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The employment impact of microcredit program participation in Bangladesh: Evidence from a longitudinal household survey

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Abstract

Microcredit program, originating in Bangladesh in the late 1970s, has played an important role to meet the financing needs of the impoverished communities around the world. While the successes and failures of microcredit in lifting the poor out of poverty have been recorded in a wide array of literature, the employment outcome of participating in a microcredit program as a pathway to poverty reduction has been studied much less. Using two waves of longitudinal data on over 2000 households, we examine the employment impact of microcredit program in Bangladesh during 1998-2004. The longitudinal nature of data allows us fixed effects estimation of the effect of microcredit program participation on self-employment hours and household labor income isolating the biases that may result from non-random program placement, censoring in self-employment work hours and income data, and non-random sample selection of households or individuals as participants who already have entrepreneurial skills or pre-existing household conditions favourable to self-employment activities. The fixed effects estimate shows that households that participate in microcredit program work on average 245 hours longer in self-employment activities and earn 9.4% higher labor income than non-participant households. These extra hours are equivalent to around 7 weeks of employment for a person. The income effect of microcredit program participation is more discernible on household labor income than on total household income due to lack of direct link of microcredit program with non-labor income sources such as remittance. The participating households at the bottom of the income distribution appear to have gained more than those at the upper end suggesting equalizing effect of microcredit program participation over and above the positive effect on employment and income growth. Thus microcredit program in Bangladesh has succeeded in providing employment generating capacities to participants and raised the potential for income growth that contributed to poverty reduction.

Keywords: microcredit, self-employment, labor income, poverty

JEL codes: I32, J21, J22, J43, J46

Highlights:

1. In Bangladesh, microcredit program has a proven record of generating self-employment opportunities and income to participating households.
2. On average, microcredit program contributes to 245 additional hours in self-employment equivalent to 7 weeks of employment of a person.
3. Participant households earn 9.4% higher labor income than non-labor income that can be attributed to microcredit program induced self-employment activities.
4. The effect of microcredit program is more discernible on household labor income than on total household income which also includes non-labor income.
5. Moreover, microcredit contributes to greater equality in income by benefitting the households at the lower end of the distribution more.

I. Introduction

Microcredit is lending of small amount of fund to the poorest people who usually lack credit history and any collateral to be qualified to take loan from the formal credit market. Bangladesh is known to be the origin of the modern institution of microcredit, that began its journey in the late 1970s, flourished in the 1980s through 1990s and has since been replicated to help the impoverished communities around the world. The decade of 1990s saw proliferations of the program in different parts of the country so numerously that any village without such interventions could hardly be found by the turn of the twenty first century. The demand for systematic and rigorous evaluation of the impact of microcredit program on social and economic welfare of the poor in Bangladesh is, therefore, longstanding.

The history of microfinance revolution in the last quarter of a century is marked with successes and failures which have been recorded in a wide array of literature. These studies so far focused on the absolute impact of microfinance in terms of income and consumption increase (Khandker 1998; Khandker et al, 1998), poverty reduction (Imai and Azam, 2012; Khandker, 2005; Hossain, 1988; Khandker 1998), welfare improvement (Bhole and Ogden, 2010) and improvement in social indicators such as women empowerment (Hashemi 1996; Kabeer 2001; Mahmud 2003; Zohir et al, 2004). Most of the studies so far used cross-sectional survey data to estimate the impact of microcredit program participation on various socio-economic outcomes.

Microcredit program is generally targeted to address the financing needs of the poor, especially women in the poor segment of the society in usually poor areas. It started off in Bangladesh at an era when poverty was pervasive, wage income was at the subsistence level, health and sanitation

situation was at the bottom in the world standard, and literacy rate was insignificant. Against this backdrop, the purposive sampling was susceptible to two major biases such as non-random program placement in relatively deprived areas and self-selection of disadvantaged households or individuals as participants. Recognizing that previous cross-sectional studies were inadequate to address these biases, Khandker (2005) applied fixed effects (FE) estimation to longitudinal data covering the period from 1991-92 to 1998-99 to study the effect of microcredit borrowing on household consumption in Bangladesh.

The employment outcome of microcredit program participation is a relatively less-studied phenomenon. Microcredit programs are expected to promote self-employment enterprises by enabling households to undertake self-employment activities (McKernan, 2002). It has been argued that the provision of microcredit opens up self-employment options to some agents who otherwise could only work for wages or live at subsistence level (Ahlin and Jiang, 2005). In a paradoxical labor market where per capita income is one of the lowest in the world but reported official unemployment rate is no more than 5%, such as in Bangladesh (World Bank, 2016), it is the extent of underemployment rather than the unemployment rate that reflect the health status of an economy. Thus employment performance may not necessarily be reflected in the increase in the number of employed; it needs to take into account the growth in work intensity (e.g. annual average working hour per household), productivity and earning potential (Edwards 1974). Using two waves of household level longitudinal data dated from 1998 to 2004, this study evaluates the employment impact of microcredit program participation in Bangladesh reflected in the difference in average annual work hours per household and annual household labor income that microcredit program participation makes.

II. Literature Review

While the literature on the impact of microcredit program participation on income, consumption and poverty alleviation is prolific (e.g. Morduch, 1998; Coleman, 1999; Karlan and Goldberg, 2007; Karlan and Zinman, 2008; Tedeschi, 2008; Banerjee et al, 2009; Berhane and Gardebroek, 2009; Roodman and Morduch, 2009; Swaminathan et al, 2010; Millimet and Tcherris, 2010; Schroeder, 2010; Berg and Shahe, 2011), the studies on the impact of microcredit program participation on self-employment are very limited.

The employment impact of microcredit, in the existing literature, has so far been assessed using cross sectional data stratified by target and non-target villages and households. A widely used dataset for studying the impact of microcredit on the social and economic outcomes for participants comes from a household survey on 1798 households from 24 program thanas (the lowest stratum of administrative unit in Bangladesh) and 5 non-program thanas, carried out jointly by the World Bank and Bangladesh Institute of Development Studies (BIDS) in 1991-92. Using this dataset, Pitt and Khandker (1998) identified positive village level impact of three major microcredit programs in Bangladesh (e.g., Grameen Bank, BRAC and BRDB project RD-12) on employment alongside household production and income, particularly in non-farm sector.

The relevance of the above experimental set up is weakened due to the rapid expansion of the microcredit program far and wide and growing competition among microfinance institutions (MFIs) to attract members since the mid-1990s, which have blurred the demarcation between program and control villages. The criteria set for credit worthiness have changed and paucity of land or income is no more a precondition to avail loan opportunity. Now, there is hardly any village

in Bangladesh where there is no microcredit program in operation. Furthermore, massive infrastructural investment throughout the country in the 1990s made spatial targeting much less attractive as a strategy for poverty reduction. The implication of this lack of stringency in the division between control and treatment villages for program evaluation is that it has turned cross-sectional comparison of outcomes between participant and non-participant groups across program and control villages less convincing. Secondly, the random choice of participation imposed by the exogenous land rule (which defines eligibility to participate in microcredit program by ownership of less than 50 decimals of cultivable land) to identify the treatment impact is no more valid (Morduch, 1998; Roodman and Morduch, 2009; Schroeder, 2010). It has been observed that 17% of participating households own more than half an acre of cultivable land which provides evidence of mistargeting by the MFIs (McKernan, 2002). In this paper, we attempt to respond to this loss of quasi-experimental design in microcredit program evaluation by using household level longitudinal data.

Besides Pitt and Khandker (1998) discussed above, two more studies can be cited as relevant to the current paper. First, Swaminathan and colleagues (2010) used data from the Malawi Financial Markets and Household Food Security survey to examine the impact of access to credit on labor allocation patterns within the household by gender. The results show that formal and informal access to credit increases the likelihood of women's participation in off-farm self-employment activities, while informal access contributes to men's choice of off-farm self-employment work. Similar result is found in case of Ecuador (USAID, 2004). Second, McKernan (2002) emphasized the role of microcredit in the purchase of capital inputs for promoting self-employment. Using data on household participants and nonparticipants in Grameen Bank and two similar microcredit

programs, this paper estimated a profit equation to find large positive effects of participation and the noncredit aspects of participation on self-employment profits. However, none of these papers dealt with self-employment hours and income.

It is maintained in the current paper that household members' self-employment work hour and labor income are better indicators of gainful economic activity compared to total household income and consumption, as work effort is more directly observable and less prone to reporting errors. Besides, loans can be either consumed or invested. If there is no profit or loss in investment, the effect of microcredit program participation on consumption may be attenuated. Self employment hours and labor income, therefore, provide more reliable information for drawing inference on the welfare impact of microcredit. Employment generation is a means to sustainable poverty reduction strategy (Osmani, 2005). If we can find any positive impact of microcredit participation on self-employment hours and income, it can be concluded that microcredit has a lasting impact on income generation and poverty reduction in Bangladesh.

III. Data

The analysis is based on two waves of data from a panel of over 2500 households tracked under the Monitoring and Evaluation Study (MES) of MFIs in 1997-98, 1999 and 2000 and the Follow-up Monitoring and Evaluation Study (FMES) of MFIs in 2004. The survey was designed to monitor the performance of the MFIs and evaluate the socio-economic impact of microcredit programs. For the purpose of the present analysis, only the first and the last rounds of the survey are included. We have considered the changes over two surveys conducted in 1997-98 and 2004

to allow a considerable length of time to elapse between the beginning and the end of the observation period such that the long term welfare impacts are accounted for.

The survey was conducted under the auspices of the Pally Karma Sahayak Foundation (PKSF), a non-profit funding agency of the government of Bangladesh launched in 1990 to provide institutional support to MFIs that became its partner organizations (POs). As of 30 June 2015, the total number of members of 274 POs is 11.12 million and 90.36% of these members are women (PKSF, 2015). During the fiscal year 2014-15, PKSF disbursed loan by the amount of BDT 28.24 billion (equivalent to about USD 353 million). The prime focus of disbursing loan is to eliminate poverty through self-employment generation among the poor.

In the first wave of survey beginning in 1997, as described in Zohir et al (2001), a three stage sampling procedure was followed to select the study villages. In the first stage, thirteen MFIs were selected for the survey—two large, two medium and the rest small. In the second stage, one thana was selected from each MFI area. In the third stage, villages were selected through a stratified random sampling design. All villages in a sampling area were stratified into control and program villages to select 2 control and 6 program villages from each area totalling 26 control and 78 program villages from the 13 sampling areas. However, due to the pervasiveness of microcredit intervention throughout the country, only 11 control villages could be found. With two additional program villages in one of the sampling areas, sample villages totalled 91.

It should be pointed out that by the fourth wave of survey in 2004, all the initial control villages effectively turned into program villages due to rapid expansion of microcredit programs in the

country leaving no room for a quasi-experimental program evaluation at the village level. While the participation rate among sample households in the program villages fell from 44% in 1998 to 32% in 2004, it rose from 1.7% in 1998 to 10.4% in 2004 in the initial control villages (Rahman et al, 2005).

Household participation status was defined in terms of current membership of either member of a household with MFI(s), be it PKSF or non-PKSF organization (e.g. Grameen Bank). The households in the program villages were grouped into eligible participants, eligible non-participants, non-eligible participants and non-eligible non-participants. As the criterion for eligibility varies across MFIs, the ownership of 50 decimals or less of cultivable land was used to define eligibility uniformly. The sample size of each group was predetermined, and within each group the sample households were drawn randomly from the census households.

A detailed questionnaire was designed to collect information from the head or other members of household on household demographics, production, income, employment, consumption, education, health, housing, sanitation, land and non-land assets, MFI membership, borrowing, lending, and crisis coping efforts. The analysis presented in this paper draws exclusively on this information. In addition to the household module, the survey had five separate modules of questionnaires to interview household members associated with MFIs; female members aged 15 to 50, village head, branch head of MFI within the village, and head of the MFIs. These modules were designed to have a closer look at MFI operations and their impacts at different levels of the agencies involved.

IV. Analytical framework

Variables

The unit of analysis for the present study is a household. The definition of household participation status is retained from the original survey design for the identification of the effect of microcredit program. The sample households were broadly classified into three groups on the basis of individual affiliation with MFIs:

(i) Regular participants: participants in any microcredit program in both the first and the fourth rounds of the longitudinal survey;

(ii) Occasional participants: those who participated in any microcredit program in either first round or fourth round only;

(iii) Non-participants: those who were non-participant in any microcredit program in both first and fourth rounds of the longitudinal survey.

For descriptive analysis, we considered only regular and non-participants, that is, regular participants and non-participants. For regression analysis, we considered both regular and occasional participants as the participant group.

The key dependent variables used for the analysis in this paper include household hours of work and labor income generated in self-employment activities, such as cultivation and other on-farm (e.g. plantation) activities, non-farm agricultural activities (e.g. animal husbandry), and non-farm non-agricultural activities (e.g. petty trade, rickshaw/van driving, hair cutting, etc.). The average hours worked per day and the number of days worked per month is reported for each member of the households, for each quarter of the year in order to capture seasonal fluctuation in employment

in the rural areas. These hours are converted to average monthly and quarterly work hours and summed across three quarters to obtain annual average hours worked by each household member, which are then summed across all members to calculate the annual average work hours of a household.

The annual income of households is calculated by adding the sales value of annual household production of crops, livestock and fishery, earnings from wage employment, farm and non-farm self-employment, and other sources such as service, help from relatives, relief, food for education, remittance, house rent, etc. For the purpose of isolating the effect of MFI program participation on employment and hence on labor income, the income from other sources such as help from relative, relief, food for education, remittance, etc., are excluded from total household income to calculate household labor income. The income data are converted to 2004 constant prices.

Apart from MFI participation status, the set of independent variables include the household level characteristics namely household size, asset holding, area of cultivable land, mobility of household members measured by the total number of days the members stayed outside of the household, and total wage income of the household. We use wage income instead of wage rate in the local market as higher wage rate can shift labor supply from self-employment to wage employment dampening the wage rate and cause endogeneity problem. The individual level characteristics are age and level of education of the household head, and the highest level of education achieved by any male and female member of the household. Along with it, one dummy variable for the absence of spouse is included to control for the role of joint or single decision-making on microcredit program participation and employment portfolio.

Due to heterogeneity in the infrastructural development across Bangladesh, it can be presumed that villages across Bangladesh are different in many observable dimensions such as wage rate, prices, communication, and so on. For the present analysis, some village characteristics such as the number of grocery shops, fertilizer shops and bus stands are considered as indicators of business opportunity in the villages. For explaining variation in household income variables, some additional village level characteristics such as average prices of common food items (rice, lentil, soybean oil, potato, egg, milk and small fish) are included in the analysis.

Two dummies were considered for the basic general level educational institution in the village, such as existence of primary school and existence of religious school called Madrasa. It is commonly believed that in traditional Muslim culture, women empowerment and women's work for cash or kind outside the homestead are not encouraged, especially in a backward rural set up characterized by low literacy rate. The presence and number of educational institutions thus indirectly contribute to participation and self-employment work hours. The village level wages for females, used by McKernan (2002) are not included in the model due to unavailability of data in most of the villages. The male wage rate is also not considered since the heterogeneity of the nature of work, ability and skill create noise in reporting wage rates by individuals. As pointed out earlier, wage rate can be endogenous to self-employment hours. Apart from the observable village characteristics, village fixed effects are used to control for unobservable heterogeneity and village level spill-over effects of microcredit program intervention.

In explaining microcredit program participation, household level characteristics also include an additional categorical variable to control for household head's primary occupation. It is included to explain program participation behavior. This variable is categorized based on the payment frequency, since occupation with frequent and immediate return is likely to have greater liquidity and higher probability of not defaulting. This variable is therefore expected to have impact on participation. Occupation of the household head is mostly pre-determined and can be treated as exogenous. The summary statistics of the observable variables used in the regression analysis are provided in Table 1.

Table 1 here

Descriptive analysis

In this paper, we first undertake descriptive analysis of annual average household work hours differentiated by microcredit program participation status of households across farm self-employment, non-farm self-employment and wage employment categories over 1998 and 2004. Similarly, the averages of total household income and household labor income are compared by MFI program participation status across the two survey years. Corresponding growth rates are calculated to determine the relative welfare improvement by participation status. No distinction is drawn between eligible and non-eligible households due to the fungibility of the land ownership criterion in the selection of participants in microcredit programs. Instead, we control for land size in the multivariate analysis of the employment outcomes of program participation.

The welfare impact of changes in income is also captured in this analysis using the *welfare dominance* approach (Hadar 1969; Saposnik 1981). As the theorem says, "… one distribution X first-order-dominates another distribution Y for the class of anonymous, increasing social welfare functions if and only if the income of the person in each rank in X is at least as great as the income of the person with the corresponding rank in Y and strictly greater someplace" (Fields 2005). By the axiom of anonymity of individuals in the income distribution, this theorem does not require that the same person be followed over time. What the welfare dominance method suggests is that we make welfare comparison between the beginning and the end of the observation period undergoing some program intervention on the basis of the comparison of income percentiles. If income increases at every percentile, we conclude that welfare has improved.

Econometric analysis

The second part of the analysis involves estimation of an econometric model using a single equation describing self-employment work hours:

$$y_{ijt} = p_{ijt}\alpha + X'_{ijt}\beta + V'_{jt}\gamma + e_{ijt} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (1)$$

where, i, j and t represent household unit, study area (village) and year of observation respectively;

y_{ijt} is the self-employment work hours of households;

p_{ijt} is an indicator variable for microcredit program participation (1 for participation and 0 otherwise);

X_{ijt} is the vector of household and environmental characteristics;

V_{it} is the vector of village level characteristics;

ε_{ijt} is the random disturbance term; and

α, β and γ are the parameters to be estimated.

Equation (1) is estimated using pooled ordinary least squares (OLS) method. The parameter of primary interest in this equation system is α that shows the impact of MFI participation on self-employment work hours of sample households. For estimation of equation (1), we pool the household level observations for both participants and non-participants from the two waves of survey and then run OLS regression of household annual self-employment work hours. The standard errors of the estimates are adjusted for multiple observations on the same household and possible correlation of intra-household error terms over time. The dependent variable is in absolute form to see and interpret the outcome in hours of self-employment creation. So no transformation is performed on it.

McKernan (2002) pointed out three sources of bias that may affect the result of estimation of the impact of microcredit program participation on an outcome variable, such as non-random program placement, censoring in self-employment work hours data, and non-random sample selection of households or individuals as participants. The bias from non-random program placement can be readily corrected by inserting a village level fixed effect term in the vector of village level characteristics V in equation (1).

The hours for a household are not observed if none of the household members participate in the self-employment activity. Those who do not engage themselves in self-employment enterprises

have zero self-employment hours reported, although they may be program participant, employed otherwise or have high ability to run any self-employment enterprise successfully. In case of Bangladesh, McKernan (2002) found 85% households are engaged in self-employment activities while Banerjee and Duflo (2007) found in 12 least developed countries (LDCS) that about 70% households have some kind of self-employment activity at the household level. The PKSF data under current analysis show that in 1998 and 2004 about 95% and 89% households respectively had self-employment engagement with positive self-employment work hours. The high prevalence of self-employment activity suggests that while the OLS estimates on pooled data can be biased due to non-random program placement or non-random selection of participants, the censoring of the data is not expected to be a major source of bias.

The remaining bias can come from self-selection or non-random sample selection that would induce endogeneity in the participation variable. Using panel data, where the differences in pre-treatment outcome variables can be taken into account, the time invariant endogenous or omitted characteristics (e.g. initial conditions of the household, background of household level entrepreneurial ability) can be eliminated by the fixed effects (FE) estimates (Moffit, 1991; Wooldridge, 2010). The FE regression equation is given by:

$$y_{ijt} = p_{ijt}\alpha + X'_{ijt}\beta + V'_{jt}\gamma + \lambda_i + v_{ijt} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where λ_i is the time invariant household level fixed effects which are correlated with the random disturbance term v_{ijt}.

In order to identify the impact of microcredit program participation on total household income and household labor income, the estimation of equations (1) and (2) are repeated using log of income as the dependent variable. However, in case of household income, we may observe the effect of an overall trend of steady national economic growth since early nineties which may influence the impact of microcredit program on household income. A trend variable is therefore included in the model to isolate the effect of MFI participation from the general trend in income such as below:

$$lnI_{ijt} = p_{ijt}\alpha_I + t\delta + Z'_{ijt}\beta_I + V'_{jt}\gamma_I + u_{ijt} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

$$lnI_{ijt} = p_{ijt}\alpha_I + t\delta + Z_{ijt}\beta_I + V_{jt}\gamma_I + \lambda_{I_i} + \epsilon_{ijt}, \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

where I is household income, Z is the set of explanatory variables, t is time variable taking 0 for 1998 and 1 for 2004, δ is the trend parameter, and the I subscripts of the coefficients indicate the income equation.

The OLS and FE estimation techniques estimate the effect of program participation and other control variables on the conditional mean of the outcome variable. The effect of program participation may, however, vary by the position of participants in the overall distribution of the outcome variable, such as household income. For example, the income effect of MFI program participation may be more pronounced at the 10th percentile than at the 90th percentile. In other words, microcredit program may be more effective in enhancing income of the poorest of the poor and therefore more equalizing. With a view to examining the equalizing impact of microcredit program, we finally apply quantile regression technique to equation (3) that estimates the effect of participation on household labor income at different points in the conditional distribution (10th, 25th, 50th, 75th, and 90th percentiles) of household labor income:

$$lnI_{ijt\theta} = p_{ijt}\alpha_\theta + X'_{ijt}\beta_\theta + V'_{jt}\gamma_\theta + \varepsilon_{ijt\theta} \quad \ldots (5)$$

where $0 < \theta < 1$ is the quantile and the coefficient vectors differ depending on the particular quantiles being estimated.

In the final part of the analysis, the participants of microcredit programs are characterized by the observable traits using a multivariate logit model of the decision to participate in the program:

$$p_{ijt} = \frac{\exp\{Z'_{ijt}\delta\}}{1+\exp\{Z'_{ijt}\delta\}} \quad \ldots (6)$$

where p_{ijt} is the probability of participation in microcredit program of household *i* in village *j* in year *t*, Z_{ijt} is the corresponding vector of household and environmental characteristics and δ is the vector of parameters to be estimated. All the estimations are done using STATA 13.

V. Empirical Findings

Descriptives

Level and growth of work hours

The cross-sectional distribution of annual average household work hours, presented in Table 2 by survey year, participation status of households and type of employment, reveals a few striking observations. First, participants work much longer hours than non-participants particularly in non-farm self-employment and wage employment. Second, participants experienced larger growth in total hours from 1998 to 2004 compared to non-participants. This growth is largely attributable to

the increase in self-employment hours in non-farm sector. Third, the average work hour in farm self-employment decreased while that in non-farm self-employment increased for both groups.

Table 2 here

Table 3 reveals the change in the composition of employment across participation status over time. First, the participant group started with higher percentage work hour in non-farm self-employment in 1998, increased the share of non-farm self-employment in total work hour between 1998 and 2004 and remained ahead of the non-participants in this respect in both periods. Second, non-participants devoted greater share of their time to farm self-employment than participants, although this share declined in 2004. Table 2 further shows that participants took the lead in both periods in terms of the allocation of total work hour to non-farm self-employment. These findings suggest that participation in microcredit program is strongly correlated with allocation of household work hours to non-farm self-employment.

Table 3 here

While participation in microcredit program likely contributed to growth in employment opportunities in non-farm sector, it is not clear from the above labor allocation pattern whether program participation caused greater opportunities in self-employment or sustained engagement in self-employment necessitated participation. So we take a closer look at the characteristics of only the self-employed households in Tables 4 and 5. The participants are consistently found to be ahead of non-participants in terms of self-employment hours, percentage of borrowers and amount of credit taken from credit institutions, be it MFI-s or non-MFIs, in both periods. It gives the

impression that the microcredit program not only benefits its participants, but also serve the ablest members of the society who would have experienced growth in self-employment hours had they not received support from MFIs. In the presence of the latter possibility, the endogeneity of participation arises, as was noted by McKernan (2002). The assessment of microcredit program participation on self-employment using standard econometric tools is therefore clearly called for.

Table 4 here

Table 5 here

Level and growth of household income

Comparing the percentiles of annual household income between 1998 and 2004, we find that growth occurred across all income strata (Figure 1). The rank dominance of the household income distribution in 2004 over that in 1998 implies that the income of the household in each percentile in 2004 was greater than the income of the household in the same percentile in 1998. While households across all the income percentiles experienced growth in household income, the overall growth performance seems to have been unevenly shared by households in different income strata. As shown in Figure 2, the absolute increase in income was primarily driven by growth at the top 50% of households.

Figure 1 here

Figure 2 here

The comparison of average household income by participation status shows that the average household income was generally higher for non-participants than participants in both 1998 and 2004 (Table 6). The income gap between the two groups widened in 2004 compared to 1998 due to faster growth of income among non-participants (6.94%) than participants (3.63%) in between. The fact that participants fell behind non-participants in generating household income is attributable to the fact that total household income has many components (e.g., remittance) that are unrelated to microcredit program participation. We, therefore, narrowed down the analysis to household annual labor income which is more likely to reflect the effects of microcredit program participation provided that microcredit program enhances income by gainful self-employment. Apparently, participants experienced faster growth in household labor income (4.07%, shown in Table 6) than in total household income (3.63%, shown in Table 6). Table 6 further shows that although participants started with higher average household labor income than non-participants in 1998, their average labor income converged by 2004 due to faster growth of labor income among non-participants. The differential of non-participating households over participating households in terms of overall annual household income is mostly due to their much higher level of and faster growth in non-labor income (Table 6).

Table 6 here

The shifting of household labor income across percentiles has been depicted by participation status in Figure 3. In this figure, the top 40% of the non-participants clearly made more progress compared to the top 40% of participants. To understand the status at the bottom end of household labor income distribution, we blow up the figure from 1st to 40th percentiles for both years in Figure

4. It shows that participating households were relatively better off in both years compared to their non-participating counterpart at the bottom 40%. It is thus evident that the bottom 40% of participants were having a clear advantage over the bottom 40% of non-participating households in generating labor income.

Figure 3 here

Figure 4 here

Effect of microcredit program participation on self-employment hours

Table 7 presents the results of estimation of the impact of microcredit on self-employment work hours based on two different regression models specified in Section IV, such as, pooled OLS and FE in equations (1) and (2) respectively. Microcredit program participation is found to make a positive and significant impact on self-employment hours of households in both models implying that participant households work longer hours in self-employment compared to non-participants. However, the FE estimate of the effect of program participation is smaller than the cross-sectional estimate—compare 245 hours (FE) with 472 hours (OLS). As the household specific time invariant characteristics, including initial household conditions and entrepreneurial skill and abilities of household members, are controlled for in FE regression, the estimated impact of microcredit program participation on self-employment hours reduces by a significant amount which can be attributed to these fixed effects omitted in pooled OLS.

Table 7 here

As the other estimated coefficients across the two sets of regression show, the presence of male head of the household has positive impact on self-employment work hours. Households without a spouse have more self-employment work hour. The maximum education of the female member of any household has insignificant contribution to self-employment work hours as observed in OLS estimates. But in case of fixed effects estimate, the coefficient is positive and significant at 5% level implying that presence of more educated female members in the household contributes to greater self-employment hours. The maximum education of male members of the household has significant and positive impact on self-employment hours across both estimates. The regional variation is an important determinant of self-employment work hours, as several of the village fixed effects are found significant (omitted in Table 7 for brevity). Wage income has negative relation to self-employment work hour as expected. The effect of the existence of Madrasa on self-employment hours is negative.

Effect of microcredit program participation on household income

The comparison of mean and growth rates in household income and household labor income in Table 6 leads us to hypothesize that participation in microcredit program may have brought some clear advantages to the rural poor with respect to generation of labor income. In this section the multivariate regression analysis is performed to evaluate the impact of microcredit program participation controlling for household and community level determinants. We pool household level observations for both participants and non-participants from the two waves of survey and then run pooled and FE regression of annual household total income and labor income. The results of estimation are presented in Table 8. The standard errors of the estimated coefficients in the

pooled regression are adjusted for multiple observations on the same household and possible correlation of intra-household error terms over time. The second and third columns of Table 8 present the results of estimation of total household income and the fourth and fifth columns present the results of estimation of household labor income based on two different regression models, such as, pooled OLS (equation 3) and FE (equation 4). The dependent variable is in natural log form to see and interpret the outcome in percentage difference in income due to participation. So the coefficient of participation variable (coded 1 if participant and 0 otherwise) indicates the percentage difference in household level total income and labor income between participants and non-participants.

Table 8 here

As shown in Table 8, the effect of microcredit program participation on total household income is positive and significant at 1% level only in pooled OLS regression. However, the FE estimation shows no statistically significant difference in total household income between participants and non-participants. On the other hand, the effect on household labor income is positive and statistically significant at 1% level in pooled OLS estimate and at 10% level in FE estimate. Moreover, the effect of microcredit program participation is more pronounced for household labor income (14.6% in pooled OLS estimate and 9.4% in FE estimate) than the effect estimated for total household income (3.9% in pooled OLS estimate).

Within the estimated effects of participation on household labor income, the FE estimate (9.4%) is found smaller than the OLS estimate (14.6%). As the household specific time-invariant

characteristics, including initial household conditions and entrepreneurial skill, are controlled for in FE regression, the estimated impact of microcredit program participation on household labor income reduces by a significant percentage which can be attributed to this unobserved heterogeneity omitted in pooled OLS regression.

As the other estimated coefficients across the two sets of regression of household labor income show in Table 8, the time trend in household labor income is positive and significant. Age of household head is not a significant determinant of household labor income. Larger asset contributes to higher household labor income. The mobility of household members has significant, although small, negative impact on household labor income. The level of education of household head has negative effect on household labor income, although it is not statistically significant in FE estimation. Larger household size results in higher household labor income. The presence of male head of the household has positive impact on household labor income. The maximum education of adult male members of the household has significant and positive impact across both estimates. The maximum education of adult female members of the household has insignificant contribution to labor income both in OLS and FE estimates. The absence of spouse in the household is positively correlated with household labor income according to the OLS estimate, although it is not significant in the FE estimate. Landholding is a significant positive predictor of higher labor income of households.

The regional variation is an important determinant of annual household labor income, as several of the village dummy variables are significant. The coefficients of village dummies are however suppressed in the table for the sake of the brevity of presentation of results. Among the prices of

essential food items, only the price of rice and soya bin oil are positively and significantly related to household labor income. The price rice explains that the income of rice farmers is dependent on the price at which they can sell their produce. On the other hand, the soya bin oil (commonly termed for cooking oil) is essential imported item. It may be connected to the petty trading of the item using microcredit under self-employment activity. The presence of primary school in the village shows significant positive effect on labor income in FE estimation.

Table 9 reports estimates of OLS and 10^{th}, 25^{th}, 50^{th}, 75^{th} and 90^{th} quantile coefficients of equation (5) for household labor income. The OLS coefficient is 0.146 (as it is also reported in Table 8) implying 14.6% higher household labor income for participants than for non-participants. In the quantile regression estimates, the coefficient is higher for 10^{th} and 25^{th} quantiles than for 50^{th}, 75^{th} and 90^{th} quantiles, although the coefficient is not significant for 10^{th} quantile. It indicates that the effect of microcredit program participation on household labor income is greater at the lowest quarter of the labor income distribution than the top three-quarters. In other words, the lowest income group benefit most from participating in the microcredit program. This result is further supported by a decreasing line of labor income coefficient for participation on a continuous scale of labor income distribution in Figure 5, vis-à-vis the horizontal line for the OLS estimate of the coefficient.

Figure 5 here

Characterization of the beneficiaries of microcredit program

Given the above findings, it is natural to ask who are the participants of microcredit program and thus the beneficiaries of gainful self-employment and earning. The decomposition of household income in labor and non-labor income components by participation status in Table 6 indicate that households with higher non-labor income are less likely to participate in the microcredit programs while the labor incomes are comparable between the two groups. Non-labor income is largely constituted by remittance of foreign earnings. It suggests that the participant households do not have as much non-labor income earning opportunities as the non-participants.

The negative relationship between non-labor income and the probability of participation in microcredit program is statistically significant as shown in Table 10 that reports the results of estimation of a logit model of microcredit program participation specified in equation (6). The logit model controls for other observable characteristics of households and the socio-economic environment of the neighbourhood that can potentially influence the decision to participate. The results indicate that households with smaller assets, lower education of household head, larger household size and less cultivable land are more likely to participate in microcredit program.

Table 10 here

Lentil and potato are more or less common crops in rural Bangladesh. Higher prices of them signify that they are economically attractive for farming. It implies that farm sector is dominant there. As a result, the probability of participation in microcredit programs which primarily facilitates non-farm activities can be lower in those villages. Larger number of fertilizer shops in any village has two implications. Firstly, it indicates greater scope of non-farm income generating activities such

as trading in any village and greater likelihood of participating in microcredit programs to support these activities. Secondly, it reflects that farm sector is dominant in the village. As a result, the probability of participation in microcredit programs which primarily facilitates non-farm activities can be lower. The net effect of these two opposite forces seems to be in favour of more participation by the people in the village having more fertilizer shops. The price of soya bin oil has positive effect on participation. It is because soya bin oil is mainly imported in Bangladesh and it enhances non-farm activities such as petty trading through grocery stores and other outlets. The other important village level characteristic is the presence of primary school that greatly enhances the likelihood of participating in microcredit program by the residents of the village.

In addition, the frequency of payment of the principal earner in the household appears to be an important determinant of microcredit program participation. Compared to the daily income earners, the likelihood of participation is lower for those who receive payments weekly, monthly, annually or irregularly. This finding is consistent with the usual weekly repayment schedule of microcredit programs that requires relatively regular and more frequent flow of income of the borrowers to comply with the repayment requirements.

VI. Discussion

Using data of over 2500 households in Bangladesh from a longitudinal survey for the period of 1998-2004, this paper identifies the effect of microcredit program participation on household self-employment work hours and labor income in Bangladesh. The fixed effects estimate shows that households that participate in microcredit program work on average 245 hours longer in self-employment than non-participant households. These extra hours are equivalent to around 7 weeks

of employment for a person. It accounts for 8% of the total annual self-employment hours (farm and non-farm) and 6% of total annual work hours of participants. At the average hourly income of around 14.40 BDT in the study area during the surevey time, the income generated from additional 245 hours of work is 3,528 BDT. This is equivalent to about 5% of the average annual household income of the households surveyed in this study.

While cross-sectional OLS estimates of the household labor supply function confirms the previous findings that microcredit increases self-employment, the smaller FE estimate reveals that the self-employment growth is attributable to a large extent to the time-invariant household characteristics such as, initial conditions and entrepreneurial skill possessed by households that are favourable to self-employment activities.

The increase in self-employment hours is translated into increase is household labor income of participants as evident in the finding that participant households have 9.4% higher labor income than non-participants, according to the FE estimate. However, non-participants have significantly higher non-labor income than participants that offsets the difference in labor income between the two groups. As a result, the difference in total household income is not observable. The failure to identify the efect of microcredit program participation on labor income in isolation from income from other sources partially explains why the evidence of any significant positive effect of microcredit program participation on overall household income or consumption is weak in some of the earlier evalutation studies of microcredit program performance. This study makes an important contribution to the literature by showing that microcredit program participation offers a

clear advantage by increasing household labor income through generation of self-employment hours.

Overall, access to credit by especially the female members of the household would increase the self-employment activity particularly in a country where women are not allowed to work outside the household. In the absence of a formal female labor market in rural Bangladesh, the access to credit would increase the likelihood of participation to self-employment activity for the female household members enhancing the overall self-employment activity at the household level (McKernan, 2002; Fugelsong and Chandler, 1993). The findings of this study thus provide supporting evidence that microcredit contributes to generation of self-employment. This is in line with the conclusion of a meta-analysis of 90 studies that the impact of microcredit on key development outcomes at the level of the client entrepreneurs is positive (Chilova, 2015).

Based on quantile regression estimates, this study also finds that the gain in household labor income by microcredit program participants is more pronounced at the lower end of the income distribution. Thus it is evident that microcredit program contributed to welfare improvement not only by increasing the level of income through self-employment, but also by enhancing income of the poorest of the poor that leads to income equalization.

VII. Conclusion

The microcredit program in Bangladesh has succeeded in providing employment generating capacities to households and raised the potential for income growth that contributed to poverty reduction. The welfare impact of microcredit program participation is more discernible on

household labor income than on total household income due to lack of direct link of microcredit program with non-labor income sources such as remittance. The participating households at the bottom of the income distribution appear to have gained more than those at the upper end suggesting equalizing effect of microcredit program participation over and above the positive effect on employment and income growth.

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Table 1: Summary statistics.

Variables	1998		2004	
	Mean	SD	Mean	SD
Proportion of microcredit program participant households	**0.586**	**0.493**	**0.442**	**0.497**
Household level characteristics				
Non-labor income ('000 Taka)	10162	31359	16492	43925
Wage income ('000 Taka)	5.43	9.18	7.09	12.2
Age of household head	44.6	13.2	48.7	12.5
Asset ('000 Taka)	27.3	43.8	34.9	47.1
Household members stayed outside area (days per annum)	61.7	122	37.4	78
Household head's education	2.66	3.85	2.9	3.97
Household size	5.77	2.31	6.81	2.81
Male-headed household	0.946	0.226	0.909	0.288
Maximum education of male members of household	4.36	4.64	5.03	4.6
Maximum education of female members of household	2.47	3.64	3.67	4.03
Absence of spouse	0.0894	0.285	0.11	0.313
Total cultivable land	105	168	93.3	163
Village level characteristics				
Number of grocery shop in the village	11	19.2	3.99	2.71
Number of bus stand in the village	0.148	0.355	0.0204	0.141
Number of fertilizer shop in the village	1.92	3.16	1.21	1.44
Price of rice (Taka/kg)	13.5	1.11	19.8	16.6
Price of lentil (Taka/kg)	38.7	1.62	38.2	6.95
Price of soybean oil (Taka/liter)	62.3	18.9	51.2	9.65
Price of potato (Taka/kg)	5.63	1.39	9.83	4.15
Price of egg (Taka/piece)	2.91	0.919	3.73	1.36
Price of milk (Taka/liter)	15.2	4.25	16	2.37
Price of small fish (Taka/kg)	42.4	11.8	41.3	14.3
Dummy for presence of primary schools in the village	0.882	0.322	0.843	0.364
Dummy for presence of Madrasas in the village	0.735	0.441	0.718	0.45
Frequency of payment of income of principal earner				
Weekly (weekly payment = 1; 0 otherwise)	23.65		19.83	
Monthly (monthly payment = 1; 0 otherwise)	13.61		9.27	
Quarterly (quarterly payment = 1; 0 otherwise)	44.96		43.49	
Half-yearly (half-yearly payment=1; o otherwise	1.9		2.32	
Annual (annual payment = 1; 0 otherwise)	3.47		0.08	
Irregular (irregular payment = 1; 0 otherwise)	12.41		25.03	

Table 2: Annual average household work hours of all households by microcredit program participation status

Type of employment	1998		2004	
	Participant	Non-participant	Participant	Non-participant
Farm self-employment	1106.64	1078.75	907.93	890.99
	(29.43)	(36.61)	(29.32)	(27.59)
Non-farm self-employment	1568.79	899.21	1983.09	1329.82
	(45.98)	(45.68)	(64.88)	(52.62)
Total wage employment	1225.1	771.87	1269.48	912.8
	(42.19)	(41.08)	(49.69)	(40.17)
Overall	3900.52	2749.83	4160.51	3133.6
	(84.47)	(85.47)	(112.44)	(91.86)
Number of observations	1543	1058	1147	1422

Note: The numbers in parenthesis are standard deviations.

Table 3: Composition of annual average household work hours (in percentage) by microcredit program participation status

Type of employment	1998		2004	
	Participant	Non-participant	Participant	Non-participant
Farm self-employment	28.37	39.23	21.82	28.43
Non-farm self-employment	40.22	32.70	47.66	42.44
Total wage employment	31.41	28.07	30.51	29.13
Overall	100	100	100	100
Number of observations	1543	1058	1147	1422

Table 4: Percentage of self-employed households in all households and average household work hours of self-employed households by participation status

	Number of observations	Self-employed (%)	Hours in self-employment	
			Mean	Standard deviation
	1998			
Non-participant	1058	92.25	2144.14	59.86
Participant	1543	97.28	2750.28	54.72
Overall	2601	95.23	2511.49	41.1
	2004			
Non-participant	1422	86.57	2565.39	65.53
Participant	1147	92.24	3134.22	75.94
Overall	2569	89.10	2826.13	49.85

Table 5: Percentage of borrower households among the self-employed households, mean and standard deviation of the amount of credit taken by the borrower households by participation status

	Number of observations[1]	Borrower (%)	Credit	
			Mean (Taka)	S.E
	1998			
Non-participant	1058	50.19	10720.57	1001.76
Participant	1543	94.36	14324.2	461.03
Overall[2]	2602	76.36	13361.18	432.38
	2004			
Non-participant	1422	28.55	13319.47	1103.69
Participant	1147	91.28	27360.10	1033.72
Overall	2588	56.53	23480.81	818.97

Note: The households who took credit from MFI or non-MFI sources were identified as borrower households.

[1] It is the sum of borrower and non-borrower of the specific category in the particular year

[2] It is the number of all borrower and non-borrower in a particular year

Table 6: Annual average household income by microcredit program participation status

Household income	1998		2004		Growth rate (%)	
	Participant	Non-participant	Participant	Non-participant	Participant	Non-participant
Labor income	35735.29	32999.92	45400.36	45957.55	4.07	5.68
	(757.82)	(977.94)	(1100.46)	(1224.58)		
Non-labor income	8236.88	13725.68	9625.88	23045.46	2.63	9.02
	(582.75)	(924.63)	(743.15)	(1107.91)		
Total household income	44472.80	47496.10	55070.55	71028.41	3.63	6.94
	(1047.42)	(1466.26)	(1390.05)	(1824.82)		
Number of observations (N)	1543	1058	1147	1422		

Notes:

1. *The numbers in parenthesis are standard deviations.*
2. *All income figures are in 2004 prices.*
3. *Mean is calculated by dropping the top and bottom 1% observations.*
4. *N represents the number of sample households that reported household income from any source.*
5. *Growth rate represents annual compound growth rate between 1998 and 2004.*

Table 6a: Annual average household income of the target households[3] by microcredit program participation status

Household income	1998		2004		Growth rate (%)	
	Participant	Non-participant	Participant	Non-participant	Participant	Non-participant
Labor income	29119.72	25074.69	40481.84	33959.09	5.64	5.18
	(1229.69)	(1229.69)	(1229.69)	(1229.69)		
Non-labor income	5654.77	7606.74	6277.82	15163.63	1.76	12.18
	(702.91)	(702.91)	(702.91)	(702.91)		
Total household income	34933.75	33046.33	46909.39	50163.58	5.04	7.20
	(1458.47)	(1458.47)	(1458.47)	(1458.47)		
Number of observations (N)	871	504	700	663		

Note: Notes for Table 6 are also applicable for Table 6a.

[3] Target households are those with less than or equal to 50decimal of land holding.

Table 7: Results of estimation of the impact of microcredit program participation on household self-employment hours

Explanatory variables	Pooled OLS	Fixed Effect
	b/se	b/se
Program participant	472.37***	245.07**
	(55.53)	(79.44)
Age of household head	10.28***	-0.83
	(2.37)	(4.36)
Asset (‘000 Taka)	1.18	4.31***
	(0.71)	(1.03)
Days stayed outside of home	-1.35***	-0.08
	(0.27)	(0.34)
Household head’s education	-77.93***	-50.10*
	(10.08)	(19.84)
Household size	293.78***	134.14***
	(12.41)	(25.42)
Male-headed household	772.01***	491.64*
	(137.84)	(210.01)
Maximum education of male members of household	53.24***	89.02***
	(9.17)	(13.88)
Maximum education of female members of household	-3.66	32.60*
	(8.83)	(12.68)
Absence of spouse	412.60***	355.71*
	(112.87)	(155.54)
Total cultivable land	-0.14	0.62
	(0.20)	(0.39)
Wage income (‘000 Taka)	-57.30***	-60.46***
	(2.59)	(3.84)
Presence of Madrasa in the village	-210.48*	-180.61*
	(91.47)	(79.96)
Constant	683.08	1155.15*
	(459.07)	(490.74)
R-squared	0.36	0.19
BIC	94272.4	88070.2
Number of observations	5,224	5,224

Notes:

1. The estimates of village-specific fixed effects are omitted.
2. ***, ** and * stand for significance at 1%, 5% and 10% levels respectively.

Table 8: The pooled OLS and FE estimates of the impact of microcredit program participation on annual household total income and labor income, 1998-2004

	Natural log of household total income		Natural log of household labor income	
Independent variables	Pooled OLS	FE	Pooled OLS	FE
	(b/se)	(b/se)	(b/se)	(b/se)
Program participation	0.039***	0.021	0.146***	0.094*
	(0.02)	(0.02)	(0.03)	(0.04)
Trend	0.005	0.027***	0.020*	0.023**
	(0.01)	(0.01)	(0.01)	(0.01)
Age of household head	0.002	-0.000	-0.001	-0.001
	(0.00)	(0.00)	(0.00)	(0.00)
Asset ('000)	0.004***	0.002***	0.003***	0.002***
	(0.00)	(0.00)	(0.00)	(0.00)
Household members staying outside (days per annum)	0.000***	0.000	-0.001***	-0.000**
	(0.00)	(0.00)	(0.00)	(0.00)
Highest grade completed by household head	-0.007*	-0.007	-0.027***	-0.006
	(0.00)	(0.01)	(0.00)	(0.01)
Household size	0.074***	0.018*	0.094***	0.039**
	(0.00)	(0.01)	(0.01)	(0.01)
Male-headed household	0.032	0.083	0.485***	0.271**
	(0.04)	(0.07)	(0.07)	(0.10)
Highest grade completed by adult male in household	0.025***	0.012**	0.022***	0.031***
	(0.00)	(0.00)	(0.00)	(0.01)
Highest grade completed by adult female in household	0.016***	0.011**	-0.002	0.006
	(0.00)	(0.00)	(0.00)	(0.01)
No spouse in household	0.040	0.095*	0.117*	0.089
	(0.03)	(0.05)	(0.05)	(0.07)
Total household land	0.001***	0.001***	0.001***	0.001***
	(0.00)	(0.00)	(0.00)	(0.00)

Table 8 (continued)				
Dependant variable	**Natural log of household total income**		**Natural log of household labor income**	
	Pooled OLS	FE	Pooled OLS	FE
	(b/se)	(b/se)	(b/se)	(b/se)
Price of rice	0.002*	0.002**	0.003*	0.004**
	(0.00)	(0.00)	(0.00)	(0.00)
Price of lentil	-0.003	-0.003	0.000	-0.001
	(0.00)	(0.00)	(0.00)	(0.00)
Price of soybean oil	0.000	0.001	0.002*	0.002*
	(0.00)	(0.00)	(0.00)	(0.00)
Price of potato	0.004	0.001	-0.002	-0.005
	(0.00)	(0.00)	(0.01)	(0.01)
Price of egg	-0.010	-0.011	0.006	-0.002
	(0.01)	(0.01)	(0.02)	(0.01)
Price of milk	0.001	0.001	0.012	0.009
	(0.00)	(0.00)	(0.01)	(0.01)
Price of small fish	0.001	0.001	-0.000	-0.001
	(0.00)	(0.00)	(0.00)	(0.00)
Presence of primary school	0.094**	0.101***	0.096*	0.111**
	(0.03)	(0.03)	(0.05)	(0.04)
Presence of Madrasa	-0.040	-0.025	-0.003	0.016
	(0.03)	(0.02)	(0.04)	(0.04)
Constant	9.689***	10.204***	8.936***	9.248***
	(0.14)	(0.17)	(0.23)	(0.17)
R-sqr	0.513	0.123	0.287	0.092
N	5223	5223	5157	5157
F-statistic	46.3	13.4	17.5	9.4
BIC	9027.2	3594.7	14064.8	7593.0

Notes:

1. The estimates of village-specific fixed effects are not reported in the table.
2. ***, ** and * stand for significance at 1%, 5% and 10% levels.
3. Standard errors are in parenthesis below the estimated coefficients.

Table 9: The pooled OLS and quantile regression estimates of the impact of microcredit program participation on annual household labor income, 1998-2004

Independent variables	Natural log of household labor income					
	Pooled OLS	Quantile regression				
		0.10	0.25	0.50	0.75	0.90
	b/se	b/se	b/se	b/se	b/se	b/se
Program participation	0.146***	0.121	0.127***	0.077**	0.088***	0.077*
	(0.03)	(0.07)	(0.04)	(0.02)	(0.02)	(0.03)
Trend	0.020*	-0.000	0.010	0.010	0.011	0.011
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
Age of Household head	-0.001	-0.004	-0.001	0.000	0.002	0.002
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Asset ('000)	0.003***	0.002*	0.002***	0.003***	0.003***	0.003***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Staying outside area	-0.001***	-0.001***	-0.001***	-0.001***	-0.000**	-0.000*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Highest grade completed by household head	-0.027***	-0.039**	-0.021**	-0.013**	-0.008*	-0.007
	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.01)
Household size	0.094***	0.086***	0.098***	0.091***	0.076***	0.069***
	(0.01)	(0.02)	(0.01)	(0.01)	(0.00)	(0.01)
Male-headed household head	0.485***	0.984***	0.647***	0.372***	0.185***	0.122
	(0.07)	(0.18)	(0.09)	(0.06)	(0.06)	(0.08)
Highest grade completed by adult male	0.022***	0.028*	0.017**	0.015***	0.018***	0.025***
	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.01)
Highest grade completed by adult female	-0.002	0.001	-0.002	0.001	0.005	0.011*
	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)
No spouse in household	0.117*	0.153	0.062	0.043	0.025	-0.015
	(0.05)	(0.15)	(0.07)	(0.05)	(0.04)	(0.06)
Total household land	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Price of rice	0.003*	0.004	0.003	0.001	-0.001	0.001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Price of lentil	0.000	0.003	-0.003	-0.003	0.000	-0.000
	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)

Table 9 (continued)						
	Natural log of household labor income					
	Pooled OLS	**Quantile regression**				
		0.10	**0.25**	**0.50**	**0.75**	**0.90**
Independent variables	b/se	b/se	b/se	b/se	b/se	b/se
Price of soybean oil	0.002*	0.002	0.002	0.001	0.000	-0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Price of potato	-0.002	-0.010	-0.002	-0.001	0.001	-0.000
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
Price of egg	0.006	0.006	0.023	-0.012	0.012	0.006
	(0.02)	(0.05)	(0.02)	(0.02)	(0.01)	(0.02)
Price of milk	0.012	0.008	0.013	0.006	0.002	0.016
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
Price of small fish	-0.000	-0.002	-0.000	0.000	0.002	0.001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Presence of primary school	0.096*	-0.003	0.116	0.133**	0.111**	0.080
	(0.05)	(0.13)	(0.06)	(0.04)	(0.04)	(0.06)
Presence of Madrasa	-0.003	-0.042	-0.018	-0.023	-0.025	-0.030
	(0.04)	(0.12)	(0.06)	(0.04)	(0.04)	(0.05)
Constant	8.936***	8.237***	8.393***	9.219***	9.654***	9.877***
	(0.23)	(0.64)	(0.31)	(0.21)	(0.19)	(0.27)
N	5157	5157	5157	5157	5157	5157

Notes:

1. The estimates of village-specific fixed effects are not reported in the table.
2. ***, ** and * stand for significance at 1%, 5% and 10% levels.
3. Standard errors are in parenthesis below the estimated coefficients.

Table 10: Results of estimation of the logit model of participation in microcredit program.

Explanatory variables	Coefficient	SE
Household level characteristics		
Non-labor income ('000 Taka)	-0.0000***	(0.00)
Wage income ('000 Taka)	0.0008	(0.00)
Age of household head	-0.0014	(0.00)
Asset ('000 Taka)	-0.0042***	(0.00)
Household members stayed outside area (days per annum)	-0.0002	(0.00)
Household head's education	-0.0346**	(0.01)
Household size	0.0926***	(0.02)
Male-headed household	0.0781	(0.17)
Maximum education of male members of household	0.0088	(0.01)
Maximum education of female members of household	0.0022	(0.01)
Absence of spouse	-0.2344	(0.14)
Total cultivable land	-0.0015***	(0.00)
Village level characteristics		
Number of grocery shop in the village	-0.0007	(0.00)
Number of bus stand in the village	0.0493	(0.18)
Number of fertilizer shop in the village	0.0504*	(0.02)
Dummy for presence of primary schools in the village	0.5209***	(0.12)
Dummy for presence of Madrasas in the village	-0.0728	(0.11)
Average price of rice in the village market	-0.0033	(0.00)
Average price of lentil in the village market	-0.0274**	(0.01)
Average price of soya bin oil in the village market	0.0074*	(0.00)
Average price of potato in the village market	-0.0838***	(0.01)
Average price of egg in the village market	-0.0597	(0.04)
Average price of milk in the village market	-0.0211	(0.02)
Average price of small fish in the village market	0.0031	(0.00)
Frequency of payment of income of principal earner†		
Weekly (weekly payment = 1; 0 otherwise)	-0.2931*	(0.12)
Monthly (monthly payment = 1; 0 otherwise)	-0.4383***	(0.09)
Quarterly (quarterly payment = 1; 0 otherwise)	0.1451	(0.23)
Annual (annual payment = 1; 0 otherwise)	-0.5359*	(0.26)
Irregular (irregular payment = 1; 0 otherwise)	-0.6472***	(0.11)
Constant	1.4919**	(0.55)
Number of observations	5,120	

Notes:
1. † The omitted category includes households that receive daily income.
2. ***, ** and * stand for significance at 1%, 5% and 10% levels respectively.

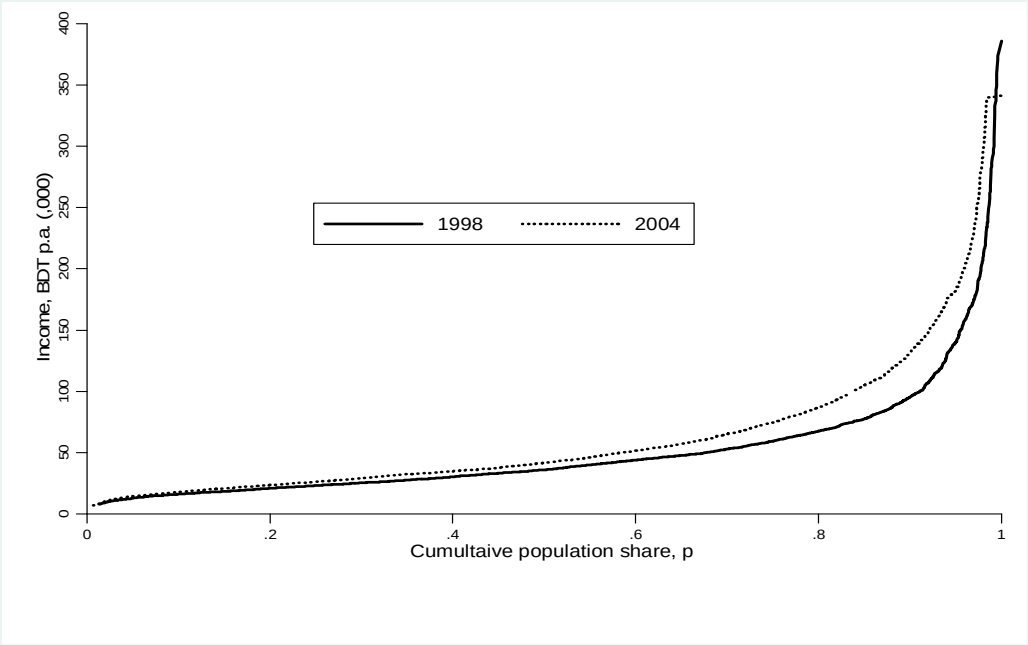

Figure 1: Shifting of household income distribution, 1998-2004.

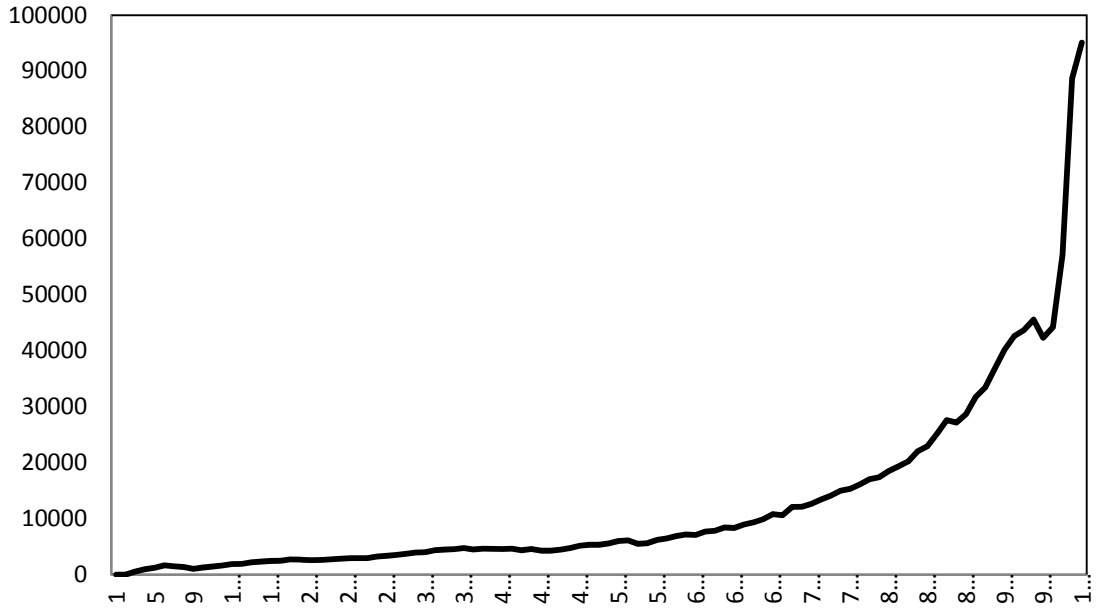

Figure 2: The growth of income over time across percentiles for all sample households, 1998-2004.

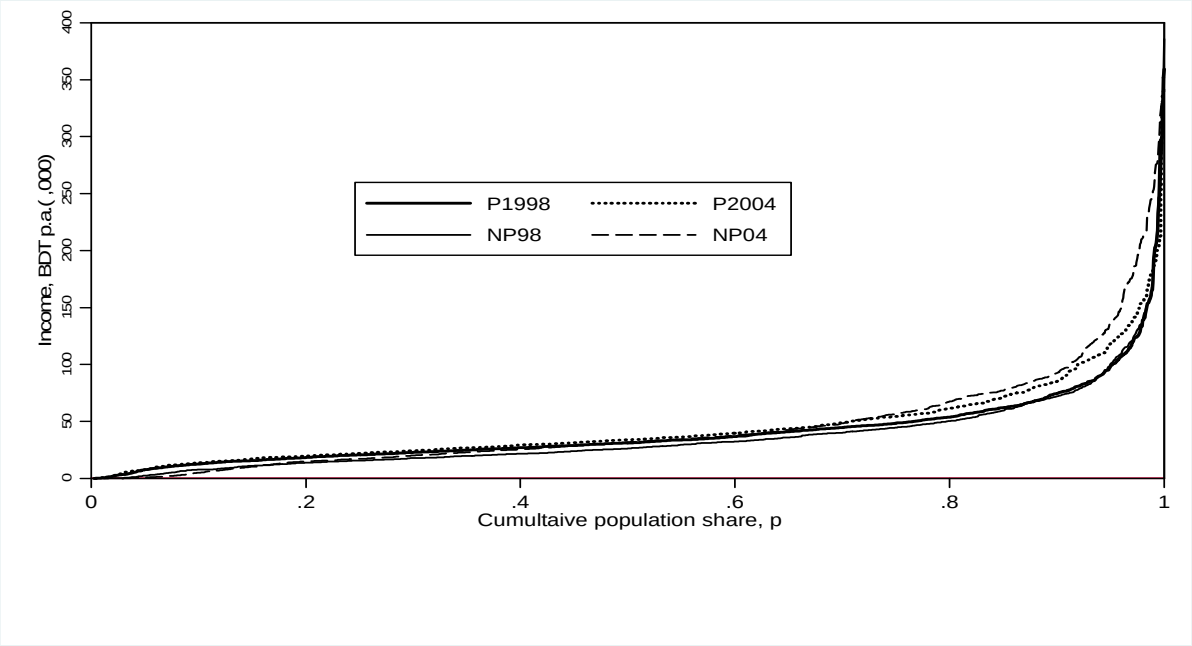

Figure 3: Shifting of annual household labor income by participation status, 1998-2004.

Note: P1998, P2004, NP1998, NP2004 refer to household labor income for participants in 1998, for participants in 2004, for non-participants in 1998 and for non-participants in 2004 respectively.

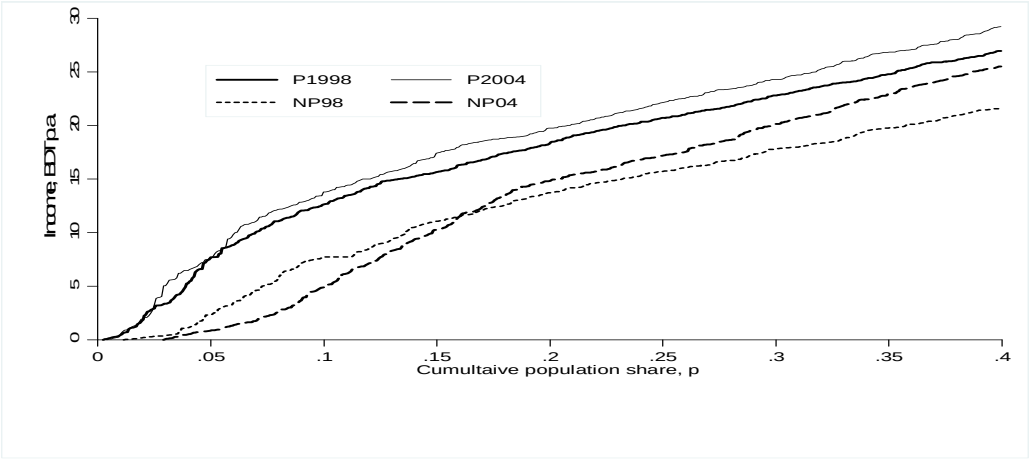

Figure 4: Shifting of household labor income distribution by participation (bottom 20%), 1998-2004.

Note: P1998, P2004, NP1998, NP2004 refer to household labor income for participants in 1998, for participants in 2004, for non-participants in 1998 and for non-participants in 2004 respectively.

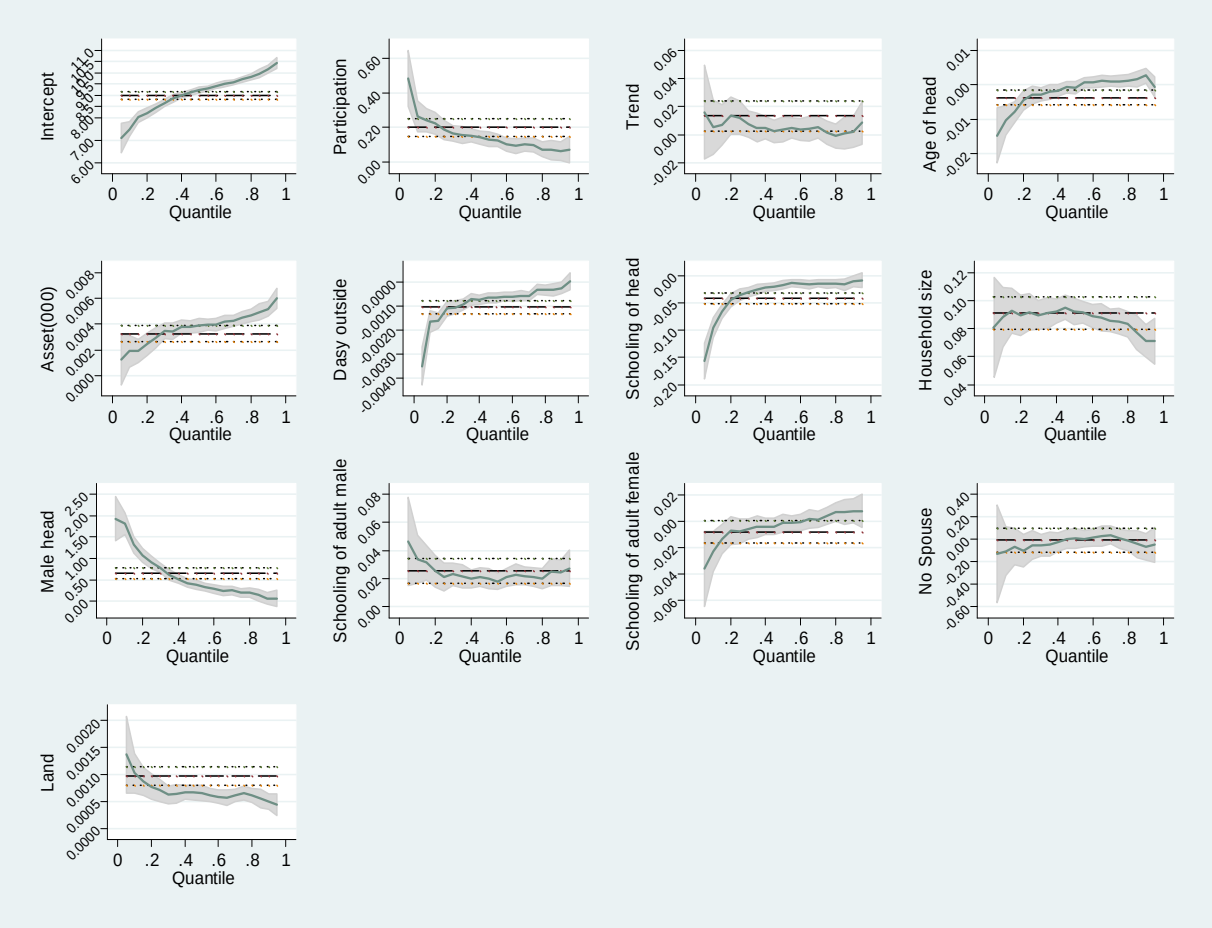

Figure 5: The coefficients of independent variables from the quantile regression of household labor income, 1998-2004