

MICRO-CREDIT PROGRAMS AND OFF-FARM MIGRATION IN CHINA

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Abstract. This paper seeks to evaluate effects of micro-credit projects on the poor. We utilize data that we collected in Sichuan Province in 1999 to investigate whether micro-credit projects have targeted the poor and whether participation in the micro-credit project increases the likelihood of migration and switching to off-farm jobs. We find that, although the micro-credit programs did not help increase assets of the participants, it did help to move one or more of their members into an off-farm job. Our findings indicate that there is a great deal of benefit in supporting micro-credit programs.

1. INTRODUCTION

In the past two decades China has witnessed a rapid rise in migration. The government does not maintain comprehensive time-series statistics on migrant labor, but various estimates have placed the number of migrants as high as 100 million (Rozelle *et al.*, 1998; Zhao, 1999a). Motivated by the extraordinarily large differences in wage rates between rural areas, particularly poor rural areas, and prosperous urban centers, migration helps to reduce poverty, narrow the income gap and supply labor for the industrialization process.

Although migration has been instrumental in improving the living conditions of people in rural areas, not all farmers are migrating. In fact, farmers in some remote areas almost seem to be trapped in their villages. Some argue that the lack of transportation infrastructure is the major constraint on migration, and that local public spending on infrastructure is important in helping these farmers to move out (Zhao, 1999b; Mohapatra *et al.*, 2002). Others posit that a lack of information about the outside labor market and land policy is keeping farmers at home (Yang, 1997; Zhao, 1999a; Hare and Zhao, 2000; Meng, 2000). If these hypotheses are correct, then the government should provide more information and permit even more market-oriented land reforms such as allowing farmers to transfer or lease land freely.

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Additionally, and equally important, the lack of initial capital for job searches and moving could have hindered farmers from migrating. The costs associated with the search for a job and initial moving expenses could represent barriers to migration for poor farmers (Zhao, 1999b; Rozelle *et al.*, 1999). While roads are now being built, and land reforms have made migration easier, little has been done to provide finance for poor farmers (Lohmar, 2002). Recent bank reforms, which have centralized lending rights, make it almost impossible for commercial banks to lend money to poor farmers (Park and Shen, 2002).

If capital is the remaining constraint, then policies targeting farmers for the provision of initial capital should help them to migrate. Without completely reforming the banking system, one of the ways to provide initial capital is through the use of micro-credit projects. Originating in Bangladesh, micro-credit projects provide finance to groups of poor farmers, which are jointly liable for the loan.¹ Although the scheme was introduced only in the mid-1990s, micro-credit projects have played an important role in lending to poor farmers in rural China (Park and Ren, 2001). If the poor in China want to move off-farm and one of the greatest constraints on their moving is the lack of credit, then it might be natural to assume that programs providing loans to the poor could have a positive effect on migration. Few, if any, studies have examined this aspect of China's emerging micro-credit program.

Overall, our paper seeks to evaluate the effects of micro-credit projects on the poor. But to narrow such a broad topic, we utilize data that we collected in Sichuan Province in 1999 to investigate whether micro-credit projects have targeted the poor and whether participation in the micro-credit project increases the likelihood of migration and switching to off-farm jobs. The data we use are from a micro-credit project implemented in 1996 by the United Nations Development Program (UNDP). We find that the project did indeed target the poor, and that participation in the project has had at least a modest effect on the likelihood of farmers switching to off-farm both inside and outside of the county. One of the main contributions of the paper is to show that participation in the Sichuan micro-credit program has helped its participants to increase their participation in the off-farm labor market, which in China is one of the best ways to escape poverty.

To accomplish our objectives, the structure of the paper is as follows. Section 2 describes the micro-credit program that we studied and the data. Section 3 provides a basic statistical summary of the program. Sections 4 and 5 employ several econometric approaches to explain the determinants and impacts of project participation. Section 6 concludes.

2. YILONG PROGRAM AND DATA

The UNDP's micro-credit programs focus on poverty alleviation. One of its earliest programs was started in Yilong County, a poor county in northern Sichuan Province. Since one of the main objectives of the study is to assess

¹ See Morduch (1999) for a good survey of the literature on micro-credit.

the impact of the program (which requires time), our focus is on households that began the program during the year it started. The initial participating households were from nine villages and three townships: Shuangsheng (two villages), Qishan (three villages), and Fengyi (four villages).

Unlike formal financial institutions, which principally loan to earn a profit, micro-credit programs are focused on mobilizing the poor into groups, providing them with training and helping them to identify a source of employment for generating income. Subject to meeting the criteria that program officials have established, individuals decide whether they want to participate. In addition to working on the projects set up by the micro-credit program, the individual's family typically carries out a number of other economic activities. Groups are formed and provided with an incentive to monitor individual members, since the ability to borrow in the future for any member of the group is a function of the repayment behavior of each and every other member. To monitor each other, group members need to meet one afternoon per week to report to each other about loan use and job status.

The Yilong Program targets the poor and women, and was initially designed to focus on poorer households. However, there were no rigorously set criteria. Interviews with one of the program administrators revealed that the selection was based largely on observations by the initial work teams. The teams visited villages and interviewed prospective participants. Team leaders told us that they did not choose candidates if their housing appeared to be too good or if there was any apparent wealth in the household (in the form of expensive or large quantities of consumer durables, for example).² Land per capita was not a selection criterion (given the fairly egalitarian distribution in the villages in this area). Information about the selection criteria is used in the specification of the participation equations in the analysis below.

The Yilong micro-credit program was set up as a Grameen Bank-style program. Program organizers put participants into groups of five, called 'peer-monitoring groups'. Organizers intended for all participants to take loans on livestock projects, and only in a minority of cases were participants allowed explicitly to take loans out for other activities. In a few cases participants applied for loans on the understanding that they were going to use them for livestock production but ended up using the funds for other activities.

In return for a loan that was guaranteed by an individual's group, the borrower made payments during mandatory weekly meetings. Although the nominal interest rate was 10.5% per annum, the nature of the payback scheme made the real interest rate higher (about 18%). Since most of Yilong's poorest villages are in mountainous areas, the time that it took members to attend meetings also increased the cost of participating for any household that valued its time highly. In addition to access to loans, however, members were then able to participate in training programs run by the project and periodically to

² In the program, if a household was judged 'too rich', it was not allowed to participate in the program. Unfortunately, the survey did not ask richer people whether or not they would have participated had they been allowed.

consult with livestock experts (e.g. veterinarians) who were present during some meetings. In short, the Yilong project was organized much like traditional Grameen Bank micro-credit project, offering benefits beyond the access to credit but at a cost that was higher than the nominal interest rate.

We conducted fieldwork and cleaned data for this program from mid-1998 to early 1999. With help from the Yilong project office, a total of 247 households were selected for the study; of these, 130 participated in the loan program. A set of 117 non-participants was randomly selected from a complete list of all households in each village in which participants resided. Information on the economic activities and employment decisions from these households will help control for location and wealth effects of the program site, and to understand the initial selection decisions.

The survey concentrated mainly on the sample households in three townships. A detailed questionnaire was designed, eliciting information on a household's loan activity, household and individual characteristics, and the changes in a household's major assets between 1996 and 1998. We also collected information about the labor allocation of the household for each family member. For all questions, information was requested from program participants and non-participants concerning both the period immediately before 1996 (the first year of the program) and at year-end 1998. These data were supplemented by a baseline survey and documentation of loan activities (e.g. each loan application and the loan contract), provided to the enumeration team by the program's accountant, for all participating households. A community-level questionnaire was also administered to gather data on village characteristics.

3. TARGETING THE POOR AND IMPROVING THEIR LIVELIHOOD

In this section we use descriptive statistics to examine the characteristics of participating and non-participating households. We also track changes in asset holdings and labor market activities over time and compare participating and non-participating households. In particular, we want to see if those that participated in the micro-credit program were making labor allocation decisions differently from those did not participate. Before proceeding, however, a caveat is needed. Descriptive statistics can sometimes be misleading. In the next two sections we examine the same set of issues by employing multivariate analysis.

The descriptive data from the household survey demonstrate that the program targets the poor (Table 1). In terms of household assets, the initial value of the housing stock and the stock of consumer durables of participating households were lower than for non-participating households. This is consistent with the observation that the initial selection by the team considered the observable wealth of households. In addition, fixed productive assets and livestock holdings of the participating households were lower than non-participating households. The project team seemed to have been focusing the project on the poor.

One of the objectives of the program was to involve more women and increase their socio-economic decision-making role in the household. Descriptive

Table 1. Descriptive statistics of sample average household, participants and non-participants, in the Yilong micro-credit program, 1996

<i>Variable name households</i>	<i>Sample average</i>	<i>Participating households</i>	<i>Non-participating</i>
(1) No. of household members	4.3 (1.2)	4.4 (1.2)	4.3 (1.3)
(2) No. of adult members	2.9 (1.2)	2.9 (1.2)	2.9 (1.3)
(3) Age – household head	44.5 (11.9)	44.8 (12.4)	44.1 (11.3)
(4) Education attainment – household head	4.9 (3.6)	4.9 (3.2)	4.9 (3.9)
(5) Education attainment – highest in family	7.0 (3.4)	7.2 (3.9)	6.9 (2.7)
(6) Woman-headed household (%)	0.09	0.14	0.04
(7) Health status – head and spouse (1 = good; 2 = sick but can work; 3 = cannot work)	1.7 (0.6)	1.7 (0.5)	1.7 (0.6)
(9) Employment status – head and spouse (% of off-farm)	0.5 (0.6)	0.5 (0.5)	0.5 (0.6)
(10) Employment status – average adults (% of off-farm)	0.3 (0.6)	0.2 (0.5)	0.3 (0.6)
(11) Migration status – head and spouse (% migrated out)	0.5 (0.6)	0.4 (0.5)	0.5 (0.6)
(12) Migration status – average adults (% migrated out)	0.3 (0.6)	0.2 (0.5)	0.3 (0.6)
(13) Value of house ('000 yuan)	8.0 (8.5)	7.7 (7.2)	8.4 (9.8)
(14) Fixed productive assets ('000 yuan)	1.8 (2.2)	1.8 (2.2)	1.8 (2.1)
(15) Consumer durables ('000 yuan)	1.1 (1.0)	1.0 (1.0)	1.2 (1.0)
(16) Livestock inventories ('000 yuan)	1.2 (1.3)	1.2 (1.4)	1.3 (1.2)
(17) Household landholding (<i>mu</i>)	3.2 (0.9)	3.2 (0.9)	3.2 (1.0)
(18) Loan size (<i>yuan</i>)		1445 (977)	

Note: Standard deviations are reported in parentheses.

statistics show that 91% (119 out of 130) of participating individuals were women. Men, however, were allowed to participate if they qualified.

Among all household members (who were aged 18 or older at the time of the survey), the average education level of participating household heads was the same as non-participating household heads (4.9 years). There was also little difference between participating and non-participating households regarding the maximum level of education of one of their members (Table 1). The average age of participating households (42) is higher than that of non-participating households, even though the average age of the household heads of participating and non-participating households is almost the same.

Loan size varies between households and across villages, depending on the purpose of the loan. Loans range from 200 to 2000 yuan. According to the program norm, loans in denominations of 500 or 1000 yuan are most common. When the project was set up, the county government's agreement with the micro-credit program's sponsors (UNDP) was that all loans would go for livestock production.³ Discussions with project organizers, however, revealed that

³ Although most micro-credit programs do not restrict their loans to any one set of economic activities (e.g. livestock), because this was one of the earliest projects set up by the United Nations, regional officials at the county level insisted that this be the case.

even during the first year a limited number of loans were made for purposes other than raising livestock. More importantly, organizers also acknowledged that loans made in cash to farmers are fungible; and, even when the expressed purpose of the loan was to increase livestock production, households sometimes used the cash to fund other activities, such as paying for children's education or searching for an off-farm job. During the first three years of the project, 85% of the loans were reported to have been for livestock production.⁴

In interviews that we conducted in 1998, although the program explicitly targeted livestock-producing households, one of the common findings was that most families were convinced that their future path of development lay in moving off the farm and out of agriculture. Land in the area studied is scarce and the quality is poor. The terrain is steep and most of the land is terraced. Households almost always stated that improvement in their standards of living depended on finding work for household members in the county or township (a local day trip for most of the villages) or through migration out of the county. However, financing such a move was often costly. Although we did not systematically collect data on the amount needed for a family's off-farm job search, respondents indicated the amounts were typically not inconsequential, especially when including the forgone on-farm income.⁵ From one point of view, given the importance of migration in the future livelihood plans of families, it seems curious that a program would focus on livestock production. Other families, however, told us that expanding the household's livestock output was consistent with their goal to move household members off the farm. Livestock could provide the cash to finance the movement off-farm, as well as providing work opportunities for those family members left behind.

Given the importance to family welfare of off-farm activities within our sample, our study investigates how participation in the credit program affects the off-farm activity of household members. Although most families that we interviewed voiced the opinion that there was a positive relationship between livestock production and the ability to move off the farm, in fact, there are several different ways in which such a targeted program could affect off-farm labor decisions. On the one hand, the program could actually reduce the number of people seeking off-farm jobs outside the village, because the program itself provided more on-farm opportunities. However, it can also be argued that, if individuals wanted to use loans to finance off farm migration, say because of the difficulty in monitoring, any program that provided credit could break the credit constraint and encourage more people to seek off-farm jobs.

⁴ Although there appear to be little reticence in the willingness of households to discuss the terms of their loans and the actual way they used them, it was often difficult to quantify exactly how much of the loan was taken for one purpose but used for another. For example, often farmers who were already raising livestock would take a livestock loan, invest the funds in livestock production and then use the funds they would have originally used for livestock production to finance other economic activity.

⁵ In other work, Zhao (1999b) finds that the cost of migration is high, reaching up to 53.3% of the household's annual per capita income.

Table 2. Impact of micro-credit program on household assets, off-farm job and migration

	Non-participating households (difference, 1996–98) (1)	Participating households (difference, 1996–98) (2)	Difference- in-difference (unadjusted) (3) = (2) – (1)	Difference- in-difference (adjusted) (4)
<i>Asset value (yuan)</i>				
(1) Consumer durables	990 (1918)	696 (1259)	-294 (2294)	-281 (273)
(2) Fixed productive assets	711 (1431)	808 (1228)	97 (1886)	87 (436)
(3) Livestock inventories	517 (1509)	843 (1754)	326 (2313)	323 (283)
(4) Total assets	2218 (2920)	2347 (2585)	129 (3899)	133 (661)
<i>Off-farm job</i> (1 = off-farm job, 0 = farm job)				
(5) Household head	0.017 (0.321)	-0.015 (0.392)	0.002 (0.507)	0.040 (0.077)
(6) Head or spouse	0.009 (0.464)	0.015 (0.447)	0.024 (0.644)	0.051 (0.089)
(7) Average adult labor	0.018 (0.241)	0.047 (0.213)	0.029 (0.321)	0.024 (0.042)
<i>Migration status</i> (1 = migrant, 0 = not)				
(8) Household head	0.026 (0.334)	-0.015 (0.372)	0.011 (0.500)	0.094 (0.075)
(9) Head or spouse	0.017 (0.473)	0.015 (0.429)	0.032 (0.639)	0.105 (0.088)
(10) Average adult labor	0.019 (0.242)	0.042 (0.199)	0.023 (0.313)	0.041 (0.042)

Notes: Numbers in parentheses are standard errors. Significance level 0.1, 0.05 and 0.01 are marked by *, ** and ***. The unadjusted model in column (3) is based on the regression with a constant, a participant indicator, a time indicator and an interaction of participation and time as regressors. The adjusted model in column (4) has the following regressors: those in the unadjusted model, number of household members, number of adult members, age, education, woman-headed household, and health status. For both the unadjusted and adjusted models, we report only the coefficient on the interaction of participation and time, which measures the participation effect.

Perhaps because of these complications, the descriptive results do not give a clear picture of the effect of program participation on migration. The percentage of people seeking off-farm jobs over time for both participating and non-participating households may increase or decrease, depending on the measures we use (Table 2, columns (1) and (2)). Moreover, the standard errors are too large to enable us to make any concrete judgment.

Another focus of the analysis is the impact of the micro-credit program on household assets (consumer durables, productive assets and livestock) changes. It might also have been helpful to compare income per capita or consumption per capita, but, given the constraints on time and financial support, it was impossible to collect enough data to measure income or consumption accurately. Thus, we have had to rely on comparisons of assets and changes in asset accumulation. Comparing asset holdings between participating and non-participating households, it is clear that participating households have fewer assets in the initial year of the project; i.e., participating households are poorer (Table 1). However, since participating in the program there have been obvious changes in household assets. Furthermore, the increment in household assets

of the participating households has been faster than that of non-participating households (Table 2, columns (1) and (2)). This is especially true for household livestock assets, as many participating households did use the fund for livestock production.

4. PROGRAM PARTICIPATION

In this section we employ multiple regressions to discover the determinants of program participation. Since there are many candidates, who are most likely partially correlated with one another, we want to use regression analysis to separate out the net effect of each factor. We use two measures of participation: (a) a yes/no answer for those who participated in the program; and (b) the size of the loan received. We use a probit model to estimate program participation and a Tobit model to estimate the loan size equation.

Following Rozelle *et al.* (1999) and Zhao (1999a), we specify participation or the loan size as a function of household demographics, human capital characteristics of household members, the gender of the household head, employment status prior to the start of the program, the household's land holding and the value of the household's consumer durables and housing stock. The value of the household's consumer durables and value of housing stock is important, since by project implementation criteria they were important for determining a household's eligibility. Village dummies are included to allow for differences in participation and loan size among villages.

The measures for off-farm and migrant employment are defined as follows. Employment status is a binary variable (1 = off-farm job; 0 = on-farm job). Migration status also is a binary variable (1 = migration; 0 = living and working at home). Throughout the analysis, we use different combinations of off-farm and migration status of the household, such as the migration status of the household head, which equals 1 if he/she migrates and zero otherwise, and the average migration status of head and spouse, which equals 1 if both migrate, 0.5 if only one of the couple migrates and 0 if neither migrates. We also use the average adult off-farm and migration status in the family in the analyses. These employment and migration variables can be used as dependent (in the impacts analysis – next section) or independent variables (in the participation equations). We use the initial values from 1996 as independent variables in our participation analysis.

The probit and Tobit regressions perform fairly well (Table 3). Most of the signs are as expected, and a number of the coefficients are significant. In particular, the two variables that were used as the selection criteria by the program office – the values of house and consumer durables – are jointly significant in both equations. The negative signs for asset variables mean that program officials did, in fact, do an adequate job in targeting.

A number of the control variables also were found to affect participation. For example, the number of members in a household is significant in determining household participation in the credit program (Table 2, column (1)). Employment status in 1996 was also significant. When the household heads

Table 3. Probit and Tobit regressions results explaining determinants of program participation and loan size in the Yilong micro-credit program

<i>Independent variable</i>	<i>Program participation – probit (1 = participation)</i>	<i>Loan size – Tobit</i>
(1) No. of household members	0.469** (0.232)	1347.0 (1059.9)
(2) No. of adult members	-0.001 (0.036)	10.9 (122.5)
(3) Age – household head	0.003 (0.003)	13.8 (11.6)
(4) Educational attainment – highest in family	0.014 (0.011)	73.1 (35.3)
(5) Woman-headed household (1 = yes, 0 = no)	0.389*** (0.082)	1098.5** (409.1)
(6) Health status, head and spouse (1 = good; 3 = cannot work)	0.024 (0.073)	52.4 (237.5)
(7) Employment status – head and spouse (no.)	0.566** (0.213)	1321.9** (557.1)
(8) Migration status – head and spouse (no.)	-0.610*** (0.212)	-1426.3** (557.1)
(9) Consumer durables ('000 yuan)	0.094** (0.041)	-188.7 (118.1)
(10) Value of house ('000 yuan)	-0.003 (0.005)	-7.7 (14.5)
(11) Household land holding ('000 yuan)	0.574 (0.407)	-1547.8 (1435.8)
(13) Village indicators	Yes	Yes
(14) Pseudo R^2	0.09	0.01
(15) No. of observations	243	243

Notes: Numbers in parentheses are standard errors. For probit regressions, we report dF/dx . Significance level 0.1, 0.05 and 0.01 are marked by *, ** and ***.

worked off-farm, households were more likely to participate in the program. However, if the household head or spouse was working long term out of the village (in the out-migration labor force), participation was lower. Most of the same variables were significant, or at least were the same sign, in the loan size equation (column (2)). One of the most noticeable findings from these results is that the program did facilitate the participation of women, especially women-headed households (see Table 2). If the woman was the head of the household, she was much more likely to participate in the program, everything else being equal, and also her household would receive a loan that was more than 1000 yuan more than a male-headed household.

The results trace out a pattern of participation, conditioned on the requirement to be poor and female, that is driven by variables that affect the value of family members' time and the need to finance the move off the farm (or out of cropping). Households with fewer members may not be able to afford the time to allow one of its members to spend one afternoon a week attending a meeting to service a loan, and so smaller households participate less.

In sum, then, the motivations to participate in Yilong's micro-credit program are quite complicated. They are affected by project design characteristics (the poor and women participate more), and there does appear to be a systematic bias towards those who have a desire to begin or continue to shift family members out of cropping and into off-farm activities, including out-migration.

Those with low and high education, the young and old, the sick and healthy, all have equal access to the program.

5. IMPACT OF PROGRAM PARTICIPATION

In the second part of our econometric analysis we examine the impacts of program participation. To estimate the impact of such participation, we need to identify a control group which did not participate in the program, but which shares other important characteristics with participants. To this end, we first used our sample of non-participants as the control group and applied a 'differences-in-differences' methodology to estimate the program effect. However, since participation in the program is not randomly assigned, our sample of non-participants may not be a perfect control group. To adjust for this effect, we use propensity score-matching to construct a more appropriately matched sample to evaluate the impacts based on estimations of the matched sample.

5.1. *The difference-in-difference method*

Following Angrist and Krueger, (1999) and Heckman *et al.* (1999), the differences-in-differences (DD) method is illustrated by the following regression equation:

$$Y_{it} = X_{it}\beta_0 + \gamma_i + \delta P_{it} + \varepsilon_{it}, \quad (1)$$

where Y_{it} represents performance measures as defined above; X_{it} is a vector of household attributes used in Table (3) that serve as control variables, and β_0 is a vector of corresponding coefficients including a constant. In addition, β_i is an indicator variable for the post-program year 1998 (if the observation from 1998 $\beta_i = 1$, otherwise 0); and γ_i is an indicator variable for project participants. Importantly, the variable P_{it} is a variable created by interacting β_i and γ_i (and is an indicator variable that equals 1 if household i was a participant in the micro-finance project and the year is 1998), and δ is the coefficient measuring the program participation effect. The key identifying assumption is that the coefficient on δ is 0 without the program. In other words, the participants and non-participants would do the same in terms of our effect measures if participants were selected but did not participate in the program.

As an initial analysis, we estimated the average effect of project participation, or δ , by applying a linear regression to (1) without X_i . Doing so is equivalent to first calculating the average year difference of participants ($E(Y_{i,1998} - Y_{i,1996} | \gamma_i = 1)$) and non-participants, respectively ($E(Y_{i,1998} - Y_{i,1996} | \gamma_i = 0)$), and then using the first difference minus the second difference to get the differences-in-differences, which is exactly δ . We call this initial analysis the unadjusted DD analysis. We are interested in assessing the impact of the micro-credit program on a wide number of measures of changes to household assets, and especially the employment decisions of the individuals in the sample households.

The unadjusted DD analysis does not produce definitive findings (Table 2, column (3), rows (1)–(4)). On the one hand, the point estimates of our results show that participation has decreased the household's consumer durables by 294 yuan. On the other hand, participation has increased the household's productive assets by 97 yuan and livestock inventories by 326 yuan. The unadjusted DD analysis also shows that program participation has a positive effect on off-farm job and migration status (Table 3, rows (5)–(12)). None of the differences, however, are significant in a statistical sense.

We find similar results when controlling for household attributes and looking at differences-in-differences between project participants and non-participants (Table 3, column (4)). While the unadjusted DD analysis implicitly assumes that all households are the same, adjusted DD analysis controls for the household attributes by estimating equation (1) using OLS. As in the other analyses, although the estimates of the participation effect are positive, they are not significant. Project participation has a positive but insignificant effect on household assets (except consumer durables) and on employment opportunities for the household head and his/her spouse.

5.2. *The propensity-score matching method*

While the DD analysis is a valid way to evaluate the effect of projects on performance, in trying to identify participation effects, the method relies on the assumption that non-participants and participants would have made the same change of either job market status or asset level without the project. If participants expected a larger (or smaller) change in the performance variables than non-participants even without the project, then the estimates of the DD method would be biased upward (or downward). In other words, if the assumption is not valid, the problem basically is due to the fact that non-participants are not a good control group for assessing the impact of the program on participants. To identify the program effect more accurately, we need a control group of non-participating households that would be more similar to the group of participants had the micro-finance program not been implemented.

To find such a control group, we used a recently developed analytical approach: *propensity-score matching*. The idea of propensity-score matching is to match each participant with a non-participant that has (almost) the same likelihood of participating the program (Heckman *et al.*, 1997; Dehejia and Wahba, 1998; Angrist and Krueger, 1999). Intuitively, we matched participants with non-participants that had the same likelihood of participating in the program, but chose not to participate for some random reasons.

Following Dehejia and Wahba (1998), the matching consists of two steps. In the first step we predict the participation probability of each household, both participants and non-participants, by using the estimated probit model referred to in Table 3. In the second step, we match the participation probability of each observation of the participant group to the observation in the non-participant group that has the participation probability that most closely matches its participant counterpart. Non-participants are drawn with replacement;

this means that, after a non-participant is matched to a participant, the observation is returned to the pool and may be used to match up with another participant. Since we had 126 participants in the sample, we had 126 non-participants in the matched control group (although some non-participant observations appear more than once). Assuming that program participation depends only on variables in the participation equation, propensity-score matching estimates of the effects of program participation on some performance variable using this constructed sample of 252 households will be consistent.

As an initial test, we calculated the unadjusted differences in our effect measures between participants and non-participants for the post-program year, 1998. As in the DD results, the initial test shows that the program has mixed effects on participants in terms of assets (Table 4, column (1)). Participants do benefit from the program in terms of total assets (282 yuan more for participants). All of the benefit is from increased fixed productive assets and livestock inventories (rows (1)–(4)). As before, the consumer durables for participants also decreased, by about 451 yuan. In terms of job and migration status, the head and spouse of participating households are on average more likely to have non-farm job or to migrate out.

To check whether this unadjusted difference is robust, we conducted an adjusted or regression analysis. We first conducted regression analysis using our matched sample for the year 1998 with three separate sets of regressors: the first by controlling household characteristics that were used in Table 3 the second by controlling only for the initial value of the performance variable, and the third by controlling for both household characteristics and the initial value of the performance variable. We also applied the DD method to our matched sample, using the household characteristics as control variables. In the table of our results, however, we report only the coefficients on the participation indicator.

The results of the adjusted propensity-score matching method are consistent with the previous results (Table 4, columns (2)–(5)). Moreover, a larger number of the findings are statistically significant. Although there is no effect on total assets, we continue to find strong evidence of the positive effect that participation in the micro-credit program has had on the employment prospects of the head of the household and his/her spouse. Generally speaking, the estimated participation effects of these regressions show that farmers in the program have been able to use the additional funds (and/or training) from the project and to help them meet their goals of finding a job off-farm. Although we cannot know exactly how the program assists farmers in finding a new job off-farm, it may have to do with the fact that the loan provides them with the financial means to stop their work in the village and/or on the farm and shift their attention to finding employment in the city.

6. CONCLUSIONS

In general, our findings are consistent with observations made by researchers in the field. The result of the experiment suggests that, although the Yilong

Table 4. Impacts of program participation in Yilong micro-credit programs using matched sample

List of dependent variables	Unadjusted (1)	Adjusted with control variables (2)	Adjusted with lagged dependent variable (3)	Adjusted with control variables and lagged dependent variable (4)	Differences- in-differences, in-differences, adjusted with control variables (5)
<i>Asset value (yuan)</i>					
(1) Consumer durables	-451** (205)	-373* (197)	-407** (174)	-374** (171)	-404* (225)
(2) Fixed productive assets	454 (315)	428 (319)	505*** (119)	481*** (118)	504 (423)
(3) Livestock inventories	315 (228)	264 (230)	270 (200)	188 (201)	248 (276)
(4) Total assets	282 (511)	286 (515)	430 (304)	406 (307)	422 (628)
<i>Off-farm job</i> (1 = off-farm job, 0 = farm job)					
(5) Household head	0.099 (0.061)	0.057 (0.055)	0.052*** (0.020)	0.048** (0.020)	0.149** (0.075)
(6) Head or spouse	0.153** (0.067)	0.114* (0.061)	0.074*** (0.078)	0.071** (0.028)	0.158* (0.086)
(7) Average adult labor	0.009 (0.028)	0.017 (0.028)	0.001 (0.016)	0.009 m(0.016)	0.008 (0.042)
<i>Migration status</i> (1 = migrant, 0 = not)					
(8) Household head	0.056 (0.059)	0.014 (0.052)	0.042** (0.021)	0.037* (0.022)	0.118 (0.073)
(9) Head or spouse	0.101 (0.067)	0.062(0.059)	0.062** (0.029)	0.057** (0.029)	0.132 (0.084)
(10) Average adult labor	-0.016 (0.028)	-0.007 (0.027)	-0.003 (0.016)	0.004 (0.016)	0.004 (0.041)

Notes: Numbers in parentheses are standard errors. Significance level 0.1, 0.05 and 0.01 are marked by *, ** and ***. The unadjusted model in column (1) is based on the simple average difference between participants and the matched control group. The adjusted model in column (2) includes the following regressors: a constant, the participation indicator, number of household members, number of adult members, age, education, woman-headed household, and health status. The adjusted model in column (3) includes only a constant, a participation indicator and a lagged corresponding dependent variable. The adjusted model in column (4) includes variables in both columns (2) and (3). The differences-in-differences model in column (5) includes the same variables as in column (2), but include both 1996 and 1998. For the first four models we report the coefficient on the participation indicator; for the last model we report the interaction of participation and post-program year.

micro-credit programs do not seem to have helped increase the total assets of the households of the participants after three years of the program, the story is more complicated. As noted above, one of the strongest objectives of households is to move one or more of their members into an off-farm job. If so, our results show that the programs may be quite successful. There is a consistently positive impact of participation in finding local employment and migration opportunities for family members. It could be that the participating households are currently in the process of investing in off-farm employment (and productive assets and livestock) and have forgone investment in consumer durables, which has held back, albeit perhaps only temporarily, rises in family wealth. This interpretation means that there could be a great deal of benefit in supporting micro-credit programs like those found in Yilong.

While provocative, our results necessarily require caution in assigning more widespread implications. First, it is difficult to draw nationwide conclusions on the basis of such a small sample from a single area. Also, work should be ongoing, since three years is too short a time to assess the impact of a program that is designed to lead to structural transformations. In any additional work, an effort should be made to understand the mechanism by which the micro-credit program led to higher employment. Did the families use the loan directly to finance the shift to the off-farm sector, or did they use the earnings from their initial investment in livestock assets? Finally, we are not judging the financial sustainability of the program. This is an important factor, especially when considering many of the implications of extending the Yilong program to other places.

These caveats aside, Yilong's program is successful by any measure and provides several lessons. First, the organizers of the Yilong program targeted the poor as well as women. Second, the program also did not discriminate against either the old, the young or the uneducated. Third, the program clearly had an impact. Perhaps the most interesting finding of the study, is the complicated nature of this impact. Participation did not lead to an immediate rise in total assets. (Indeed, our results show a consistent fall in the ownership of durable goods such as televisions.) Instead, the program appears to have helped household members find a job off-farm locally or in the migrant job market. If this is the case, and assuming earnings in the off-farm sector are higher than those of agriculture, it is likely that, sooner or later, most families participating in the program will benefit from having an extra member working off-farm.

The results of our study may also show that sectoral targeting in credit programs does not seem to make much sense. Since capital is fungible, although households may invest in livestock, they may have been ready to do this anyhow. In such a case, then, the loan is used for livestock and the family's funds that were originally going to be used for livestock are used to finance the move off-farm (and be supplemented by livestock earnings, if a profit is made). At the very least, given the preference that farmers tell us they have for programs that allow them to enter the off-farm labor force, more effort should go into the design of programs that will enable them to facilitate such shifts.

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