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Impact assessment of credit program for tenant farmers in Bangladesh: Evidence from a field experiment*

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Abstract

We study the role of agricultural credit on productivity and livelihoods of small, marginal, and landless tenant farmers based on a randomized control trial (RCT) field experiment in Bangladesh. Twenty percent of the eligible households from the treatment group participate in the credit program and utilize sixty percent of their loans for agricultural purposes. Results show that access to credit increases adoption of modern seed varieties, productivity, and farming income in the treatment group. We find that impacts are heterogeneous over households′ headship, tenancy status, and farm size. We also examine distributional impacts using quantile regressions and find that impacts of the credit are mostly concentrated in the upper tail of the distributions.

keywords: Access to credit, tenant farmers, productivity, income diversification

jel class: C21,D22, E51, G21, O15

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1 Introduction

Access to credit works as an enabling factor to adopt productivity enhancing practices for many credit constrained farmers. In the presence of credit constraint, farming households cannot smooth consumption which forces them to a sub-optimal level of input allocation or risk-inefficient crop choices (Kumar, Turvey, and Kropp 2013). As a result, they end up with a productivity level which is well below the first-best outcome (Ali, Deininger, and Duponchel 2014). Formal financial institutions are usually reluctant to lend money to poor households because of inadequate collateral (Littlefield and Rosenberg 2004; Burgess and Pande 2005). Microfinance institutions (MFIs) can create opportunity of access to credit for these neglected households (Gonzalez 2014) and potentially enable them to escape poverty by combining credit with other factors such as human capital (education and training) and social capital (local organization). However, MFIs typically cater more to small non-farm businesses (Beaman et al. 2014) which leads to a low adaptation of financial services by the farmers (Armendariz and Labie 2011). This case is even more severe for those farmers who do not own any land and instead cultivate land rented from other households through the tenancy market (Hossain and Bayes 2009).

A number of studies examine the role of agricultural credit on productivity and livelihoods of farm households. In a literature review study on the role of credit in agriculture, Gonzalez (2014) finds that micro-finance improves farmers′ livelihoods by allowing them to adopt new technologies and to purchase both higher quality and higher quantity of seeds. He concludes that micro-finance increases farmers′ productivity and leads to increased sale and income. Beaman et al. (2014) also examine the return to capital for farmers who borrow and those who do not borrow and find a higher investment responses and returns in the treatment group in Mali. However, none of the studies focus on the effect of access to credit service for the small, marginal, and landless tenant farmers; they will be referred thereafter as tenant farmers.

We examine the impacts of agricultural credit on tenant farmers in Bangladesh using a randomized control trial (RCT) evaluation of a credit program known as Borgachashi Unnayan Prakalpa (BCUP). Eligibility for credit through BCUP was assigned at the branch level; branch is the administrative unit to disburse loans and collect payments from borrowers in a particular area. We estimate Intent-to-Treat (ITT)[1] effects of the program on productivity, adoption of modern variety seeds, and household income among the tenant farmers located in the 20 branches randomly selected to be eligible for BCUP. The data set consists of a single baseline round and a single follow-up

[1]We consider all the households from the random assignment into our analyses irrespective of their actual program participation.

of 4,301 agricultural households, including 2,155 from the 20 BCUP branches and 2,146 from the 20 branches not selected for BCUP. BCUP was administered by BRAC, the largest non-governmental organization (NGO) in the world based in Bangladesh.[2] The primary goal of the BCUP credit program was to increase credit access among tenant farmers lacking the collateral needed to access credit from formal financial institutions.

We find that 20 percent of eligible households from the randomly assigned treatment group participate into the BCUP credit program. The average loan size is BDT 31,100 ($400) among the participant farmers, which is approximately equal to rice production cost in one hectare of land.[3] Credit utilization information shows that 60 percent of the loan amount is used for agricultural purposes and another 13 percent is used for non-agricultural self-employment business activities. Our results indicate that the BCUP program increases yields in both major rice seasons and also increase adoption of Modern Varieties (MV) such as hybrid and High Yielding Variety(HYV) seeds. We also find that the BCUP credit intervention increases household farming income but decreases wage income indicating some signs of substitution between income sources. Additionally, we find some weak positive impact on access to land through tenancy market but no impact on input investment in the farming sector.

Our findings show that the female headed households in the treatment area invest significantly higher amount in rice inputs and also have higher impacts on yields compared to the male headed households. We also find that the pure tenant households do worse in all outcome variables compared to the owner households, as do smallholders relative to larger landholders. We use quantile regression analysis to see the distributional impact for two important outcome variables, yields and income. We find that farming income gain is significantly positive over all the quantiles, although gain is proportionally higher in the upper tail and wage income loss is significantly negative only in the middle quantiles of the distribution. We also find a similar patterns in rice yields that most of the yield gains in both rice seasons belong to the upper quantiles of the distribution.

2 Background of the intervention

About 70 percent of the total population of Bangladesh live in rural areas where agriculture is the primary source of employment and income (Gautam and Faruqee 2016). More than half of the total population own less than 0.5 acres of land while another 45 percent own only 0.5 to 0.75 acre

[2]https://www.ngoadvisor.net/announcing-top-500-ngos-world-2016

[3]Average cost of rice production is BDT 38,800 for rice and BDT 29,000 in one hectare of land (Source: estimation from the survey data).

of land (Faruqee 2010). Tenant farmers who rent land from other households in some contractual arrangements make up a large part in the farming system. Their share has increased from 44 to 58 percent while their land operation increased from 23 to 42 percent over the last 25 years (Hossain and Bayes 2009). However, access to finance facilities in the agricultural sector is not encouraging. The market share of formal financial institutions such as agricultural banks, cooperative banks, and public and private commercial banks has remained stagnant over time at around 16 to 32 percent in the total agricultural credit market (Faruqee 2010). Access to formal financial institutions is also mostly limited to rich farmers. For example, Hossain and Bayes (2009) show that only 1.5 percent of farmers who own less than 0.5 acre of land have access to bank credit. The scenario is not encouraging in the case of MFIs either. Although the number of MFI and their coverage has been growing over time, their role in crop agriculture is not increasing. For example, two leading MFIs in Bangladesh, Grammen and BRAC, disburse only 15 percent and 13 percent, respectively, of their total loan in crop farming(Faruqee 2010).

3 The BCUP program

BRAC launched the BCUP program with financial support from the central bank of Bangladesh, Bangladesh Bank, in 2009, and the program is currently ongoing. The main goal of the program is to increase credit access of the farmers who don′t have access to the formal financial institutions and rely on informal financial sources. The BCUP program has disbursed a total of \$255[4] million in loans among 291,000 farmers as of February 2015. According to BRAC′s records, 71 percent of total credit is distributed for crop cultivation and the reminder is for non-crop farming activities such as livestock, fishery, land lease, and machinery purchases.

BRAC follows several stages in the selection process to ensure that credit goes to targeted farmers. When a farmer expresses interest to borrow from the BCUP program, BRAC screens the applicant using the following eligibility criteria: (a) must have a national identification card, (b) must be 18 to 60 years of age, (c) may have at most 10 years of schooling, (d) must have been residing at that particular area for at least three years, (e) must have landholding below 200 decimals,[5] and (f) must not be a member of other MFIs. BCUP program organizers (PO) also visit the actual site for the proposed investment to examine whether the farmer is actually seeking a loan for farming activities or not. After the initial screening, all of the selected farmers are briefed about the BCUP program and its terms and conditions. A village organization (VO) is formed as a platform for

[4] We use \$1=BDT78 in this article.

[5] 100 decimals equal to one acre and 247 decimals equal to one hectare.

the delivery of services for the farmers. Every VO consists of four to eight teams where each team consists of five members from the same village. The BCUP program organizer (PO) and all the members of the VO meet once a month to discuss loan utilization, potential new investments, and collection of due installments.

The BCUP program offers several types of loans depending on farmers′ needs. The most common loan is for crop production, which ranges from BDT 5,000 ($64) to BDT 50,000 ($641). BCUP also offers maximum BDT 60,000 ($769) to rent land from others and maximum BDT 120,000 ($1,538) for purchasing machinery. The usual credit repayment period is 1 year with monthly installments. The farmers need to pay 19 percent interest at a reducing balance, which is lower than the 27 percent rate charged by other existing microfinance programs in Bangladesh. If a farmer fails to repay installments in due time, s/he needs to pay the added interest amount in the following installment. The BCUP program had complementary extension services for the farmers in initial phases. BRAC′s agricultural development officers used to provide information and advice about modern cultivation systems during the monthly VO meeting. However, the priority of extension services decreased over time due to administrative reasons and the BCUP loan program gradually turned into an agricultural micro-finance scheme,[6] thus we cannot evaluate joint effectiveness of credit and extension services in the existing set up of the BUCP program.

4 Experimental Design

In order to measure the impact of the BCUP program, BRAC introduced BCUP through a cluster-randomized control trial designed set up in new areas. As mentioned earlier, the BCUP program began in 2009 and after that, BRAC expanded the BCUP program activity to new branches at different time periods. This study was conducted in 40 sub-districts /branches[7] randomly chosen from the BCUP program′s potential new branch list. We randomly selected six out of the 10-12 villages within an eight kilometer radius of the center point of each branch location. The eight kilometer periphery was chosen because BRAC branch offices usually operate within eight kilometers for administrative purposes. Thus, the sub-district/branch is our first unit of randomization followed by village/community. We conducted a household level census in all 240 villages in order to identify eligible households. The census covered a total of 61,322 households among which 7,563 households fulfilled the program eligibility criteria and were willing to take agricultural credit. We randomly selected 4,301 households from the eligible household list for detailed data collection. We adopted a

[6] http://brac.net/microfinance-programme/item/862-agricultural-microfinance

[7] Sub-district is the administrative unit in Bangladesh. There are total 4,90 sub-districts in Bangladesh.

simple random sampling method to select households from each village. The final sample of study includes 2,155 households in the treatment group and 2,146 households in the control group. We surveyed a fraction of the original households, 1,607, about their detailed time allocation in different activities.

We randomly allocated 20 branches as the treatment area and rest of the 20 branches as the control area after the baseline survey. Contamination issues between treatment and control branches are unlikely as each branch is a separate administrative unit and the BCUP PO was aware of the assigned treatment in the respective study area. We present distribution of treatment and control branches in figure 1 which shows that only a few treatment and control branches are next to each other. However, it is not a concerning issue as each treatment branch has more than 6 villages, so it is very unlikely that the PO will cross the treatment branches and will disburse loans in the control branches. After the baseline survey, BRAC started working to launch the BCUP program in all the treatment branches. The POs visited all the eligibles households to identify who wanted to take loans from the BCUP program and followed the procedures as mentioned in the previous section.

5 Baseline Survey and balance

We conducted a baseline survey in July-August, 2012. We collected detailed information on household demographics, asset holdings, farming system, engagement in economic activities and income, asset holding, and credit history. We expect no systematic differences in baseline information between treatment and control groups as treatment was randomly assigned. Table 1 shows a statistical comparison between treatment and control groups. We present baseline mean for the control group and mean differences between the two groups for each variable. Results show that there are no significant differences between the two groups except for household headship and NGO membership (p-value 0.08). This indicates that randomization was overall successful in generating balanced treatment and control groups. We also use F-test to check the joint significance of all the baseline characteristics in predicting treatment assignment and find a statistically significant F-value. We discuss more about strategies to overcome potential problems related to significant F-value in the impact identification section. We find five percent of households had NGO membership before the intervention. This is not a large enough percentage to generate biased program impacts; nevertheless, we estimate program impacts excluding these households as a robustness check.

We can also see overall characteristics of our sample households from table 1. Average

households size is five persons, and most households are headed by male member (94 percent). The household head′s average education level is only three years. Sample households also belong to the lower tail in the land distribution. Households have limited ownership of cultivable land (38 decimal) implying that most of the farmers are marginal [8] or landless. The scarce amount of landholdings also implies that some households resorted to the rental market to increase the size of operational land. Our baseline data show that around 64 percent of the households are either purely tenant farmers or mixed tenant farmers.[9] The average amount of rented in land was around 51 decimals. Only a limited number of households rented out land; the average amount of land rented out is only 7 decimals.

6 End-line Survey and attrition

We conducted the end line survey in July- August 2014, two years after the baseline survey. About 96 percent of the respondents were successfully re-interviewed. We check whether the attrition rate is different between treatment and control groups which can potentially create biasness in impact estimates. Table 2 shows the regression results, where we find that attrition is similar between the treatment and control groups: 3.9 percent in the treatment group and 3.6 percent in the control group. We also test whether the attrition rate is related with observed characteristics and find no such evidence. We find that only the household head′s education level has significant relation with attrition rate, however, joint significance tests for all the observed characteristics are insignificant in all the specifications. Overall, we can conclude that the attrition rate is unlikely to generate any biasedness in impact estimates.

7 Regression framework

We estimate ITT effects which compare average outcomes in treatment and control groups in order to estimate the impact of the BCUP program. As we find that most of outcome variables are balanced over household′s treatment status during the baseline, we need to decide whether we will use only end-line or both baseline and end-line outcome information for impact estimation. Attanasio et al. (2015) mentions that the choice between only endline or both rounds data depends on the relative strength of the variance of time invariant individual effects versus the variance of transitory shocks. As we don′t know the relative sizes of both previous factors, we use both rounds of data for all

[8] Own less than 50 decimals of land following Hossain and Bayes (2007).
[9] Cultivate both owned land and rent in land.

analyses. Whether we use the difference-in-difference (DID) or lagged dependent variable model depends on the extent of autocorrelation between baseline and end-line outcome information for a particular outcome variable. We prefer the DID model as the autocorrelation coefficients for most of the outcome variables are higher than 0.50 threshold point.[10] We use the following regression model to estimate the program impacts,

$$Y_{it} = \alpha + \beta_1.T_i + \beta_2.W_t + \beta_3.T_i.W_t + X_i\gamma + \eta_d + \varepsilon_{it} \quad (1)$$

where Y_{it} is an outcome for household i at time period t, T_i is a dummy variable indicating the treatment status, W_t is a dummy variable taking the value of 1 if the observation is from 2014 and 0 otherwise, X is vector of baseline covariates, and η_d is branch level fixed effects.β_3 will show the ITT estimate. In the baseline balance section, we find that point estimates of the baseline differences for some variables are large in magnitude and the joint hypothesis test is also significant; therefore, we include baseline values of covariates (X) in all regression models. Branch level fixed effects η_d are included to improve efficiency of the estimates (Bruhn and McKenzie 2009). We cluster all standard errors at the branch level to account for intra-cluster correlation in inference.

To account for multiple hypothesis testing, we estimate an index of outcome variables by using the simple average of normalized[11] values of the variables that are more likely to belong in a "family" following Kling, Liebman, and Katz (2007). In addition, we use both unadjusted and false discovery rate (FDR) adjusted p-values (Benjamini and Hochberg 1995) for multiple hypothesis testing across all the indices.

8 Results

8.1 *Access to credit*

Table 3 shows the impact of the BCUP intervention on household access to credit services. We consider other sources of credit such as banks, other MFIs, and informal lenders to see whether the BCUP credit substitutes for or complements other credit sources. Panel A shows that about 20 percent of the eligible households in the treatment area take loans from the BCUP program. We

[10] McKenzie (2012) suggests that using DID may limit statistical power when autocorrelation is lower. He also mentions that in case of a single baseline and end-line survey with autocorrelation coefficient below 0.50, statistical power is high when one regresses end-line outcome on baseline outcome, treatment indicator and some baseline covariates.

[11] We normalize a variable by subtracting the mean in the control group and dividing by the standard deviation of the control group.

do not find any significant impact of the BUCP intervention on other borrowing sources. Panel B shows the impact on the borrowed amount. We find that treatment households borrow BDT 6,200 ($80) more in loans from the BCUP program. We do not find any significant impacts of the BCUP credit amount on the amount of borrowing from other credit sources.

We find that the take-up rate is only 20 percent, which is slightly better or similar to other general micro finance take-up rates. Take up rates in general micro-finance studies are documented as 12.7 percent in India (Banerjee et al. 2015), 10 percent in Morocco (Crepton et al. 2015), 10 percent in Mexico (Angelucci, Karlan, and Zinman 2015), and 36 percent in Ethiopia (Tarozzi, Desai, and Johnson 2015) . We also find that beneficiaries report having spent most of the BCUP credit for productive purposes. Around 43 percent of total credit was reported as being spent for crop cultivation followed by 14 percent for investment in livestock, poultry, and fisheries. BCUP credit is also used for investment in non-farm business (13.4 percent of total credit) activities. Some portion of the BCUP credit is also used for other purposes, for example, to repay earlier debts (6.7 percent of total) and house repairs (5.9 percent of total). We also find that none of the households in the control branches have received credit from the BCUP program, which also reconfirms our anticipation regarding low probability of contamination among treatment and control branches.

8.2 *Rice yield and adoption of modern varieties*

Rice comprises 75 percent of both total crop production value and total cultivated area in Bangladesh (Talukder and Chile 2014). Thus one of the main outcome variables for this study is whether the BCUP intervention has any impact on rice productivity. We also check whether or not the rice farmers adopt modern variety (MV) seeds such as hybrid and HYV after taking the BCUP credit.

Results are presented in Table 4. Panel A shows a significant positive effect on rice yields in both amon and boro seasons.[12] Compared with the mean of the control group, we see that that yields increase by 53 percent in the amon season and 15 percent in the boro season compared to the control group. Panel B also shows positive impacts on adoption of MV seeds in both amon and boro seasons. We find that treatment households are 12 percent more likely to adopt HYV seeds and 6 percent more likely to adopt hybrid seeds in the amon season. We also find that treatment households are 8 percent more likely to adopt hybrid seeds in the boro season. The aggregate yield rate index coefficient is not statistically significant but shows a positive sign. On the other hand, the aggregate index for MV adoption is significant and positive even after adjusting for multiple

[12]Rice is cultivated mainly in three seasons, Aus (pre-monsoon), Amon (monsoon) and Boro (irrigated). Boro is the main season while Aus is the least cultivated season.

inferences and shows an increase of 0.35 standard deviations. Impact of microcredit on productivity is also evident in other studies as well; for example, Ayaz and Hussain (2011) find positive effects on productivity in Pakistan and Girabi and Mwakaje (2013) also find positive impacts on agricultural productivity in Tanzania.

We also estimate quantile regressions models to determine the distribution of impact on yields for both amon and boro seasons. Figure 2 shows that there is very little or no difference in yields between treatment and control groups until 70th percentiles and that most of the impacts on yields belong to the upper tail of the distributions in both seasons.

8.3 *Impact on Income and expenditure*

We examine the impact of the BCUP program on income and expenditure as both indicators reflect household welfare. Results are presented in Table 5. Panel A shows the impact of the BCUP credit on households′ income from different sources. We find a significant positive effect on households′ farming income. Farming income increased about BDT 4,700 ($60) in the treatment group compared to the control group. We also find a positive point estimate for business income, although, it is not statistically significant. Our result also shows that wage income decreased about BDT 5,132 ($66) in the treatment area. One of the reasons for decreased wage income may be that the treatment households place more emphasis on self-employment activities in both farming and non-farming sectors and reduce wage labor jobs. We find no significant effect on total household income as gains from the farming activities are offset by the losses from wage labor sectors. Figure 3 shows distributions of the BCUP credit impact on farming and wage income. We find that the gain in farming income is significantly positive in the entire distribution, although the gain is proportionally larger in the upper quantiles. On the other hand, impact on wage income is significantly negative only around 40th to 70th quantiles. There are no significant differences between treatment and control groups in the lower tail of the distribution, and the point estimates are also around zero.

Panel B shows the effect on household food, non-food and total expenditure. We find that none of the indicators are statistically significant, although all the indicators have positive point estimates. Similar results hold for the aggregate expenditure indicator. Insignificant impact on expenditure is not surprising because we find that the BCUP program has no impact on households′ total income.

8.4 *Labor supply*

BCUP credit is expected to increase farmers′ working capital, which they can use to cover different input costs. As most of the farmers in our study are marginal and landless tenant farmers, it would not be surprising if some farmers work more hours to increase profits by saving hired labor costs. It is also interesting to examine whether or not there is any change in working hours for rest of the family members, especially for the children. Table 6 shows impacts on working hours by different age and sex groups.

We find that working hours in agricultural activities has increased in all groups, although the coefficients are significant only for male working members and children. Children′s involvement in income generating activities is considered as a downside of microfinance involvements, although the findings from other studies are not conclusive. For example, Augsburg et al. (2015) find that parents involve adolescents in business activities in Bosnia; on the other hand, Banerjee et al. (2015) find no such evidence in India.

8.5 *Impact on land holding and livestock assets*

In earlier sections, we find that the treatment households are more involved in farming activities. It is also expected that the tenant farmers would try to diversify their livelihood strategies among different activities and acquire more productive assets to increase income. They can also use those assets as buffer stocks in the case of financial difficulties or crop failures. We check whether the BCUP credit increases household access to land and livestock assets such as cow, goat and chicken (Table 7). We do not find any significant effect on land ownership and access; however, point estimate for rented land is considerably large enough to indicate that the BCUP participants try to increase their land access through the tenancy market. We also find that the BCUP participants hold significantly higher numbers of cows and goats compared to the control group. Overall asset index has a positive sign but it is not statistically significant.

8.6 *Impact on investment and sale*

We also check whether the BCUP credit intervention increased households′ investment in rice, non-rice crop and business activities. Results are presented in Table 8. We do not find significant impacts on any of these variables; however, the point estimates are all positive (Panel A). Panel B explores whether or not credit access can allow the farmers to wait to sell their products until they can get a desirable price.This is a potentially important issue as many tenant farmers borrow loans from

informal sources to cover production costs and have to sell their products immediately after the harvesting at lower prices to repay loans. We expect that the BCUP credit access will relax this constraint and will help farmers to wait for desirable prices to sell their crops. We don′t find any significant changes between selling within 1 month of harvesting and selling in the next 11 months. However, we find that point estimates are positive for sale in the last 11 months and negative for sale within 1 month.

9 Heterogeneous effects

We check whether there are any heterogeneous impacts by comparing different groups which can help us to understand how and for which groups treatment intervention is more suitable. We categorize households by three different baseline characteristics: household headship, tenancy status, and farm size. Female headship is an important category because previous studies show that female involvement in income generating activates is limited compared to that of male members in Bangladesh. For example, Jaim and Hossain (2008) show that women′s participation in crop farming is only 3.85 percent compared to a 53 percent participation rate for men, and women′s participation in agricultural work is typically limited to the livestock and poultry sectors. Tenancy status is an important category as the BCUP intervention is mainly targeted to the tenant farmers; and tenancy status is also important to determine if access to credit can help the pure tenant farmers. We modify our main regression specification in equation 1 to estimate heterogeneous treatment effects as follows,

$$Y_{it} = \alpha + \beta_1.T_i + \beta_2.W_t + \beta_3.T_i.W_t + \lambda_1.H_i + \lambda_2.H_i.W_t + \lambda_3 H_i.T_i.W_t + X\gamma + \eta_d + \varepsilon_{it} \quad (2)$$

where H is the heterogeneity indicator and all other variables are same as equation 1. λ_3 will tell us whether there is any significant heterogeneous treatment effect for a particular group.

Table 9 shows estimation results. We present results only for the some of the important outcome variables. Panel A shows that female headed households have significantly higher yields in boro season and also spend more money in rice farming compared to the male headed households. Thus part of increased yields in the female headed households can be attributed to the increased investment in rice farming. This result contradicts the results of previous literature about the productivity of female headed households in the context of Bangladesh. It is argued that female headed households cannot supervise their farming activities as they cannot move freely outside of their homestead area because of social norms(Jaim and Hossain 2008). Thus access to credit has

some positive effects on social transformation thorough increasing the involvement of the female headed households in economic activities.

We also compare mixed and pure tenant households to the households that only cultivate their own land. Panel B shows that mixed tenant households hold significantly higher farming income, have higher yields, and also invest higher amount in rice farming activities. On the other hand, pure tenant households hold significantly less farming income, have more wage income, have lower yield rates, and also invest less in farming activities. It is also important to note that the owner households hold significantly higher business income compared to other tenant groups. We notice a trend in income composition over the tenancy status, owner households are more diversified in both farm and non-farming self-employment activities, mixed tenant households only specialize in farming activities, and pure tenant households are more dependent on wage income. Finally, we find a similar results when we categorize households by their farm sizes. We compare households with farm sizes less than 50 decimals, and 50 to 100 decimals against households who whose farm sizes are more than 100 decimals. Panel C shows that households with lower farm sizes have higher wage labor income and lower farming income. We also find that the smallest farm size groups have significantly lower yields and also invest significantly lower amounts in both rice and non-rice crop activities compared the larger farm size groups.

10 Robustness checks

We check the robustness of our results by making different adjustments to our regression specification in equation 1. First, the clustered standard error, although widely used, has limitations as its bias depends on the number of branches instead of the number of households (Cameron and Miller 2015); therefore, we re-calculate standard errors based on wild cluster bootstrap-t procedure.[13] Second, to check the sensitivity of our model inference, we re-estimate all regressions without baseline covariates. Third, we estimate program impacts dropping households that were members of MFIs at baseline. Results for all three robustness checks are presented in table 10 in panel A, B and C, respectively. Our findings remain consistent in all the specifications which indicates that our estimation results are robust to the regression specifications.

[13]It bootstraps the residuals of the model and creates a new bootstrap data set by sampling on clusters. It approximates the distribution of estimates using the resampled data.

11 Conclusion

We estimate the impact of the BCUP credit program, which intended to increase credit access for tenant farmers in Bangladesh. We find that 20 percent of farmers take loans from the BCUP program and they invest about 60 percent of total loans in agricultural activities like crop cultivation, livestock, poultry, and fishery sectors. We show that the BCUP program increases productivity, adoption of MV seeds, and farming income. We do not find any significant impact on households′ total income, which is largely due to significant reduction in wage income. We also do not find any evidence of additional investments in farming inputs.

Earlier studies on the effects of credit on households′ income are inconclusive. Banerjee, Karlan, and Zinman (2015) review six microfinance interventions and find no significant impacts on income. Gonzalez (2014) reviews 21 agriculture credit studies and also finds inconclusive results. In this study, we find change in income composition such as increases in farming income and decreases in wage income. This change in composition has potential implications for sustainable livelihoods of the participant farmers because farmers are shifting to more stable self-employment activities from volatile wage labor jobs (Khandker 2011). Evidence of involving in self-employment activities are also reflected in farmers′ increased time allocation in farming activities. We find that farmers in the treatment area are spending more time in farming activities compared to the control area. Similar evidence of changes in time allocation are also documented in other studies in the context of Bangladesh. For example, Pitt and Khandker (1998) show that microfinance participants shift from wage employment to self-employment. Islam (2011) also finds similar trends of household labor choices.

One important pitfall of general microfinance schemes is the question of whether they increase child labor hours. We find that the BCUP credit intervention increases child involvement in farming activities. This finding is similar to Augsburg et al. (2015) who find a significant increase in labor supply of teens (16-19) in business activities. Other similar studies, however, find no such evidence (Angelucci, Karlan, and Zinman 2015; Tarozzi, Desai and Johnson 2015; Banerjee et al. 2015). If child labor increases due to increased access to credit, it will have negative consequences in children′s futures, including low income (Ilahi, Orazem and Sedlacek 2000) and early drop out from school (Beegle, Dehejia, and Gatti 2005).

Despite the possibility of higher yields and availability of credit services, tenant farmers′ low adoption of MV seeds hinges on the fact that they face other constraints as well. Brooks (2010) mentions that these irrational choices seem to be rational choices for the farmers as they face

additional constraints. Farmers′ education, their wealth level and adoption by neighbors (Foster and Rosenzweig 2010) and insurance service (Dethier and Effenberger 2012) are also important for the adoption of modern technologies. These imply a need of other services such as training or insurance mechanisms for the marginal and landless tenant farmers to get benefit of access to credit. We conclude that the BCUP credit program helps the participant farmers to increase farming income, expands households′ abilities to adopt MV seeds, and also to increase rice yields; however, most of the effects belong to the upper quantiles of the distributions implying that the marginal and landless tenant farmers face additional constraints compared to the large farmers.

12 References

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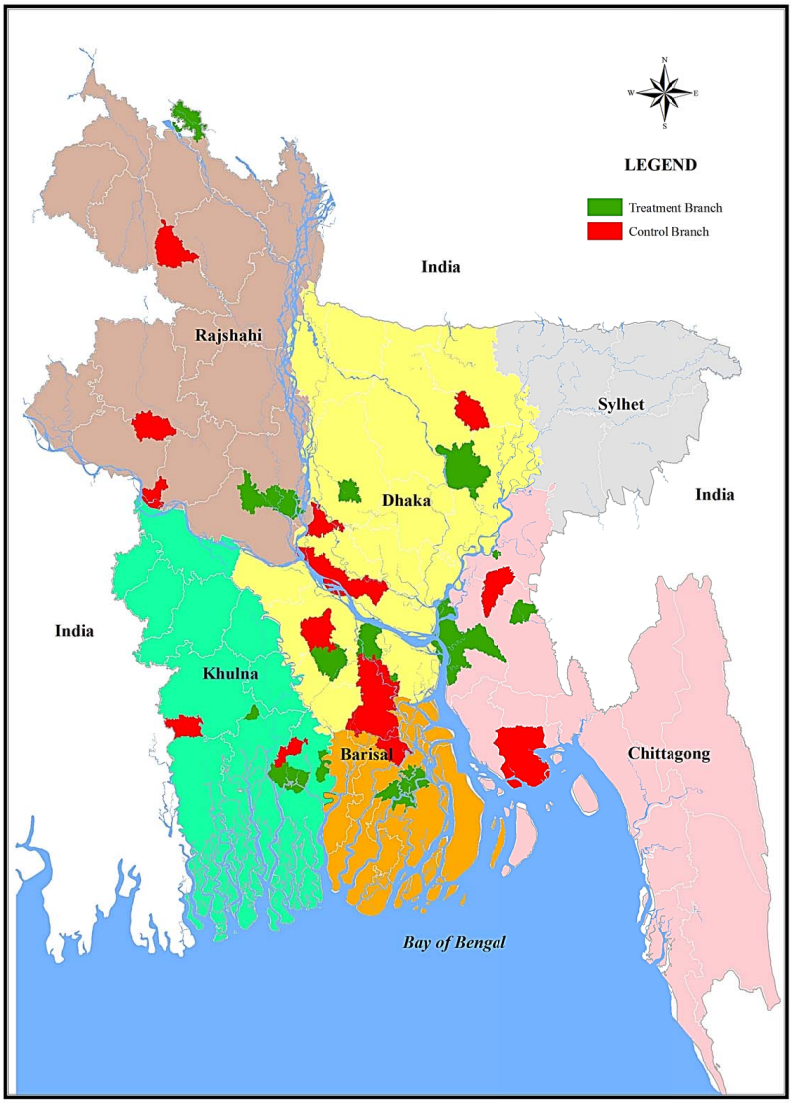

Figure 1: Study area map

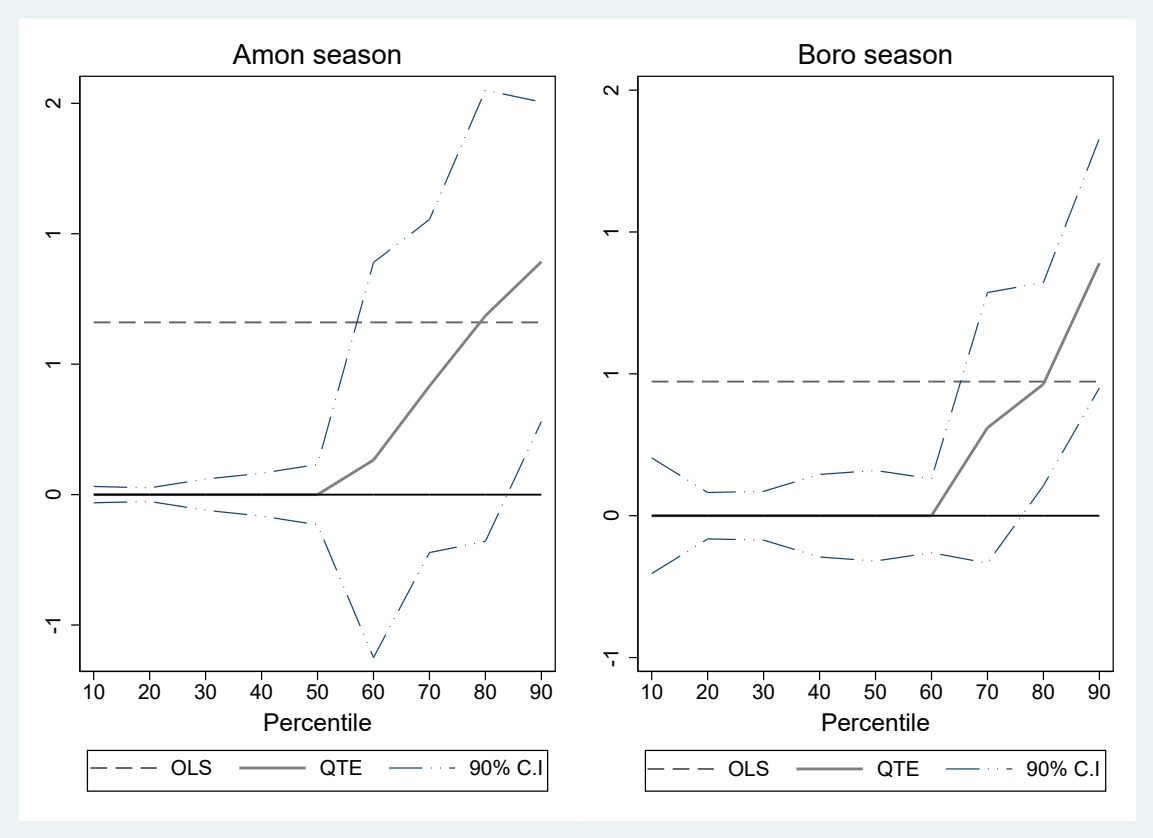

Figure 2: Quintile Treatment Effect (QTE) on yields

Figure 3: Quintile Treatment Effect (QTE) on income

Table 1: Baseline Summary Statistics

		Control group		Treatment-control	
	Observation	Mean	SD	Coeff.	P-value
	(1)	(2)	(3)	(4)	(5)
Household composition					
Number dependent	2069	1.726	1.238	0.181	0.126
Number working age	2069	3.039	1.287	-0.005	0.953
Household size	2069	4.766	1.691	0.176	0.330
Head's education	2069	3.023	3.353	0.184	0.566
Head's age	2069	44.571	12.091	0.724	0.303
Female head	2069	0.051	0.221	0.032	0.080
Farm size(Dec)					
Own land	2069	38.706	51.828	-1.251	0.700
Rented in land	2069	51.246	78.601	0.288	0.969
Rented out land	2069	7.657	26.193	0.593	0.619
Infrastructure					
Concreate floor	2069	0.142	0.349	-0.016	0.578
Have sanitary latrine	2069	0.163	0.370	-0.020	0.525
Distance from Upzila (km)	2069	3.903	2.166	0.380	0.432
Access to credit					
Microfinance member	2069	0.067	0.250	-0.020	0.084
Microfinance loan(BDT)	2069	1448	9918	-521	0.137
Have informal loan	2069	0.036	0.187	-0.015	0.159
Informal loan amount (BDT)	2069	1757	17945	-70	0.941
Income and expenditure(BDT/yearly)					
Wage income	2069	33617	43718	7085	0.104
Crop farm income	2069	14603	27509	-3498	0.154
Non-crop farm income	2069	6067	12915	460	0.615
Non-farm business income	2069	12031	38963	4207	0.128
Other income	2069	24447	131446	7933	0.310
Total income	2069	115210	274072	24120	0 .107
Food expenditure	2069	55698	25082	2848	0.305
Non-food expenditure	2069	41530	31205	-2058	0.464
Total expenditure	2069	97227	49090	790	.878
Joint hypothesis test: F (18,39) =4.61, Prob>F=0.00, R-square=0.044					

Notes:Standard errors of differences are clustered at the branch level in column 4. P-values are for the difference of mean tests between the treatment and control groups.

Table 2: Attrition rate

Dependent variable: Households attrited between baseline and endline						
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment	0.003	0.003	0.002	0.003	0.003	0.003
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Household size		-0.002	-0.002	-0.002	-0.002	-0.002
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Female headship			0.027	0.027	0.027	0.028
			(0.018)	(0.018)	(0.018)	(0.018)
Head′s education				0.002*	0.002*	0.002*
				(0.001)	(0.001)	(0.001)
Own cultivated land					0.000	0.000
					(0.000)	(0.000)
Household income						-0.000
						(0.000)
Constant	0.036***	0.046***	0.043***	0.037***	0.037***	0.036***
	(0.005)	(0.011)	(0.011)	(0.011)	(0.010)	(0.010)
Observations	4,301	4,301	4,301	4,299	4,299	4,299
F test	0.131	0.893	1.251	1.707	1.364	1.248
Prob>F	0.719	0.418	0.305	0.168	0.259	0.303

Notes: Cluster-robust standard errors in parentheses. Asterisk (*), double asterisk (**), and triple (***) denote variable significant at 10

Table 3: Impact on Access to Credit

	BCUP	Bank & Cooperative	Grammen	Other NGO	Informal	Index
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Access to credit (1=Yes, 0=No)						
Treatment * 2014	0.201***	0.0135	0.0106	-0.0132	0.0111	1.473***
	-0.0275	-0.0134	-0.015	-0.0136	-0.0123	-0.188
Control mean						
(Follow-up)	0	0.0353	0.0507	0.103	0.0387	0.0204
N	8280	8280	8280	8280	8280	8280
Benjamini and Hochberg P-value						0.0001
Panel B. Credit amount (BDT)						
Treatment * 2014	6230.6***	385.9	391.8	-394.3	1516.9	2.930***
	-886.6	-902.3	-451	-865.3	-2212.4	-0.401
Control mean						
(Follow-up)	0	2030.4	1206.4	3767	2197.5	0.0267
N	8280	8280	8280	8280	8280	8280
Benjamini and Hochberg P-value						0.0001

Notes: Cluster-robust standard errors in parentheses. Column 6 presents impact of the BCUP program on an index of the outcome variables in columns 1−5 following Kling, Liebman, and Katz (2007). We control household baseline characteristics including number of age dependent member (age ¡15 and age¿64), number of working age family member (age 15 to 64), household head′s education and age, if household has concrete floor and has access to sanitation. Asterisk (*), double asterisk (**), and triple asterisk (***) denote variable significant at 10%, 5%, and 1%, respectively.

Table 4: Impact on Yield Rate and Modern Variety Adoption

Panel A. Yield rate (Ton/hectare)					
	Aus	Amon	Boro	Index	
	(1)	(2)	(3)	(4)	(5)
Treatment * 2014	-0.0104	0.660**	0.473**	0.187	
	(0.158)	(0.247)	(0.182)	(0.123)	
Control mean (Follow-up)	0.0827	1.243	3.145	-0.0627	
N	8280	8280	8280	8280	
Benjamini and Hochberg P-value				0.305	
Panel B. Modern variety adoption (1=Yes, 0=No)					
	Amon		Boro		
	HYV	Hybrid	HYV	Hybrid	Index
Treatment * 2014	0.117**	0.0589***	0.0592	0.0767***	0.345***
	(0.0494)	(0.0125)	(0.0411)	(0.0230)	(0.0581)
Control mean (Follow-up)	0.256	0.0029	0.505	0.0333	-0.0794
N	8280	8280	8280	8280	8280
Benjamini and Hochberg P-value					0.0001

Notes: Cluster-robust standard errors in parentheses. Column 5 in panel B presents impact of the BCUP program on an index of the outcome variables in columns 1−4 following Kling, Liebman, and Katz (2007). We control household baseline characteristics including number of age dependent member (age ¡15 and age¿64), number of working age family member (age 15 to 64), household head′s education and age, if household has concrete floor and has access to sanitation. Asterisk (*), double asterisk (**), and triple asterisk (***) denote variable significant at 10%, 5%, and 1%, respectively.

Table 5: Impact on Household Income and Expenditure

Panel A: Income (Yearly/BDT)							
	Crop-farm	Non-crop farm	Non-farm business	Wage	Other	Total	Index
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Treatment * 2014	4701.4**	-698.6	2762.9	-5131.9**	-3316.3	-4998.8	0.0135
	(1971.7)	(1859.8)	(2774.5)	(2505.9)	(6414.4)	(13351.4)	(0.0341)
Control mean (Follow-up)	18145.9	11437	13697.5	47966.9	37019.1	165285.4	0.0877
N	8280	8280	8280	8280	8280	8280	8280
Benjamini and Hochberg P-value							0.781
Panel B: Expenditure (Yearly/BDT)							
	Food	Non-food	Total	Index			
Treatment * 2014	772.2	3918.8	4691	0.0519			
	(4410.9)	(6369.4)	(10191)	(0.125)			
Control mean (Follow-up)	80940.7	66566	147506	0.321			
N	8280	8280	8280	8280			
Benjamini and Hochberg P-value				0.875			

Notes: Cluster-robust standard errors in parentheses. Column 7 in panel A presents impact of the BCUP program on an index of the outcome variables in columns 1−6 and column 4 in panel B presents impact of the BCUP program on an index of the outcome variables in columns 1−3 following Kling, Liebman, and Katz (2007). We control household baseline characteristics including number of age dependent member (age ¡15 and age¿64), number of working age family member (age 15 to 64), household head′s education and age, if household has concrete floor and has access to sanitation. Asterisk (*), double asterisk (**), and triple asterisk (***) denote variable significant at 10%, 5%, and 1%, respectively.

Table 6: Impact on Working Hours by Age Group

	Agri-culture	Non-agri-culture	House-hold activity	Agri-culture	Non-agri-culture	House hold activity	Index
	Children (age 5 to 14)			Male member (age 15 -64)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Treatment * 2014	0.087*	-0.078	-0.007	0.69*	0.30	-0.36	
	(0.051)	(0.078)	(0.089)	(0.40)	(0.40)	(0.328)	
Control mean (Follow-up)	0.082	0.175	0.249	2.718	3.421	1.04	
N	2779	2779	2779	2779	2779	2779	
	Female member (age 15 -64)			Aged group (age >64)			
Treatment * 2014	0.131	-0.060	1.091*	0.028	-0.053	0.102	0.036
	(0.287)	(0.151)	(0.607)	(0.057)	(0.048)	(0.076)	(0.038)
Control mean (Follow-up)	0.973	0.166	7.856	0.0937	0.077	0.231	-0.039
N	2779	2779	2779	2779	2779	2779	2779
Benjamini and Hochberg P-value							0.302

Notes: Cluster-robust standard errors in parentheses. All the values show hours daily. Column 7 presents impact of the BCUP program on an index of the outcome variables in columns 1−6 following Kling, Liebman, and Katz (2007). We control household baseline characteristics including number of age dependent member (age ¡15 and age¿64), number of working age family member (age 15 to 64), household head′s education and age, if household has concrete floor and has access to sanitation. *** Significant at the 1 percent level. Asterisk (*), double asterisk (**), and triple asterisk (***) denote variable significant at 10%, 5%, and 1%, respectively.

Table 7: Impact on Access to Land and Asset Holdings

	Own cultivation	Rented in	Rented out	Cow	Goat	Chicken	Index
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Treatment * 2014	0.518	5.778	-0.398	0.0405*	0.0448*	-0.0163	0.0367
	(2.512)	(3.873)	(1.062)	(0.0204)	(0.0227)	(0.0300)	(0.0275)
Control mean (Follow-up)	34.17	44.64	11.16	0.542	0.222	0.806	-0.00983
N	8280	8280	8280	8280	8280	8280	8280
Benjamini and Hochberg P-value							0.341

Notes: Cluster-robust standard errors in parentheses. Column 1-3 shows land amount in decimal and column 4-6 shows number of respective assets. Column 7 presents impact of the BCUP program on an index of the outcome variables in columns $1-6$ following Kling, Liebman, and Katz (2007). We control household baseline characteristics including number of age dependent member (age ¡15 and age¿64), number of working age family member (age 15 to 64), household head′s education and age, if household has concrete floor and has access to sanitation. Asterisk (*), double asterisk (**), and triple asterisk (***) denote variable significant at 10%, 5%, and 1%, respectively.

Table 8: Impact on Investment and Sale

Panel A. Input investment (BDT/Per decimal)					
	Rice	Non-rice crop	Non-farm business	Index	
	(1)	(2)	(3)	(4)	(5)
Treatment * 2014	1.75	15	3369	0.0605	
	(9.071)	(29.20)	(4414.2)	(0.0652)	
Control mean (Follow-up)	180.1	143.1	3331.5	0.0816	
N	6974	3339	8280	8280	
Benjamini and Hochberg P-value				0.540	
Panel B. Sale in market (BDT/yearly)					
	Rice		Non-rice crop		
	Within 1 month	last 11 month	Within 1 month	last 11 month	index
Treatment * 2014	-57.32	53.08	-2011.3	869.9	-0.00152
	(99.03)	(106.1)	(2154.7)	(2285.5)	(0.0700)
Control mean (Follow-up)	489.8	650.8	9051.1	11907.3	0.0641
N	8280	8280	8280	8280	8280
Benjamini and Hochberg P-value					0.983

Notes: Cluster-robust standard errors in parentheses. Column 4 in panel A presents impact of the BCUP program on an index of the outcome variables in columns 1-3 and column 5 in panel B presents impact of the BCUP program on an index of the outcome variables in columns 1-4 following Kling, Liebman, and Katz (2007). We control household baseline characteristics including number of age dependent member (age ¡15 and age¿64), number of working age family member (age 15 to 64), household head′s education and age, if household has concrete floor and has access to sanitation. Asterisk (*), double asterisk (**), and triple asterisk (***) denote variable significant at 10%, 5%, and 1%, respectively.

Table 9: Heterogeneous impact analysis

	Income			Yield rate		Modern variety adoption				Investment per dec.	
						Amon		Boro			
	Crop-Farming	Non-far Business	wage	Amon	Boro	HYV	Hybrid	HYV	Hybrid	Rice	Non-rice
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Panel A. Household headship status (Base=Male headed households)											
Female headed	-2750	5692	-1040	-0.132	0.777**	-0.081	-0.051**	0.037	-0.0033	52.62***	-0.621
	(2889)	(3505)	(7122)	(0.282)	(0.350)	(0.077)	(0.019)	(0.065)	(0.037)	(16.56)	(42.8)
Panel B. Household tenancy status (Base=Owner households)											
Mixed tenant	4760***	-8399*	854	0.196**	0.426***	0.043**	0.015	0.042	0.0673**	-4.483	-24.86
	(1464)	(4983)	(4391)	(0.076)	(0.143)	(0.018)	(0.011)	(0.026)	(0.027)	(4.17)	(19.2)
Pure tenant	-5257***	-7226*	13049***	-0.168	-0.077	-0.071***	0.0069	-0.069***	0.0616**	-11.98**	-49.8**
	(1789)	(3926)	(3985)	(0.11)	(0.155)	(0.024)	(0.010)	(0.022)	(0.026)	(5.784)	(21.51)
Panel C. Household farm sizes (Base=Farm sizes greater than 100 decimals)											
<50 dec	-17439***	-2644	16620***	-0.594***	-0.922***	-0.155***	-0.056***	-0.162***	-0.068***	-8.28	24.92
	(2136)	(3116)	(3077)	(0.13)	(0.207)	(0.034)	(0.019)	(0.037)	(0.020)	(5.427)	(27.59)
50 - 100 dec	-10072***	3320	6493**	-0.0041	-0.192	-0.0106	-0.0319*	-0.032	-0.0341	-4.498	4.41
	(2236)	(4070)	(3021)	(0.098)	(0.144)	(0.025)	(0.017)	(0.023)	(0.021)	(4.781)	(8.22)

Notes: Cluster-robust standard errors in parentheses. We control household baseline characteristics including number of age dependent member (age ¡15 and age¿64), number of working age family member (age 15 to 64), household head′s education and age, if household has concrete floor and has access to sanitation. Asterisk (*), double asterisk (**), and triple asterisk (***) denote variable significant at 10%, 5%, and 1%, respectively.

Table 10: Robustness check

	Income			Yield rate		Modern variety adoption				Asset holdings	
						Amon		Boro			
	Crop-Farming	Non-far Business	wage	Amon	Boro	HYV	Hybrid	HYV	Hybrid	Cow	Goat
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Panel A. Panel A. Wild bootstrap											
Treatment *2014	4701	2,757	-5,144	0.661	0.474	0.117	0.059	0.059	0.077	0.041	0.045
P-vale	0.020	0.320	0.100	0.020	0.020	0.020	0.000	0.120	0.000	0.080	0.020
Panel B. No baseline covariates											
Treatment *2014	4704.3**	2769.7	-5141.3**	0.660**	0.472**	0.117**	0.0589***	0.0591	0.0767***	0.0406*	0.0445*
SE	(1972.7)	(2773.5)	(2507.8)	(0.247)	(0.181)	(0.0494)	(0.0125)	(0.0411)	(0.0230)	(0.0206)	(0.0226)
Panel C. Household with no MFI involvement in baseline											
Treatment *2014	3979.8**	2655.5	-5714.9**	0.641**	0.473**	0.114**	0.0586***	0.0588	0.0776***	0.0368*	0.0452**
SE	(1842.8)	(2649.5)	(2466.6)	(0.250)	(0.185)	(0.0495)	(0.0120)	(0.0418)	(0.0220)	(0.0201)	(0.0221)

Notes: Cluster-robust standard errors in parentheses in panel B and C. In Panel A and panel B, we control household baseline characteristics including number of age dependent member (age ¡15 and age¿64), number of working age family member (age 15 to 64), household head′s education and age, if household has concrete floor and has access to sanitation.Asterisk (*), double asterisk (**), and triple asterisk (***) denote variable significant at 10%, 5%, and 1%, respectively.