (8)$$

Here $j = 1, 2, 3$, and stands for land market, labour market, and both land and labour markets and ε_{3i} is a normally distributed error term with mean zero and unit variance, and γ is the vector of parameters to be estimated.

Since participation in a particular market j for household i is preceded by market participation decision M_i^* given by (4), one observes K_{ij} only for households for which $M_i^* \geq 0$. Following Heckman (1979), the study corrects for this sample selection bias using the same device in probit analysis.¹⁴ Taking into consideration the issue of sample selection bias, (8) can be rewritten for the sub-sample of households for which $M_i^* \geq 0$:

$$E(K_{ij} | Y_i, M_i^* \geq 0) = \gamma Y_i + E(\varepsilon_{3i} | Y_i, M_i^* \geq 0) \quad (9)$$

Denoting ρ as the correlation coefficient between ε_{1i} and ε_{3i} :

$$E(\varepsilon_{3i} | Y_i, M_i^* \geq 0) = \rho \lambda_i \quad (10)$$

where $\lambda_i = f(A_i) / F(-A_i)$, $A_i = -[\beta' X_i]$, and f and F are the standard normal pdf and cdf respectively. Introducing the correction term, equation (9) can be rewritten as:¹⁵

$$K_{ij}^* = \gamma Y_i + \rho \lambda_i + \tilde{\varepsilon}_{3i} \quad (11)$$

¹³ See Maddala (1983, page 229).

¹⁴ See van de Ven and van Praag (1981), where a dichotomous choice is used to correct for sample selection bias.

¹⁵ For a complete derivation see Heckman (1979, pp. 156-77). See also van de Ven and van Praag (1981), pp. 235-39.

where $E(\tilde{\varepsilon}_{3i} | M_i^* \geq 0) = 0$ and $E(\tilde{\varepsilon}_{3i}^2 | M_i^* \geq 0) = \tau_i^2$, and $\tau_i^2 = 1 + \rho^2 \lambda_i (A - \lambda_i)$. Assuming K_{ij} is the observed bivariate state of K_{ij}^* , dividing equation (11) by $\tau_i (\tau_i > 0)$, the estimating equation for the sub-sample of households with $M_{ij}^* \geq 0$ is:

$$\begin{aligned} K_{ij} &= 0 \text{ if } \gamma'(Y_i / \tau_i) + \rho(\lambda_i / \tau_i) + \varepsilon_{4i} < 0 \\ &= 1 \text{ if } \gamma'(Y_i / \tau_i) + \rho(\lambda_i / \tau_i) + \varepsilon_{4i} \geq 0 \end{aligned} \quad (12)$$

where $E(\varepsilon_{4i} | M_i^* \geq 0) = 0$ and $E(\varepsilon_{4i}^2 | M_i^* \geq 0) = 1$.

The study has estimated three types of factor market participation under the above sample selection framework. Table-12 reports the estimated coefficients. In addition to telephone use status as a regressor, it has included a household's factor endowments and factor prices described in section-4. Under the perfect market assumption where agricultural households act as price takers, both labour-adjustment and land-adjustment decisions depend on wages and rent, and on income. For identification purposes, with the exception of telephone use status, the set of variables that has been included in the selection equation has not been included in any particular factor adjustment decision. For all three cases, the selection equation has included the following variables: gender, age, age square, educational level and occupation of the head of the household, and the household's income.

[Table-12 here]

Telephone use status has significant impact on market participation in general, as can be seen from the selection part of table-12. Households that use a telephone are more likely to participate in the market. The signs and coefficients of the selection equation are very much in line with the results of factor market participation that have been derived in the previous subsection.

Table-13 reports the marginal effects of telephones on the type of factor adjustment correcting for sample selection. As can be seen from the table, once a household participates in the market, the use of a telephone does not have any significant impact on the type of factor market participation.

[Table-13 here]

6 Conclusions

One important policy issue concerning agricultural households in developing countries is their selective factor market participation both for land and labour. One reason that has been proposed in the literature for selective market participation of rural households is the imperfect information and the presence of transaction costs. In this study, in the case of Bangladesh it has been seen that if land and labour markets do not function properly, partly because of costly and imperfect information, increase in information availability in the form of access to a telephone may change the functioning of markets and households' market participation.

Using data from a household survey in Bangladesh, the study has found that use of a telephone might increase the farm households' market participation by as much as 10 to 14 percentage points. However, as has been argued in the paper, there is a reason to be concerned that this estimate is subject to an omitted variable bias. One possible source is that the households that are most likely to use a telephone are also those most likely to adopt measures to reduce information imperfection and transaction costs. However, correction of this bias does not eliminate the impact of telephone use on factor market participation: use of a telephone increases factor market participation by at least 8 percentage points even when controlling for possible omitted variable bias.

In addition to the impact of factor market participation in general, the study has estimated the impact of telephones on specific factor market participation using a two-stage probit model. The findings of the present estimation suggest that though the use of telephones increases farm households' land and labour market participation, once a household is already in the market, the use of a telephone does not have any impact on which specific factor market the household is going to participate in.

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Table-1: Observed Factor Adjustment of Agricultural Households in Bangladesh

Factor Market Participation	Land		Labour	
Remain in autarky	107	(37.68)	102	(35.92)
Participate in factor market	177	(62.32)	182	(64.08)
Hired-in/Leased-in	68	(23.94)	131	(46.12)
Hired-out/Leased-out	56	(19.72)	35	(12.32)
Both in and out	53	(18.66)	16	(5.63)
Total	284	(100.00)	284	(100.00)

Numbers in the parentheses are the percentages; source: primary survey.

Table-2: Use of Telephone and Factor Market Participation

Factor Market Participation	Telephone Use Status				Total (%)	
	Yes (%)		No (%)			
No	5	(5.81)	39	(19.70)	44	(15.49)
Yes	81	(94.19)	159	(80.30)	240	(84.51)
Total	86	(100.00)	198	(100.00)	284	(100.00)
Mean of participation	0.942	(0.235)	0.803	(0.399)	0.139**	(0.046)

Numbers in the parentheses are the percentages and standard deviations/errors; **the mean difference is significant at 1% level. Source: primary survey.

Table-3: Availability of Family Labour and Labour Market Participation in Bangladesh

Family size	Labour market participation									
	Remain in autarky		Hired-in		Hired-out		Both hired-in and out		Total	
1-4	31	(34.44)	43	(47.78)	11	(12.22)	5	(5.56)	90	(100.00)
5-6	51	(38.35)	53	(39.85)	19	(14.29)	10	(7.52)	133	(100.00)
7+	20	(32.79)	35	(57.38)	5	(8.20)	1	(1.64)	61	(100.00)
Total	102	(35.92)	131	(46.12)	35	(12.32)	16	(5.63)	284	(100.00)

Numbers in the parentheses are the percentages; source: primary survey.

Table-4: Availability of Family Land and Land Market Participation in Bangladesh

Farm size (in decimals)	Land market participation									
	Remain in autarky		Leased-in		Leased-out		Both leased-in and out		Total	
0-<100	63	(40.10)	48	(30.60)	16	(10.20)	30	(19.10)	157	(100.00)
100-300	31	(33.70)	20	(21.70)	25	(27.20)	16	(17.40)	92	(100.00)
>300	13	(37.10)	0	(0.00)	15	(42.90)	7	(20.00)	35	(100.00)
Total	107	(37.68)	68	(23.94)	56	(19.72)	53	(18.66)	284	(100.00)

Numbers in the parentheses are the percentages; source: primary survey.

Table-5: Adjustments of both Margins: Cross Tabulations

Land→ Labour↓	Remain in Autarky		Lease Land-in		Lease Land-out		Both lease-in and out		Row totals	
Remain in Autarky	44	(15.49)	14	(4.93)	38	(13.38)	6	(2.11)	102	(35.92)
Hire labour-in	44	(15.49)	38	(13.38)	17	(5.99)	32	(11.27)	131	(46.13)
Hire labour-out	15	(5.28)	8	(2.82)	0	(0.00)	12	(4.23)	35	(12.32)
Both hire-in and out	4	(1.41)	8	(2.82)	1	(0.35)	3	(1.06)	16	(5.63)
Column totals	107	(37.68)	68	(23.94)	56	(19.72)	53	(18.66)	284	(100.00)

Numbers in the parentheses are the percentages; source: primary survey.

Table-6: Land and Labour Adjustments: Conditional Probabilities

<u>Labour, given land:</u>		
	<i>(land = 0)</i>	<i>(land ≠ 0)</i>
$P(\text{labour} = 0 \text{land})$	0.41	0.33
$P(\text{labour} \neq 0 \text{land})$	0.59	0.67

<u>Land, given labour:</u>		
	<i>(labour = 0)</i>	<i>(labour ≠ 0)</i>
$P(\text{land} = 0 \text{labour})$	0.43	0.35
$P(\text{land} \neq 0 \text{labour})$	0.57	0.65

Table-7: Use of Telephone and Factor Market Participation: Conditional Probabilities

Market participation	Telephone use	
	<i>(telephone = 0)</i>	<i>(telephone = 1)</i>
$P(\text{mkt} = 0 \text{telephone})$	0.197	0.058
$P(\text{labour} = 1 \text{telephone})$	0.263	0.128
$P(\text{land} = 1 \text{telephone})$	0.152	0.326
$P(\text{land} \& \text{labour} = 1 \text{telephone})$	0.389	0.488

Note: 1 indicates that a household participates and/or uses a telephone and 0 indicates the opposite.

Table-8: Summary Statistics

Variables	Mean	Std.
1. Household Characteristics		
Gender of the household head (Female=0)	0.944	0.231
Age of the household head	46.567	12.737
Education of the household head (illiterate 0, others 1)	0.838	0.369
Occupation of the household head	0.535	0.500
Log of Yearly household expenditure	10.946	0.787
2. Factor Endowments		
Farm size (owned)	154.581	246.195
Household's labour supply	3.785	1.666
Log of average price of land	10.147	0.692
Log of average wage of labour	4.248	0.183
Household member migrated to city	0.130	0.337
Household member migrated abroad	0.180	0.385
3. Information availability		
Telephone use status (users 1, others 0)	0.303	0.460
Distance of the nearest telephone in KM	4.887	5.391
Telephone users as a percentage of sample size	30.282	19.716
Village type (village with telephone=1)	0.158	0.366

Table-8a: Education of the Head of the Household

Level of Education	Frequency	Percent
Illiterate	46	16,20
Can sign only	76	26,76
From Class 1 to 5	48	16,90
From Class 6 to 10	58	20,42
Secondary School Certificate	29	10,21
Higher Secondary Certificate	6	2,11
Graduate	21	7,39
Total	284	100,00

Table-8b: Occupation of the Head of the Household

	Frequency	Percent
Taking Care/Managing the household	27	9,51
Agriculture (crop)	102	35,92
Agriculture (non-crop)	2	0,70
Rural Industry	4	1,41
Agriculture Labour	19	6,69
Non-agriculture Labour	10	3,52
Transport	6	2,11
Govt./Private Service	40	14,08
Business/Trade	54	19,01
Others	18	6,34
Total	284	100,00

Table-8c: Distribution of Household Members' Migration Status

Family members migrated to city	Frequency	Percent
No	247	86,97
Yes	37	13,03
Total	284	100,00
Family members migrated abroad		
No	233	82,04
Yes	51	17,96
Total	284	100,00

Table-9: Effects of Telephone Use on Factor Market Participation*Dependent variable: Factor market participation status (0,1)*

Normalized probit coefficients (marginal effects)

	Model 1	Model 2	Model 3
Telephone use status (yes=1, No=0)	0.1388 (0.03789)**	0.1071 (0.0309)**	0.063 (0.0258)*
Household Characteristics:			
Gender, household's head (Male=1)		0.1075 (0.1679)	0.0904 (0.1679)
Age, household's head		0.0105 (0.0065)~	0.0157 (0.0064)*
Age square		-0.0001 (0.0001)	-0.0001 (0.0001)*
Education (literate=1)		0.0643 (0.0593)	0.0238 (0.0348)
Occupation (Agriculture=0)		0.1136 (0.0381)**	0.0782 (0.0326)**
Ln of household expenditure		0.0093 (0.0213)	0.0042 (0.0148)
Log of farm size			0.0258 (0.0098)**
Log of stock of labour			-0.1053 (0.0392)**
Number of observations	284	284	284
Log likelihood	-117.3185	-78.8387	-65.1347
LR chi2	10.27	87.22	114.63
Probability >chi2	0.0014	0.0000	0.0000
Pseudo R2	0.0419	0.3562	0.4681

Standard errors are in the parentheses. ~Values are probit coefficients, not marginal effects. **, *: Significant at 1%, and 5% respectively.

Table-10: Determinants of Telephone Use: Standard Probit Coefficients (Normalized)

Regressors	Coefficients
Log of household expenditure	0.2893 (0.0444)**
Distance of nearest telephone in KM	-0.0044 (0.0068)
Telephone users as a % of sample size	0.01 (0.0019)**
Family member migrated abroad	0.0581 (0.0275)*
Family member migrated to city	0.0269 (0.0378)
Number of observations	284
Log likelihood	-113.28388
LR chi2	121.75
Probability >chi2	0.0000
Pseudo R2	0.3495
Observed probability	0.3028169
Predicted probability	0.2366276

Standard errors are in the parentheses. **, *: Significant at 1%, and 5%.

Table-11: Factor Market Participation, Bivariate Probit Coefficients (Normalized)

Regressors	Model 1	Model 2	Model 3
User Status (fitted)	0.1726906 (0.0782)*	0.1362 (0.0619)*	0.0806 (0.0481)~
Household Characteristics:			
Gender, household's head (Male=1)		0.1394 (0.1608)	0.0583 -0.1248
Age, household's head		0.0111 (0.0074)	0.0175 (0.0069)*
Age square		-0.0001 (0.0001)	-0.0002 (0.0001)*
Education (literate=1)		0.0981 (0.07)~	0.037 (0.0451)
Occupation (Agriculture=0)		0.1002 (0.0385)*	0.0717 (0.0312)*
Ln of farm size			0.0378 (0.0114)**
Ln of labour supply			-0.0275 (0.0101)**
Number of observations	284	284	284
Log likelihood	-119.94062	-85.3576	-72.9388
LR chi2	5.02	74.19	99.02
Probability >chi2	0.0250	0.0000	0.0000
Pseudo R2	0.0205	0.3029	0.4043

Standard errors are in the parentheses. **, *, ~: Significant at 1%, 5%, and 10%, respectively.

Table-12: Type of Factor Adjustment, Given Market Participation

Covariates	Land Only	Labour Only	Both Land and Labour
Telephone use status (user=1)	0.3456 (0.3538)	-0.4585 (0.3789)	-0.1359 (0.3208)
Log of land price	0.1965 (0.1751)		0.195 (0.1561)
Log of wage		-1.8897 (0.6249)*	0.7553 (0.5514)
Log of initial stock of land	0.0569 (0.0743)		-0.1229 (0.0619)*
Log of initial stock of labour		0.189 (0.2259)	0.0357 (0.1845)
Constant	-3.6906 (1.7786)*	6.793 (2.6806)*	-3.7963 (2.3239)
<u>Covariates for Selection</u>			
Telephone use status (user=1)	0.8436716 (0.3528)*	0.8496 (0.3629)*	0.9501 (0.351)*
Gender of the head of the HH	0.6541 (0.4358)	0.4141 (0.4345)	0.6432 (0.4368)
Age of the head of the HH	0.0923 (0.0415)*	0.099 (0.0444)*	0.1034 (0.0391)*
Age square	-0.0009 (0.0004)*	-0.0009 (0.0005)*	-0.001 (0.0004)*
Education (Illiterate=0)	0.1796 (0.2544)	0.1608 (0.2869)	0.0651 (0.2405)
Occupation (Agriculture=1)	0.6307 (0.1915)**	0.4679 (0.1967)*	0.716 (0.1934)**
Constant	-2.6113 (1.1305)*	-2.387 (1.1172)*	-2.7652 (1.0651)*
Log likelihood	-233.1928	-234.3181	-233.7675
Wald Chi2	40.50	29.77	67.80
Probability > chi2	0.0000	0.0001	0.0000
Number of observations	284	284	284
Censored observations	44	44	44
LR Test of independent equations (rho=0)			
Chi2	6.89	0.06	13.10
Probability > chi2	0.0086	0.8096	0.0003

Standard errors are in the parentheses. **, * Significant at 1% and 5% respectively.

Table-13: Type of Factor Adjustments: Marginal Effects

Covariates	Land market only	Labour market only	Both land and labour market
Telephone use status (fitted)	0.0957 (0.098)	-0.1366 (0.124)	-0.0534 (0.126)
Log of land price	0.0544 (0.0487)		0.0766 (0.0613)
Log of wage		-0.5629 (0.2103)*	0.2967 (0.2163)
Log of initial stock of land	0.0157 (0.0205)		-0.0483 (0.0242)*
Log of initial stock of labour		0.0563 (0.0656)	0.014 (0.0725)

Standard errors are in the parentheses. **, * Significant at 1% and 5% respectively.