Microfinance and Investment: a Comparison with Bank and Informal Lending

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Abstract

Abstract. Using data from a World Bank survey carried out in Bangladesh during the period 1991-1992, we compare the impact of microfinance programs and other types of credit on agricultural investment. After controlling for several measurable determinants of credit agreements, such as interest rates and collateral, estimates still show that microfinance programs are more likely to increase variable input expenditure than informal and bank credit are able to do. This provides evidence that microfinance incentive devices (joint responsibility, peer monitoring, social sanctions, future credit denial in case of default, etc.), perhaps together with other services associated with programs, are effective in order to promote a productive use of funds.

Keywords: Microfinance, Banks, Informal lending, Investment.

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1 Introduction

In recent years, a significant branch of the literature has focused on the impact that microfinance –mainly operating through group lending– has on poverty reduction. Many studies analyze the impact of the major lending programs on some households' and firms' behavior, such as per-capita consumption, labor supply, children school enrollment (Pitt and Khandker, 1997 and 1998; Pitt, 1999), or business profits and revenues (Madajewicz, 1999).

All these studies provide evidence that microcredit programs can reduce poverty through capital provision and through some additional benefits directly linked to program participation (non-credit services), such as financial education, the observation of basic health rules, skill training and consciousness development.

What is not clear is to what extent these programs are better than other types of credit contracts –informal and bank ones– in order to reduce poverty. In fact, impact studies are focused on group-based programs alone, while much of the remaining information concerning other sources of credit is missing. This provides biased estimates for the performance of these programs and gives no room for policy implications concerning the opportunity of replacing traditional credit with alternative instruments, such as group lending.

Moreover, it is crucial to define what we intend by "reducing poverty", and much depends on the time horizon we refer to. In a low income framework, one of the main purposes of lending, and especially of microfinance, should be that of providing the basis for improving standards of living by increasing not only present (credit-based) consumption, but also future (possibly self-sustained) one.

However, in order to achieve self sustainability, credit should not be myopically consumed, but rather invested in productive activities. It is no surprise that this recommendation bears a resemblance to one of the sixteen decisions promoted by the Grameen Bank. It states: "During the plantation seasons, we shall plant as many seedlings as possible".

Therefore, it seems that investment –and savings as well– should receive more attention by the microfinance sector (Båge, 2004). However, to the best of our knowledge, there are no empirical works trying to investigate the impact of microlending programs and other types of credit on investment and this paper tries to shed light on this issue.

Using data from a survey carried out by the World Bank during years 1991 and 1992 in Bangladesh, we compare the effectiveness of group-based lending programs, informal and bank credit on agricultural investment.

We consider three major institutions granting microlending in Bangladesh

(the Grameen Bank, the Bangladesh Rural Advancement Committee, and the Bangladesh Rural Development Board). We also add to this category all other secondary non-government organizations. On the opposite side, we include in the informal class all the loans obtained from landlords, input suppliers, shopkeepers, employers, relatives and friends. Banks are commercial, as well as government owned.

Under the assumption that farmers are input constrained, credit of whatever source should have a positive impact on investment. Following Pitt and Khandker (1998) and Madajewicz (1999) we use three different estimation techniques in order to identify the impact of different lending contracts on investment, starting from Two-Stage Least Squares, then adding two other approaches more suited to address both the problem of the censoring nature of credit and the selection bias that originates from endogenous credit market participation[1].

We find that all credit sources achieve the goal of rising agricultural investment and this can be explained by less binding liquidity constraints. However, after controlling for measurable differences in the structure of the three credit agreements –such as interest rates and collateral[2]– we find that microfinance programs are still more likely than informal and bank credit to positively affect investment. The implication is that some other non measurable factors are supposed to determine the better performance of group lending.

At a first glance one may think about the role of non-credit services, such as the mentioned recommendation of planting as many seedlings as possible. However, this "good-behavior rule", is quite obvious for those who carry out an agricultural activity, independently from the type of lender one may face. And, by itself, it would probably lack enforcement power if incentives were not set up along with the basic statement, like in the case of some other principles included in the sixteen decisions.

In fact, it is not easy that people are willing to follow simple suggestions if they have not convenience to do so. In particular, it has been shown that poorer individuals –the target of microlending programs– have a higher rate of time preference with respect to richer ones (Lawrance,

[1] Much weight has been given to the problem of endogeneity. As Pitt and Khandker (1998) point out, it is possible to summarize the sources of endogeneity in three broad classes, and within these classes it is important to distinguish pure endogeneity from self selection into a particular program. Since the endogeneity argument represents one of the most important features of the econometric exercise, we will discuss this topic in detail further on.

[2] Usually, within a credit agreement, the requirement adopted to enforce the productive use of funds, and debt recovery at the end, is the presence of collateral. However, one of the main features of the Grameen model of microfinance is the absence of any form of physical collateral.

1991). Thus, microfinance borrowers might be tempted to dramatically rise present consumption rather than buying inputs[3].

Conversely, much of the incentives to behave correctly –i.e. invest more and consume less– might reflect the type of punishment that follows a default of the borrower. A considerable number of development economists assert that the strength of microfinance, and particularly of group lending programs, is mainly due the peer monitoring system and the presence of social sanctions for the borrower in case of misbehavior (Stiglitz, 1990; Besley and Coate, 1995; Ghatak and N'Guinanne, 1999).

Social sanctions can be interpreted as reciprocity denial and exclusion from the community life. Typically they are imposed by individuals that are close enough to the borrower so as to be able to observe her/his good or bad behavior at a relatively low cost. These feature is commonly interpreted as a form of social collateral.

Indeed, a very important device set up by microfinance institutions in order to enforce good behaviors –and to increase repayment rates as well– is the joint responsibility of group members for the repayment of the entire sum lent, along with future credit denial imposed to all peers in case of default of the group (joint punishment).

Thus, since net revenues and future credit availability for each peer depend upon the effort of all group members, this stimulates reciprocal monitoring at a relatively low cost and creates the basis for the imposition of social sanctions in case of bad behavior[4].

One may reasonably think that, due to close relationships between borrowers and informal lenders, the latter also have easy access to the information concerning the actions of the former, and can eventually impose social sanctions in case of misbehavior.

However, the effect of this social stigma can end up to be smoothed in informal lending. In fact, some moneylender may disregard effort since she/he can be compensated by physical collateral in case of default. Furthermore, the threat of social sanctions can be ineffective when the relationship is too close (i.e. when lenders are represented by relatives and friends)[5].

[3] "A small income, other things being equal, tends to produce a high level of impatience, partly from the thought that provision for the present is necessary for the present itself and for the future as well, and partly for the lack of foresight and self-control" (Fisher 1930).

[4] As in Dalla Pellegrina (2006), the difference between economic and social sanctions in contracts without collateral is that the former are a share of the borrower's output, which may depend on effort and luck, while the latter are negatively correlated to effort. Hence, the observability of the borrower's actions is a necessary condition in order to apply social rather than economic sanctions.

[5] That is why Grameen requires that group members do not belong to the same

The argument holds to a greater extent in bank agreements, where collateral is more often required (see Section 3) and borrowers' actions are observed only at a relatively high cost due to the considerable distance intercurring between the counterparts.

Our results seem to somehow reflect the ranking described so far with respect to the system of incentives set up by group lending. This ranking shows that microfinance/group lending *unmeasurable* characteristics promote a higher rete of investment –which can be interpreted as a proxy of effort– than any other type of contract, while informal agreements perform better than bank ones.

The rest of the paper is organized as follows. In section 2 we give an overview of the differences between microcredit, banks and informal moneylenders in Bangladesh. Section 3 illustrates the dataset. Section 4 turns to the estimation techniques adopted. In section 5 we discuss results. Finally, section 6 concludes.

2 Microfinance institutions, informal moneylenders and banks in Bangladesh

This section gives a brief overview of the role of microcredit institutions located in Bangladesh and compares these institutions with the informal credit market and banks.

2.1 Microfinance institutions

The major organizations providing microcredit to low income households in Bangladesh are: the Grameen Bank (GB), the Bangladesh Rural Advancement Committee (BRAC) and the Bangladesh Rural Development Board's RD-12 Program (BRDB), together with some other minor non-governmental institutions.

The Grameen Bank, established in 1976 by Professor Muhammad Yunus with the aim of creating a group-based credit system able to serve the poorest of the poor, has now more than 2.4 million borrowers, 95 percent of whom are women. With 1,170 branches, the GB provides services in 40,000 villages, covering more than half of the total villages in Bangladesh.

The positive impact of the GB presence on poor and formerly poor borrowers has been documented in many independent studies carried

household.

out by external agencies including the World Bank, the International Food Research Policy Institute (IFPRI) and the Bangladesh Institute of Development Studies (BIDS).

The BRAC was established as a relief and rehabilitation organization in 1972 after the Bangladesh Liberation War by Mr. Fazle Hasan Abed. Over the years, BRAC has gradually evolved into a large and multifaceted development organization, serving[6] more than 60,000 villages over 86,000 in Bangladesh, corresponding to 4.07 millions of borrowers and covering almost all the country area.

Furthermore, the Agriculture Extension Programme of BRAC aims to increase the nutritional and income status of the rural households by increasing agricultural production through technology transfer and quality input supply. The Agriculture Programme is also running a number of collaborative projects with Bangladesh Rice Research Institutes (BRRI) and the International Rice Research Institute (IRRI).

The BRDB, transformed in 1982 into a nation-wide institution after the success of the Integrated Rural Development Program (IRDP) launched in 1972, is the prime government agency engaged in rural development and poverty alleviation. BRDB basically operates by organizing the small and marginal farmers into cooperative societies for increasing agricultural production through improved means and by forming formal and informal groups of landless men and distressed women who jointly borrow to start income generating activities in the rural areas.

With 63,000 primary agricultural cooperatives promoted and 28% of the beneficiaries that have crossed the poverty line, statistics assess that BRDB is now one of the pioneers in poverty alleviation.

Credit programs offered by the GB, the BRAC and the BRDB, mainly operate through group lending. The system relies on solidarity groups of four to six persons consisting of co-opted members coming from the same background and trusting each other.

2.2 Informal lenders

The class of informal contracts is represented by suppliers and merchants, landlords, relatives and friends. In general, borrowing from informal moneylenders has the advantage of having immediate approval and flexible amounts of money. Moreover, they frequently accord debt renegotiation in case of difficulty with repayment at maturity.

On one hand, loans from suppliers and other merchants are extended to farmers mainly against the standing crops of the current season. Such

[6] As in the case of the GB, credit services also rely on group landing.

loans are almost exclusively short-term based, and are recovered through the purchase of the output at a price agreed in advance, which is always below the market one. Most of the credit provided by these agents is carried out during the flowering or ripening season of the crop, when contractors need advances for inputs.

It is worth to mention that these lenders are often engaged in activities like buying or selling agricultural inputs and outputs, thus they clearly have some advantage in lending to farmers, because this rises the incentives for the latter to trade agricultural inputs and outputs with them.

On the other hand, landlords are typically wealthy persons linked to the borrower by a close relationship and are usually influent members of the community. Typically they set much higher interest rates than microfinance programs[7], and often require physical collateral.

Finally, relatives and friends usually lend at lower interest rates and do not require collateral.

2.3 Banks

The Banking sector accounts for a substantial share of of the financial system (55% of the total) and is dominated by 4 Nationalized Commercial Banks, which together control more than 54% of deposits and operate with 3,388 branches.

There are also five specialized banks. In particular, two of them (Bangladesh Krishi Bank, which is included in our sample, and Rajshahi Krishi Unnayan Bank) were created to meet the credit needs of the agricultural sector. Twenty-eight financial institutions are also operating in Bangladesh although they manage a reduced quantity of funds with respect to commercial and specialized banks.

As common in the literature on less developed countries, the main problem with banks is raised by asymmetric information between lenders and borrowers, often due to the long distance between the two, and also to scarce infrastructures. The consequence of this phenomenon is clearly credit rationing (Stiglitz and Weiss, 1981).

This problem is exacerbated when borrowers are poor and lack any adequate collateral. Thus, bank lending is not very frequent for people living in rural areas of the country.

[7]Interest rates of 150 per cent and more are not difficult to observe. These interest rates are to be compared with 15 to 20 per cent set by program lending. See next section for further details.

3 The data

The dataset consists of a sample of 516 households. These are rice farmers selected from a survey carried out on 1,798 households in rural Bangladeshi villages by the Bangladesh Institute of Development Studies at the World Bank in 1991/92[8].

The original sample consists of three randomly selected villages from each of the 29 districts (thanas) surveyed. In 24 of these districts, a microcredit program (Grameen, BRAC or BRDB) had been in operation for at least three years. A total of 20 households in each village were surveyed.

Traditional rice was the main crop in Bangladesh at the time of the survey[9]. We deliberately focused on this crop because including high yield rice or other crops in the econometric analysis would typically originate a selection problem which is already present in the credit market (see next section for details).

Moreover, although the survey has been conducted three times during the period, we had to concentrate on the Aman season (November-February), which is also called the "peak season" for rice crops, since much information is missing during the "lean seasons".

Table 1 reports statistics emerging from the sample of rice farmers and compares them with those of the full sample. Discrepancies are very small, suggesting that rice farmers do not behave and are not treated differently from the rest of the population surveyed. Therefore, there should be no bias due to sample-selection criteria.

In the sample of rice farmers 222 households borrow from microfinance institutions (65 per cent of total loans made), 66 from informal lenders (22 per cent), and 49 from banks (13 per cent), for a total of 337 borrowing households[10].

Credit of whatever nature is the amount of borrowed funds from each type of lender[11]. Average microloans are 6,622 taka, as compared with

[8] Although microfinance has made further improving steps in recent years, still group lending is the core of credit services provided by these institutions. Informal and bank credit are also granting almost the same services as in 1991/1992. Hence, the dataset seems not to supply aged information with respect to the issues raised in this paper.

[9] At the time of the survey only a few farmers were cultivating high-yield crops. Only after the devastating floods of 1998, some governmental and non-governmental organizations introduced high-yield hybrids.

[10] A few number of households (six) contemporaneously borrow from different sources. In order to avoid correlations among the errors in the estimated equations (see next section) they have been dropped from our sample.

[11] Some authors treat credit as a binary variable. We instead use a continuous measure of principal because a higher investment should not depend on the simple

a lower average principal for informal loans (3,743 taka). The average principal is substantially higher (15,071 taka) for bank loans. Moreover, principal is slightly lower for rice farmers as compared to the entire sample, at least as long as households borrow from microfinance institutions or moneylenders.

Interest rate is 16 per cent on average in both microfinance and bank contracts, as compared with a mean of 50 per cent in the informal credit market. In particular, informal credit rates considerably differ across the sample with a standard deviation of 63 in the full sample and of 61 in the sub-sample of rice farmers[12].

In the dataset there are no observations concerning the value of collateral. However, basing on information about whether collateral has been actually required, a dummy was built and used as a control variable. From Table 1 it is possible to observe that informal moneylenders require some collateral only on 13 per cent of loans, while banks do it on 60 per cent of loans (67 per cent when loans are directed to rice farmers).

[Table 1 about here]

Summarizing, statistics in Table 1 draw the following path: banks grant larger sums with respect to microfinance organizations and informal lenders. Interest rates are almost fixed in microcredit programs and bank loans, while they are considerably higher and volatile on informal ones. However, banks require collateral on a very high share of loans. Collateral is sometimes required in informal agreements –but not often– and never in microfinance programs.

We use a continuous measure of land to capture the role of potential collateral[13]. Following Pitt (1999), we treat land as exogenous with respect to credit. In fact, land market in South Eastern countries like Bangladesh emerges to be very static (see for example results in Rosenzweig and Wolpin, 1985, on Indian survey data). Therefore, it seems plausible to assume that credit is not used to buy land. Moreover, this variable also represents a possible exogenous proxy of wealth.

Besides land we control for two other variables as proxies of collateral, that is the ownership of a house –which in our data emerges to be

choice between borrowing or not borrowing, but rather on total credit availability.

[12]High interest rates might reflect some moneylender's usurious behavior. This possibility has been widely discussed in the literature (see Basu, 1984; Rahman, 1977 and Bhardan, 1979, to mention just a few).

[13]Since actual collateral required is observable only if a household is borrowing money, we cannot use this variable for credit estimation purposes.

sometimes required as a collateral by banks– and transport ownership[14]. Since house and transport dummies are potentially endogenous with respect to credit (they might be bought with a loan) our dummy variables "house" and "transport" take the value 1 only when the item has been inherited, is a gift, or it is part of a dowry.

Investment is interpreted as working capital, that is per-acre variable costs. These costs include expenditure for seeds, fertilizers, pesticides, water and tillage costs[15].

We also consider semi-fixed assets, which consist of the value of bullocks, ploughs and other agricultural equipment[16]. Land is not included among these determinants because, as we discussed above, it is a properly fixed asset in this economy and credit is rarely used to buy land.

Table 2 reports summary statistics on investment and semi-fixed capital stock.

[Table 2 about here]

Investment is 345 taka per acre, with a standard deviation of 422[17]. The stock of semi-fixed assets is 3,007 taka per acre, with a standard deviation of 6,144 (Table 2).

Furthermore, in every regression we include a set of personal variables, such as age and education of household head and spouse, the gender of the household head, the number of persons in the household, their religion, as well as variables such as land tenure (sharecropper or fixed rent).

[14] In the survey, if a person has been granted a loan, he/she is asked whether a collateral has been required by the lender. In case the answer is positive, the borrower is asked to include the collateral in some category. These are: land, buildings, gold, personal guarantee and "other". Since some borrowers choose "other" it is possible that bicycles, motorbikes, hand or horse-carts, boats and rickshaws belong to this category.

[15] We exclude labor costs the analysis for reasons connected with the possible endogenous nature of an instrumental variable (illness) discussed in the following section.

[16] We do not have information on semi-fixed capital flows, since the dataset provides almost all missing values for the difference between the assets owned after the loan has been obtained and those owned before. However, we include this stock measure in order to –at least partially– verify whether credit might have some significant effect on capital. If this were the case, significant impacts on both investment and capital should be weighted in order to assess the better performance of one or the other type of credit.

[17] Labor expenditure per acre is only 12 taka on average, thus its exclusion for reasons due to endogeneity of variable input expenditure (see next section for details) should not dramatically affect it.

The database provides also useful records on the number of relatives who are alive and those who own land. The first variable is very helpful to measure *potential* transfers[18] for the household.

Moreover, the number of relatives who are alive represents a useful measure of the social net surrounding the household, which can be a good support in case, for example, one aims at forming a group in order to borrow from microfinance institutions.

Finally, dummy variables are built in order to correct for district fixed effects[19], including prices of various goods, which are common to each community. We summarize all variables in the Appendix.

4 Estimation techniques

The empirical work aims at testing whether microfinance programs are effective in inducing a reduction of the quantity of funds used for unproductive purposes and an increase of investment. The empirical work seems interesting from at least two standpoints.

First, it is widely assessed that bank loans are extremely inefficient in order to promote borrowers' effort in a setup where substantial asymmetric information occurs (Stiglitz and Weiss, 1981; Ghosh et al., 2000). Conversely, the presence of social ties and the mechanism of peers' delegated-monitoring can make group lending work in such contexts. Thus, it seems interesting to check if data are consistent with theory. Second, what occurs in the informal sector, where social ties are likely to be effective and possibly incur in determining borrowers' attitudes towards effort?

In order to pursue the objective we have in mind we need to investigate the mechanism underlying the process of selection into each credit market. This is a crucial issue in order to address the problem of the endogenous nature of credit with respect to investment and the paucity of instruments available to correct for this bias.

So far, the selection mechanism for microfinance loans has been deeply investigated (Pitt and Khandker, 1998). One of its main exogenous determinants has been recognized to be the eligibility rule for programs, that is the ownership of less than 0.5 acres of cultivable land. Thus, informal and banking sectors might be residual markets for all individuals that are rationed out of microcredit programs.

[18] A large literature provides evidence for the endogeneity of *effective* transfers in similar contexts (Guiso and Jappelli, 2002).

[19] Village fixed-effects cannot be used due to the relatively low number of observations in the sample.

However, it may also be the case that some agents choose to self-select into other markets for different reasons, like a particular relationship with the lender, the need of contract terms flexibility, or even because, given the known unproductive destination of funds, they are excluded from group formation. Nonetheless, the empirical analysis is extremely precious to shed light on factors that push borrowers towards the informal market or banks.

In this section we present the equations estimated in the econometric exercise, then we briefly discuss some sources of endogeneity that frequently arise when dealing with selection issues. Finally, we illustrate in detail the used estimation procedure.

4.1 The equations

We estimate the investment (equation (1)), conditioned on the total amount of credit borrowed (equations (2)-(4)) and on a set of control variables representing household preferences and technology.

The complete set of reduced form equations estimated is the following:

$$A_{ij} = X_{ij}\alpha_A + Z^A_{ij}\beta_A + C^N_{ij}\gamma_A + C^I_{ij}\delta_A + C^B_{ij}\lambda_A + \mu_{jA} + \epsilon_{ijA} \quad (1)$$

$$C^N_{ij} = X_{ij}\alpha_N + Z^C_{ij}\beta_N + \mu_{jN} + \epsilon_{ijN} \quad (2)$$

$$C^I_{ij} = X_{ij}\alpha_I + Z^C_{ij}\beta_I + \mu_{jI} + \epsilon_{ijI} \quad (3)$$

$$C^B_{ij} = X_{ij}\alpha_B + Z^C_{ij}\beta_B + \mu_{jB} + \epsilon_{ijB} \quad (4)$$

where i stands for household, which is the unit of observation, and j refers to the district.

A_{ij} is per-acre investment; C^N_{ij} is the cumulative quantity of credit borrowed by the household from GB, BRAC, BRDB and NGOs; C^I_{ij} is the cumulative quantity of informal loans, and C^B_{ij} is the cumulative quantity of bank loans.

X_{ij} are general characteristics of the household common to all equations (such as religion, age of the household head and education, number of household members, and a dummy capturing if the household head is male) as well as technological features (land tenure).

Z^A_{ij} are either measurable characteristics of credit contracts such as actual interest rate and collateral required[20], or elements that affect investment behavior but not credit; while Z^C_{ij} are characteristics of the

[20] As we previously mentioned, these cannot be used to determine credit transactions since credit is censored and we observe these variables only if credit is positive.

household that affect credit transactions but not other household's estimated behaviors (total land owned and other measures of potential collateral)[21].

μ_{jN}, μ_{jI}, μ_{jB} and μ_{jA} are district specific-effects, while ϵ_{ijN}, ϵ_{ijI}, ϵ_{ijB}, and ϵ_{ijA} are idiosyncratic errors, such as $E(\epsilon_{ij.}|X_{ij}, Z^C_{ij}, \mu_{j.}) = 0$ in equations (2)-(4), and $E(\epsilon_{ij.}|X_{ij}, C_{ij}, Z^A_{ij}, \mu_{j.}) = 0$ in equation (1). The covariance matrix is assumed to be diagonal[22].

In the next subsection we discuss some endogeneity issues concerning the relationship between our variables C^N_{ij} and A_{ij}, then we illustrate the estimation procedure and the set of available instruments adopted to solve for the bias arising from this problem.

4.2 Sources of bias

As pointed out by Pitt and Khandker (1998), the sources of bias that may arise when treating programs effects can be summarized into three major classes.

The first class originates from nonrandom placement of credit programs. This problem mainly concerns microfinance credit and may be due to the fact that programs are most frequently allocated in poorer districts or more flood-prone areas. Treating program placement as random can lead to a downward bias of program effects, as discussed in Pitt, Rosenzweig and Gibbons (1993) and Heckman (1990). The same argument holds for banks, that may not be uniformly distributed across the sample.

The second class of bias is related to unmeasured district attributes that affect both credit transactions and household behavior. Climate conditions and a high propensity to natural disasters, among the others, are important characteristics affecting both these variables, especially when dealing with agricultural aspects. We correct for these two forms of bias using district fixed effects in both credit and investment equations.

The last source of bias concerns unmeasured household features that affect both credit transactions and household behavior (selection mechanism). These are intrinsic characteristics or personal qualities, like ability and individual aptitudes: it may occur, for example, that more skilled farmers are also more able in obtaining one type of credit, and this would wrongly attribute to that type of credit the higher investment that might instead be due to a higher ability.

[21] Variables included in Z^C_{ij} cannot be interpreted as exogenous instruments since they can be correlated with the term ϵ_{ijA}.

[22] Two out of three estimation techniques adopted provide evidence of no correlation among the errors of the equations in the system (see next sections for details).

Such unobservable characteristics may originate the endogenous nature of credit with respect to investment. In fact, the decision of borrowing and the choice of a specific credit market can be driven by some unmeasurable factor falling in the error term. Problems of this kind are traditionally solved using instrumental variables when these are available.

The selection system originated by programs exogenous eligibility rules or by the presence of an exogenous shock can be exploited to correct for the market selection mechanism. In fact, in order to solve the problem of endogeneity of different nature, we need to augment the Z^C matrix with variables that are not correlated with the error term of both cumulative credit and investment equations.

Finally, another source of bias not related to endogeneity is the censoring nature of credit. In the sample of traditional rice farmers, investment is a continuous variable, but only a portion of these households is borrowing money. Credit is thus censored in equations (2)-(4).

Thus, specific Tobit or selection models are set up in order to correctly estimate censored cumulative credit. Moreover, by means of the selection model we are able to generate further instruments for cumulative credit, namely the Mills ratio found in the first stage of the selection procedure. We will illustrate the methodology used to correct biases in the following section.

4.3 Estimators

Pitt and Khandker use a quasi-experimental survey design to provide statistical identification of program effects in a LIML context. They identify the effect of participation in a credit program on some households outcomes exploiting the information coming from not eligible households in program districts and the exogenous rule of half an acre of land as a proxy for eligibility.

However, this information is relatively weak in order to instrument informal credit in particular, which is available in every village and does not imply any eligibility rule. Moreover, the presence of a lager number of equations makes that method cumbersome in our case.

The estimation procedure illustrated below goes through the following scheme: first, we adopt an estimator that treats the problem of endogeneity of credit by augmenting the matrix Z_{ij}^C with exogenous instruments. We further consider the issue of the censoring nature of credit and the possibility of detecting some credit market selection mechanism from household measurable characteristics.

The first technique is a Two-Stage Least Squares (2SLS). Here we use fixed effects to correct for nonrandom allocation of credit and unmeasured district characteristics that affect both credit transactions and household investment. Instruments[23] are also used to further correct for unmeasured household features that affect both credit transactions and investment.

However, as described above, 2SLS techniques do not consider the censoring nature of credit. Thus, a Two-Stage Tobit estimator (2STobit) is adopted to treat all sources of bias cited above together with the censoring nature of credit.

A third estimator based on Heckman (1976) also makes the market selection device explicit in the credit transaction equations correcting for the fraction of selection bias that is ascribable to its observable determinants.

The way 2STobit and Heckman estimators are built follows the procedure of instrumental variables, that is replacing endogenous regressors with their expected value in order to eliminate unmeasurable error components, but there are clearly several differences in the way the predicted values of the endogenous variables are computed.

The 2STobit uses a Tobit model to estimate predicted credit transactions, augmented with all exogenous instruments for credit. The predicted expected values of credit are then plugged into the behavioral equation for investment (1)[24] and finally these are estimated with standard maximum likelihood techniques.

Predicted values are computed in the following way:

$$\widehat{C} = E(C|X_{ij}, Z_{ij}^{C}, \widehat{\beta_C}, \widehat{\sigma_\varepsilon^C}) = \int_0^\infty C^* f(C^*|X_{ij}, Z_{ij}^{C}, \widehat{\beta_C}, \widehat{\sigma_\varepsilon^C})\ dC^* \qquad (5)$$

where $C = C^N$, C^I, or C^B.

The Heckman estimator follows the same procedure as the one described above, but this method includes a credit market selection correction term which is used as an additional instrument for credit. In general, sample selection bias refers to problems where the dependent variable is only observed for a restricted, non-random sample. In this particular case, one only observes household cumulative program borrowing if the household has joined a program. Conversely, household

[23] See next sub-section for a discussion on available instruments.

[24] We also estimated a different version of the 2STobit and Heckman models, using the corrected fitted values of endogenous variables as instruments for the actual ones, together with all other exogenous instruments. However, results did not deeply changed with respect to the Two-stage method illustrated above.

cumulative informal or bank borrowing are observable if the household has agreed to an informal or a bank contract.

We thus estimate a first stage Probit model to predict the probability of participation and in the second-stage, we estimate the expected value of cumulative borrowing including inverse Mills ratios as regressors.

According to this type of model, the participation effect does not show up as an eligibility dummy variable (an exogenous proxy for participation), but rather in the fact that the constant terms and betas may differ from the sample of program borrowers to that of informal borrowers. Predicted values of credit are computed according to (5).

4.4 Instruments

As we discussed above, endogeneity basically arises due to some unmeasurable qualities, like ability and individual aptitudes that are correlated to both credit demand and investment.

We first use an exogenous measure of eligibility for credit program participation to instrument credit. In fact, for some microcredit programs, such as the Grameen, the ownership of less than half an acre of cultivable land[25] constitutes the main eligibility rule. Pitt and Khandker (1998) argue that credit is rarely used to buy land due to the static features of the land market in Eastern Asia. Hence, the ownership of less than half an acre of land seems a suitable instrument since it is exogenous with respect to credit[26].

Since our sample includes both eligible and non eligible households for microcredit programs, we built a dummy variable named "target" which takes the value 1 if a household is eligible for entering a microfinance program and zero otherwise.

From Table 3, one can observe that 84 per cent of rice farmers that borrow from microfinance institutions fulfil the eligibility criteria for a program, while among informal borrowers 65 per cent own less that half an acre of land. Bank customers are instead less frequently eligible for programs (39 per cent).

From these data we can presume that eligibility induces borrowers to self select into program lending, and possibly that it discriminates

[25] So far, the use of this eligibility rule as an instrument has been a widely debated issue. See Morduch (1998) and Pitt (1999).

[26] Controlling for land –and also for land owned by parents and other relatives– should capture the wealth status of the household. This leaves the error term in each equation free from wealth components and should not arise endogeneity issues due their presence. However, ability and individual aptitudes are still non measurable and still may involve some bias.

among non eligible households that, by contrast, are conveyed towards bank lending. However, the fact that 65 per cent of the households borrowing from moneylenders are eligible for microfinance programs, induces thinking that non eligibility is not the main reason that pushes borrowers to look for informal financing.

At this point is worth thinking about the characteristics of informal lending. We discussed so far about the particular flexibility granted by informal lenders with respect to the amount borrowed and the possibility of debt renegotiation in case of difficulty with repayment at maturity. This flexibility becomes crucial when households have to face unexpected shocks[27].

In particular, one looks for flexibility when the causes that induce borrowing are associated with uncertainty for the future. Think for example about a serious disease. It is not easy to know at the time of diagnosis how will a certain person react to drugs, and how long it will take to recover. Thus flexibility –in particular in the reimbursement schedule– becomes a strong determinant in order to select a lender.

In the dataset we have information about cases of illness in each household. Some of them seem to be endogenous due to correlation with personal features like behavioral attitudes and ability, that can be present in the error term of the investment equation.

However, as opposite to other types of illness[28], a bacterial infection[29] like tuberculosis cannot be easily connected with unmeasurable personal characteristics of the household, such as ability. Neither it seems to be correlated with our exogenous proxies of wealth or with average loan principal[30].

[27] See for example Udry (1994).

[28] We also have observations concerning stomach problems, diarrhea, flu, which might be avoided through better hygienic standards or other kinds of precautions. However, the fact of adopting these correct behaviors can be connected with ability. For example, a more informed individual can avoid these types of illness via correct hygiene behaviors and can also acquire more information regarding investment strategies.

[29] Tuberculosis (TB) is an infectious diseases of man and other animals caused by species of Mycobacterium. It is primarily spread by coughing and sneezing and is more frequent in highly populated countries (especially in South.Eastern Asia) and urban centers. For more detailed information see the World Health Organization website (www.who.int).

[30] Tables A6 and A7 in the appendix reports some t-tests for equal means across the sub-samples of households whose members have been affected by tuberculosis and households whose members have not. Statistics in Table A6 provide evidence that there is no correlation between tuberculosis and our proxies for wealth (i.e. land owned by the household members and their relatives). Thus in our sample it does not seem that richer individuals are less affected by the desease than poorer ones. Moreover (Table A7), the null hypothesis of equal average principal for households

Moreover, tuberculosis requires a long time and continuous treatment to recover, thus credit is supposed to be used to finance such large expenditures. Due to these characteristics we use the number of cases of tuberculosis in order to instrument credit, and particularly informal credit[31].

In Table 3 we also report statistics concerning other deseases –measles and malaria– that may randomly affect household members. However, due to their scarce incidence in our sample, we cannot rely upon them as very powerful instruments.

[Table 3 about here]

5 Results

In this section we present estimates of the model described by equations (1-4). Results are reported in Tables 4-6. Table 4 refers to credit market selection mechanism; Table 5 refers to cumulative credit transactions, and Table 6 illustrates the estimated parameters for investment.

In this section we discuss results obtained with the most reliable among the three econometrics techniques previously described. In fact, as we already mentioned, only the Heckman procedure accounts for all biases due to endogeneity, censoring nature of credit and self-selection.

We leave all the results provided by the other two techniques in the Appendix. In particular, Tables A2-A4 and A3-A5 refer to 2SLS and Tobit estimation respectively. Tables A4 and A5 instead focus on the estimation of the investment equation.

5.1 Credit market selection

Table 4 reports estimates of the first stage (Probit) of the Heckman procedure. Participation effects are evident in this case. First of all, it is possible to observe that the eligibility rule based on half an acre of land positively and significantly affects participation in microfinance programs (second column)[32].

Furthermore, the parameter associated to the variable "target" in the estimation of bank lending (fourth column) is negative. The fact of

whose members have or have not been affected by TBC is not rejected.

[31] From Table 3 it is evident that a higher presence of household whose members have been hit by this disease is registered in the informal credit market.

[32] This is in line with Pitt and Khandker (1998).

being a target household is instead not significant for participation in the informal credit market (third column). This evidence has as least two possible explanations.

This result provide a first evidence with respect to targeting rules. On the one hand, the choice of microfinance institutions to provide credit to landless households may induce rationing for landed households, who are more likely pushed towards bank lending rather than towards the informal market.

On the other hand, it is possible that landed households have more access to bank lending since they are endowed with collateral –which is more often required in bank loans than in other types of contracts, as we saw in Table 1– and they voluntarily choose to borrow from banks rather than from other credit providers[33].

A corollary of these arguments, supported by the non significance of the dummy "target" in the informal market participation equation, is also the possible voluntary or forced choice –not determined by land endowment– to borrow from the informal sector. This occurs even if some terms of the agreement are not convenient with respect to other types of credit (interest rates).

Indeed, a significant determinant of the choice to borrow from informal lenders is our measure of adverse shocks, captured by the cases of tuberculosis within a household[34]. This phenomenon is not present in microfinance and bank loans. There are several explanations that may account for it.

First, it is plausible that the destination of a loan is less likely to be productive where the borrower has been hit by a shock (e.g. in case of an injury sums are often used to buy medicines or to pay doctors). Thus, peers may not be willing to form a group with people suffering shocks. Hence, a negative event may end up to be a factor that creates rationing in microfinance programs due to group selection mechanisms.

Second, banks may or may not be informed about shocks occurred to potential customers and the relatively high risk embedded in a non productive loan. If they are informed, they will be reluctant to lend, unless the market value of collateral is greater than the sum due at maturity. If they are not, it is even possible that collateral has such a high value for his/her owner that he/she prefers to resort to other forms of lending rather than facing a high probability of loosing it. Also in this

[33] This effect is in line with Madajewicz (1999), who shows that the impact of peer monitored loans on profits declines with wealth among the poor, relative to the impact of individual loans.

[34] As expected, measles and malaria are not significant in our regressions, possibly due to the extremely low number of observations.

case we end up with a form of credit rationing. This and the previous argument may explain a forced choice of informal markets in case of idiosyncratic negative shocks.

Third, as previously mentioned, the flexible structure of informal credit, is likely to be particularly appealing in situations where an adverse shock occurs to the household. In fact, despite the presence higher interest rates, informal lenders are more flexible (Tibmerg and Ayiar, 1984) and more willing to grant terms renegotiation in case of difficulty. This might explain a voluntary choice of informal markets in case of idiosyncratic negative shocks.

Pushing further the empirical analysis in order to gauge more information on which is the stronger effect among those described so far, is certainly a difficult task given the scarce number of available observations on informal agreements. However, exogenous factors driving the choice of borrowers towards informal lending, bank credit and microfinance, suggest that informal credit market may represent a complement of microfinance and bank lending, rather than a substitute of the remaining two.

In particular, it seems that when some project is planned, households are more likely to resort to microfinance institutions or banks in order to get financed, and they split between these two markets basing on land status. Conversely, when facts are unexpected and future events involve high uncertainty, households end up to be financed by informal moneylenders, either because they cannot access the other markets (too much risk) or by voluntary choice (possibly driven by high flexibility features of this market).

Turning to the other determinants of credit choice, we find that the number of siblings alive is a positive and highly significant determinant of access to microfinance (second column). This possibly supports the idea, already mentioned in previous sections, that the social network surrounding the household may be extremely important to both achieving a good knowledge of the opportunities offered by microfinance institutions and to easily constitute a group.

By the same token, it is quite plausible that the high significance of the sharecropper status in order to access informal credit (third column) is due to a strong relationship with the landlord, who is also likely to be a moneylender.

It seems that owning a house has a positive and significant effect in inducing participation to microlending. However, this result should be taken carefully. Microfinance institutions, in fact, try to raise consciousness recommending their participants to build up their own houses. Therefore, we suppose that the high significance of the parameter is due

to the effectiveness of this advice but it is also extremely endogenous.

Finally, Islamic religion[35] negatively affects microcredit participation. This result may have several explanations. One example could be the compliance with Islamic religious customs, which do not allow pre-arranged interest rates, but rely instead on profit and loss sharing principles[36]. Indeed, this is also reflected in the negative sign of bank participation. Informal lenders may instead accord more flexibility in interest rates arrangements as well. The negative relation between Islamic religion and partipation to microfinance programs may also represent a wealth effect. In fact Islamic, rather than Hindu households, are on average richer.

[Table 4 about here]

5.2 Cumulative credit

Results in Table 5 show that informal borrowing mainly grows with the quantity of land owned and it is highly plausible that this captures the role of land as a collateral[37]. In fact, since moneylenders are often landlords, this form of guarantee can be particularly appealing for them.

Another interesting feature is the positive effect that land owned by siblings has on bank lending (third column). This should reflect the fact that banks often accept personal guarantees from close, and obviously richer, relatives.

This feature is reversed in informal loans with regard to children owning land [38] (third column), meaning that the higher the number of daughters and sons owning land, the lower the amount of informal credit borrowed from moneylenders. This may be explained by wealth effects. In fact, when one has many children owning land she/he is supposed to be richer. If it is true that informal lending occurs following unexpected negative events, it is possible that richer households use their own savings to face these shocks.

Land seems to be the only collateral required, since the dummy that identifies whether other assets –a house or transport– has been inherited

[35] The dummy takes a value of 1 if the religion of the households is Islam and zero if religion is Hindu.

[36] See for example Lewis and Algaud for details on Islamic financial contracts.

[37] With 2SLS estimation techniques (see Table A2 in the Appendix) is possible to observe that this evidence is also present in bank lending.

[38] See also Table A3 in the Appendix where this effect is also evident in microfinance. However, we should take these results carefully since the Heckman estimation procedure does not provide significant results.

is not significant. However, this statement must be taken carefully. In fact, land represents a proxy of the wealth status of a household[39]. Thus, it may be positively correlated with other assets ownership, like gold, which is also frequently required as a loan guarantee.

Other controls, such as age, education, gender of the household head, etc. are almost never significant in our regressions.

Finally, it is worth to observe that Mills lambdas are negative and significant in each estimated equation for cumulative credit. Thus, the higher the probability of participation in a given credit market –identified by factors such as negative shocks or land ownership– the lower the sum borrowed in that market. This seems quite reasonable, at least for microfinance and informal credit.

[Table 5 about here]

5.3 Investment

Table 6 (second column) reports estimates of the impact of the three different types of credit on investment.

Program credit parameter is positive and significant at 1 per cent level, while informal and bank credit are positive and significant at 10 per cent level in the investment equation. Moreover, where they are significant, informal and bank credit parameters are lower than microfinance ones.

As a consequence, our results show that microlending has a higher impact than informal and bank credit on investment and that bank loans have the lowest impact. These discrepancies should not be ascribable to any feature of credit agreements which is not specified in the regressions, in particular neither to the cost of credit nor to the presence of collateral.

Differences should instead reflect all the characteristics of microlending that are not included as regressors in the investment equation. These features may include the role of non credit services, the monitoring system set up by peers, the presence of social sanctions and future credit denial in case of default[40]. As discussed in the previous sections, these

[39] As it occurs for borrowers, the measure relatives' wealth can be captured by land ownership. Moreover, the presence of borrowers' and relatives' land ownership is extremely important in order to clear residuals from components that might reflect income or wealth and that may be correlated with our instruments.

[40] Some of may represent incentives that are positively linked to the presence of social ties. This could also explain the difference between the informal and bank credit estimated parameters.

elements are considered the strength of microfinance and seem to be effective in order to promote a responsible use of sums borrowed.

In order to test wheter borrowed funds are diverted toward the acquisition of other inputs, in the third column we also report estimates for semi-fixed capital stock. We find that credit of whatever nature has a non significant effect on it. Our interpretation for these findings is that credit is not used to buy expensive assets. Conversely, household that need to borrow are strongly input constrained. In fact, the negative sign of the (although not significant) parameters suggests that borrowers own on average less semi-fixed assets as those who are not borrowing.

Paying attention to the other determinants of investment, and according to the theory (Ghosh, Mokherjee and Ray, 2000), we expect that, if investment is interpreted as effort, interest rate should have a negative impact on it while collateral should do the opposite. These elements emerge from our estimates, particularly with respect to interest rates[41].

Islamic religion plays a positive role in determining investment. As we discussed above with regard to credit market participation this could again represent a wealth effect.

Total area cultivated negatively affects investment, as well as the stock of semi-fixed assets. This is obviously no surprise due to decreasing returns.

Semi-fixed assets are also positively affected by the education of the household head and the number of children alive. The first might in part be a wealth effect –educated persons are also richer– while the second might be an inter-generational one. In fact, farmers who have many children are perhaps more willing to hold fixed assets that tomorrow will be inherited by their children.

Finally, parents owning land also negatively determines the stock of semi-fixed assets. The reason can be that in low income and high solidarity environments people borrow expensive assets to their relatives rather than buying them (for example the same plough may be used by many farmers during the same crop season).

[Table 5 about here]

[41] We also estimated a model without interest rates and collateral as controls in equation (1). Results do not substantially change with respect to credit parameters, possibly supporting the fact that all discussed devices set up by microfinance programs are more effective than traditional ones (i.e. collateral).

5.4 Robustness

Comparing results of the Heckman selection model with those reported in the Appendix for the other two estimation techniques, it seems that endogeneity in the credit market[42], together with other possible biases arising from the censored nature of credit and self-selection mechanisms, are relevant issues[43].

Possibly for this reason, 2SLS (Table A4 in the Appendix) provide non significant parameters for all types of credit, while estimates start becoming significant once we adopt models that account for biases (2STobit and Heckman). In particular, parameters associated to informal and bank lending are not significant unless we correct for market selection with the Heckman procedure.

Furthermore, Sargan (1958) test for overidentification (statistics are reported at the bottom of Tables 6, A4 and A5) does not reject the joint null hypothesis that the excluded instruments are valid and the model is correctly specified.

Finally, the hypothesis of no correlation among the errors of the equations in the system could not be rejected at 1 per cent significance level for all equations in the Tobit and Selection specifications[44]. Therefore, our choice to separately estimate equations (1-4) seems appropriate.

[Table 6 about here]

[42] In fact, Hausman-Durbin-Wu (Durbin, 1954; Wu, 1973; Hausman, 1978) test for endogeneity rejects the null hypothesis that an OLS estimator yields consistent estimates in the variable inputs equation. Durbin-Wu-Hausman Chi-sq statistic for variable inputs is 10.679. The opposite holds for the semi-fixed assets equation (Chi-sq=0.271). However, for coherence in the estimation procedures we use instruments for the semi-fixed assets equation as well. This would provide less efficient (but consistent) estimates.

[43] As an example, suppose that the sharecropper status is a positive determinant of informal market participation, as it actually is. By estimating an equation where the dependent variable is total amount of loans with a 2SLS or 2STobit, one may infer that sharecroppers borrow a higher quantity of money from informal lenders (see table A2 in the Appendix). However, this might not be the right interpretation, since it does not distinguish among the higher propensity for this category of farmers to borrow from informal lenders (participation effect) and the quantity of funds they are able to rise (volume effect). The comparison between results of the first and the second stage of the Heckman model can help disentangling this problem.

[44] However, the test on 2SLS brings ambiguous results, since it does not reject the null hypothesis of no correlation between microlending or bank credit and variable inputs, while it does for informal credit.

6 Conclusions

As a consequence of the rapid growth of microfinance, a considerable number of papers concerning the impact of these lending programs on poverty reduction has been written so far. Many studies analyze the effects of the major institutions, like the Grameen Bank, on some household behavior and most part provide evidence that microcredit programs can reduce poverty through productive capital provision.

However, there are no works focusing on investment. Moreover, there is no attempt to compare the impact of different credit agreements on households behaviors.

Using data from a World Bank survey carried out in Bangladesh during the period 1991/1992, we estimate and compare the impact of microfinance –mainly operating through group loans– and other credit contracts –informal and bank ones– on agricultural investment.

Results show that borrowers belonging to a group lending program invest more in variable inputs than borrowers who receive loans from an informal lender or a bank. These findings should not be ascribable to any measurable feature of credit agreements, in particular to interest rates and collateral required, which have been taken into consideration while running our estimates.

Regression outcomes are more likely to provide evidence that unmeasurable characteristics of microlending are effective means to promote borrowers' effort and a responsible use of funds.

Incentives set up by microfinance institutions in order to minimize the rate of project defaults –the peer monitoring system, social sanctions and future credit denial in case of default, together with some non credit services– are almost all non measurable elements, and possibly account for a large portion of the difference in the estimated parameters for the three types of credit.

Furthermore, in order to solve the problems of endogeneity and censoring nature of credit, we obtain interesting information on credit market selection mechanism.

We find that household who participate to program lending are landless, as predicted by the Grameen and other similar programs' eligibility rules set up to select poor households. Conversely, owning land, and having relatives who own land allows a privileged access to bank lending, possibly due to a collateral effect. But land ownwership may also imply that bank borrowers are more likely to be rationed from microfinance programs.

Informal credit is instead frequently chosen by agents who are subject to an adverse shock –such as a serious desease– and perhaps require flexibility in the structure of the credit agreement, with particular attention

to the repayment schedule. Another interpretation which is compatible with our results is that informal borrowers may suffer rationing by other lenders due to the high riskiness associated with the use of their loan.

Finally, microfinance borrowers have a more solid relationship net within the community where they belong –as measured by the number of relatives alive and living in the village– and this perhaps allows them to easily find contacts in order to constitute or have access to a group. In contrast, we find that informal borrowers have a specific bilateral relationship with the lender (as in the case of sharecroppers and landlords).

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TABLES

Table 1 – Credit and terms conditions

	Full Sample[†]	Rice Farmers[† †]
MICROFINANCE PROGRAMS:	816 households	222 households
Average Principal (taka)	7,546	6,622
	(6,827)	(5,091)
Interest Rate (%)	16.3	16.3
	(0.6)	(0.4)
Collateral (% loans requiring -)	0.014	0.016
	(0.11)	(0.12)
INFORMAL CREDIT:	172 households	66 households
Average Principal (taka)	4,449	3,743
	(4,834)	(3,222)
Interest Rate (%)	49.6	50.3
	(62.6)	(61.2)
Collateral (% loans requiring -)	0.13	0.13
	(0.34)	(0.34)
BANK CREDIT:	96 households	49 households
Average Principal (taka)	13,644	15,071
	(51,587)	(63,150)
Interest Rate (%)	16.0	16.0
	(0.3)	(0.5)
Collateral (% loans requiring -)	0.60	0.67
	(0.49)	(0.47)

Standard errors in parenthesis
[†] 1,798 households, among those 1,084 are borrowers
[† †] 516 households, among those 337 are borrowers

Table 2 – Investment and semi-fixed assets	
Per-acre investment in variable expenditure (taka)	345
	(422)
Per-acre stock of semi-fixed assets (taka)	3,007
	(6,144)
Standard errors in parenthesis	

Table 3 - Instruments	
MICROFINANCE PROGRAMS:	222 hh
Hold Less than 0.5 Acres of Land (target)	84 %
TBC	5 %
Malaria	0.8 %
Measles	1.3 %
INFORMAL MARKET:	66 hh
Hold Less than 0.5 Acres of Land (target)	65 %
TBC	13 %
Malaria	0.8 %
Measles	0.4 %
BANKS:	49 hh
Hold Less than 0.5 Acres of Land (target)	39 %
TBC	4 %
Malaria	0.4 %
Measles	0.4 %

Table 4 – Credit Market Selection (First Step Heckman Estimation Procedure)

Dependent variable is: obtain loan (dummy)	MF Programs	Informal Credit	Bank Credit
Religion	-0.339*	0.121	-0.073
	(0.199)	(0.308)	(0.416)
Tenure: Fixed rent	0.166	-0.041	-0.061
	(0.205)	(0.221)	(0.307)
Tenure: Sharecropper	0.011	0.553***	0.447*
	(0.191)	(0.203)	(0.239)
N. parents own land	-0.027	0.066	-0.130
	(0.108)	(0.132)	(0.173)
N. siblings own land	-0.054	0.018	0.035
	(0.038)	(0.039)	(0.045)
N. daughs.-sons own land	-0.018	0.019	-0.022
	(0.051)	(0.037)	(0.044)
N. parents alive	-0.071	-0.178	-0.225
	(0.111)	(0.123)	(0.153)
N. siblings alive	0.085***	-0.018	0.004*
	(0.032)	(0.032)	(0.002)
N. daughs.-sons alive	0.040	-0.001	-0.007
	(0.031)	(0.028)	(0.035)
Land owned	0.319***	-0.004	0.008
	(0.120)	(0.026)	(0.031)
Own a house	1.130***	-0.201	0.112
	(0.247)	(0.298)	(0.329)
Own transport	-0.797	1.166*	-4.894
	(0.786)	(0.691)	(0.000)
Target	22.765***	-0.360	-1.143***
	(1.167)	(0.225)	(0.268)
Injured (TBC)	-0.206	0.753**	-0.210
	(0.393)	(0.309)	(0.481)
Constant	-22.808	-1.481	-6.882
	(0.000)	(1.411)	(0.000)

Standard errors in parentheses
*significant at 10%; ** significant at 5%; *** significant at 1%

Other controls: age of the hh head, age of the hh spouse, education of the hh head, education of the hh spouse, gender of the hh head, number of persons in the household, other relatives own land/alive, malaria, measles

Table 5 – Cumulative Credit (Second Step Heckman Estimation Procedure)

Dependent variable is: Cumulative credit (in taka)	MF programs	Informal Credit	Bank Credit
Religion	-1,728.480	-1,451.052	-24,245.903
	(1,056.152)	(2,503.150)	(35,143.413)
Tenure: Fixed rent	-750.010	220.043	28,339.855
	(790.298)	(1,689.410)	(26,127.136)
Tenure: Sharecropper	-357.946	-3,728.179*	-20,727.125
	(728.095)	(2,140.168)	(23,328.709)
N. parents own land	101.568	-1,080.212	-13,826.375
	(457.821)	(1,033.326)	(19,570.975)
N. siblings own land	-81.838	-204.435	13,719.035***
	(143.667)	(340.327)	(3,869.293)
N. daughs.-sons own land	-34.271	-766.351**	-1,915.969
	(156.798)	(339.220)	(3,430.287)
N. parents alive	-111.043	1,205.643	-10,717.390
	(433.545)	(966.526)	(15,646.435)
N. siblings alive	-181.425	485.584*	2,500.547
	(150.092)	(271.656)	(2,689.265)
N. daughs.-sons alive	-124.200	96.422	-145.804
	(123.689)	(198.466)	(2,894.771)
Land owned	-571.673	1,689.024***	273.385
	(474.843)	(531.026)	(1,649.857)
Own a house	-1,384.886	-2,986.623	-53,019.705*
	(1,362.606)	(2,423.003)	(31,220.039)
Own transport	-363.166	-2,216.386	
	(2,266.157)	(5,599.009)	
Mills lambda	-4,525.384*	-5,542.561*	-44,029.980**
	(2,680.751)	(3,278.665)	(19,091.877)
Constant	9,923.575**	2,937.468	147,679.812*
	(4,787.616)	(7,276.396)	(80,298.521)

Standard errors in parentheses
*significant at 10%; ** significant at 5%; *** significant at 1%

Other controls: age of the hh head, age of the hh spouse, education of the hh head, education of the hh spouse, gender of the hh head, number of persons in the household, other relatives own land/alive

Table 6 – Investment and Semi-Fixed Assets (Heckman Estimation Procedure)

Dependent variable is: per-acre investment; per-acre stock of semi-fixed assets	Investment	Semi-Fixed Assets
MF Programs	0.044***	-0.282
	(0.008)	(0.342)
Informal credit	0.017*	-0.004
	(0.010)	(0.171)
Bank Credit	0.003*	-0.049
	(0.001)	(0.124)
Religion	116.153**	-1,192.520
	(57.727)	(980.061)
Tenure: Fixed rent	21.626	245.375
	(38.459)	(652.933)
Tenure: Sharecropper	-57.109	-878.390
	(34.734)	(589.707)
N. parents own land	-12.102	-757.923**
	(21.764)	(369.496)
N. siblings own land	-1.689	131.421
	(6.997)	(118.797)
N. daughs.-sons own land	11.942*	-15.694
	(6.268)	(106.417)
N. parents alive	15.631	427.793
	(21.255)	(360.854)
N. siblings alive	-5.699	-166.635*
	(5.828)	(98.944)
N. daughs.-sons alive	-8.094	250.048***
	(5.381)	(91.364)
Collateral	73.066	3,462.828*
	(118.068)	(2,004.503)
Interest rate	-6.536**	-239.074**
	(2.681)	(106.431)
Total area cultivated	-44.557***	-1,097.515***
	(17.110)	(290.482)
Days stop work (illness)	3.379*	-36.682
	(1.810)	(30.731)
Use: personal	-13.950	-390.851
	(46.393)	(787.642)
Use: dowry	0.518	-2,098.969
	(127.259)	(2,160.542)
Nonfarm activities	53.332	-164.705
	(34.985)	(593.957)
Lender	32.158	863.640
	(78.709)	(1,336.281)
Constant	-10.473	3,717.700
	(200.447)	(3,403.097)

Standard errors in parentheses
significant at 10%; ** significant at 5%; *** significant at 1%
Variable inputs: Sargan Chi-sq(1) 0.031 Semi fixed assets: Sargan Chi-sq(1) 0.022

Other controls: age of the hh head, age of the hh spouse, education of the hh head, education of the hh spouse, gender of the hh head, number of persons in the household, other relatives own land/alive

Appendix

Table A1 – Descriptive Statistics

Variable	N. Obs.	Mean	Std. Dev.	Min	Max
Religion: Islam‡	516	0.86	0.35	0.00	1.00
Age household head	516	42.05	12.99	18.00	85.00
Age household spouse	516	32.18	14.00	0.00†	67.00
Education household head (years)	516	3.56	3.72	0.00	14.00
Education household spouse (years)	516	1.76	2.69	0.00	12.00
Household head is male‡	516	0.99	0.12	0.00	1.00
N. of persons in the house	516	5.80	2.46	1.00	17.00
Land tenure: fixed rent‡	516	0.25	0.43	0.00	1.00
Land tenure: sharecropper‡	516	0.52	0.50	0.00	1.00
N. Parents own land	516	0.88	1.09	0.00	4.00
N. Siblings own land	516	3.87	3.57	0.00	16.00
N. daughs.-sons own land	516	1.48	3.22	0.00	20.00
N. Other relatives own land	516	3.59	4.35	0.00	26.00
N. Parents alive	516	1.76	1.27	0.00	4.00
N. Siblings alive	516	8.14	3.85	0.00	25.00
N. daughs.-sons alive	516	6.88	4.64	0.00	24.00
N. Other relatives alive	516	6.32	5.51	0.00	32.00
Land owned	516	1.21	2.93	0.00	52.50
Own a house‡	516	0.17	0.37	0.00	1.00
Own transport‡	516	0.01	0.12	0.00	1.00
Non-farm activities‡	516	0.38	0.49	0.00	1.00
Household lends money‡	516	0.04	0.20	0.00	1.00
Total area cultivated (acres)	516	1.16	1.21	0.03	8.20
Use of loan: personal‡	313*	0.03	0.17	0.00	1.00
Use of loan: dowry‡	313*	0.28	0.45	0.00	1.00
N. days stop work	28**	11.68	12.10	0.00	45.00

† Minimum age of household spouse if alive is 15
‡ Dummy variable
* Computed on the number of borrowers
** Computed on TBC injured

Table A2 – Cumulative Credit (First Stage Least Squares Estimation Procedure)

Dependent variable is: Cumulative credit (in taka)	MF Programs	Informal Credit	Bank Credit
Religion	-2,013.743***	-258.521	-227.505
	(628.529)	(270.956)	(3,271.124)
Tenure: Fixed rent	86.672	16.993	1,326.777
	(426.085)	(183.683)	(2,217.520)
Tenure: Sharecropper	-517.411	355.809**	1,800.445
	(379.348)	(163.535)	(1,974.284)
N. parents own land	71.395	-37.180	-1,582.648
	(242.319)	(104.463)	(1,261.129)
N. siblings own land	-102.719	1.006	959.097**
	(74.440)	(32.091)	(387.415)
N. daughs.-sons own land	-70.947	-55.766*	-237.721
	(70.680)	(30.470)	(367.848)
N. parents alive	-275.395	-75.329	-1,280.659
	(233.475)	(100.650)	(1,215.099)
N. siblings alive	85.574	13.021	374.432
	(64.070)	(27.620)	(333.447)
N. daughs.-sons alive	26.140	18.684	332.433
	(59.189)	(25.516)	(308.041)
Land owned	-16.556	57.102*	840.252**
	(70.150)	(30.241)	(365.092)
Own a house	2,316.015***	-210.069	-1,237.283
	(504.557)	(217.512)	(2,625.919)
Own transport	-1,485.730	707.970	-1,427.710
	(1,530.124)	(659.628)	(7,963.390)
Target	3,524.666***	-378.577*	-2,797.011
	(490.510)	(211.456)	(2,552.813)
Injured (TBC)	-632.198	855.349***	-1,086.685
	(747.293)	(322.154)	(3,889.220)
Constant	3,558.914	-200.687	8,940.063
	(3,002.431)	(1,294.332)	(15,625.880)

Standard errors in parentheses
*significant at 10%; ** significant at 5%; *** significant at 1%
R2 MF Programs=0.42; R2 informal credit=0.38; R2 bank credit=0.31

Other controls: age of the hh head, age of the hh spouse, education of the hh head, education of the hh spouse, gender of the hh head, number of persons in the household, other relatives own land/alive, malaria, measles

Table A3 – Cumulative Credit (First Stage Tobit Estimation Procedure)

Dependent variable is: Cumulative credit (in taka)	MF programs†	Informal Credit††	Bank Credit†††
Religion	-3,322.128***	-482.660	-3,062.471
	(1,232.023)	(1,692.174)	(23,131.525)
Tenure: Fixed rent	793.387	-103.586	-823.565
	(899.708)	(1,221.605)	(16,681.910)
Tenure: Sharecropper	-990.622	2,950.285***	23,598.123*
	(836.470)	(1,139.201)	(13,063.287)
N. parents own land	-388.557	190.360	-12,238.537
	(520.370)	(725.356)	(10,265.643)
N. siblings own land	-373.273**	80.714	4,986.561**
	(161.436)	(210.893)	(2,384.236)
N. daughs.-sons own land	-554.262***	-55.060	-1,483.800
	(159.478)	(202.213)	(2,400.559)
N. parents alive	-221.936	-935.325	-16,351.455*
	(491.297)	(668.259)	(8,695.287)
N. siblings alive	357.344**	-45.536	1,964.762
	(141.324)	(176.107)	(2,125.688)
N. daughs.-sons alive	136.343	54.391	136.328
	(134.835)	(149.090)	(1,922.191)
Land owned	-1,020.020***	70.482*	909.023
	(374.231)	(41.483)	(1,333.823)
Own a house	6,628.350***	-1,358.052	-8,922.539
	(915.401)	(1,668.751)	(18,865.901)
Own transport	-1,217.269	5,669.651	-266,024.375
	(2,811.397)	(3,795.052)	(0.000)
Target	542.446*	-2,483.011**	-59,011.797***
	(309.626)	(1,244.608)	(15,256.182)
Injured (TBC)	-936.770	4,126.374**	-30,945.565
	(1,584.244)	(1,655.363)	(30,389.153)
Constant	2,662.989	-10,338.651	-221.245
	(6,569.384)	(7,553.340)	(73,707.475)

Standard errors in parentheses
*significant at 10%; ** significant at 5%; *** significant at 1%
Parameters have to be scaled by the probability of falling in the uncensored region, respectively: 0.43†, 0.13††, 0.09†††

Other controls: age of the hh head, age of the hh spouse, education of the hh head, education of the hh spouse, gender of the hh head, number of persons in the household, other relatives own land/alive, malaria, measles

Table A4 – Investment and Semi-Fixed Assets (Second Stage Least Squares Estimation Procedure)

Dependent variable is: per-acre investment; per-acre stock of semi-fixed assets	Investment	Semi-Fixed Assets
MF Programs	-0.405	0.460
	(0.852)	(3.608)
Informal credit	0.364	-0.244
	(0.598)	(2.532)
Bank Credit	0.063	-0.184
	(0.138)	(0.586)
Religion	-446.943	76.009
	(1,307.968)	(5,538.595)
Tenure: Fixed rent	4.481	192.340
	(249.597)	(1,056.918)
Tenure: Sharecropper	-109.441	-811.273
	(186.980)	(791.768)
N. parents own land	85.120	-908.952
	(213.778)	(905.243)
N. siblings own land	-50.498	188.007
	(91.882)	(389.076)
N. daughs.-sons own land	36.862	-8.963
	(61.071)	(258.604)
N. parents alive	-38.007	583.342
	(138.087)	(584.729)
N. siblings alive	-11.231	-178.942
	(32.042)	(135.683)
N. daughs.-sons alive	-25.518	274.318
	(41.763)	(176.845)
Collateral	-485.843	5,631.026
	(1,724.317)	(7,301.627)
Interest rate	163.015	-224.693
	(330.442)	(142.190)
Total area cultivated	-237.706	-773.141
	(360.497)	(1,526.525)
Days stop work (illness)	30.224	-108.373
	(66.094)	(279.875)
Use: personal	-228.960	-459.126
	(391.645)	(1,658.423)
Use: dowry	-535.269	-1,853.115
	(1,133.997)	(4,801.917)
Nonfarm activities	146.286	-0.585
	(374.337)	(1,585.131)
Lender	160.937	537.683
	(798.027)	(3,379.249)
Constant	411.224	2,623.295
	(1,171.183)	(4,959.379)

Standard errors in parentheses
*significant at 10%; ** significant at 5%; *** significant at 1%
R2 variable inputs=0.23; R2 fixed assets=0.21
Variable inputs: Sargan Chi-sq(1) 0.253 Semi fixed assets: Sargan Chi-sq(1) 0.052

Other controls: age of the hh head, age of the hh spouse, education of the hh head, education of the hh spouse, gender of the hh head, number of persons in the household, other relatives own land/alive

Table A5 – Investment and Semi-Fixed Assets (Second Stage Tobit Estimation Procedure)

Dependent variable is: *per-acre investment;* *per-acre stock of semi-fixed assets*	Investment	Semi-Fixed Assets
MF Programs	0.028***	-0.198
	(0.010)	(0.174)
Informal credit	0.004	-0.305
	(0.039)	(0.646)
Bank Credit	0.009	0.050
	(0.007)	(0.121)
Religion	84.114	-976.077
	(60.224)	(1,007.484)
Tenure: Fixed rent	15.033	294.382
	(39.184)	(655.505)
Tenure: Sharecropper	-72.697**	-695.099
	(36.533)	(611.159)
N. parents own land	-12.010	-716.266*
	(22.215)	(371.628)
N. siblings own land	-2.920	79.265
	(7.081)	(118.451)
N. daughs.-sons own land	10.793	-1.947
	(6.577)	(110.026)
N. parents alive	13.907	508.012
	(22.402)	(374.758)
N. siblings alive	-5.990	-172.559*
	(6.045)	(101.127)
N. daughs.-sons alive	-10.146*	249.176***
	(5.490)	(91.841)
Collateral	43.747	3,423.066*
	(122.442)	(2,048.332)
Interest rate	-2.272	-232.992**
	(2.619)	(106.985)
Total area cultivated	-42.047**	-1,145.622***
	(17.154)	(286.966)
Days stop work (illness)	2.172	-16.239
	(1.802)	(30.151)
Use: personal	-10.861	-426.072
	(47.501)	(794.636)
Use: dowry	-14.360	-1,887.308
	(129.842)	(2,172.131)
Nonfarm activities	53.535	-191.873
	(35.761)	(598.239)
Lender	29.170	1,093.040
	(79.884)	(1,336.371)
Constant	342.130***	3,452.098
	(10.650)	(3,462.320)

Standard errors in parentheses
*significant at 10%; ** significant at 5%; *** significant at 1%
Variable inputs: Sargan Chi-sq(1) 0.027 Semi fixed assets: Sargan Chi-sq(1) 0.021

Other controls: age of the hh head, age of the hh spouse, education of the hh head, education of the hh spouse, gender of the hh head, number of persons in the household, other relatives own land/alive

Table A6 – Two-sample t test with equal variances on TBC injured

Variables: proxies of wealth	Mean if not injured (1)	Mean if injured (2)	Difference (1)-(2)	abs. val. t statistic[†]
Land owned	1.214152 (0.1356376)	1.144286 (0.2365541)	0.0698663 (0.569508)	0.1227
N. Parents own land	0.9016393 (0.0498795)	0.5 (0.166666)	0.4016393 (0.2120943)	0.8183
N. Siblings own land	3.875 (0.1617444)	3.785714 (0.6869092)	0.0892857 (0.6949798)	0.1285
N. Daughs.-sons own land	1.461066 (0.1450949)	1.785714 (0.6673749)	-0.3246487 (0.6263599)	0.5183
N. Other relatives own land	3.594262 (0.1974104)	3.428571 (0.8008405)	0.1656909 (0.846212)	0.1958

Standard errors in parentheses
[†] H_0: difference = 0
d.f.= 514

Table A7 – Two-sample t test with equal variances on TBC injured

Variable: principal	Mean if not injured (1)	Mean if injured (2)	Difference (1)-(2)	abs. val. t statistic[†]
MF Programs	6564.915 (344.665)	7727.273 (2023.008)	-1162.358 (1576.142)	-0.7375 [(a)]
Informal credit	3533.621 (372.0038)	5262.5 (1872.54)	-1728.879 (1805.5)	1.0137 [(b)]
Bank Credit	617.0213 (313.7951)	591.8367 (301.3693)	617.0213 (1536.594)	0.4016 [(c)]

Standard errors in parentheses
[†] H_0: difference = 0
[(a)] d.f.=220 [(b)] d.f.= 64 [(c)] d.f.= 47