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## Financial Literacy and Financial Behaviour

Sayinzoga, Aussi; Bulte, Erwin H.; Lensink, Robert

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## FINANCIAL LITERACY AND FINANCIAL BEHAVIOUR: EXPERIMENTAL EVIDENCE FROM RURAL RWANDA\*

*Aussi Sayinzoga, Erwin H. Bulte and Robert Lensink*

We organise a field experiment with smallholder farmers in Rwanda to measure the impact of financial literacy training on financial knowledge and behaviour. The training increased financial literacy of participants, changed their savings and borrowing behaviour and had a positive effect on the new business start-up. However, it failed to have a significant (short-term) impact on income. Using a two-stage regression framework, we identify enhanced financial literacy as one of the important factors explaining behavioural changes. We also test whether financial knowledge spillovers from trained farmers to their peers in local village banks but find no evidence for that.

The expansion of microfinance has increased rural households' access to financial services in many developing countries (Hulme *et al.*, 2009). However, evidence is mounting that access to credit may not be the most critical impediment to economic progress (Karlán and Morduch, 2009), while the evidence regarding the effects of access to finance on reducing poverty increasingly appears mixed. For example, McKenzie and Woodruff (2008) find that small injections of working capital have high rates of return, and Bruhn *et al.* (2013) report that an expansion of bank credit increases household income and employment for low-income households in Mexico. But Banerjee *et al.* (2014) show that access to microcredit does not make existing firms in India more profitable, nor does it increase household expenditures or affect key development outcomes such as health and education. Angelucci *et al.* (2014) provide evidence that microcredit has positive effects on qualitative well-being and women's bargaining power but also document it does not improve wealth, expenditures, or profits, on average. Using experimental data from a business grant programme, De Mel *et al.* (2008) document modest rates of return to capital. Berge *et al.* (2012) also use experimental data from a business grant intervention but find no evidence that capital has any influence on economic outcomes, such as profits or sales.

These findings do not spell the end of the microfinance-based development agenda but do suggest the need to reconsider basic expansion strategies. Specifically, evidence points to considerable heterogeneity in treatment effects, suggesting the impact of microfinance may be conditional on human capital of the borrower. If human and financial capital complements the development process, scaled-up microfinance programmes might usefully be accompanied by efforts to increase the human capital of potential recipients.

\* Corresponding author: Robert Lensink, Department of Economics, Econometrics and Finance, University of Groningen, 9712 CP Groningen, the Netherlands. Email: b.w.lensink@rug.nl.

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Experimental evidence regarding the impact of such efforts in developing countries is very scarce, and again produces mixed signals. While Karlan and Valdivia (2011) find little robust evidence that training influences economic outcomes, such as profits or sales, others report substantial effects (Berge *et al.*, 2012). One key component of human capital, amenable to outside intervention, is financial literacy. Financial literacy is defined as consumers' awareness, skills and knowledge enabling them to make informed, effective decisions about financial resources. While a growing literature focuses on measuring financial literacy, few studies rigorously address its impact on economic behaviour in developing countries. Experimental evidence on the impact of trainings is especially scant. Hence, 'research on efforts to enhance financial literacy suggest that some interventions work well, but additional experimental work is needed to explore and establish causality' (Lusardi and Mitchell, 2014, p. 5). Despite this paucity of evidence, financial education initiatives for unbanked, under-served and other disadvantaged groups are often perceived as critical to enable sustainable economic development (Malkin, 2003).

The objectives of this study are twofold. First, we use an experimental approach to assess the impact of financial literacy training on financial knowledge, behaviour and income. Second, we examine to what extent financial knowledge spillover from trained persons to their peers via informal networks. Implementing agencies often assume useful knowledge from trainings will spread beyond the directly targeted population – inflating the 'scale' or total impact of the intervention. But the empirical basis for such beliefs and assumptions is extremely weak.

To probe these issues, we organised a randomised field experiment in rural Rwanda, a dynamic African country experiencing rapid changes to its savings culture. According to the National Institute of Statistics of Rwanda, the percentage of adult Rwandans with saving accounts increased from 9% in 2006 to almost 21% in 2011. Most savings in rural areas involve village banks; accordingly, we partnered with an international non-governmental organisation (NGO) that provides financial training to village bank members and exposed a random subsample of them to standard financial literacy training. Specifically, we used a design where the timing of treatment was randomly determined, so the control group received the treatment later. We did not train a randomly selected bank member, but instead asked the village bank to send a volunteer or representative.<sup>1</sup> This representative was explicitly asked by the NGO to share the information learned with his peers. To probe the extent to which such spillovers actually occurred we also selected a random member from all village banks in the treatment and control group. After 15 months, we revisited households in both the treatment and control groups (representatives and randomly selected village bank members) and compared their financial knowledge and behaviour, including savings, borrowing, their efforts to initiate new income-generating activities and changes in their monthly expenditures (our proxy for income or consumption).

<sup>1</sup> We will show below that, not surprisingly, the village bank representative tends to belong to the elite of the bank, in terms of assets and education. Note that village banks receiving treatment and in the control group had the same incentive to appoint a knowledgeable representative as the control group was scheduled to receive the same treatment later.

Our results are mixed. The encouraging part is that financial literacy training affects financial knowledge of trained persons, and that enhanced financial knowledge translates into more savings and borrowing, along with an increased likelihood of starting new income-generating activities. Our data fit the proposition that financial and human capital can work together to promote economic development. However, we also find that the beneficial effects of the training stay confined to the trained target population, and do not spillover to the local peers of trained farmers (within the time-frame of our study). In other words, the total impact of the training intervention is much smaller than anticipated, compromising the cost-effectiveness of the intervention.

In the next Section, we summarise existing literature on human capital and financial behaviour in developing countries, paying special attention to the scant evidence available regarding financial literacy. In Section 2, we describe the details of our intervention, explain our sampling strategy and introduce our data. Section 3 outlines our identification strategy, which is relatively simple in light of the (experimental) nature of our data. In Section 4, we present our results, and attempt to unravel the chain from training to financial literacy to financial behaviour and probe the existence of spillover effects. Section 5 concludes.

## 1. Financial Literacy and Financial Behaviour

Traditionally, savings represent the key factor explaining investment and economic development. Efforts to understand the determinants of saving behaviour have a long tradition in economics research. Savings are driven by a range of variables, including demographic factors, the quality of financial institutions, investment opportunities, income dynamics, interest rates and markets for pensions and insurance (Deaton, 1989). Financial literacy might also matter, though it is comparatively under-researched in developing countries. Instead, most studies focus on measuring the existing levels of financial literacy (often using the financial literacy module developed by Lusardi and Mitchell, 2007). These assessments show that overall levels of financial literacy are disappointingly low (Lusardi and Mitchell, 2007, 2008; Xu and Zia, 2012), with ample room for improvement, even in more developed nations. In Africa, estimates of financial literacy levels are scarce or, for many countries, non-existent. FinScope studies provide some proxy measures (see <http://www.finscope.co.za/new/pages/default.aspx>) but the financial literacy information they provide is limited, because they focus on access to financial products, not capabilities.

Insofar as financial literacy is an important determinant of financial behaviour in developing countries, financial training may be a promising supplementary activity for development agencies, accompanying the extension of financial services to heretofore unbanked populations. This prediction implicitly assumes a causal chain, or a so-called ‘theory of change’, describing how the intervention leads to the desired results (Gertler *et al.*, 2011). The relevant theory of change envisaged by the intervening agency is as follows:

- (i) Financial literacy training increases financial knowledge, which
- (ii) affects financial behaviour and economic outcomes. Moreover, as a prerequisite for achieving ‘scale’ cost-effectively, it is generally assumed that

- (iii) financial knowledge diffuses beyond the trained population and improves the livelihoods of large swaths of the target population.

In support of the first link in that chain, Jappelli (2010) reveals, using survey data from 55 countries that financial literacy correlates positively with proxies for human capital. In developed countries, various studies verify this finding (Danes *et al.*, 1999; Greenspan, 2001; Tennyson and Nguyen, 2001; Hira and Loibl, 2005) but no matching evidence exists for developing countries. Research into business training, which perhaps relates to financial literacy, reveals that training can affect knowledge and financial management (Karlan and Valdivia, 2011). Giné and Mansuri (2011) show that business training, focused on business planning, marketing and financial management, increases business knowledge and improves business practices among entrepreneurs in rural Pakistan.

Regarding the second link, by which financial knowledge translates into behaviour, most of the empirical analyses again focus on developed countries.<sup>2</sup> A handful of studies assesses the impact of financial literacy on behaviour in developing countries. Cohen and Young (2007) and Giné *et al.* (2012) offer some evidence that financial literacy is an important determinant of insurance adoption. Tustin (2010) evaluates the impact of a financial literacy programme on savings in Limpopo province (South Africa), using three survey questions, and finds self-reported effects of financial literacy training on saving behaviour. Landerretche and Martínez (2013) similarly find that financial literacy increases savings in private pension plans in Chile. Among the studies that examine the impact of financial literacy on bank account ownership, Honohan and King (2009), using FinScope data, assert there is no robust relationship but Cole *et al.* (2011) indicate an impact of a two-hour financial literacy training session in India and Indonesia. The Indonesian study, which featured a randomised field experiment, has constituted the only published experimental evaluation in a developing country thus far.<sup>3</sup> Although they find no impact of the training for the entire population, they suggest that the likelihood of opening a bank account increased among the subsample of uneducated, less financially literate households. Finally, Bruhn *et al.* (2013), with a large-scale financial literacy experiment in Mexico City, focus on the impact of a short financial literacy course.

<sup>2</sup> Researchers have probed the impact of financial knowledge on a range of behaviour, such as savings, insurance, retirement planning, (financial) market participation, bank account ownership, investments, debt management and financial practices (Braunstein and Welch, 2002; Hilgert *et al.*, 2003; Clark *et al.*, 2004; Mavrinac and Chin, 2004; Courchane and Zorn, 2005; Hogarth *et al.*, 2005; Kimball and Shumway, 2006; Lusardi, 2008; Lusardi and Mitchell, 2008; Lusardi and Tufano, 2009; Carpena *et al.*, 2011; Robb, 2011; van Rooij *et al.*, 2011, 2012; Xu and Zia, 2012). Some studies also explore the effects of financial education provided in the workplace on savings or contributions to pension funds (Bayer *et al.*, 1996, 2009; McCarthy and Turner, 1996; Clark and Schieber, 1998; Bernheim and Garrett, 2003). Cole *et al.* (2014) study the impact of education on financial market participation and credit management in the US. Using a natural experiment (changes in compulsory schooling laws) they find that education improves financial decision-making. Experimental work by Duflo and Saez (2003) suggests smaller effects than documented in most non-experimental studies, but the overall evidence affirms that financial education affects behaviour, including the findings that Gibson *et al.* (2012) obtain from a randomised experiment to evaluate the impact of financial literacy training for migrants in New Zealand and Australia.

<sup>3</sup> Several randomised evaluations of financial literacy programmes in developing countries are currently underway (Xu and Zia, 2012), and some evaluations focus on the financial education of children.

While the demand for such financial education appears limited, the course appears to have had some short-term impacts on knowledge and savings.

Little evidence supports the assumption that the benefits from training spillover to others beyond the directly trained population. We are aware of one experimental study, probing the existence of spillover effects from a business training in a developing country setting.<sup>4</sup> Berge (2011) measures knowledge and behaviour spillovers among a sample of microfinance clients in Tanzania (comparing clients with and without a trained group member). His results are mixed. ‘Indirectly-treated’ clients are not more knowledgeable than their peers and do not change their marketing practices or increase their profits. Along other dimensions, however, there are significant effects, and Berge concludes spillover effects generate a more ‘business-minded’ attitude among group members. A potentially important characteristic of this study is that the clients studied are jointly liable when a group member defaults on a loan from the microfinance institution. This creates a direct incentive for trained group members to share (some) information with fellow group members.

There are several reasons why the intervening agency’s theory of change may not be borne out by the data (and not all reasons correspond with a failing intervention). Binding constraints may prevent respondents from adjusting their behaviour. They may lack resources to increase their savings, or lack collateral to obtain a loan. Or some respondents may already behave optimally – for example, rationally deciding not to save much or accumulate debts because the investment prospects are too risky. It is also unlikely that financial literacy training will affect everybody’s behaviour in the same way (Lusardi and Mitchell, 2014, p. 36). For instance, for some agents, it may be optimal to increase savings, while for others a decrease in saving would be more in line with their preferences. Enhanced financial literacy may reduce over-borrowing while also increasing borrowing to finance new start-up activities. While a theoretical model may be needed to rigorously analyse impact (Lyons and Neelakantan, 2008), this is beyond the scope of the current article. Instead, we limit ourselves to an assessment of the impact of the intervention, and contrast the evidence to the expectations of the NGO.

## 2. Intervention, Sampling and Data

This Section explains the treatment, experimental details and measures of financial literacy. We also summarise the data and show how our randomisation effort helped us obtain a balanced sample, in terms of a range of observable variables, such that the treatment and control groups are similar at the baseline.

### 2.1. *Financial Literacy Intervention*

We evaluate the impact of standard financial literacy training offered by an international NGO to rural households in Rwanda, which aims to improve knowledge

<sup>4</sup> See O’Mahony and Riley (2012) for recent evidence on four European countries.

of basic financial concepts and engender changes in financial behaviour. The data were collected from five agricultural savings and credit cooperatives, located in the southern province of Rwanda. The five cooperatives were randomly selected from among ten agricultural savings and credit cooperatives that together form the Union Ejo Heza (CLECAM, or *Coopérative Locale d'Épargne et Crédit Agricole Mutuel*). The savings and credit cooperatives comprise vast numbers of village banks, which in turn consist of the so-called solidarity groups, made up of five to seven individual members each. Village bank members meet twice a month to discuss their socio-economic concerns. During these meetings, each member contributes Rwf 500 (around US\$0.9); the money collected then is used to provide loans to solidarity groups or individuals, depending on the policy of the village bank. All participants in this study are members of a savings and credit cooperative. Virtually all Rwandans in rural areas are encouraged to join village bank schemes, also called Umurenge SACCOs (Savings and Credit Cooperatives).

We invited the randomly selected village banks to send one representative to a central location to participate in financial literacy training for one week. The underlying idea of the implementing NGO was that the village bank representatives would share what they had learned with their fellow members, so that financial literacy would spread across the country. Indeed, village banks representatives were explicitly instructed to do so. We focus both on knowledge and behaviours of trained village bank representatives as well as on spillover benefits to randomly selected fellow village bank members.

Training was administered by trainers from the same (or a nearby) district. The training involved lecturing, discussions, questions and illustrations; at the end of each day, a module of exercises was provided. The training took place in the local language, and the content was very similar across the five cooperatives (with minor differences in the examples used, depending on regional specificities). The standardised training programme consisted of six modules:

- (i) cooperative principles;
- (ii) explanation of microfinance activities, savings and credit;
- (iii) how to develop a business plan for small, income-generating activity;
- (iv) loan management;
- (v) basic bookkeeping and management of small income-generating projects; and
- (vi) example business plans for small income-generating projects (see Appendix A).

Training sessions started at 8:00 a.m. and went on till 5:00 p.m., for five consecutive days. Tea and lunch were provided, and each participant received Rwf 2000 (around US\$3.5) as compensation for transportation and the opportunity costs of their time.

## 2.2. *Sample Issues*

Of the ten cooperatives in the CLECAM Ejo Heza, we randomly selected five to include in the study (Kamonyi, Kabagari, Mushishiro, Ruhango and Ntongwe). These five cooperatives included a total of 378 village banks; we randomly selected 72 village banks per cooperative (360 village banks in total) and randomly allocated



half of them to the treatment group.<sup>5</sup> The other half represented the control group, which was scheduled to receive the same treatment later. Thus, the treated and control banks had the same incentive to select and send a ‘good representative’ – someone able to understand the material offered and share it with other members. Representatives of all 360 village banks also received an invitation to participate in a baseline survey. From the treated (control) group, 174 (167) representatives participated, indicating low non-compliance (19 of 360 representatives, or about 5%) that was relatively equally spread across the two groups. From each village bank (treated and control banks), we also randomly selected one other member to examine spillover effects.

We organised activities at the cooperative level, including five consecutive interviews and training sessions, each with a maximum of 36 village bank representatives. The field work consisted of three activities. First, the treatment and control group members participated in a baseline survey (March–April 2011), including a few questions to measure *ex ante* financial literacy. Second, the 174 representatives of the treatment group received the one-week financial literacy training (March–May 2011). Third, approximately 15 months later, we conducted a follow-up survey (July–September 2012). In this follow-up survey, we received responses from 279 respondents, or 82% of the respondents to the baseline survey. Several initial respondents were unavailable for the follow-up because they were away from their homes during our visit. We also probed whether the attrition was random by estimating a probit model that explained their absence using our vector of baseline variables. When regressing dropouts on the full vector of baseline controls (12 variables,  $N = 253$ ; Table 1, variables 7–18), we find only one significant variable, ‘Years in cooperative’ (negative sign). For a slightly more parsimonious model with only 10 baseline variables (omitting ‘Land size’ and ‘Own livestock’, which increases the sample size to 338 respondents), only the measure of household expenditures (‘Annual expenditures’) was significant (and ‘Years in cooperative’ is not). Thus, there is little reason to believe that our statistical results are compromised by non-random attrition bias, as we detail in Appendix B, Table B1.

### 2.3. *Measuring Financial Literacy*

We used the responses to six survey questions to construct a measure of financial literacy for each respondent. Following Carpena *et al.* (2011), we tried to construct a measure that would capture more than just financial numeracy. The first two questions (compound interest and inflation) come from Lusardi and Mitchell (2007). The remaining four questions are based on the training material. Specifically, the third question seeks to elucidate if respondents can compute an interest rate, and the fourth question tests their knowledge of the difference between savings and deposits. We also ask about acceptable collateral and whether the respondents could recall at least three of eight requirements that cooperative

<sup>5</sup> Two cooperatives, Ruhango and Ntongwe, included fewer than 72 village banks, so we included all of their village banks (randomly allocating half to the treatment group and the rest to the control group), then invited more than one representative per village bank to arrive at a total of 72 representatives per cooperative.



members must fulfil to apply for a loan. In Appendix C, we provide the wording for all six questions. Respondents could earn one point for each correct answer (and fractions of points could be earned for partially correct answers to Questions 5 and 6).

Both the treatment and control groups scored higher on the follow-up survey than on the baseline version, though this difference was significant only at the 5% level for the treatment group. At the baseline, the financial literacy scores of the treated and control groups were statistically similar (2.88 *versus* 2.73; see Table 1). At the end, treated respondents earned average scores of 3.35 out of 6, whereas the control group members scored only 2.99 on average, that is, the *ex post* financial literacy scores for the treatment group were significantly higher than those for the control group. The associated p-value of the t-test equaled 0.016 – early evidence that the training contributed to building financial knowledge.

#### 2.4. Data Summary and Balance Check

Table 1 summarises our baseline data for the selected village bank representatives. Panel (a) contains the behaviour data, which provide the main dependent variables when measured in the follow-up survey. For all five variables, at the baseline, there is balance between the control and treatment groups. The measures focus on savings and entrepreneurship. We measure ‘savings’ by the amount of money saved with the agricultural savings and credit cooperative during the last 12 months. Respondents could easily remember this amount and we were able to double-check the accuracy of the information for most respondents by using cooperative data. Our second outcome variable is the ‘savings rate’, which is simply computed as the ratio between annual savings and annual expenditures (multiplied by 100). Our third outcome variable is called ‘borrowing’, and this is a binary variable for the uptake of any loan from the local cooperative. Our fourth outcome variable is called ‘started new income-generating activity’. This is another binary variable capturing whether the respondent had started a new income-generating during the last 12 months. Examples of income-generating activities are poultry breeding, buying and reselling agricultural produce (mainly beans and sorghum), small animal rearing (rabbit, goat, pig), bicycle transportation, sewing, petty trade in manufactured items, selling traditional beer, legume and fruit production, or bee keeping. Finally, we also test whether the financial literacy training affected (monthly) expenditures – a proxy for consumption or income. Our fifth outcome variable is ‘monthly expenditures during past 30 days’, and is constructed from detailed spending information on food staples, energy and communication, meat and fish, drinks, tobacco, soap, and miscellaneous expenses.

While changes in financial knowledge and behaviour are ‘outcomes’ from the perspective of the intervention, the ultimate (impact) goal is to increase consumption and improve livelihoods. It seems worthwhile to probe whether such an impact actually materialises, but of course we realise that expenditures are affected by many factors and that there may be considerable delays between the timing of investments and the realisation of returns. Hence, we do not really expect to find much for the expenditures measure.

Table 1  
Balance Test

Variables	Mean and differences between groups				
	Treatment (1)	Control (2)	Difference (3)	p-value (4)	N (5)
<i>Panel (a): Dependent variables</i>					
1. Savings	36,355 (6,624)	33,108 (5,248)	3,247 (8,503)	0.7029	285
2. Savings rate	17.448 (2.716)	16.889 (2.375)	0.5585 (3.622)	0.8776	285
3. Borrowing	0.454 (0.0379)	0.509 (0.0388)	-0.055 (0.0542)	0.3113	341
4. Monthly expenditures	37,384 (2,914)	43,616 (3,316)	-40,436 (2,205)	0.1580	341
5. Initiated new Income-Generating Activity	0.24 (0.0238)	0.26 (0.0233)	-0.02 (0.0333)	0.9868	341
<i>Panel (b): Independent variables</i>					
6. Financial literacy score (out of 6)	2.875 (0.0905)	2.727 (0.09)	0.1489 (0.1277)	0.2443	341
7. Gender	0.529 (0.038)	0.497 (0.0388)	0.032 (0.0543)	0.5592	341
8. Age	40.856 (0.8133)	39.940 (0.8541)	0.916 (1.179)	0.4375	341
9. Married	0.753 (0.0328)	0.766 (0.0328)	-0.014 (0.0464)	0.7699	341
10. Education	4.023 (0.2247)	3.862 (0.2118)	0.161 (0.3093)	0.6037	341
11. Household size	5.886 (0.1752)	5.925 (0.179)	-0.04 (0.2504)	0.8734	327
12. Cognitive ability score (out of 9)	6.414 (0.115)	6.467 (0.127)	-0.053 (0.1713)	0.7560	341
13. Years in cooperative	4.411 (0.2759)	4.609 (0.3136)	-0.198 (0.4165)	0.6355	338
14. Land size	1.414 (0.2136)	1.080 (0.093)	0.333 (0.2325)	0.1527	265
15. Own livestock	0.841 (0.0281)	0.873 (0.0265)	-0.032 (0.0388)	0.4065	328
16. Annual expenditures	432,727 (49,577)	502,218 (84,180)	-69,491 (96,755)	0.4731	341
17. Subjective happiness	0.621 (0.0369)	0.659 (0.0368)	-0.038 (0.0521)	0.4666	341
18. Take at least monthly notes of income and expenditures	0.580 (0.0375)	0.545 (0.0387)	0.036 (0.0539)	0.5096	341

*Notes.* This Table reports a test of random assignment to treatment for a financial literacy training. Column (1) and (2) give means for eighteen variables for treated and control, respectively. The test for difference between the means of treated and untreated is given by p-values in column (4). Currency for savings and expenditures is Rwandan Francs and exchange rate was Rwf560 = \$1 during baseline data collection.

Panel (b) of Table 1 contains a vector of household characteristics, including our financial literacy score at the baseline, which is the same for the treatment and control groups, as we noted. It also contains a range of survey-based socio-demographic and wealth variables that we use as covariates in some of the regression models. Most are standard controls that are self-explanatory, but four are not. ‘Cognitive ability scores’ are generated based on responses to nine

numeracy questions.<sup>6</sup> The binary variable ‘taking notes’ identifies individuals who systematically keep record of their income and expenditures (at least on a monthly basis), which we interpret as a proxy of *ex ante* financial awareness. ‘Annual expenditures’ is our proxy for annual income and was computed by aggregating expenditures over the last 12 months (including school fees, uniforms and other school expenses, purchases of clothing, equipment and construction, energy, leisure, transport, payments to domestic workers and other miscellaneous monthly expenditures discussed above). ‘Subjective happiness’ captures the self-assessed level of overall happiness. We used a four-point Likert scale to measure happiness (ranging from very happy to miserable) and converted the scores into a binary variable by assigning a value of one to households indicating they were happy (three or four), and a value of zero to households indicating they were unhappy (one or two). The treatment and control groups are similar in terms of gender composition, age, marital status, education levels, household size, cognition, wealth, years of cooperative membership and cognitive ability. We also find no difference in the ‘taking notes’ variable.

In Appendix B, Table B2 we also summarise baseline data for the randomly selected village bank members – sampled to measure spillover effects. Two things are noteworthy. First, the treated and control group are balanced for the full set of observables. Second, these randomly selected bank members are different from the bank representatives, selected by their peers to participate in the training. Casual comparison of sample means for the bank representatives (Table 1) and random members (Appendix B, Table B2) suggests that bank representatives have higher savings and expenditures, are more likely to start up new income-generating activities, have higher financial literacy scores and own larger farms. In other words, and not surprisingly, the representatives selected for receiving the training tend to be members of the rural elite.

### 3. Estimation Methods

To probe the impact of financial literacy training on knowledge and behaviour, we used various regression techniques, all of which should provide unbiased estimates of the effects of training and financial knowledge on our outcome variables of interest. Including additional controls is theoretically unnecessary for unbiased measures of treatment effects, because randomisation implies that financial literacy should be orthogonal to household characteristics. In principle, differences between control and treated households after the training can be attributed to the training. However, we include control variables in several models, to increase the precision of our estimates, which is particularly helpful because our sample is relatively small, so differences between the two groups might exist. We also present

<sup>6</sup> Our numeracy measures include three simple arithmetical questions (Cole *et al.*, 2011), four numeracy questions adapted from the 2002 English Longitudinal Study of Aging (ELSA) questionnaire (see appendix 1 in Banks *et al.*, 2010), and two questions that ask respondents to observe a series of pictures and contrast them. See all nine cognitive ability questions in the questionnaire used to measure all important variables reported in the online Appendix D.

difference-in-difference estimates (controlling for time-invariant unobservable variables).

To examine the effect of the financial literacy training, we first estimate parsimonious and elaborate ordinary least square (OLS) models, controlling for a vector of covariates, as follows:

$$Y_{it} = \alpha + \beta D_i + \delta_j \sum X_{ij(t-1)} + u_{it}, \quad (1)$$

where  $Y_{it}$  denotes an outcome variable for respondent  $i$  (in 2012),  $D_i$  is a dummy variable equal to 1 if the respondent received training,  $X_{ij}$  is a vector of  $j$  covariates measured at the baseline (in 2011), and  $u_i$  is an IIDN( $0, \sigma^2$ ) error term. Furthermore,  $\beta$  is the coefficient of interest, which measures the difference between the treatment and control groups in terms of savings, borrowing, monthly expenditures and start-up of new income-generating activities. In our regressions, we cluster standard errors at the cooperative level.

Because we have access to baseline and post-training data, we can improve on the specification in (1) by estimating a panel with fixed effects that also controls for unobservable variables:

$$Y_{it} = \alpha_i + \beta D_i + \delta_j \sum X_{ijt} + u_{it}. \quad (2)$$

In this model, the training dummy takes a value of 1 only for the treated group in 2012.

As a robustness analysis, we also estimate an analysis of covariance (ANCOVA) specification and regress the outcome variables ( $Y_{2012}$ ) on the training dummy  $D_i$  and a lagged outcome variable ( $Y_{2011}$ ):

$$Y_{i,2012} = \alpha + \beta D_i + \delta Y_{i,2011} + u_i. \quad (3)$$

We use the ANCOVA estimates to estimate treatment effects, because the comparison of ANCOVA estimates with diff-in-diff estimates may improve the power considerably (McKenzie, 2012).

### 3.1. Probing the Theory of Change

An important aim of our study is to test whether the causal impacts of the financial literacy training are in line with the desired outcomes as envisaged by the implementing NGO. The theory of change that motivates financial literacy interventions is simply that participating in a training builds financial knowledge, which translates into better informed financial decision-making (e.g. more formal savings, more investment in productive activities), which in turn translates into improved economic outcomes. Moreover, financial knowledge will spread spontaneously among the target population, so that training a small number of village bank representatives will eventually affect the livelihoods of many more farmers.

We seek to unravel the first stages of the causal chain by estimating an instrumental variable (IV) model, exploiting our *ex post* and *ex ante* financial literacy data. Specifically, we use two-stage least squares (2SLS) to explain variation in financial behaviour according to the differences in financial knowledge and a set of controls, such that financial knowledge is instrumented by the training dummy and all other exogenous variables in the system. The IV set-up identifies

exogenous variation in financial knowledge and addresses conventional endogeneity challenges that occur when regressing behaviour on knowledge (i.e. omitted variables and reverse causality). We run two sets of IV regressions: one based on the follow-up data, and another using panel data. The first stage of each model includes regressions of the measure of financial literacy ( $FL$ ) on the training dummy  $D$  (and its covariates). The cross-sectional version of the model is as follows:

$$FL_i = \alpha + \beta D_i + \delta_j \sum X_{ij} + u_i. \quad (4)$$

In the second stage, we explain financial behaviour by including the predicted level of financial literacy,  $FL^*$ , in outcome (1), which yields

$$Y_i = \alpha + \beta FL_i^* + \delta_j \sum X_{ij} + u_i. \quad (1')$$

Training is orthogonal to smallholder characteristics, and the instrument is properly exogenous. Since the number of excluded instruments does not exceed the number of endogenous variables, we cannot perform a test of the over-identification restriction. Note that it is uncertain if the exclusion restriction is fully satisfied – the training may affect financial behaviour through financial literacy but possibly also via alternative channels. Carpena *et al.* (2011) observe that financial literacy may affect financial decision-making by making households more aware of product choices available to them, equipping them to ask the right questions to financial providers, encouraging them to seek professional and personalised financial advice and changing their attitudes towards purchasing and recommending formal financial products and services. These alternate channels may be as important if not more than enhancing numeracy skills. This is an empirical question we will explore below.

If financial literacy training affects financial behaviour through channels other than enhanced financial literacy, our IV approach based on exogenous variation in financial literacy will provide a biased estimate of the total effect of the training.

We next consider the follow-up stage of the theory of change, or the expectations that financial literacy knowledge spontaneously diffuses among the target population. To probe this issue we compare randomly selected farmers from the same village banks in terms of the same outcome variables (financial literacy scores, savings, borrowing, business start-up and expenditures). We refer to peers from trained farmers as the ‘indirectly treated’ and to peers from untrained representatives as the control group. If knowledge spills over from the trained person to their peers, then we would expect significant differences between the indirectly treated and control farmers. To test this, we use a series of OLS models with and without covariates. As treatment status is orthogonal to respondent characteristics, this should produce an unbiased estimate of impact.

In addition to examining whether spillover effects exist, we also try to identify whether social distance affects information flows. To do this, we introduce a binary variable in the regression models indicating whether the trained farmer and the indirectly trained respondent are of the same type,  $Z_i$ , and interact this with the training dummy  $D$ :

$$Y_i = \alpha + \beta D_i + \gamma Z_i D_i + \delta_j \sum X_{ijt} + u_i, \quad (5)$$

where, in the first model,  $Z_i = 1$  if both the trained farmer and her peer are females. In subsequent models, we explore whether reduced social distance, as reflected in similar age cohort (both ‘old’, or aged over 45 years), similar cognitive ability (both scoring above-mean in the baseline cognitive test) and similar socio-economic status (both having baseline wealth placing them in the top quintile, operationalised by the ownership of land). If information travels more easily between ‘similar’ persons, then we would expect  $\gamma > 0$ .

#### 4. Results

In Table 2 we report the OLS and panel results of models in which we explain variation in financial behaviour induced by the training dummy.<sup>7</sup> The top row presents the results of a series of parsimonious models, in which we only regress outcome measures on the training dummy. We also present the results of a series of more complete models, controlling for a range of covariates. The results are similar and consistent.

From the OLS estimates, we observe that attending the training leads to significantly greater savings, more borrowing and a higher probability of starting new income-generating activities. Using the elaborate model, we find that farmers who received the training save an extra Rwf 15,917 compared with farmers in the control group, on average ( $p = 0.035$ ), and their savings rate is 5.8% higher ( $p = 0.034$ ). Trained farmers exhibit a 16% greater probability to start up a new income-generating activity ( $p = 0.003$ ).<sup>8</sup> Such coefficients can be compared easily against the baseline values for the same group, which reveals that the training invites economically significant changes in behaviour. Savings are 44% higher than at the baseline, the savings rate is 33% higher, the share of the population that has taken a loan increases by 24% and the start-up rate of new activities is 16% higher. Furthermore, though some of the covariates have significant effects in some models, none of them is significant across columns (or Tables). Thus, financial literacy training appears to offer one of the few robust determinants of financial behaviour. Not surprisingly, perhaps, in the light of the relatively short period between the intervention and the measurement period, we find no significant effect of the training on monthly expenditures – this is true for all models we explore.

Panel (b) of Table 2 contains the fixed effects panel estimates, that is, the results of the difference-in-difference model. This model is based on within, rather than between, subject variations in financial behaviour. The results for the propensity to borrow are significant in the elaborate model but not in the parsimonious specification.

<sup>7</sup> Data files: a do file that allows replication of results; a README file that explains how to replicate results, and online Appendix D detailing our survey questionnaire are all available online.

<sup>8</sup> Qualitatively similar results emerge when we omit sub-sets of explanatory variables (such as the subjective happiness proxy, which may be an endogenous variable in these elaborate models).

Table 2

*Impact of Training on Savings, Borrowing, Expenditures, and Starting a New Business*

	Outcome variables				
	Savings (1)	Savings rate (2)	Borrowing (3)	New business (4)	Monthly expenditures (5)
Panel (a): OLS with single baseline and endline					
<i>Without covariates</i>					
Training dummy	11,653* (4,507)	6.174** (1.796)	0.1157* (0.0663)	0.1623** (0.0573)	-2,302 (2,342)
Constant	39,978 (6,481)	12.592 (1.423)	0.4327 (0.0488)	0.1953 (0.0321)	28,426 (3,785)
R-squared	0.0054	0.0208	0.0133	0.0322	0.0027
Fixed effects	No	No	No	No	No
N	271	228	228	279	228
<i>With covariates</i>					
Training dummy	15,917** (5,056)	5.774** (1.824)	0.1157* (0.0682)	0.1632** (0.0590)	-1,922 (3,418)
Age	-2,111 (2,216)	-0.1582 (0.779)	0.0294 (0.023)	0.0098 (0.0151)	185 (609)
Age squared	21 (26)	0.001 (0.0066)	-0.0003 (0.0003)	-0.0001 (0.0002)	-0.51 (6)
Married	15,494** (5,173)	-4.079 (2.59)	0.008 (0.0902)	0.0105 (0.0230)	7,717** (3,080)
Education	-1,836 (1,442)	-0.3716 (0.2272)	0.0044 (0.0133)	0.0031 (0.0054)	1,417** (651)
Household size	-252 (2,827)	-1.1411** (0.3192)	-0.0144 (0.0158)	-0.0178 (0.0090)	1,175 (666)
Years in cooperative	-159 (746)	0.6648** (0.2443)	0.0065 (0.0094)	0.0082 (0.0061)	13 (423)
Log of expenditures	13,909** (3,954)	-1.098 (1.344)	0.0453 (0.0332)	0.0549* (0.0262)	
Own livestock	-6,411 (7,558)	-4.717** (1.513)	-0.0666 (0.0982)	0.0367 (0.0734)	-3,158 (2,328)
Size of land owned	701 (4,312)	-0.3244 (0.3176)	0.0121 (0.0119)	-0.0006 (0.0135)	196 (1,174)
Subjective happiness	-3,470 (7,710)	-4.491 (5.457)	0.0733 (0.0741)	0.0332 (0.0300)	7,535*** (1,565)
Take notes	-10,109 (8,256)	1.278 (3.057)	0.049 (0.0724)	0.0044 (0.0735)	4,576 (2,816)
Cognitive ability	4,846 (4,498)	0.1413 (1.332)	-0.0185 (0.023)	0.0306 (0.0223)	-268 (985)
Constant	-97,792 (31,793)	45.282 (19.496)	-0.6339 (0.5696)	-0.8513 (0.3193)	-3,284 (16,112)
R-squared	0.0699	0.0973	0.0535	0.0857	0.1312
Fixed effects	No	No	No	No	No
N	265	225	225	273	225
Panel (b): Fixed effects					
<i>Without covariates</i>					
Training dummy	17,239*** (632)	5.251* (2.864)	0.0101 (0.0587)	0.0202 (0.0469)	-2,273 (3,296)
Constant	26,028 (184)	14.278 (0.8072)	0.529 (0.0165)	0.2579 (0.0132)	29,568 (929)
Fixed effects	Yes	Yes	Yes	Yes	Yes
N	484	440	440	440	440



Table 2  
(Continued)

	Outcome variables				
	Savings (1)	Savings rate (2)	Borrowing (3)	New business (4)	Monthly expenditures (5)
<i>With covariates</i>					
Training dummy	13,219* (6,285)	11.809*** (2.745)	0.1552* (0.0936)	-0.0348 (0.0668)	-1,823 (3,991)
Age	24,144* (9,988)	8.218 (8.336)	0.069 (0.1406)	0.0407 (0.1666)	-4,765 (5,256)
Age squared	-275 (148)	-0.133 (0.1057)	-0.0019 (0.0018)	0.0002 (0.0016)	73 (50)
Married	-12,544* (5,853)	5.441 (9.383)	0.1836 (0.1164)	-0.0464 (0.1054)	464 (2,986)
Education	-717 (1,078)	-1.32 (0.9936)	0.0123 (0.0148)	0.0167 (0.0085)	-96 (552)
Household size	2,444* (1,093)	0.3196 (0.9006)	0.0138 (0.0294)	0.0051 (0.0349)	1,896 (1,426)
Years in cooperative	-658 (785)	-0.116 (0.2944)	0.0039 (0.0112)	-0.0029 (0.0106)	-211 (148)
Log of expenditures	1,444 (3,200)	-11.302*** (0.8939)	-0.0264 (0.0412)	-0.0346 (0.0273)	
Own livestock	5,962 (7,517)	3.854 (6.964)	0.1219 (0.1052)	-0.1328 (0.1600)	-17,543*** (2,785)
Size of land owned	907 (1,923)	1.531 (1.619)	0.0054 (0.0134)	-0.0222 (0.0126)	-503 (568)
Subjective happiness	13,808 (8,166)	2.884 (4.663)	-0.1211 (0.0905)	-0.0357 (0.0505)	-4,869 (3,601)
Take notes	3,532 (5,799)	6.3*** (1.407)	0.0617 (0.0866)	0.2682** (0.0824)	-3,282* (1,323)
Cognitive ability	1,295 (2,411)	0.2518 (1.571)	0.0598** (0.0293)	0.0135 (0.0380)	-648 (1,180)
Constant	-511,576 (153,775)	43.372 (159.724)	0.7399 (3.254)	-1.56 (4.36)	109,920 (132,981)
Fixed effects	Yes	Yes	Yes	Yes	Yes
N	458	431	431	431	431

*Notes* This Table reports OLS and fixed effects regressions predicting the effects of a financial literacy training on financial behaviour. Panel (a) reports OLS regressions for five financial behaviour variables in column (1)–(5), while panel (b) gives fixed effects results for the same set of five financial behaviour variables. The upper part of the Table gives results of parsimonious models with a training dummy as a sole independent variable. To improve precision, the lower part includes a set of twelve respondent characteristics as covariates. Outcome variables are from endline data, while for covariates we utilise baseline data. Standard errors clustered at the cooperative level are in parentheses. \*\*\* Indicates statistical significance at the 1% level or less, \*\* at 5% level, and \* at 10% level. Currency for savings and expenditures is Rwandan Francs and exchange rate was Rwf560 = \$1 in the baseline and Rwf610 = \$1 during follow-up.

Table 3 contains the results of the robustness analyses. According to the ANCOVA model, training significantly influences four of our five outcome variables: savings (rates), borrowing and start-up of new activities. The estimated coefficients are similar to those in the OLS models. Except for the lagged value of the variable measuring the start-up of income-generating activities, we find that the lagged outcome variables are statistically significant.

Table 3

*ANCOVA of the Effects of Training on Savings, Borrowing, Starting a New Business, and Expenditures*

Covariates	Outcome variables (with follow-up data)				
	Savings (1)	Savings rate (2)	Borrowing (3)	Started new business (4)	Monthly expenditures (5)
Training dummy	11,953.97*** (2,602.259)	6.8308* (2.6398)	0.1424** (0.0698)	0.1503** (0.0613)	217 (1,552)
Savings in baseline	0.2613** (0.0734)				
Savings rate in baseline		0.2207*** (0.0479)			
Borrowing in baseline			0.3387*** (0.0705)		
New business in baseline				-0.0274 (0.0724)	
Monthly expenditures in baseline					0.36*** (0.08)
Constant	22,795.44 (3,635.748)	10.0054 (1.9197)	0.2551 (0.066)	0.2078 (0.0441)	18,854 (2,967)
<i>N</i>	211	184	184	211	211

*Notes.* This Table reports the results of ANCOVA specified as follows: regression of an outcome variable on its own lagged value and on a training dummy. Thus, we utilise follow-up data for outcome financial behaviour variables in columns (1)–(5), while their lagged values are given by baseline data. Standard errors clustered at the cooperative level are in parentheses. \*\*\* Indicates statistical significance at the 1% level or less, \*\* at 5% level, and \* at 10% level. Currency for savings and expenditures is Rwandan Francs and exchange rate was Rwf560 = \$1 in the baseline and Rwf610 = \$1 during follow-up.

#### 4.1. Knowledge and Behaviour

In Table 4, we try to identify the mechanism that links the training to financial behaviour; to instrument financial literacy, we use the training dummy. Again we provide the results of the parsimonious models (without covariates), followed by the matching results for more elaborate models. Column (1) of panel (a) presents a first-stage regression of the 2SLS model (associated with the savings model in column (2); other first-stage models are comparable). The first-stage outcomes confirm that attending the training improves financial literacy, such that attendance increases the FL score by 0.36 points, which constitutes a large effect when we consider that the average score was only 2.8 at the baseline. The partial F-statistic for this parsimonious model exceeds the conventional threshold of 10, though the same finding does not hold for the other IV models, for which the partial F-scores range from 5 to 10. Thus, the excluded instrument does not appear very strong.

We use predicted financial literacy to explain variation in financial behaviour in columns (2)–(6). The results support the OLS results from Table 2, though the coefficients are larger in magnitude and tend to be somewhat less significant. According to panel (a), respondents with higher financial literacy scores save more (higher savings rates) and are more likely to start new income-generating activities, in both the parsimonious and elaborate models. The coefficients for the borrowing

variable are of the expected sign, but neither the parsimonious nor the elaborate model produces statistically significant results.

When we use the panel structure of the data (panel (b), Table 4), we obtain results that are statistically weaker. That is, (predicted) financial literacy significantly explains

Table 4  
*Impact of Financial Knowledge on Savings, Borrowing, Expenditures, and Starting a New Business (IV regression models)*

	Outcome variables					
	First stage			Second stage		
	FL scores (1)	Savings (2)	Savings rate (3)	Borrowing (4)	New business (5)	Monthly expenditures (6)
Panel (a): IV regression with single baseline and endline data						
<i>Without covariates</i>						
Training dummy	0.3648** (0.1092)					
FL scores		32,290* (18,224)	47.745* (26.728)	0.1866 (0.2787)	0.447** (0.188)	-4,061 (4,415)
Constant	3.008 (0.0975)	-56,674 (60,020)	-124.204 (82.176)	-0.0976 (0.8929)	-1.137 (0.6087)	44,008 (16,259)
N	266	266	246	274	274	274
F of excluded instrum.	11.16 (0.0288)					
<i>With covariates</i>						
Training dummy	0.3699** (0.1222)					
FL scores		43,229* (24,519)	17.49* (10.36)	0.2828 (0.193)	0.415** (0.1762)	-368 (6,986)
Married	-0.0241 (0.0804)	16,817** (7,066)	-3.036* (1.586)	0.0143 (0.0434)	0.0171 (0.0289)	8,643 *** (2,903)
Household size	0.0341 (0.0230)	-2,355 (2,613)	-1.607*** (0.2719)	-0.015 (0.0145)	-0.0319*** (0.0102)	1,331 (619)
Log of expenditures	0.0372 (0.0592)	10,499*** (2,722)	-2.229 (1.692)	0.0304 (0.0353)	0.051** (0.0229)	
Own livestock	-0.2301 (0.1552)	2,961 (4,184)	0.7426 (2.387)	0.0171 (0.0725)	0.1191*** (0.044)	2,001 (3,954)
Size of land owned	0.0243 (0.0251)	-577 (4,673)	-0.7352 (0.5264)	0.0075 (0.0138)	-0.01 (0.0142)	767 (1,460)
Subjective happiness	0.1509 (0.1101)	-9,902 (7,063)	-6.657* (3.94)	0.0401 (0.0988)	-0.0333 (0.0509)	11,318 *** (1,956)
Take notes	0.177 (0.0803)	-17,052*** (4,676)	-2.506 (4.678)	-0.0266 (0.0792)	-0.0661 (0.0603)	1,777 (2,244)
Cognitive ability	0.111* (0.0628)	-634 (5,780)	-1.775 (2.034)	-0.0478 (0.0376)	-0.0168 (0.0397)	3,291 *** (1,225)
Constant	1.642 (0.7407)	-200,321 (57,175)	16.573 (14.58)	-0.4234 (0.3899)	-1.404 (0.4915)	-14,243 (18,927)
Fixed effects	No	No	No	No	No	No
N	262	262	226	226	270	271
F of excluded instrum.	7.32 (0.0538)					

Table 4  
(Continued)

	Outcome variables					
	First stage			Second stage		
	FL scores (1)	Savings (2)	Savings rate (3)	Borrowing (4)	New business (5)	Monthly expenditures (6)
Panel (b): IV regression with fixed effects (with panel data)						
<i>Without covariates</i>						
Training dummy	0.4167*** (0.1609)					
FL scores		35,678** (17,433)	27.898* (15.881)	0.0261 (0.1524)	0.05 (0.156)	-3,574 (6,565)
N	344	344	356	356	344	344
F of excluded instrum.	6.71 (0.0104)					
<i>With covariates</i>						
Training dummy	0.4047** (0.167)					
FL scores		30,516* (17,704)	19.58* (10.583)	0.1259 (0.1585)	0.0965 (0.1756)	999 (5,954)
Married	-0.9788*** (0.3722)	16,244 (23,398)	23.846 (13.986)	0.3087 (0.2095)	0.0467 (0.2321)	1,788 (8,244)
Household size	0.1118* (0.0681)	-1,645 (3,329)	-2.078 (1.99)	0.0052 (0.0298)	-0.012 (0.033)	2,397** (1,241)
Log of expenditures	0.1219 (0.1121)	1,928 (5,660)	-13.604*** (3.384)	-0.0622 (0.0507)	-0.0352 (0.0561)	
Own livestock	0.2098 (0.3119)	5,903 (14,237)	-0.1511 (8.51)	0.1024 (0.1274)	-0.1586 (0.1412)	-14,434*** (5,255)
Size of land owned	0.0164 (0.0436)	461 (1,861)	1.012 (1.113)	0.002 (0.0167)	-0.0204 (0.0185)	-342 (699)
Subjective happiness	0.3388 (0.2225)	-3,930 (12,098)	-4.748 (7.231)	-0.1545 (0.1083)	-0.081 (0.12)	-4,180 (4,482)
Take notes	-0.1744 (0.2298)	15,033 (10,288)	10.705* (6.149)	0.0857 (0.0921)	0.2754*** (0.102)	-3,683 (3,882)
Cognitive ability	0.173** (0.0723)	-4,252 (4,055)	-3.527 (2.424)	0.0298 (0.0363)	-0.0057 (0.0402)	-176 (1,450)
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	342	342	342	342	342	342
F of excluded instrum.	5.87 (0.0165)					

*Notes.* This Table reports a set of two types of instrumental variable (IV) regressions in which we explain financial behaviour with financial literacy scores instrumented with a training dummy. We run two sets of IV regressions: in panel (a), columns (2) through (6) report IV regressions in which we use follow-up data for dependent variables and baseline data for independent variables; panel (b) reports IV regressions with fixed effects based on our two waves of data. In each panel, column (1) gives the first-stage which is almost similar for all IV regressions displayed in columns (2) to (6). The upper part of the Table gives results of parsimonious models with financial literacy scores (instrumented with a training dummy) as a sole independent variable. To improve precision, the lower part includes a set of eight respondent characteristics as covariates. FL Scores in full is: financial literacy scores. Standard errors clustered at the cooperative level are in parentheses. \*\*\* Indicates statistical significance at the 1% level or less, \*\* at 5% level, and \* at 10% level. Currency for savings and expenditures is Rwandan Francs and exchange rate was Rwf560 = \$1 in the baseline and Rwf610 = \$1 during follow-up.

variation in savings behaviour (and savings rates) but we no longer obtain significant effects for activity start-ups. The signs of the associated coefficients are in the expected directions but the coefficients are less precisely estimated.<sup>9</sup>

One interpretation of these results, consistent with Tables 2 and 4, is that financial literacy training has an impact on financial behaviour through multiple channels. In addition to the financial literacy channel (theory of change), it may exert an impact on behaviour due to changed attitudes or different perceptions of the salience of financial intermediation (Carpena *et al.*, 2011).

The OLS and panel results in Table 2 thus might provide a reduced form estimate of the total effect of the training; the IV results in Table 4 should be interpreted with care, because the exclusion restriction may not be fully satisfied.

#### 4.2. Spillover Effects

Tables 5 and 6 summarise the results from our analyses comparing fellow members from the same village banks.

In Table 5, the training dummy indicates the respondent is drawn from a village bank where one member has received the training (i.e. the subject is 'indirectly trained'). In the top panel of Table 5 we report coefficients for simple models without covariates, and in the bottom panel we report coefficients from more elaborate models including the full vector of respondent characteristics. The results are sobering and robust: for no outcome variable do we observe any evidence of spillover benefits after 15 months. Even for financial knowledge, the first element in the envisaged causal chain, we do not detect any differences between the indirectly trained farmers and farmers from the control group. Similar results are found when we use a panel study design (details available on request).

Table 6 includes the social distance interaction terms but these also tend to enter insignificantly. There is marginally significant evidence that women learn more easily from other women (column 1) but this does not translate into the desired behavioural impact.

Across the board, the conclusion must be that the benefits of the intervention stay limited to those farmers receiving the training and do not spread to other members of the local village bank (the average bank has some 50 members). Even individuals whose 'social distance' to the trained subject is small (in terms of gender, age, cognitive

<sup>9</sup> About half of the respondents received a loan from the cooperative before the training; among this subsample, we also consider repayment performance, using data provided by the cooperative. Thus, we could construct a simple measure of repayment behaviour as a sum of the number of delayed payments. We focus on respondents who took out a loan *before* the training, to avoid non-random differences between borrowers in the control and treatment groups (i.e. loans initiated because the respondent participated in the training and learned how to borrow money). In this case, we compare similar smallholders who self-select into a borrowing group prior to the intervention. Therefore, a selection bias may limit the external validity of our estimate of the impact of the training on repayment performance for a broader population of smallholders. Because the subsample of borrowers is much smaller than our savings and investment samples, the statistical power of these tests also is compromised. Nevertheless, when we use 'repayment behaviour' as a dependent variable, we also observe significant differences between the treated and control group for most (but not all) models – as expected, repayment behaviour of the treated tends to outperform that of the control group. Detailed results available on request.

Table 5  
*Financial Literacy and Financial Behaviour Spillovers*

	FL scores	Savings	Savings rate	Borrowing	New business	Monthly expenditures
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Without covariates</i>						
Training dummy	0.0204 (0.2089)	-6,778 (5,693)	7.99 (13.46)	0.0764 (0.0881)	0.0317 (0.0792)	5,378 (5,987)
<i>N</i>	179	179	179	179	179	179
R-squared	0.0001	0.0066	0.0031	0.0058	0.0015	0.0030
<i>With covariates</i>						
Training dummy	0.0786 (0.2074)	-9,409 (9,247)	7.22 (12.95)	0.0593 (0.0596)	0.0603 (0.0527)	5,863 (5,181)
<i>N</i>	175	175	175	175	175	176
R-squared	0.1379	0.1143	0.0277	0.1323	0.1193	0.1160

*Notes.* This Table reports results from OLS regressions to predict financial literacy and financial behaviour spillovers. In the upper part of the Table, we regress financial literacy scores (FL scores) in column (1) and financial behaviour variables (columns 2–6) on a training dummy only. In the lower part of the Table, we improve precision by adding (to the training dummy) a set of 12 trainees' characteristics (see the exhaustive list of all twelve covariates in Table 2 and their explanation in Section 3 above). We use follow-up data for outcome variables and baseline data for covariates. Standard errors clustered at the cooperative level are in parentheses. Currency for savings and expenditures is Rwandan Francs and exchange rate was Rwf560 = \$1 in the baseline and Rwf610 = \$1 during follow-up.

ability or wealth) do not gain from the extra knowledge instilled in the village bank representative.

## 5. Conclusion and Discussion

Access to finance correlates robustly with poverty reduction but recent empirical work suggests that improved access alone may not be enough to improve consumers' economic performance. Financial literacy emerges as an increasingly important component of financial reform efforts. The perceived problem of limited financial literacy has triggered governments, firms and NGOs to allocate considerable resources to financial education programmes, designed to target millions of potential beneficiaries. Yet, especially in developing countries, rigorous evidence of the impact of financial education remains scant.

We organised a field experiment to probe the impact of an intensive one-week training on financial literacy, financial behaviour and spillover effects of a sample of Rwandan smallholders. Not surprisingly, financial literacy of trained persons improved through training; in addition, the training exerted an effect on financial behaviour that is both statistically and economically significant. Our results reveal that training increased savings, induced non-borrowing farmers to take up loans and enhanced the start-up of new income-generating activities. More speculatively, we obtain an auxiliary result that confirms a claim by Carpena *et al.* (2011). When trying to explain the differences in financial behaviour by focusing on the financial literacy channel in an IV framework, we obtain results that are weaker for borrowing, investment and changes

Table 6  
*Social Distance and Financial Literacy Spillovers*

	FL scores	Savings	Savings rate	Borrowing	New business	Monthly expenditures
	(1)	(2)	(3)	(4)	(5)	(6)
<i>First set of models</i>						
Training dummy	-0.1034 (0.1705)	-7407 (8,388)	11.14 (16.60)	0.1675 (0.1003)	0.0180 (0.0620)	3,120 (8,171)
Trained and indirectly trained are both female	0.3276* (0.1367)	2,697 (7,869)	-9.84 (11.11)	-0.2003** (0.0598)	0.0681 (0.0627)	7,218 (16,934)
N	175	175	175	175	175	175
R-squared	0.0122	0.0064	0.0050	0.0289	0.0058	0.0058
<i>Second set of models</i>						
Training dummy	0.0501 (0.1536)	-6,475 (7,333)	11.14 (16.60)	0.0386 (0.1147)	0.0586 (0.0976)	3,249 (9,636)
Trained and indirectly trained are both at least 45 years old	-0.1454 (0.2285)	-15 (9,429)	-9.84 (11.11)	0.2147* (0.0931)	-0.0614 (0.1091)	8,422 (23,113)
N	175	175	175	175	175	175
R-squared	0.0022	0.0059	0.0050	0.0294	0.0049	0.0063
<i>Third set of models</i>						
Training dummy	-0.1958 (0.3568)	8,733* (3,556)	-4.35 (5.14)	0.0818 (0.1049)	0.0340 (0.1168)	17,618 (11,619)
Trained and indirectly trained both have above mean cognitive ability score	0.4241 (0.3248)	4,657 (7,966)	25.03 (21.63)	0.0347 (0.0764)	0.0153 (0.0925)	-24,829* (11,331)
N	175	175	175	175	175	175
R-squared	0.0227	0.0075	0.0185	0.0103	0.0027	0.0369
<i>Fourth set of models</i>						
Training dummy	0.0315 (0.1885)	-9,456* (4,490)	-0.099 (6.84)	0.0638 (0.1259)	0.0885 (0.0714)	8,933 (6,908)
Trained and indirectly trained both own at least 0.50 ha (of land in the baseline)	-0.2194 (0.2818)	8,895 (9,095)	-6.50 (4.82)	0.1552 (0.1322)	-0.1527 (0.0817)	-12,427 (8,633)
N	167	167	167	167	167	167
R-squared	0.0050	0.0112	0.0061	0.0217	0.0185	0.0096

*Notes.* This Table reports financial literacy and financial behaviour spillovers that might occur due to characteristics that are common to both the trained individual and a randomly selected member of the same village bank (the 'indirectly trained'). Each column reports 4 regression results from regressions of an outcome variable in a given column on a training dummy and on a common characteristic to trained individuals and indirectly trained interacted with a training dummy. The first set of models (in the upper part of the Table) gives OLS regressions of FL scores (financial literacy scores in column one) and financial behaviour variables in columns (2)–(6) on a training dummy and on its interaction with a dummy taking one when the trained individual and indirectly trained are both female and zero otherwise. The second set of models regress dependent variables in columns (1)–(6) on a training dummy and on its interaction with a dummy for the trained individual and indirectly trained being both at least 45 years old. The third set of models regress dependent variables in columns (1)–(6) on a training dummy and on its interaction with a dummy for the trained individual and indirectly trained both having above mean cognitive ability score. The fourth set of models in the lower part of the Table regress dependent variables in columns (1)–(6) on a training dummy and on its interaction with a dummy for the trained individual and indirectly trained both owning at least 0.50 ha of land at baseline. Standard errors clustered at the cooperative level are in parentheses. \*\*\* Indicates statistical significance at the 1% level or less, \*\* at 5% level, and \* at 10% level. Currency for savings and expenditures is Rwandan Francs and exchange rate was Rwf560 = \$1 in the baseline and Rwf610 = \$1 during follow-up.



in monthly expenditures. Therefore, the training appears to influence financial behaviour through multiple channels but that enhanced financial literacy may not be the only factor inducing behavioural change – for example, altered attitudes towards financial services could matter too.

In light of the relatively short period between the intervention and the follow-up survey (about 15 months), it is not surprising that we cannot explain variation in a variable of ultimate interest, namely household consumption (proxied by expenditures). More disappointing is that we did not find any evidence that the benefits of the intensive training spilled over to other members of the village bank. However, such endogenous diffusion is a critical component of implementation strategies to achieve ‘scale’. When confirmed in other studies, this finding should inspire development agencies to rethink their expansion or up-scaling strategies, perhaps relying less on spontaneous processes to determine diffusion.

Our findings are consistent with prior research related to financial literacy training. Various studies report that financial education efforts translate into greater financial literacy and that financial literacy is a relevant determinant of financial decision-making (e.g. Cole *et al.*, 2011; Berge *et al.*, 2012; Giné *et al.*, 2012). However, our findings contrast with other results. For example, Bruhn *et al.* (2013) report very limited demand for financial education and assert that participation in such programmes is usually very limited. Such limited participation may reflect binding constraints on potential beneficiaries, preventing them from participating, or it may suggest that respondents expect to gain very little from participating. For our sample of Rwandan smallholders, we obtained nearly full compliance, possibly because the intervention was organised in a convenient period, with modest opportunity costs (i.e. no overlap with important agricultural practices). We also paid transport costs. Differences in demand also could reflect the nature of the intervention. Our partner NGO offered a full-week intensive course, which is likely to have created greater benefits than a single training session that lasted just a few hours. Importantly, the high participation rate and large treatment effect on the treated may also be due to the design of the intervention. A non-random subsample of village bank members was selected by their peers to represent them. Our data suggest selected farmers are different from their peers, belonging to a rural elite, and arguably they stand to gain more from the training than the average village bank member. Our findings also contrast with Berge (2011), who finds some evidence for spillover effects. A possible reason for the difference in results is that Berge (2011), unlike our study, considers joint liability groups where members have a direct incentive to train their peers.

We close with a word of caution regarding the external validity of these findings. Rwanda is a small country with a strong state. The government’s reach into the hinterland is considerable, facilitated by a complex architecture of local institutions. Although our respondents are poor, they have access to a range of financial services offered through a country-wide system of village banks (organised in cooperatives, which in turn are accountable to the state). They also can access a range of markets for various factors and commodities. It is an open question to what extent the lessons learned in Rwanda apply to countries characterised by weaker states and more limited market integration. More research in this domain remains a priority.

## Appendix A. Financial Education Training Material

The AQUAVED financial education programme comprises the following modules:

1. 'Teaching cooperative principles';
2. 'Teaching concepts of microfinance, savings and credit';
3. 'Teaching how to make a business plan for a small income-generating activity';
4. 'Teaching loan management';
5. 'Basic bookkeeping and management of small income-generating activities';
6. 'Examples of business plans of small income-generating projects'.

Module 1 entitled 'Teaching cooperative principles' focuses on the role and objectives of savings and credit cooperatives, how they are managed and various tasks of their management organs, the duties of their members and what they can benefit from them. During workshops, participants are invited to raise problems encountered while working with their cooperatives, and suggest solutions for any difficulties evoked.

Module 2, 'Teaching concepts of microfinance, savings and credit', explains how MFIs operate, their main mission of serving the poor, various services offered by MFIs including savings and credit, the difference between savings and deposits, and the role of credit officers.

Module 3, 'Teaching how to make a business plan for a small income-generating activity', takes participants through all steps to elaborate a business plan for small income-generating projects. Using an example of an income-generating activity existing in the study area, the trainer goes step by step showing participants how to make a business plan. These steps include the description of the product and its market, the financial appraisal that details investment costs, financing plan, loan repayment, working capital, expected operating costs, as well as wide socio-economic impact that the project might have for the population.

Module 4, 'Teaching loan management', covers explanation of how to apply for a loan and the requirements to secure it, the types of loans according their terms and destination, the types of collaterals, how to compute interests and the best practices in loan management.

Module 5, 'Basic book keeping and management of small income-generating projects', teaches participants how to find markets for their products, how to determine product prices, and the importance of keeping records. Participants are taught how to record entries, uses, and balance, how to keep inventories by recording purchases, sales, and stock on hand. They also learn how to keep record of those who owe them money, as well as how to keep record of money they repay.

The last module 'Examples of business plans of small income-generating projects', consists of review and practice of business plan elaboration. The trainer recapitulates how to make a business plan using examples of a business plan of a small project to sell milk in a small town, an example of a small project of selling local beer on a local market and a small project of raising poultry. Then, participants are divided into groups to practise how to make business plans.

## Appendix B. Probing Attrition Randomness and Balance Test for the Spillover Sample

Table B1  
*Probing Attrition Randomness*

Covariates	Binary for attrition	
	Attrition	Attrition
Training dummy	-0.3611 (0.3037)	-0.3906 (0.3186)
Age	0.0418 (0.0518)	-0.0218 (0.0427)
Age squared	-0.0007 (0.0006)	0.0000 (0.0005)
Married	-0.0946 (0.1077)	-0.1279 (0.1448)
Education	-0.0329 (0.0287)	0.0042 (0.0196)
Household size	0.0142 (0.0523)	-0.0265 (0.037)
Years in cooperative	-0.0332*** (0.0109)	-0.0009 (0.0237)
Log of expenditures	0.0639 (0.0506)	0.0861*** (0.0123)
Own livestock	-0.288 (0.3517)	
Size of land owned	-0.0057 (0.03)	
Subjective happiness	-0.2956 (0.1853)	-0.1985 (0.1625)
Take notes	-0.1424 (0.28)	-0.1876 (0.2772)
Cognitive ability	0.0471 (0.0291)	0.0558 (0.0403)
Constant	-1.603 (1.193)	-0.8741 (0.7785)
<i>N</i>	253	338

*Notes.* Robust standard errors in parentheses. \*\*\* Indicates statistical significance at the 1% level or less, \*\* at 5% level, and \* at 10% level.

Table B2  
*Balance Test for the Spillover Sample*

	Mean and differences between groups				
	Indirectly trained (1)	Control (2)	Difference (3)	p-value (4)	<i>N</i> (5)
<i>Dependent variables</i>					
1. Savings	12,736 (1,774)	18,356 (3,786)	-5,620 (3,978)	0.1595	179
2. Savings rate	23.28 (7.27)	15.79 (2.67)	7.49 (8.37)	0.3712	177
3. Borrowing	0.42 (0.05)	0.37 (0.05)	0.05 (0.07)	0.4416	179
4. Monthly expenditures	21,802 (2,719)	20,323 (2,688)	1,479 (3,863)	0.7022	177
5. Initiated new income-generating activity	0.11 (0.03)	0.16 (0.04)	-0.05 (0.05)	0.3801	179
<i>Independent variables</i>					
6. Financial literacy score (out of 6)	1.54 (0.10)	1.43 (0.10)	0.11 (0.14)	0.4696	179
7. Gender	0.43 (0.05)	0.41 (0.05)	0.02 (0.07)	0.8058	179
8. Age	44.55 (1.28)	44.15 (1.31)	0.40 (1.85)	0.8288	179
9. Married	0.69 (0.05)	0.61 (0.05)	0.08 (0.07)	0.2592	179
10. Education	3.34 (0.33)	3.66 (0.36)	-0.32 (0.48)	0.5147	179
11. Household size	5.41 (0.24)	5.28 (0.26)	0.13 (0.35)	0.7105	179
12. Cognitive ability score (out of 9)	4.72 (0.20)	4.74 (0.22)	-0.02 (0.29)	0.9399	179
13. Years in cooperative	4.15 (0.36)	4.49 (0.40)	-0.34 (0.54)	0.5194	177
14. Land size	0.57 (0.08)	0.69 (0.11)	-0.12 (0.14)	0.3751	179
15. Own livestock	0.61 (0.05)	0.72 (0.05)	-0.11 (0.07)	0.1328	178
16. Annual expenditures	222,309 (27,037)	185,485 (27,750)	36,824 (39,007)	0.3465	177
17. Subjective happiness	0.48 (0.05)	0.44 (0.06)	0.04 (0.08)	0.5456	179
18. Take at least monthly notes of income and expenditures	0.23 (0.04)	0.28 (0.05)	-0.05 (0.07)	0.4123	179

*Notes.* This Table reports a test of random assignment between 'indirectly trained' and control for the spillover sample. Cells for column (1) 'Indirectly trained' and column (2) 'Control' contain means for 18 variables indicated in the rows. The test for the difference between means of indirectly trained and control is given by the p-values in column (4). Standard errors are in parentheses. Currency for savings and expenditures is Rwandan Francs and exchange rate was Rwf560 = \$1 during baseline.

### Appendix C. Financial Literacy Questions\*

1) Suppose you had Rwf100,000 in a savings account and the interest was 20% per year, and you never withdrew money or interest payments. After five years, how much would you have in this account in total?

**More than Rwf200,000?**

Exactly Rwf200,000?

Less than Rwf200,000?

Do not know

2) Imagine interest on your savings was 1% and inflation was 2% per year. After one year, how much would you be able to buy with the money in this account?

More than today?

Exactly the same?

**Less than today?**

Do not know

3) Given a Table showing how interest and other loan charges are computed for a loan of Rwf6,000 for six months at 2% interest a month and Rwf1,000 to be paid per month on the principal? Fill in the Table interest to be paid after the second month, given that interest for the first month was 120.

Answer: **100**

4) Is the following statement correct? Savings and deposit are both for the long term.

Yes

**No**

5) Give three types of collateral that are accepted by your savings and credit cooperative?

Properties and durable goods

Solidarity groups' guarantee

Savings

6) Mention three requirements that have to be fulfilled by members of your cooperative who wish to apply for loans? (any three among the following)

To have already paid one's contribution;

To have no bad records for the last three months;

To prove that you have an income-generating activity in which you are going to invest money in;

To show proof of reimbursement capacity;

To have in your account 20% of the amount applied for if you are a member of solidarity groups and 30% of the amount for non-solidarity group members;

To have demonstrated integrity before;

To accept to be monitored;

To demonstrate experience in the project for which you apply loan for.

\*Correct answer in bold for the first four questions.

*University of Rwanda, and Development Economics Group, Wageningen University*

*Development Economics Group, Wageningen University*

*University of Groningen*

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Additional Supporting Information may be found in the online version of this article:

**Appendix D.** Questionnaire used to measure important variables.

**Data S1.**

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