

The Effects of Peer Monitoring on Investment

(A Comparison Between Group Lending and Informal Credit)

PRELIMINARY DRAFT

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Abstract

Abstract. A key difference within group lending and informal credit may be the strength of social sanctions imposed on borrowers that are not able to repay loans. The model presented here predicts that the higher the threat of social sanctions imposed in case of misbehavior of the borrower (non-productive use of credit), the better the agent performs investing more funds and consuming less. Using data from a World Bank survey carried out in Bangladesh during the period 1991-1992, we try to isolate the impact of social sanctions on investment for rice farmers. After controlling for all other determinants of the two credit contracts, estimates show a stronger influence of group lending on investment as compared to informal/individual lending, possibly validating the hypothesis that the threat of social sanctions is more severe when they are promoted by group peers than when they are promoted by individual/informal lenders.

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1 Introduction

In recent years, as a consequence of microcredit rapid diffusion, a significant branch of the literature has focused on the impact that it has on poverty reduction. Many studies analyze the effects of the major lending programs on some households' and firms' behavior, such as per-capita consumption, labor supply, children school enrollment (Pitt and Khandker 1998; Morduch 1998; Pitt 1999), or business profits and revenues (Madajewicz, 1999).

Although it is evident that microcredit programs can reduce poverty through productive capital provision (credit services) and through some additional benefits directly linked to program participation (non-credit services), such as education, the observation of basic health rules, skill training and consciousness development, it is not clear to what extent this form of credit is better than others in promoting productive investment in order to help borrowers to become self sustainable.

Actually, due to considerable information asymmetries between lenders and borrowers, poor people are frequently rationed out of the formal banking sector (Stiglitz and Weiss, 1981; Gosh et al., 2000)¹, and the only available sources of credit for them become either participating to a program offered by one or more institutions or resorting to the informal sector. In fact, despite the large number of lending programs introduced by governmental and non-governmental organizations, informal credit is still an important source of funds for rural households in low income countries.

Thus, the main question addressed in this paper is the following: is there any particular feature concerning group lending that pushes investment to a larger extent than informal (individually based) credit is able to do?

The answer we provide relies on social sanctions and peer pressure. A considerable number of development economists assert that the strength of microfinance programs, supported by the very high repayment rates (over 90 per cent), is mainly due to a particular feature of group loans, which is the presence of social sanctions associated with peer monitoring. Thus, the aim of this paper is to check if borrowers' self sustainability, achieved through investment, is better promoted by an increase of social sanctions and if this particular device is stronger in group contracts rather than in individual/informal ones.

By means of a two-period model where individuals have no initial en-

¹In many countries credit rationing may also be the outcome of the introduction of interest rate ceilings, as a consequence of usury laws (Blitz and Long, 1965; Shay, 1970; Greer 1973; Dunkelberg and DeMagistris, 1979).

downments and need to borrow for both consumption and investment purposes, we show that investment of input constrained agents grows with the strength of social punishment that may follow an adverse behavior of the borrower (i.e., too much credit used for present consumption and a paucity of resources invested), which ends up affecting him/her through the denial of economic benefits from the community. Social sanctions are imposed on the level of effort exerted by the borrower by individuals that are close enough to her/him, so as to be able to gather information regarding his/her actions. Thus, perfect information on the borrower's actions is required².

Using data from a survey carried out by the World Bank during years 1991 and 1992 in Bangladesh, we investigate the possibility that agricultural investment is higher in case people borrow from a group lending program than when they borrow from an individual/informal moneylender.

In the broad class of microcredit we consider three major programs available in Bangladesh: the Grameen Bank, the Bangladesh Rural Advancement Committee (BRAC) and the Bangladesh Rural Development Board's RD-12 Program (BRDB). We also add to this category all other secondary non-government sources of credit (i.e., cooperatives). On the opposite side, we include in the informal class all the loans obtained from landlords, input suppliers, shopkeepers, employers, relatives and friends.

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 institutional programs versus informal credit 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 participation³.

We find that credit services achieve the goal of relaxing farmers' lack of resources and this can raise investment in variable inputs. Moreover, institutional credit is more likely than informal loans to positively affect variable input expenditure. Controlling for other differences in the structure of both credit contracts we are able to state that this differ-

²This is the reason why we compare two types of credit where this condition is likely to hold.

³Much 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.

ence depends on the effectiveness of social sanctions promoted by peers rather than by informal moneylenders.

Finally, two important things have to be pointed out. First, whereas institutional credit is almost exclusively granted for productive purposes⁴, the path of informal credit transactions is not so clear and has to be investigated: a side-aim of this paper is indeed to focus on the mechanism underlying credit market selection process, identifying which categories more heavily rely on one or the other form of lending. Second, there are other factors that might affect the path of investment, such as the price of credit and the presence of collateral: we do not concentrate on these features in the theoretical part, but rather we control for these determinants in the econometric analysis, in order to clean up the estimated coefficients from their presence.

The rest of the paper is organized as follows. Section 2 gives an overview of the differences between institutional microcredit and informal moneylenders. Section 3 briefly describes the model. Section 4 illustrates the dataset. Section 5 turns to the estimation techniques adopted. Section 6 focuses on the results. Finally, section 7 concludes.

2 Microcredit institutions and informal moneylenders

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

As we described in the previous section, the major organizations providing credit to low income households in Bangladesh are: the Grameen Bank, 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 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 Grameen Bank presence on poor and formerly poor borrowers has been documented in many independent studies carried out by external agencies including the World Bank, the International

⁴Although it is possible that some institutions provide consumption loans, these represent a very low percentage over the total amount of available credit. The Grameen Bank, for example, offers a few number of housing loans.

Food Research Policy Institute (IFPRI) and the Bangladesh Institute of Development Studies (BIDS).

The Bangladesh Rural Advancement Committee 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 more than 60,000 villages over 86,000 in Bangladesh, corresponding to 4.07 million 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 Bangladesh Rural Development Board (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 to promote 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 Grameen Bank, the Bangladesh Rural Advancement Committee and the Bangladesh Rural Development Board, mainly operate through group lending. This system relies on solidarity groups: these are small informal groups of four to six persons consisting of co-opted members coming from the same background and trusting each other.

According to the perspectives of this paper, it has to be pointed out that at the beginning, credit provided by these institutions is restricted to income-generating production operations, freely selected by the borrower. Moreover, group members are jointly liable⁵ for the total amount borrowed by the group: if one individual fails to repay his/her share of the loan, all other members of the group have to undertake the burden of the share remained unpaid, otherwise the all group is excluded from any other program of the same institution. Each group member is thus monitored by his/her peers under the threat of social sanctions, allowing

⁵See Ghatak and N'Guinane for details on joint liability.

this system to remove the need for physical collateral.

The microcredit system also encourages people to participate to extra-credit activities organized by the bank. These activities take place during weekly meetings and are based on training, discipline and creativity. For example, members of Grameen programs are invited to memorize and repeat the “sixteen decisions”. These are rules aimed at raising people’s consciousness and dignity, thus improving household’s standard of living and capability of managing scarce resources.

However, it is not easy to enforce these basic rules⁶. Moreover, the opportunity cost of participating to weekly meetings and other activities organized by the bank, may be very high for individuals forced to live under the poverty line. These are reasons that can push borrowers towards informal credit contracts compensating the positive effects of non-credit services⁷, although they are not the only ones. In fact, it is possible that individuals look for an informal loan for different causes, such as the non-eligibility status for institutional programs, or simply because they have easier access to other forms of funds raising, like intra-family transfers.

The class of informal contracts may be divided in two sub-categories: the first one is formed by suppliers and merchants, while the second is made of landlords, relatives and friends. The difference between these two classes is mainly ascribable to the type of collateral required.

Loans from suppliers and other merchants are extended to farmers mainly against the standing crops of the current season. Such 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. It is worth to mention that these people 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 raises the incentives for the latter to trade agricultural inputs and outputs with them.

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 producers, labor and packing material. Borrowing from informal moneylenders at this stage is optimal because they give immediate approval and flexible amounts of money. The use of physical collateral

⁶For example, one could repeat many times "plant as many seeds as possible" at weekly meetings, but once she/he goes back home, if an effective system is not setup in order to enforce this rule and punish adverse behaviors, one might be tempted to eat all the seeds and plant nothing.

⁷This is mainly the reason why we do not give much weight about excluding non-credit services from the remaining part of the analysis.

is not required in contracts of this kind, but rather some other tying arrangement is used as a substitute for it⁸.

Landlords are also part of the category of moneylenders. They are typically wealthy persons linked to the borrower by a close relationship. These individuals are usually influent members of the community to which they belong, and for this reason the monitoring system between borrowers and lenders is sometimes stronger than in the case of suppliers and merchants. Furthermore, these lenders set much higher interest rates than institutional programs⁹.

Relatives and friends usually lend at lower interest rates and do not require collateral. However, it must be reminded that due to the particular relationship existing between the borrower and the lender, the threat of social sanctions might be quite ineffective¹⁰.

Summary statistics on these two different types of credit are illustrated in the Appendix. These statistics emphasize many advantages of program credit versus informal credit (no collateral, lower interest rates, etc.). At this point, one may think that, given eligibility, it would be completely irrational to ask for an informal loan. The idea is that people are sometimes forced to resort to moneylenders. As we illustrated in the previous section, informal credit markets might be a catalyst for those people that are not eligible for a program, but the pattern of this choice is somewhat ambiguous and difficult to investigate given simple surveys. For this reason we try to find if there is evidence of some categories of individuals that are more suited to borrow from informal lenders, or if there is any evidence of some common behavior within households that choose this form of financing. This evidence is discussed further on.

3 The model

We consider a two-period model where an agent maximizes her/his intertemporal utility. She/he produces and consumes a unique good but has no initial wealth to be used for these purposes (i.e., reservation utility is zero).

The agent receives a capital C from a lender and has to decide how to split this capital between consumption in the first period (X_0) and investment in production. Investing allows her/him to consume the quantity X_1 in the second period, after repaying the loan. Suppose that the

⁸Usually, as we pointed out above, the standing crop is used as collateral.

⁹Interest 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 institutional programs.

¹⁰That is why Grameen requires that group members do not belong to the same family.

amount of the loan consumed in period 0 when she/he borrows from lender i (either an NGO offering group loans or an informal/individual lender) is $a_i C$, while investment expenditure is $E_i = (1 - a_i)C$, where $0 < a_i < 1$. Output (Y_i) is random and proportional to the amount of funds that are invested:

$$Y_i = (1 + \delta) \gamma (1 - a_i) C$$

where γ is the proportionality factor, and the term $1 + \delta$ represents total factor productivity. We assume that δ is a random shock distributed on $[-1, 1]$, with zero mean and constant variance σ^2 .

The agent will pay back his/her loan plus interests if he/she has money to do so, and this will occur with probability p which negatively depends on the share of funds consumed in the first period. Without loss of generality, we assume that $p(a_i) = (1 - a_i)$. With probability $(1 - p(a_i)) = a_i$ the output is not sufficient to recover the loan and the agent defaults repaying. In this case, two types of sanctions are imposed, economic ($s_{e,i}$) and social ones ($s_{s,i}$).

On one hand, economic sanctions are typically a share of the output¹¹ and depend on the level of law enforcement in the economy, $s_{e,i} = \psi Y_i$, where ψ is the share of output that the lender is able to recover. We assume that enforcement power is the same for all individuals in the economy, so that an equal share of output is subtracted either by an informal lender in case of default of the borrower, or by the NGO in case of default of the group (see Besley and Coate, 1995). Unlike Besley and Coate, we assume that also peers that rescue some defaulting member of their group have enforcement power and can recover part of the cost incurred by rescuing¹².

On the other hand, social sanctions¹³ are a punishment inflicted by the community and we can assume that they are positively correlated to the standard of living of the agent in the first period. Thus social sanctions are proportional to $a_i C$, that is $s_{s,i} = \theta a_i C$, where $\theta_i > 0$. Social sanctions are inflicted by informed subjects that are “close enough” to the defaulting agent, so that this closeness justifies the perfect knowledge of her/his level of consumption¹⁴. The parameter θ_i represents the

¹¹This is not a crucial hypothesis. In fact, the first order condition reported below does not change if we allow for a fixed collateral which does not depend on output.

¹²This assumption is like saying that, in case of default, a peer must partially contribute with his/her own (although insufficient) resources to his share of the loan.

¹³See again Besley and Coate (1995) on the role of social sanctions.

¹⁴This is why we concentrate on informal credit and group lending and not on bank lending, where a problem of moral hazard would typically arise.

“threat”, or “pressure”, exerted by informal creditors or peers (in the case of a group loan)¹⁵ on the defaulting agent.

Like Besley and Coate (1995) we interpret social sanctions as the exclusion from a community life and reciprocity denial. Basically forms of reciprocity applied in some communities are costless for its members (they still remain inside the community exploiting the benefits of reciprocity). Moreover, we assume that reciprocity denial does not benefit creditors who have not been paid at maturity, but only have a negative incidence on defaulting borrowers.

Thus, the participation constraint of the lender, who works under perfect competition and has to choose the optimal interest rate to charge on her/his loans, can be written as follows:

$$(1 - a_i)(1 + r_i)C + a_i\psi Y_i - C = 0$$

where r_i is the interest rate required by the lender.

The intertemporal utility function of the agent is additively separable with instantaneous utility functions that depend on consumption in each period and β is the intertemporal discount factor. Borrowers maximize their utility with respect to the quantities consumed in each period and the share of funds to be consumed/invested, under their intertemporal budget constraint¹⁶ and the participation constraint of the lender.

The problem to be solved by the borrower is:

$$\begin{aligned} & \underset{X_{0,i}, X_{1,i}, a_i}{Max} \quad U(X_{0,i}) + \beta E \{U(X_{1,i})\} \\ & s.t. \\ & E(X_{1,i}) = Y_i - (1 - a_i)(1 + r_i)C - a_i(\theta_i a_i C + \psi Y_i) \\ & X_{0,i} = a_i C \\ & (1 - a_i)(1 + r_i)C + a_i\psi Y_i - C = 0 \end{aligned}$$

¹⁵Given that repayment rates in group lending are around 100 per cent, it is reasonable to think that whenever one defaults the peers will rescue the group by paying his/her share of the loan.

¹⁶Assuming that the opportunity cost of money is \bar{r} , the intertemporal budget constraint is the following:

$$1 + \frac{\tilde{Y}_i}{1 + \bar{r}} = X_0 + E_i + \frac{(1 - a_i)(1 + r_i)C + a(s_{s,i} + s_{e,i}) + X_1}{1 + \bar{r}}$$

After simplifications this reduces to:

$$X_1 = Y_i - (1 - a_i)(1 + r_i)C - a_i(s_{s,i} + s_{e,i})$$

And, by substituting the definition of social and economic sanctions:

$$X_1 = Y - (1 - a)(1 + r)C - a(\theta a C + \psi Y)$$

$$E(Y_i) = \gamma(1 - a_i)C$$

Substituting the constraints into the utility function, the maximization problem becomes that of choosing the share of the loan used for present consumption:

$$\underset{a_i}{Max} U \{a_i\} C + \beta U \{ \gamma(1 - a_i)C - C - a_i^2 \theta_i C \}$$

The first order condition for the problem is:

$$U'_{X_{0,i}} C + \beta U'_{X_{1,i}} [-\gamma C - 2\theta_i a_i C] = 0$$

Hence, the share of funds consumed/invested is a negative function of the threat of social sanctions¹⁷:

$$a_i = \frac{1}{2\theta_i} \left[\frac{U'_{X_{0,i}}}{\beta U'_{X_{1,i}}} - \gamma \right]$$

Given that $a_i = 1 - (E/C)$, than investment E is a positive function of θ :

$$E_i = \left(1 - \frac{1}{\theta_i} k \right) C$$

where $k = 1/2 \left[\left(U'_{X_{0,i}} / \beta U'_{X_{1,i}} \right) - \gamma \right]$. This is the equation that will be estimated in the econometric section.

In the Appendix we check for robustness of the model by allowing both the production function to be non linear with the presence of a fixed input and the quantity of credit to be endogenously determined.

4 The data

The dataset consists of a sample of 516 households. These are rice farmers¹⁸ selected from a survey carried out on 1798 households in rural

¹⁷The condition $a_i = \frac{1}{2\theta_i} \left[\frac{U'_{X_{0,i}}}{\beta U'_{X_{1,i}}} - \gamma \right]$ can be written as follows: $\frac{U'_{X_{0,i}}}{\beta U'_{X_{1,i}}} = 2\theta_i a_i + \gamma$.

Suppose that θ_i and a_i increase. This implies that $\frac{U'_{X_{0,i}}}{\beta U'_{X_{1,i}}}$ must also increase. Since $U'_{X_{0,i}}$ negatively depends on a_i it necessarily decreases. Thus, given β , the term $U'_{X_{1,i}}$ must decrease to compensate the lower value of $U'_{X_{0,i}}$. But this is impossible given that $E(X_{1,i}) = \gamma(1 - a_i)C - C - a_i^2 \theta_i C$ decreases when a_i becomes larger. Hence, a_i necessarily decreases when θ_i increases.

¹⁸It has to be pointed out that, although agricultural activities seem not the main target of some institution, like the Grameen Bank, they are a primary source of

Bangladeshi villages by the Bangladesh Institute of Development Studies at the World Bank in 1991/92. The reason why we choose this class of farmers is that rice is widely cultivated in Bangladesh.

Moreover, traditional rice, at the time of the survey, was the main crop, while treatment of high yield rice or other crops would typically originate a selection problem in the type of crop. Since a selection issue is already treated in the credit market (see next section for details) we preferred not to further complicate the analysis. We present statistics comparing the full sample of borrowers from NGOs and from informal lenders in the survey and the sample of rice farmers in Tables 1 and 2.

The survey has been conducted three times during the period 1991 and 1992, but we concentrated 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”. The original sample consisted of three randomly selected villages from each of the 29 thanas (sub-districts) surveyed. In 24 of these thanas, a microcredit program (Grameen, BRAC or BRDB RD-12) had been in operation for at least three years. A total of 20 households in each village were surveyed.

Statistics from the selected sample of rice farmers surveyed show that bank credit is 13 per cent of total loans made, institutional (NGO) credit represents a share of 65 per cent, while informal credit covers 22 per cent of total loans. Moreover, 35 per cent of the loans are for agricultural purposes, 63 per cent for non-agricultural activities, and 28 per cent for personal uses. From these statistics we can observe the distribution of loans with respect to the credit source: as stated above, informal lenders are more likely to grant loans for personal use (62 per cent of the total), while NGOs finance only 22 per cent of personal use loans; 33 per cent of informal market credit constitutes agricultural loans, as well as for microcredit institutions. NGOs credit is instead massively devoted to non-agricultural activities (72 per cent, as compared with 15 per cent of group loans).

Average NGO loans are 6,622 taka, as compared with a lower average principal for informal loans (3,743 taka). Program interest rate is 16.13 per cent on average, as compared with a mean of 57.30 per cent in the informal credit market. However, NGO interest rates are almost fixed, while informal credit rates considerably differ across the sample with a standard deviation of 65.04.

income for rural households in poor countries. Moreover, although the Grameen Bank targets more new small self-employment activities, the importance of agriculture is stressed in the “sixteen decisions” promoted by the Bank.. Furthermore, they are more relevant for other lenders, like the Bangladesh Rural Advancement Committee (BRAC), or the Bangladesh Rural Development Board (BRDB).

[Tables 1 and 2 about here]

In the dataset there are no observations concerning the value of collateral: based on information about whether collateral has been actually required, a dummy was built and used as a control variable together with other measures of transaction costs, such as the distance to the lender.

The sample includes both eligible and not eligible households for microcredit programs. So far, the eligibility rule has been a widely debated issue (Morduch 1998; Pitt 1999). It is common to all microcredit programs that the ownership of less than half an acre of cultivable land constitutes the principal eligibility rule. The main problem is that land quality is unobservable: sometimes households own uncultivable lands, or it may occur that lands cultivated during one season are poorly suited to agriculture during another season. Furthermore, many of these households have small gardens around their houses, even if they do not own any cultivable land. Pitt (1999) points out that the difference between total land ownership and cultivable land is primarily homestead land. Hence, we use total land owned minus homestead land to determine whether an household should be considered a target for NGOs. Since this criterion still does not perfectly match actual program credit participation in the sample, we also use a continuous measure of land to identify the effects of credit on the variables of interest.

Another measure of land has been used to control for decreasing returns to scale: this measure consists of the total area cultivated by household members and includes all rice-cultivated acres by the household, augmented by the share received for sharecrop or fixed-rent outstanding contracts.

Credit of whatever nature is the total amount of borrowed funds from each of the two examined sources, institutional (NGO) and informal. Some authors treat credit as a binary variable: we rather use a continuous measure of principal because a higher investment should not depend on the simple choice between borrowing or not borrowing, but on the amount of money that actually can raise investment, that is total borrowing.

Investment in input is divided in working capital and semi-fixed assets. Working capital is per-acre variable costs. These costs include expenditure for seeds and fertilizers, tillage water costs, etc.. Semi-fixed assets consist of the value of bullocks, ploughs and other agricultural equipment¹⁹. Land is not included among these determinants because,

¹⁹The difference with variable expenditure is that if a farmer cannot seed his/her

as we discussed above, land is a properly fixed asset in this economy and credit is rarely used to buy land.

Crop is traditional rice. At the time of the survey only a few farmers were cultivating high-yield crops. Only after the devastating floods of 1998, some NGOs introduced high-yield hybrids.

Furthermore, we include personal variables, such as age and education of households members, their religion and the gender of the household head, as well as technological variables, such as land tenure and other controls like the use of loans. Moreover, the database includes records on the number of relatives who are alive and those who own land. Since a large literature provides evidence of endogeneity of transfers in similar contexts, these represent good controls since they are an exogenous measure of the potential transfers that a household can achieve. Finally, dummy variables are considered in order to correct for village fixed effects, including prices of inputs and rice, which are common to each community.

For more detailed information on the regressors used in the estimation, we summarize all variables in the Appendix.

5 Estimation techniques

The empirical work attempts to check two hypothesis: the first is the higher aptitude of institutional credit versus informal loans in raising working capital. The theory, as illustrated in previous sections, predicts that a larger share of investment is associated with program credit because the threat of social sanctions reduce the quantity of funds used for unproductive purposes. Furthermore, since programs provide short-term loans by definition, whereas informal credit can have a variable structure, we test the same hypothesis on semi-fixed capital: the reason is to determine whether informal funds may be used to finance higher value projects like purchasing agricultural equipment.

The second point we pursue is to investigate the mechanism underlying the process of selection into one or the other credit market. This is a crucial issue because the endogenous nature of credit and the paucity of instruments available could lead to serious biases. So far, the selection mechanism for institutional credit has been investigated by some authors (Pitt and Khandker, 1998), and one of its main exogenous determinants has been recognized in the eligibility rule for programs, that is the ownership of less than 0.5 acres of cultivable land. Thus, the informal sector

plot, for example because of a flood, he/she does not have to buy variable inputs but has to bear the cost for semi-fixed assets anyway.

might be a residual market for all individuals that are rationed out of institutional programs.

However, as pointed out in the previous sections, it may also be the case that some agents choose to self-select into the informal market for different reasons, like a particular relationship with the lender, or even because, given the personal and unproductive destination of funds, they fear high pressure from other group members. Nonetheless, factors that push borrowers towards the informal market are not uniquely determined and have to be investigated through the empirical analysis.

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 estimation procedure used.

5.1 The equations

Following the approach suggested by Pitt and Khandker (1998) and relying on the theory illustrated in previous sections, we estimate conditional variable input investment (equation (3))²⁰, conditioned on the total amount of credit borrowed (equations (1) and (2)) and on a set of control variables representing household preferences and technology.

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

$$C_{ij}^N = X_{ij}\alpha_N + Z_{ij}^C\beta_N + \mu_{jN} + \epsilon_{ijN} \quad (1)$$

$$C_{ij}^I = X_{ij}\alpha_I + Z_{ij}^C\beta_I + \mu_{jI} + \epsilon_{ijI} \quad (2)$$

$$E_{ij}^W = X_{ij}\alpha_W + Z_{ij}^E\beta_W + C_{ij}^N\gamma_W + C_{ij}^I\delta_W + \mu_{jW} + \epsilon_{ijW} \quad (3)$$

$$E_{ij}^F = X_{ij}\alpha_F + Z_{ij}^E\beta_F + C_{ij}^N\gamma_F + C_{ij}^I\delta_F + \mu_{jF} + \epsilon_{ijF} \quad (4)$$

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

C_{ij}^N is the cumulative quantity of institutional credit borrowed by the household from Grameen Bank, BRAC, BRDB and other NGOs, while C_{ij}^I is the cumulative quantity of informal loans; E_{ij}^W is per-acre variable input expenditure and E_{ij}^F are per-acre semi-fixed assets. We refer to

²⁰We add to the system an equation for conditional semi-fixed input expenditure (4), which includes ploughs and other machinery, excluding land, in order to check the possibility that credit also affects investment in the long-run.

variable input expenditure and semi-fixed assets as household estimated behaviors.

X_{ij} are general characteristics of the household common to all equations (such as religion, age of the household head and education) as well as technological features (land tenure, total area cultivated, etc.) and control variables (interest rate, collateral and distance to the lender).

Z_{ij}^C are characteristics of the household that affect credit transactions but not other household's estimated behaviors (such as eligibility status, total land owned²¹ and other exogenous measures of potential collateral); while Z_{ij}^E are controls for other characteristics of credit contracts that differ from social pressure (actual interest rate, collateral required).

μ_{jN} , μ_{jI} , μ_{jW} and μ_{jF} are village specific-effects, while ϵ_{ijP} , ϵ_{ijI} , ϵ_{ijW} and ϵ_{ijF} are idiosyncratic errors, such as $E(\epsilon_{ij} | X_{ij}, Z_{ij}, \mu_j) = 0$ in equations (1)-(2), and $E(\epsilon_{ij} | X_{ij}, C_{ij}, \mu_j) = 0$ in equations (3)-(4). The covariance matrix is assumed to be diagonal. 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 with the Tobit and Selection specifications. However, the test on OLS brings ambiguous results: since it does not reject the null hypothesis of no correlation between NGO credit and expenditure, while it does for informal credit, we decided to estimate separately each equation in the system for coherence with the other specifications.

In the next subsection we discuss some endogeneity issues, then we illustrate the estimation procedure.

5.2 Sources of bias

As illustrated in 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 institutional credit and may be due to the fact that programs are most frequently allocated in poorer villages or more flood-prone areas, rather than in wealthier ones. 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 informal lenders that may not be uniformly distributed across the villages included in the sample.

The second class of bias is related to unmeasured village attributes that affect both credit transactions and household behavior. Climate

²¹For a discussion on the exogeneity of land see Pitt and Khandker (1998) and Pitt (1999).

conditions and a high propensity to natural disasters, among the others, are important characteristics affecting both these variables, especially when dealing with agricultural aspects. Also prices and infrastructures are important elements that must be taken into consideration. We correct for these two forms of bias using village fixed effects in both credit and expenditure equations.

Finally, 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. Such unobservable characteristics may originate a self-selection problem that consists in both the decision of borrowing and the choice of a specific credit market, which in this case can be the institutional or the informal one. Problems of this kind are traditionally solved using instrumental variables when these are available.

A Durbin-Wu-Hausman procedure has been used to test for endogeneity in the sample used. The null hypothesis of no correlation between credit and the error term in equation (3) has been rejected in both cases of institutional and informal credit respectively at 5 and 10 per cent significance level²².

However, credit market selection mechanism can be splitted in two components, an observable and an unobservable one, and some additional information can be exploited using the observable component. A number of individual determinants of the market choice mechanism, like ability, are unmeasurable by definition, but some of them are indeed measurable. The selection system originated by programs exogenous eligibility rules, or by existing relationships between the borrower and the lender, are an example of this measurable variables that can be exploited to correct for the market selection mechanism.

In order to solve the problem of endogeneity of different nature, two approaches have been utilized in this work, in addition to the use of fixed effects: the first is related to a particular recursive structure of the system, while the second involves a selection procedure.

As we illustrated above, the system (1-4) assumes a recursive nature, due to the presence of the Z^C matrix. This is particularly useful in order

²²Credit seems not to be endogenous in explaining semi-fixed assets, although for coherence, and since results do not substantially vary, we report estimates computed with instrumental variables in both equations rather than Two-Stages LS for variable input expenditure and OLS for semi-fixed assets.

to have instruments to identify parameters associated to endogenous regressors, such as credit. In both equations (3) and (4), the variable credit can be instrumented with all the regressors included in Z_{ij}^C but not in X_{ij} . Instruments adopted are program eligibility status (less than 0.5 acres of land owned interacted with a dummy variable that takes value of 1 if there is an NGO in the village) and two continuous and exogenous measures of land owned and inherited assets (house). But exploiting the recursive structure of the system may not be enough, since instruments are still inadequate. However, since there is evidence of self-selection in each credit market, a specific selection model can be estimated in order to generate further instruments, namely the Mills' ratio found in the first stage of the selection procedure.

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 (1) and (2). We will illustrate the methodology used to correct for this bias in the following section.

5.3 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 of a credit program on some households outcomes exploiting the information coming from not eligible households in program villages and the exogenous rule of half an acre of land as a proxy for eligibility. Lacking any information of this kind relatively to informal credit, which is available in every village and does not imply any eligibility rule, we do not use the same approach. Moreover, the presence of a larger number of equations makes that method cumbersome in this 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 exploiting the reduced form recursivity of the system (1-4). 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 an instrumental variable method (Two-Stage Least Squares-FE). This simple estimation technique treats endogeneity using fixed effects to correct for nonrandom allocation of credit and unmeasured village characteristics that affect both credit transactions and household behavior, instrumenting endogenous regressors to further

correct for unmeasured household features that affect both credit transactions and household behavior²³.

However, as described above, IV techniques do not consider the censoring nature of credit. We thus treat these issues with a second estimation technique: the Tobit-IV-FE estimator treats all sources of bias cited above together with the censoring nature of credit.

A third estimator (Selection-IV-FE)²⁴ 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 determinants²⁵.

The way Tobit-IV-FE and Selection-IV-FE 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 Tobit-IV-FE uses a Tobit model to estimate predicted institutional and informal credit transactions, augmented with all exogenous instruments for credit mentioned above. The predicted expected values of credit are then plugged into the behavioral equations (3) and (4)²⁶ and finally these are estimated with standard maximum likelihood techniques.

Predicted values are computed in the following way:

$$\widehat{C} = E(C|X_{ij}, Z_{ij}^C, \widehat{\beta}_C, \widehat{\sigma}_\varepsilon^C) = \int_0^\infty C^* f(C^*|X_{ij}, Z_{ij}^C, \widehat{\beta}_C, \widehat{\sigma}_\varepsilon^C) dC^* \quad (5)$$

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

The Selection-IV-FE estimator follows the same procedure as the one described above for the Tobit-IV-FE, but this method includes a

²³Instruments used are the eligibility rule of half an acre of land owned interacted with the presence of an office of an NGO supplying group loans to people living in the village, a continuous measure of land owned and the value of inherited assets (house).

²⁴This estimator is based on Heckman (1976).

²⁵Instruments are the eligibility rule of half an acre of land owned interacted with the presence of an office of an NGO supplying group loans to people living in the village in the first stage, while a continuous measure of land owned and the value of inherited assets (house), together with the Mills' ratio, are used to instrument cumulative credit.

²⁶We also estimated a different version of the Tobit-IV-FE and Selection-IV-FE 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 change with respect to the Two-stage method illustrated above.

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 cumulative informal borrowing is observable if the household has agreed to an informal contract.

Moreover, the assumption that underlies a sample selection model is that participation does not have only an intercept effect, but also a slope effect (i.e., the betas differ according to participation status as well). We thus estimated a first stage Probit model to predict the probability of program participation and informal market participation and in the second-stage, we estimated with OLS the expected value of cumulative borrowing including in the subsets of program members and informal borrowers their respective 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) times the probability that credit is observed. The following section compares the results from the estimation techniques described above.

6 Results

In this section we present the estimates of the model described by equations (1-4). The results are reported in Tables 3-7. Tables 4 and 5 refer to institutional and informal cumulative credit transactions, while Table 3 reports the first stage of the selection technique. Finally, Tables 6 and 7 illustrate the estimated parameters values of working and semi-fixed capital.

Moreover, instead of reporting the Tobit actual estimated parameters in column 3 of Tables 4 and 5, we scaled them by the probability of falling in the uncensored region, in order to allow comparisons with the least squares marginal effects in column 2 of each table. Thus, institutional credit parameters were scaled by $\hat{\Phi} = \Phi(\hat{\beta}'\bar{X}/\hat{\sigma}) = 0.43$, while informal credit parameters were scaled by $\hat{\Phi} = \Phi(\hat{\beta}'\bar{X}/\hat{\sigma}) = 0.13$.

6.1 Credit

Since the dependent variable in credit equation (cumulative loans) may capture both the probability of joining a particular credit market as

well as the actual quantity of cumulative funds borrowed, it would be interesting to separate these two determinants.

As an example, suppose that the sharecropper status is a positive determinant of informal borrowing. By estimating an equation where the dependent variable is total amount of loans with a Two-Stage LS or Tobit, one may infer that sharecroppers borrow a higher quantity of money. However, this might not be the right conclusion, since it does not distinguish among the higher propensity for these category of farmers of borrowing in this market and the quantity of funds they are able to raise.

Indeed, sharecroppers have easier access to informal markets because of their close relationship with landlords, but these loans show on average smaller amounts because sharecroppers are in general poorer than other class of farmers, (i.e., they have inadequate collateral). Even Tobit estimates fail to capture this effect, while the comparison between results of the first-stage selection model with other estimators can help disentangling this problem. Bearing in mind this aspect, a detailed description of the main determinants of credit transactions follows.

Land status is measured by two variables. The first is a dummy variable (Target*NGO) which assumes a value of 1 if the household owns less than 0.5 acres of land, interacted with a dummy for the presence of an NGO in the village, thus identifying program eligibility. As previously discussed, there are various explanations for the non-significance of that variable in the cumulative credit equations. However, this variable becomes significant in the determination of program participation in (Table 3, column 2). Conversely, the possession of less of half an acre of land deters informal borrowing (Table 3, column 3).

A continuous measure of land captures the program target of landless borrowers once we do not control for program participation (Table 4, column 3). On the other hand, the cumulative amount of informal borrowing grows with land owned: this feature very well captures the important role of land as a collateral for informal credit contracts in agriculture. Moreover, land seems to be the only collateral required, since the dummy that identifies whether a house has been inherited is not significant.

Male education is another important determinant of the amount of loans granted, especially for informal lending: this reflects the fact that moneylenders tend to lend larger amounts of money to highly reliable individuals in the village. Religion is also a determinant of cumulative borrowing: Islamic, rather than Jewish households are granted larger loans, and this might be a wealth effect, since in Bangladesh the latter are on average poorer than the former.

Other determinants of program credit transactions are potential sources of transfers: a higher number of parents, children and siblings who own land, which is an exogenous proxy of intrahousehold transfers and wealth, generally tends to decrease cumulative borrowing in both cases of informal credit and group lending.

On the other hand, the number of relatives who are alive, slightly tends to increase the propensity of participating to group lending and deters participation in the informal market: this might be the effect of the spreading information among relatives regarding some benefits of microcredit (e.g. lower interest rates, no collateral and non-credit services). However, this variable, especially the number of children and siblings alive, seems to increase cumulative informal borrowing, and this might be the effect of the use of human collateral.

In conclusion, it seems that informal credit is chosen by agents who have a close relationship with the lender, as in the case of sharecroppers, trusted (i.e., more educated) persons in the village, that own land (which is the only collateral accepted by moneylenders). On the other hand, household that participate to program lending are landless (as required by NGOs targeting), potentially poor (with landless relatives) but might be more informed concerning life in the village, thanks to the larger net of relatives they possess.

[Tables 3-5 about here]

6.2 Investment

Tables 6 and 7 report estimates of the impact of credit on working and semi-fixed capital.

The hypothesis that NGO credit has a higher impact than informal credit on investment in variable inputs seems to hold. This impact seems not to be due to any difference between group loans and informal contracts which are not specified by the model: neither to the cost of credit, since we controlled for both interest rates actually faced and other transaction costs²⁷, nor to the presence of collateral on informal loans²⁸. On the other hand, credit of whatever nature has no impact on semi-fixed

²⁷Although they are not significant, the signs of the parameters associated to the cost of credit have a negative sign as predicted by the model, at least for what concerns short-run expenditure.

²⁸If we consider, as in the spirit of the model, that collateral can increase the incentive to invest due to the threat represented by its loss in case of default, its parameter should have a positive sign in the expenditure equation, as it actually does.

assets, which are very poor in the sample used, and this is consistent with our short-run model.

Furthermore, the issue of endogeneity seems relevant, since parameters associated to informal credit variable are not significant unless we correct for the bias arising due to the market selection component. Institutional credit parameter is positive and significant at 5 per cent level in 2SLS and at 10 per cent level in the Tobit, while it is significant at 1 per cent level in the Selection model. On the other hand, informal credit parameters are lower than NGO credit parameters as the model predicts, even though they need a correction for selectivity in order to become significant.

Variable input expenditure is higher the better educated are the household head and his wife, although education seems to strongly determine the acquisition of semi-fixed capital. Moreover, the traditional inefficiency of sharecropping contracts shows up in a lower investment in variable inputs with respect to the rest of the sample (fixed-rent croppers and self-cultivating ones).

Total area cultivated seems not to determine variable input expenditure, but rather it strongly influences semi-fixed input accumulation. As expected, indeed, semi-fixed input expenditure shows an inexistent link with rural credit, since the amount borrowed is often too low to finance investments greater than seeds and fertilizers. Semi-fixed input expenditure rather massively and negatively depends on the extension of the area cultivated. In fact, the pattern of decreasing returns is clearly more evident here than it is for variable expenditure, where the parameters show the same signs but are not significant.

Finally, Hausman tests performed comparing credit coefficients estimated in equation (3) with OLS, versus IV, Tobit, or Selection specifications, rejects the null hypothesis of no regressor-error correlation only with Tobit or Selection specifications, suggesting that IV are probably not the correct technique to be used in this case.

[Table 6 and 7 about here]

7 Conclusions

As a consequence of the rapid growth of microcredit institutions, a considerable number of works concerning the impact of these programs on poverty reduction has been written so far. Many studies analyze the effects of the major lending institutions on some household behavior and

most part of these works provide evidence that microcredit programs can reduce poverty through productive capital provision. However, there are no models focusing on investment, which is actually the main purpose of NGOs. Moreover, there are no works trying to compare the impact of social devices used to enforce a productive use of borrowed funds within different types of credit contracts.

In fact, despite the large number of lending programs introduced by governmental and non-governmental organizations, informal credit is still an important source of funds for rural households in low income countries.

There is a common feature between these two types of credit contracts, that is the perfect observability of borrowers' behavior in terms of consumption by the community where they live. Thus the community can impose social sanctions (identified by the denial of economic benefits from the community) basing on this information. In this work we exploit this feature in order to compare the effectiveness of social sanctions within group lending and individual/informal lending and their impact on investment.

We show that in an intertemporal framework investment of input constrained agents grows with the strength of social punishment that may follow an adverse behavior of the borrower (i.e., too much credit used for present consumption and a paucity of resources invested), which ends up affecting him/her through social sanctions.

Using data from a World Bank survey carried out in Bangladesh during the period 1991-1992, we try to isolate and estimate the impact of social sanctions in group lending and in informal credit contracts. Results show evidence that borrowers belonging to a group invest more in variable inputs than borrowers who receive individual loans from an informal lender possibly supporting the evidence that social sanctions promoted by peers are more severe than when they are promoted by individual/informal lenders.

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Appendix

Here we check for robustness of the model by allowing both the production function to be non linear with the presence of a fixed input and the quantity of credit to be endogenously determined. For simplicity, here we omit the index i .

$$\begin{aligned}
 & \underset{a}{Max} U \{X_0\} + \beta U \{X_1\} \\
 & s.t. \\
 & X_0 = aC \\
 & X_1 = Y - (1-a)C(1+r) - a[\theta a + \psi Y] \\
 & (1-a)(1+r)C + a\psi Y - C = 0 \\
 & Y = [(1-a)C]^\gamma L^{1-\gamma}
 \end{aligned}$$

$$\begin{aligned}
 & \underset{a}{Max} U \{aC\} + \beta U \left\{ Y - (1-a)C \frac{C-a\psi Y}{(1-a)C} - a[\theta a + \psi Y] \right\} \\
 & \underset{a,C}{Max} U \{aC\} + \beta U \{Y - C - a^2\theta\}
 \end{aligned}$$

The two first order conditions are:

$$\begin{cases}
 \frac{\partial U}{\partial a} = U'_{X_0} C + \beta U'_{X_1} \left[\frac{\partial Y}{\partial a} - 2\theta a \right] = 0 \\
 \frac{\partial U}{\partial C} = U'_{X_0} a + \beta U'_{X_1} \left[\frac{\partial Y}{\partial C} - 1 \right] = 0
 \end{cases}$$

Combining the two first order conditions, we obtain:

$$2\theta a^2 - \frac{\partial Y}{\partial a} a - C + \frac{\partial Y}{\partial C} C = 0$$

Hence, by implicitly deriving this function we get:

$$\boxed{\frac{\partial a}{\partial \theta} = - \frac{2a\theta C}{4a\theta - \frac{\partial Y}{\partial a} - \frac{\partial^2 Y}{\partial a^2} a + \frac{\partial^2 Y}{\partial a \partial C} C}}$$

It is easy to show that the denominator of this fraction is greater than zero.

[Table A1 about here]

Table 1 – NGO Credit

Variables	Full Sample	Rice Farmers
Average Principal (in taka)	7546	6622
Distance to the Lender (miles)	5.0	6.1
Households who Hold Less than 0.5 Acres of Land	76%	53%
Age of Household Head	40	41
Age of Household Spouse	29	32
Education of Household Head (years)	2.8	3.2
Education of Household Spouse (years)	1.3	1.6

Table 2 – Informal Credit

Variables	Full Sample	Rice Farmers
Average Principal (in taka)	4800	3743
Average Interest Rate	49.26	50.30
Loans on which Collateral Has Been Required	12%	13%
Distance to the Lender (miles)	4.0	4.3
Households who Hold Less than 0.5 Acres of Land	68%	53%
Age of Household Head	42	44
Age of Household Spouse	31	34
Education of Household Head (years)	4.1	4.7
Education of Household Spouse (years)	2.1	2.3

Table 3 – First Step Heckman Procedure

	NGO Credit	Informal Credit
Religion	-0.473 (1.48)	0.269 (0.68)
Age HH Head	0.002 (0.22)	-0.011 (0.77)
Age HH Spouse	-0.001 (0.14)	0.001 (0.11)
Education HH Head	0.033 (1.04)	0.055 (1.42)
Education HH Spouse	-0.028 (0.65)	-0.013 (0.24)
Household is Male	0.702 (0.93)	-0.321 (0.31)
Number of Persons in the HH	0.071 (1.48)	0.079 (1.40)
Fixed Rent	0.310 (1.55)	-0.258 (1.00)
Sharecropping	0.057 (0.30)	0.556** (2.15)
Total Area Cultivated	-0.235** (2.09)	-0.113 (0.95)
Parents Own Land	-0.089 (0.81)	0.024 (0.15)
Siblings Own Land	-0.048 (1.25)	0.090* (1.67)
Children Own Land	-0.086*** (2.62)	0.034 (0.80)
Other Relatives Own Land	-0.000 (0.01)	-0.006 (0.13)
Parents Alive	0.063 (0.57)	-0.189 (1.25)
Siblings Alive	0.073** (2.17)	-0.075* (1.80)
Children Alive	0.063** (2.09)	-0.016 (0.48)
Other Relatives Alive	-0.019 (0.61)	0.047 (1.23)
Land	-0.105 (1.22)	0.009 (0.26)
House	1.958*** (7.20)	-0.399 (1.24)
Target*NGO	0.457** (2.12)	-1.459* (1.88)
Constant	-7.683*** (4.44)	-6.285 (.)

Absolute value of t-statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4 – NGO credit

	2SLS (I st.)	Tobit	Heckman
Religion	-2,468.564*** (3.13)	-1,755.74*** (2.82)	-637.932 (0.57)
Age HH Head	31.087 (1.21)	30.32 (1.35)	46.495 (1.04)
Age HH Spouse	3.298 (0.15)	6.64 (0.35)	4.370 (0.12)
Education HH Head	80.678 (1.19)	25.44 (0.43)	52.259 (0.50)
Education HH Spouse	11.611 (0.12)	71.52 (0.89)	144.978 (1.04)
Household is Male	196.021 (0.11)	965.42 (0.61)	1,216.738 (0.43)
Number of Persons in the HH	83.236 (0.81)	124.98 (1.37)	-21.665 (0.12)
Fixed Rent	353.748 (0.78)	340.43 (0.87)	-447.173 (0.63)
Sharecropping	-19.188 (0.05)	-201.86 (0.53)	-202.340 (0.29)
Total Area Cultivated	-635.046*** (2.89)	-587.82*** (2.74)	-193.215 (0.48)
Parents Own Land	-142.861 (0.56)	-252.15 (1.14)	27.255 (0.07)
Siblings Own Land	-80.181 (0.93)	-30.53 (0.43)	-19.268 (0.16)
Children Own Land	-184.038** (2.46)	-179.28*** (2.62)	-74.026 (0.54)
Other Relatives Own Land	18.322 (0.22)	69.06 (0.96)	145.475 (1.15)
Parents Alive	-25.690 (0.10)	-67.61 (0.32)	-136.162 (0.36)
Siblings Alive	102.303 (1.45)	91.14 (1.50)	132.860 (1.11)
Children Alive	93.824 (1.48)	67.98 (1.23)	-136.161 (1.28)
Other Relatives Alive	35.270 (0.52)	-5.67 (0.09)	-17.368 (0.16)
Land	-1.943 (0.02)	-236.56* (1.83)	143.236 (0.40)
House	3,104.209*** (6.08)	3,028*** (7.57)	-2,991.724** (2.10)
Target*NGO	377.538 (0.29)	73.22 (0.17)	
Mills lambda			-3,694.536** (2.13)
Constant	1,221.912 (0.26)	7,027.13*** (3.29)	20,632.896*** (3.50)
R-squared	0.46		

Absolute value of t-statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 5 – Informal credit

	2SLS (I st.)	Tobit	Heckman
Religion	-316.308 (1.04)	-47.50 (0.49)	-2,271.765** (2.06)
Age HH Head	-3.958 (0.40)	-7.87 (0.91)	-3.114 (0.07)
Age HH Spouse	4.706 (0.56)	8.35 (1.13)	-1.536 (0.04)
Education HH Head	50.444* (1.93)	45.38** (2.22)	228.913* (1.88)
Education HH Spouse	-27.016 (0.75)	-24.50 (0.88)	190.501 (1.16)
Household is Male	46.806 (0.07)	68.39 (0.98)	44.237 (1.38)
Number of Persons in the HH	1.230 (0.03)	6.95 (0.22)	-225.666 (1.00)
Fixed Rent	-39.311 (0.23)	84.13 (0.59)	1,217.728 (1.28)
Sharecropping	147.186* (1.68)	177.84* (1.79)	-2,501.825** (2.48)
Total Area Cultivated	-2.241 (0.03)	-39.19 (0.61)	-0.656 (0.00)
Parents Own Land	-83.216 (0.85)	-127.47 (1.48)	-1,436.272** (2.50)
Siblings Own Land	18.609 (0.56)	18.66 (0.70)	-246.344 (1.38)
Children Own Land	-43.876 (1.52)	-12.34 (0.51)	-224.102** (2.03)
Other Relatives Own Land	6.329 (0.20)	24.77 (1.02)	218.910 (1.33)
Parents Alive	-26.129 (0.27)	-26.99 (0.33)	750.403 (1.50)
Siblings Alive	18.384 (0.68)	11.13 (0.53)	265.651* (1.90)
Children Alive	15.301 (0.62)	3.66 (0.19)	224.163* (1.80)
Other Relatives Alive	6.921 (0.26)	8.36 (0.40)	102.334 (0.64)
Land	60.085* (1.91)	26.54* (1.72)	396.222** (2.57)
House	-289.823 (1.47)	-677.51 (1.01)	-1,079.643 (0.80)
Target*NGO	-389.647 (0.79)	-561.97** (2.00)	
Mills lambda			-1,885.354* (1.88)
Constant	71.777 (0.04)	-1,793.35** (2.25)	-1,702.319 (0.47)
R-squared	0.39		

Absolute value of t-statistics in parentheses

significant at 10%; ** significant at 5%; *** significant at 1%

Table 6 – Variable Input Expenditure

	2SLS (II st.)	ML(Tobit)	ML(Heckman)
NGO Credit	0.126** (2.15)	0.032* (1.66)	0.054*** (3.08)
Informal Credit	0.109 (0.45)	0.016 (0.45)	0.012* (1.67)
Religion	312.128 (1.25)	94.427 (0.67)	136.278 (1.00)
Age HH Head	-5.241 (0.87)	-1.592 (0.36)	-1.199 (0.28)
Age HH Spouse	-2.733 (0.57)	-3.673 (1.00)	-4.506 (1.24)
Education HH Head	13.518 (0.70)	24.962** (2.18)	20.763* (1.80)
Education HH Spouse	27.906 (1.36)	23.268 (1.50)	26.337* (1.70)
Household is Male	427.335 (1.04)	276.091 (0.89)	295.849 (0.96)
Number of Persons in the HH	-14.661 (0.63)	-7.345 (0.42)	-14.365 (0.83)
Fixed Rent	113.503 (1.10)	85.469 (1.12)	82.926 (1.09)
Sharecropping	-163.166* (1.80)	-167.713** (2.43)	-164.814** (2.40)
Total Area Cultivated	-30.941 (0.32)	-54.564 (0.75)	-36.863 (0.51)
Total Area Cultivated Squared	11.929 (0.78)	9.228 (0.80)	8.452 (0.74)
Use: Dowry	-17.322 (0.04)	-74.263 (0.29)	-26.200 (0.11)
Use: Non farming activities	131.268 (0.95)	54.339 (0.67)	48.523 (0.65)
Distance to the Lender	-6.087 (0.90)	-2.013 (0.51)	1.532 (0.45)
Interest Rate	-1.846 (0.97)	-1.653 (1.33)	-0.801 (0.76)
Collateral	351.124 (0.38)	344.705 (1.23)	356.824 (1.50)
Constant	-1127.456 (0.73)	662.934 (0.74)	702.883 (0.89)
R-squared	0.34		

Absolute value of t-statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Other controls: Parents Own Land; Siblings Own Land; Children Own Land; Other Relatives Own Land; Parents Alive; Siblings Alive; Children Alive; Other Relatives Alive.

Table 7 – Fixed Input Expenditure

	2SLS (II st.)	ML(Tobit)	ML(Heckman)
NGO Credit	0.016 (0.04)	-0.174 (1.09)	-0.094 (0.65)
Informal Credit	0.167 (0.09)	-0.357 (1.26)	-0.070 (1.12)
Religion	44.263 (0.02)	-483.096 (0.42)	-294.633 (0.26)
Age HH Head	-51.224 (1.22)	-44.885 (1.25)	-51.206 (1.43)
Age HH Spouse	17.569 (0.52)	18.663 (0.62)	20.576 (0.68)
Education HH Head	174.492 (1.18)	200.265** (2.12)	190.403** (1.99)
Education HH Spouse	5.770 (0.04)	5.070 (0.04)	5.148 (0.04)
Household is Male	356.292 (0.12)	345.043 (0.14)	353.768 (0.14)
Number of Persons in the HH	130.447 (0.79)	155.139 (1.09)	166.033 (1.15)
Fixed Rent	335.353 (0.48)	310.052 (0.49)	298.736 (0.47)
Sharecropping	-694.233 (1.08)	-642.032 (1.13)	-722.953 (1.27)
Total Area Cultivated	-2,293.545*** (3.42)	-2,357.154*** (3.96)	-2,330.437*** (3.89)
Total Area Cultivated Squared	239.161** (2.25)	236.529** (2.49)	241.271** (2.53)
Use: Dowry	-2,645.794 (0.64)	-1,806.261 (0.86)	-2,330.659 (1.13)
Use: Non farming activities	-1,025.094 (1.10)	-766.716 (1.15)	-856.640 (1.39)
Distance to the Lender	24.845 (0.48)	48.405 (1.49)	26.638 (0.94)
Interest Rate	6.654 (0.42)	16.015 (1.56)	6.339 (0.72)
Collateral	-466.591 (0.07)	1,002.150 (0.44)	207.532 (0.11)
Constant	1,557.132 (0.22)	40,181.473*** (6.16)	40,202.28*** (6.16)
R-squared	0.26		

Absolute value of t-statistics in parentheses

significant at 10%; ** significant at 5%; *** significant at 1%

Other controls: Parents Own Land; Siblings Own Land; Children Own Land; Other Relatives Own Land; Parents Alive; Siblings Alive; Children Alive; Other Relatives Alive.

Table A1 - Description of the Variables

Variables	Mean	Std. Dev.	Min	Max
Religion	.8585271	.3488469	0	1
Age of Household Head	42.04845	12.9902	18	85
Age of Household Spouse	32.17636	14.00145	0	67
Education of Household Head (years)	3.562016	3.717974	0	14
Education of Household Spouse (years)	1.75969	2.693466	0	12
Household Head is Male	.9864341	.1157922	0	1
Number of Persons in the Household	5.804264	2.46499	1	17
Fixed Rent	.25	.4334329	0	1
Sharecrop	.5232558	.4999436	0	1
Total Area Cultivated (acres)	1.156226	1.206419	.025	8.2
Non Farming Activities	.3817829	.4862952	0	1
Parents Own Land (number)	.879845	1.09416	0	4
Siblings Own Land (number)	3.870155	3.572902	0	16
Children Own Land (number)	1.478682	3.220916	0	20
Relatives Own Land (number)	3.585271	4.350482	0	26
Parents Alive (number)	1.761628	1.272319	0	4
Siblings Alive (number)	8.141473	3.85481	0	25
Children Alive (number)	6.875969	4.637136	0	24
Relatives Alive (number)	6.323643	5.511674	0	32
Land Owned (acres)	1.210361	2.92784	0	52.5
House Ownership	.1686047	.3747657	0	1
Variable Expenditure (per-acre)	1082.318	923.1539	0	11272.73
Semi-Fixed Capital (per-acre)	3006.889	6144.073	0	76250