

Literacy, Skills and Welfare: Effects of Participation in Adult Literacy Programs*

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Abstract

This paper examines the effect of adult literacy program participation on household consumption in Ghana. The adult literacy programs in Ghana are of special interest since they are more comprehensive than standard literacy programs and incorporate many additional topics. We use community fixed effects combined with instrumental variables to account for possible endogenous program placement and self-selection into program participation. For households where none of the adults have completed any formal education we find a substantial, positive and statistically significant effect on household consumption. Our preferred estimate of the effect of participation for households without education is equivalent to a ten percent increase in consumption per adult equivalent. The effects of participation on welfare for other households are smaller and not statistically significant, and become smaller the more educated the household is. We find positive and statistically significant effects of participation on literacy and numeracy rates, although the increases are too small to be the only explanation for the welfare effects. There is also evidence that participants are more likely to engage in market activities and to sell a variety of agricultural goods. Taking account of both direct cost and opportunity cost we argue that the social returns to adult literacy programs are substantial.

Keywords: Literacy, program evaluation, consumption, poverty, Ghana

JEL: D1, I2, I3, J2, O1

1 Introduction

In a population where many adults cannot read or write, adult literacy programs may be an effective way of improving people’s livelihoods since numerous studies have found a positive impact on economic outcomes from literacy and numeracy.¹ Large scale adult literacy programs have, however, generally not lived up to the expectation that they would be a cheap and effective way to educate the adult population. Most programs have performed poorly in terms of enrollment, graduation rates and the long-term literacy of participants. During the 1970s, for example, many programs had efficiency rates of about 12.5 percent with few graduates having stable literacy skills (Abadzi 2003, p. 2). These experiences lead the World Bank to finance almost no adult literacy programs during the 1980s and to questions in the development community about whether literacy is really necessary for development. A case in point is Venezuela’s recent attempt to eliminate illiteracy through the “Misión Robinson” campaign; as shown by Ortega and Rodriguez (2008) there are at best small gains in literacy as a result of the program.

Surprisingly there has been little rigorous analysis of the impact of adult literacy programs on economic outcomes. Existing studies find a beneficial impact for participants who became literate, but suffer from several methodological problems that cast doubts on the validity of the results.² First, the samples are small.³ Second, typically only simple statistics such as the fraction of completers who are able to read and/or do written calculations are reported. Finally, and most importantly, they do not take account of possible endogeneity in program placement and participation decisions.

This paper therefore examines the effect of participation in adult literacy programs on the standard of living, measured by household expenditures per adult equivalent, using data from a large household survey from Ghana. As described below, the programs in Ghana are different from other literacy programs in that they take much longer to complete and teach many other topics in addition to literacy. After controlling for the possibilities of endogenous program placement and self-selection into the program we find a substantial and statistically significant effect on consumption for households where no adults have completed any formal education. For other households the effects are smaller in magnitude and not statistically significant. While there are significant effects on literacy and numeracy from participation, these are comparable to what have been found for other literacy programs and hence are likely too small to be the only explanation for the positive effect on welfare. Participation do, however, also lead to households being significantly more likely to be engaged in market activities such as selling agricultural goods.

Adult literacy programs in Ghana have a long history going back to the eighteenth

¹ See, for example, Glewwe (1999), Vijverberg (1999) and Jolliffe (1999) on Ghana, Boissiere, Knight, and Sabot (1985) on Kenya and Tanzania and Moll (1998) on South Africa. For developed countries, examples include Mitra (2002), Murnane, Willett, and Levy (1995), Tyler, Murnane, and Willett (2000), Ishikawa and Ryan (2002), Green and Riddell (2003), Chiswick, Lee, and Miller (2003) and Dustmann and Fabbri (2003).

²See, for example, Carron, Mwiria, and Righa (1989) and Carr-Hill, Kweka, Rusimbi, and Chengelele (1991)

³In Carron, Mwiria, and Righa (1989) the treatment and control groups are 291 and 66 individuals, respectively. The equivalent numbers from Carr-Hill, Kweka, Rusimbi, and Chengelele (1991) are 272 and 59.

century and were mainly religiously based until after the Second World War.⁴ The first national literacy program was introduced in 1948 but collapsed in 1968 after the Nkrumah government’s fall in 1966 since it had become closely politically associated with the Nkrumah movement and since the skills taught were often not considered relevant by the participants. In 1987 the Non-Formal Education Division was established in the Ministry of Education to organise and co-ordinate adult literacy programs and other non-formal education. Baseline studies were undertaken to ensure that what is taught would be of immediate use and relevance to participants. Based on the baseline studies 28 main themes covering issues as varied as nutrition, immunization, family planning and traditional and modern farming were identified as important issues and concerns of communities to be addressed in adult literacy programs. The themes can be divided into three broad areas: Social and health issues, income-generation/occupational skills and civic awareness.⁵ One of the main features of the program is income generation, which aims at equipping participants with occupational skills appropriate for the area they live in. It takes about 21 months to complete the course and the classes meet two to three times a week for two to three hours each time. For comparison, the Venezulean “Misión Robinson” courses mentioned above last only seven weeks. In most cases there are 20 to 30 participants to an instructor/facilitator.

2 Estimation Strategy

This section discusses the estimation strategy and the associated potential econometric issues. Denote the outcome of interest for household i by y_i and let y_{i1} be the outcome with participation and y_{i0} the outcome without participation. Furthermore, let p_i be a binary variable equal to one if household i participated in the program and zero if not. We can then describe the outcome of interest by

$$y_i = \alpha p_i + \mathbf{x}_i \boldsymbol{\beta} + u_i, \tag{1}$$

where \mathbf{x}_i are other explanatory variables (including a constant) and u_i is an error term. The parameter of interest is α , which reflects the effect of participation. The two main econometric issues are the possibility of endogenous program placement and self-selection into program participation. We discuss each in turn.

Endogenous program placement refers to the possibility that programs may not be randomly distributed, spatially and/or temporally, throughout the country.⁶ While this in itself is not a problem, it does lead to biased estimates if any of the factors that determine program

⁴For a more complete description of the history of adult literacy programs and their current function and curriculums see Blunch and Pörtner (2004).

⁵ For social and health issues topics include family planning, teenage pregnancy, environmental hygiene, immunization, aids, safe motherhood and child care, drug abuse, traditional medicine, safe drinking water. For income-generation topics include cocoa farming, maize cultivation, dry season farming, basket weaving, animal husbandry, bee-keeping, oil palm cultivation, borrowing money for work, hygienic way of preserving and selling fish, farm extension services, pottery and soap making. Finally, for civic awareness topics include taxation, bush fires, interstate succession law, child labor, chieftaincy, community empowerment and expensive funerals.

⁶See discussions in, for example, Rosenzweig and Wolpin (1986), Pitt, Rosenzweig, and Gibbons (1995) and Angeles, Guilkey, and Mroz (1998).

placement also influence the outcomes of interest and are unobservable to the researcher. Say that a local administrator is charged with placing literacy programs in his area and that he places them according to his perception of how much “entrepreneurial spirit” there are in the different communities. Given that “entrepreneurial spirit” is also likely to be an unobservable determinant of the outcomes of interest our estimates of the program’s effectiveness will be biased if we do not take account of the endogenous program placement.⁷

Given the constraints that the available data impose the best available option for dealing with endogenous program placement is to use community fixed effects. This effectively removes all community characteristics that might influence both placement and outcomes and if the communities are small enough there will be no bias from endogenous program placement. Using community fixed effects means, however, that the effect of the program is identified purely from the differences between individuals and households within the community. This is also the main downside of using community fixed effects: It becomes harder to address the issue of self-selection into the programs because we cannot use variation between communities.

The two main methods for dealing with possible self-selection into participation are the “ignorability of treatment” approach described by Rosenbaum and Rubin (1983) and instrumental variables (Wooldridge 2002, p. 603).⁸ The “ignorability of treatment” method assumes that, conditional on a set of explanatory variables \mathbf{x} , the participation p and the outcomes (y_0, y_1) are independent. This is unlikely to hold here since factors such as the unobservable ability of individuals potentially affect both participation and the outcomes of interest.⁹ Hence, we use instrumental variables to deal with self-selection into participation. What is needed are instruments that affect the decision to participate net of the other explanatory variables but are not correlated with the unobservable heterogeneity. The challenge is to find a set of instruments that vary within communities and which do not directly affect the outcome(s) of interest. In the absence of community fixed effects an obvious candidate would be the exposure one has had to the literacy program, measured, for example, by how long the program has been available, but this clearly does not vary within the community. It is, however, likely that different types of individuals and households will respond differently to the introduction of a program. In that case a valid set of instruments is program exposure interacted with exogenous individual or household characteristics. These interactions should have no direct effect on the outcome variables and will not be correlated with unobservables like innate ability. One drawback of the instrumental variables approach is, however, that what we identify is the effect of participation among those for whom the instruments affect the decision to participate. We discuss our choice of instruments in more detail below.

As discussed by Wooldridge (2002, Chapter 18, p. 621-625) the effect of participation

⁷The direction of the bias depends on how the omitted variable(s) affect the placement decision and the outcome(s) of interest. If the most “entrepreneurial” communities get the programs first and also do better in terms of the outcome variables then the estimates of the program’s effectiveness will be biased upward.

⁸This is obviously a simplification as can be seen from the review of methods in Ribar (2003).

⁹Imagine that someone with higher ability face a higher return to participation than somebody with lower ability and that higher ability people also do better in terms of the outcome(s) of interest. In this case the predicted effect of participation will be biased upward if we do not take account of self-selection into the program.

can be estimated under relatively relaxed conditions using a modified two-stage method. The first stage estimates the determinants of the participation decision. In the second stage the consumption equation is estimated by IV using the predicted probabilities from the first stage and \mathbf{x} , which includes all other explanatory variables and an intercept, as instruments. An attractive feature of this approach is that the results are robust even if the participation equation is not correctly specified.

3 Data

The Ghana Living Standards Survey (GLSS) is a nationally representative stratified multi-purpose household survey collected in 1987, 1988, 1991 and 1998, consisting of a household survey, a community survey covering the rural areas and a price survey. We use the most recent of these (GLSS 4) here.

The household part of the GLSS contains modules ranging from education and health to migration, credit and assets. For our purposes, the most important modules are the education and household expenditure modules. The education module includes information on educational attainment, participation in adult literacy courses and literacy and numeracy proficiency (reading and writing in a Ghanaian language, English reading and writing and ability to do written calculations). The module on household expenditures includes information on food and non-food expenditures, where the former is additionally decomposed into frequently and less frequently purchased items. From the community questionnaire we use information whether there is or has been an adult literacy program in the community and if so, for how long.

GLSS 4 employed a two-stage sampling design. Out of the available enumeration areas 300 were chosen in the first stage with a probability based on the size of the EA in the 1984 Census. In the second stage 20 households were selected from each of the chosen enumeration areas, yielding a total of 5,998 households and 24,611 individuals. We drop 13,145 individuals who are less than 18 years of age, since our focus is on adult literacy and participation in adult literacy programs. Furthermore, we drop 529 adults who are either not family members (hired help or tenants) or are household members who do not fulfill the GLSS's definition of being present and therefore had no information collected about them, leaving 12,737 adults. Of these, 253 have missing information about their schooling and/or their participation in adult literacy programs. Since there is only information on adult literacy programs in the community survey and the community survey was only done in rural areas we drop all 4,613 individuals who live in urban areas. An additional 38 individuals are dropped because there was no information about the household head in the survey and 124 individuals are dropped because of inconsistent or unusable age and/or education data.

A number of enumeration areas had multiple communities within them and the enumerators were supposed to note which households belonged to which communities. Unfortunately, this did not happen for the vast majority of the areas.¹⁰ As mentioned above we rely on community fixed effects to counter any potential bias from endogenous program placement

¹⁰While it is in principle possible to deduce where the individual households reside from the raw data Ghana Statistical Service has not done this and will not allow non-employees access to the relevant raw data.

and to avoid problems for this approach we drop all enumeration areas that covered more than one community, which leads to 987 individuals being dropped.¹¹ This ensures that enumeration area fixed effects are exactly the same as community fixed effects. On average an enumeration area covers less than 18 km² (or just less than 7 square miles), which means that it is in principle possible to walk from one end to the other in a little over one hour without too much effort. The 1984 population census had a total of 13,012 enumeration areas and even though enumeration areas were likely bigger in rural areas than in urban areas most houses in rural areas tend to be clustered in communities close to roads, paths or water sources.¹² Hence, we are confident that any bias from possible endogenous program placement within an enumeration area will be negligible. After dropping these observations our base sample consists of 6,713 adults from 3,219 households living in 166 communities. Hence, there are just over 40 individuals and just below 20 households within each community.

3.1 Variables

Tables 1 and 2 present the descriptive statistics for the sample of individuals and the sample of households, respectively. The variables are divided into dependent, individual, household and instrumental variables. The four variables that are treated as dependent or endogenous variables are attendance in an adult literacy program, log of per adult equivalent expenditure and literacy and numeracy. This section presents the variables for the base sample and the associated basic descriptive statistics. The following section examines the descriptive statistics for program participation, welfare, literacy and numeracy in more detail.

Information on participation in adult literacy programs comes from the Education section of the GLSS 4 which includes the question: “Has (NAME) ever attended a literacy course?”¹³ All individuals who answer yes are coded one and the rest zero. Households where at least one adult member answers yes are coded one and those where nobody has participated are coded zero. For the base sample about 11 percent of all individuals have participated in an adult literacy program, while 20 percent of the households have at least one member who have attended.

We use household expenditures per year as our measure of household welfare. As is often discussed in poverty analyses, not all household members require the same level of consumption; children and adults, for example, have different caloric requirements. We therefore use an adult-equivalent corrected measure of consumption, where different types of household members are assigned different weights depending on their age and sex, and total consumption is divided by the sum of these weights.¹⁴ Henceforth, when we refer to welfare,

¹¹Of the 997 individuals dropped because of this, 233 live in enumeration areas where some communities have a literacy program and some do not, 360 live in enumeration areas where the program has not been available the same number of years in different communities and the remainder are dropped simply because the community survey states that there are multiple communities within the enumeration area.

¹²The enumeration areas are described in more detail in Central Bureau of Statistics [Ghana] (1984) and had to be small enough to be handled by an enumerator covering all households in one day. In 1984 the average population of an enumeration area was 1000 in urban areas and 700 in rural areas (Central Bureau of Statistics [Ghana] 1984, p. 7).

¹³Note that there is unfortunately no information about whether the individual has finished the course or when participation took place.

¹⁴The results for the per-capita consumption measure are available on request from the authors. They are

consumption or expenditures this should be taken to mean per adult equivalent expenditures per year.

Consumption or household expenditures are preferable to earnings or wages as a measure of economic well-being for at least two reasons. First, if households smooth their consumption over time the link between latent household economic well-being and earnings or wages is weaker than that between latent household economic well-being and consumption expenditures. Second, consumption expenditures are likely to be more accurately measured than earnings or income (Appleton 2002). This is especially the case for our sample which consists purely of rural households, most of which have agricultural production as their main and often only income source.

The average of the log of per adult equivalent expenditure is around 13.8 for both the individual and the household samples. This is approximately equal to 985,000 Cedis per adult equivalent.¹⁵ For comparison, previous work on poverty in Ghana using the same data set employ two poverty lines: An upper line at 900,000 cedis and a lower at 700,000 cedis (Canagarajah and Pörtner 2003). Consuming above the upper poverty line means that one is able to meet one’s nutritional requirements and basic non-food needs. The lower poverty line is the level at which an individual is not able to meet his minimum nutrition requirements, even if he allocates his entire budget to food.

We consider a person literate if he can read a letter in either English or a Ghanaian language, while he is considered numerate if he answers yes to being able to do written calculations.¹⁶ Both the ability to read a letter and do written calculations are self-reported, although if the respondent was not present during the interview the main respondent is asked to supply the information. Of the individuals in the base sample 41 percent report that they can read a letter in either English or a Ghanaian language, while 45 percent can do written calculations. The distribution of literacy and numeracy by education levels and program participation is discussed below.

Slightly more than half of the individuals are female and, as expected given the population growth in Ghana, relatively young. To ease interpretation, we use four age groupings for individuals: 18 to 29, 30 to 44, 45 to 59 and 60 to 99. These age groups roughly correspond to young adults, prime age adults, middle-aged and older and constitute 33, 31, 20 and 16 percent of the sample, respectively. More than half (53 percent) of all adults in the sample have not completed any education, while 12 percent have completed primary school, 29 percent middle school and six percent a post middle school education.

Just over thirty percent lives in households that own land, while around ten percent are in non-agricultural households, which are households that report no agricultural production at all. The remainder hence lives in households where the only land available is rented land. The three household level education variables measure the percentage of individuals within a household that have completed a given level of education. The distribution is approximately the same as for individual education and varies little whether one looks at

broadly similar to the results for the adult-equivalent consumption measure.

¹⁵Note that in 2007 Ghana redenominated its currency with 10,000 old cedis equal to 1 new cedi. All values here are given in old cedis (which are called second cedi).

¹⁶The relevant questions in GLSS are “Can (NAME) read a letter in English?” and “In what Ghanaian language can (NAME) read a letter?”. The former is answered yes/no, while the latter includes the option “None”. Numeracy is based on the question: “Can (NAME) do written calculations?”.

the sample of individuals or the household sample. It is worth noting that in just over half of all households, none of the adults have completed any formal education. In the individual sample households consist of on average just over five persons of which 2.6 are adults, while in the household sample the corresponding numbers are 4.4 and just over two.¹⁷ For the household sample age is defined as average age of the adults in the households and split into six groups: 18 to 29, 30 to 34, 35 to 39, 40 to 49, 50 to 59 and 60 to 99. These groups are of approximately the same size.

We use as instruments the exposure to the literacy program in the community interacted with individual and household characteristics. Exposure is defined as the length of time the program has been in the community and is capped at 15 years since the national program essentially was non-existent from 1968 until 1986 and generally believed to be of little use before 1968.¹⁸ For the individual sample the variables interacted with exposure are female, the age groups, ownership of land, non-farming household, the levels of education in the household in percent, household size and number of adults in the household. For the household sample the same set is used except that there is no female dummy and that the household average age groups are used instead of individual age groups.

What is important for the performance of the instruments is the role exposure plays in the decision to participate. One can think of two opposite effects of increasing exposure: One where the return to participation is known and one where it is not. First, the longer the program has been in an area the more likely it is that those individuals with higher expected net returns will have participated. In practice, even with a higher expected return than other individuals, there are likely factors preventing at least some of the high net return individuals from participating right away.¹⁹ If this is the case, one would expect increasing exposure to lead to a divergence in the proportion who have participated between those types of individuals with a high expected net return and those with a lower expected net return. The second possible effect arises from people learning about the return to participation over time. Even provided the program has a positive return, we would expect the most risk averse (and/or credit constrained) individuals to postpone participation until more and better information is available about the effect of participation. In this case the expected result is a convergence in participation over time.

No matter which of these effects dominate, the important point is whether the interactions between exposure and characteristics capture differences in the likelihood of participation for each of these groups. We will discuss this in detail below when we present the results. Furthermore, while we would expect age and the other variables to have a direct effect on outcomes it is unlikely that the interactions of these variables with exposure should have

¹⁷A possible concern with including variables reflecting household characteristics is that some individuals might have participated in an adult literacy program before joining the households. Hence, those variables could in principle be influenced by the participation decision and subsequent outcomes rather than the other way around. This could, for example, happen if a person who has learned to read through an adult literacy program is a more attractive partner than somebody with the same characteristics who has not. As we show below it appears that relatively few individuals are very young when they participated in the program making these issues less of a concern.

¹⁸The relevant questions in the community questionnaire are: "Is there, or has there been, an adult literacy program in this community?" and "In what year was this program launched?"

¹⁹This can, for example, be the case if there are not enough space to accommodate all interested participants when they first apply to participate.

Table 1: Descriptive Statistics - Individuals

Variable	Mean	Std. Dev.	Min	Max
Dependent:				
Attended literacy program	0.11	0.32	0.00	1.00
Log of per adult equivalent expenditure	13.76	0.68	11.68	17.09
Literate	0.41	0.49	0.00	1.00
Numerate	0.45	0.50	0.00	1.00
Individual:				
Female	0.55	0.50	0.00	1.00
Aged 30-44	0.31	0.46	0.00	1.00
Aged 45-59	0.20	0.40	0.00	1.00
Aged 60-99	0.16	0.37	0.00	1.00
Primary education	0.12	0.33	0.00	1.00
Middle education	0.29	0.45	0.00	1.00
Post middle education	0.06	0.23	0.00	1.00
Household:				
Owns land	0.31	0.46	0.00	1.00
Non-farming household	0.10	0.30	0.00	1.00
Percent with primary education	0.12	0.23	0.00	1.00
Percent with middle education	0.29	0.33	0.00	1.00
Percent with post middle education	0.06	0.17	0.00	1.00
Household size	5.29	2.77	1.00	21.00
Number of adults in household	2.64	1.30	1.00	8.00
Instruments:				
Female \times exposure	2.94	4.07	0.00	15.00
Aged 30-44 \times exposure	1.63	3.36	0.00	15.00
Aged 45-59 \times exposure	1.11	2.90	0.00	15.00
Aged 60-99 \times exposure	0.88	2.58	0.00	15.00
Owns land \times exposure	1.54	3.18	0.00	15.00
Non-farming \times exposure	0.44	1.89	0.00	15.00
Primary education (%) \times exposure	0.69	1.70	0.00	15.00
Middle education (%) \times exposure	1.63	2.64	0.00	15.00
Post middle education (%) \times exposure	0.30	1.09	0.00	15.00
Household size \times exposure	29.18	31.09	0.00	225.00
Number of adults \times exposure	14.57	15.52	0.00	105.00
Number of observations		6,713		
Number of communities		166		

a direct effect on outcomes once we control for observable and unobservable community characteristics through fixed effects and the direct effect of the individual and household characteristics. This is the case even if exposure works mainly through learning about the return to participation. Consider as an example the difference in participation of men and

Table 2: Descriptive Statistics - Households

Variable	Mean	Std. Dev.	Min	Max
Dependent:				
Attended literacy program	0.20	0.40	0.00	1.00
Log of per adult equivalent expenditure	13.87	0.71	11.68	17.09
Household:				
Owns land	0.30	0.46	0.00	1.00
Non-farming household	0.13	0.34	0.00	1.00
Average age 30-34	0.18	0.39	0.00	1.00
Average age 35-39	0.17	0.38	0.00	1.00
Average age 40-49	0.21	0.40	0.00	1.00
Average age 50-59	0.12	0.32	0.00	1.00
Average age 60-99	0.14	0.34	0.00	1.00
Percent with primary education	0.12	0.26	0.00	1.00
Percent with middle education	0.28	0.36	0.00	1.00
Percent with post middle education	0.05	0.18	0.00	1.00
Household size	4.37	2.54	1.00	21.00
Number of adults in household	2.09	1.07	1.00	8.00
Instruments:				
Avg age 30-34 \times exposure	0.91	2.59	0.00	15.00
Avg age 35-39 \times exposure	0.90	2.63	0.00	15.00
Avg age 40-49 \times exposure	1.14	2.93	0.00	15.00
Avg age 50-59 \times exposure	0.66	2.32	0.00	15.00
Avg age 60-99 \times exposure	0.64	2.11	0.00	15.00
Owns land \times exposure	1.46	3.08	0.00	15.00
Non-farming \times exposure	0.58	2.11	0.00	15.00
Primary education (%) \times exposure	0.66	1.83	0.00	15.00
Middle education (%) \times exposure	1.54	2.75	0.00	15.00
Post middle education (%) \times exposure	0.25	1.06	0.00	15.00
Household size \times exposure	23.34	26.05	0.00	225.00
Number of adults \times exposure	11.18	12.10	0.00	105.00
Number of observations		3,219		
Number of communities		166		

women. If women are more risk averse and/or otherwise constrained that should clearly have an effect on their average consumption, but once we control for being a woman the interaction between being a woman and exposure should not have an impact on consumption except through participation in the adult literacy program.

4 Descriptive Analysis

This section provides a more detailed look at the descriptive statistics for program participation, literacy, numeracy and welfare. It first looks at participation, literacy and numeracy and then at welfare. Table 3 shows participation rates by completed education level and literacy and numeracy rates for participants and non-participants, also by level of completed education. Not surprisingly, participation rates decrease with level of education. Of those who have not completed primary school 17 percent have attended an adult literacy program, while just over ten percent of adults who have completed primary school have. For those with middle school and those with more than middle school the participation rates are 3.6 and 1.5 percent, respectively.²⁰ The differences in participation rates across education levels do not reflect differences in access to an adult literacy program. Around 80 percent of all adults in the sample have access to an adult literacy program in their community and there appears to be little difference in access rate by education level.²¹

Table 3: Participation, Literacy and Numeracy Rates by Program Availability and Education

Completed education	Participated	Participants		Non-Participants		Number of observations
		Literate	Numerate	Literate	Numerate	
Complete Sample						
None / Koranic	0.170	0.148	0.149	0.031	0.062	3,592
Primary	0.103	0.571	0.607	0.480	0.667	816
Middle	0.036	0.986	0.971	0.926	0.955	1,914
Post Middle	0.015	1.000	1.000	0.992	0.992	391
No Program Available						
None / Koranic	0.119	0.177	0.167	0.027	0.065	809
Primary	0.072	0.818	0.818	0.433	0.688	152
Middle	0.037	1.000	1.000	0.910	0.967	382
Post Middle	0.009	1.000	1.000	0.991	0.982	111
Program Available						
None / Koranic	0.184	0.142	0.146	0.032	0.061	2,783
Primary	0.110	0.534	0.575	0.491	0.662	664
Middle	0.036	0.982	0.964	0.930	0.952	1,532
Post Middle	0.018	1.000	1.000	0.993	0.996	280

Note. A person is considered literate if he can read a letter in either English or a Ghanaian language and numerate if he answers yes to being able to do written calculations. Program availability is based the question in the community questionnaire is: “Is there, or has there been, an adult literacy program in this community?”

²⁰The low participation rates for the two highest education levels mean that the sample of participants from these groups consists of only 75 adults (69 for middle and 6 for post middle).

²¹The possible exception is among those with post middle education where just over 71 percent currently have access.

For all education levels participants in adult literacy programs generally have higher literacy and numeracy rates than those who have not participated. It is clear, however, that even among participants the literacy and numeracy rates are still low. For those without education only around 15 percent of adults who have participated in a program can read and do written calculations, compared to three percent literate and six percent numerate among non-participants. Among adults who have completed primary school, literacy increases from 48 percent without participation to 57 with participation, while numeracy appears to decline from 67 percent to 61 percent. Only for graduates of middle school and above do literacy and numeracy rates approach 100 percent and even then there are more than seven percent of those who have graduated from middle school who report being unable to read a letter in either English or a Ghanaian language.

We can learn three important things from these results. First, it appears that the adult literacy programs in Ghana do poorly in terms of teaching people literacy and numeracy, although the efficiency rates are in line with those discussed in Abadzi (2003). Secondly, that the literacy and numeracy rates are so low even after six years of education indicates that the quality of the rural primary schools in Ghana is indeed low. Finally, it appears that overestimation of respondents' ability to read and do math is not a serious issue. The latter is important since there is often a perception that self-reporting of literacy will lead to too high literacy rates. Ortega and Rodriguez (2008), for example, argue that semiliterate persons might claim that they are literate after participation in a "Misión Robinson" course. It is, however, also possible that participation in an adult literacy program will lead to participants learning that they really cannot read.

A noticeable feature of the data is that a substantial number of people report having participated in an adult literacy program, but live in communities without a program. Not surprisingly the participation rate is generally larger in areas with a program, although the differences are not as substantial as one might expect: The largest differences is for individuals without any completed education, where the participation rate is about 19 percent in areas with a program and 12 percent in communities without. The differences in literacy and numeracy rates among non-participants in communities with and without an adult literacy program are small, with literacy rates lower among those who live in areas without a program. There are, however, substantial differences between participants who live in communities with an adult literacy program and participants in communities without a program. What is particularly interesting is that the literacy and numeracy rates are *higher* in communities without a program. For participants with no completed education the literacy rates are 17.7 and 14.3 percent in communities without and with a program, respectively. Especially striking are the corresponding rates for those who have completed primary school, where the literacy rate for participants in communities without a program is 81.8 percent while it is only 52.8 percent among participants in communities with a program.

The high participation rate and the higher literacy and numeracy rates among individuals who state they have participated in an adult literacy program, yet live in communities where a program is not available are important since they influence the strength of our instrumental variable estimation strategy. As discussed above, we include community fixed effects to control for endogenous program placement. Then to account for unobservable individual characteristics that may influence both the decision to participate and the outcomes we rely on the length of exposure to the program interacted with observable characteristics to in-

strument for participation. This means that our instruments, once we control for community fixed effects, will have no explanatory power for individuals in areas without an adult literacy program since exposure is zero. Given that the effect of participation is only identified for those affected by the instruments, our instrumental variable estimations essentially ignore anybody living in an community without an adult literacy program, which includes the subgroup of participants who have higher literacy and numeracy rates than other participants. We will discuss this further in Section 5.

4.1 Welfare

Table 4 shows levels of consumption and associated statistics by participation and education using the household sample. In addition to the complete sample, households are divided into four exclusive groups by the highest education level among its adult members. Hence, say, the “Middle” households all have at least one member who has completed Middle school and no members that have completed an education level higher than that. Within each group the statistics are presented for both those households that have had no members participate in an adult literacy program, those that have had members participate and the two categories combined.

As expected, consumption increases with the level of highest education within the household, although the differences might not seem large. While the difference in mean consumption between households where no adults have completed any level of schooling and those where at least one adult has completed a post middle education is 26 percent, the differences between the no education group and the middle and primary groups are only 7.3 and 5.0 percent, respectively. Furthermore, even if we, in general, measure consumption more precisely than income there is still potential for measurement error. In the case of subsistence households, who may barter for the part of their consumption which they do not produce themselves, we impute expenditures, which obviously introduce the possibility of errors. This may explain the very low values for the minimum observation expenditures in Table 4, which are substantially below the lower poverty line, even for the better educated households.²²

What is mainly of interest here are the differences between households with adults who have participated in a literacy program and those without. The only group where average consumption is higher among participants than non-participants is the no education group, where there is almost a 19 percent difference. For everybody else, the participant households have substantially lower consumption than the non-participant households; participant middle education households have an average consumption which is more than twenty percent lower than non-participant households.²³ Note that it is difficult to say anything about the causal impact of participating in an adult literacy program on household consumption from these numbers. It is possible that the participant households would have done even worse in the absence of participation or that there are substantial differences in area characteristics that influence consumption.

²²It is, of course, possible that the poverty lines themselves are not perfect measures of the actual cost of the minimum nutritional requirements.

²³The biggest difference is for post middle education households but there are very few participants in this group.

Table 4: Per Adult Equivalent Expenditures by Participation and Education Level of Household

Participant	Mean ^a	Min	Max	Std. Dev.	N
Complete Sample					
No	1,387	118	26,486	1,198	2,588
Yes	1,296	183	11,110	1,150	631
All	1,369	118	26,486	1,189	3,219
Post Middle ^b					
No	1,731	208	26,486	1,937	281
Yes	945	183	2,657	530	42
All	1,629	183	26,486	1,835	323
Middle ^b					
No	1,438	170	7,615	1,014	1,006
Yes	1,151	236	11,110	1,000	229
All	1,385	170	11,110	1,017	1,235
Primary ^b					
No	1,377	247	6,198	1,025	315
Yes	1,261	252	8,510	1,260	74
All	1,355	247	8,510	1,073	389
None ^b					
No	1,240	118	12,240	1,124	986
Yes	1,473	195	9,287	1,268	286
All	1,292	118	12,240	1,161	1,272

Note. Participation status reflect whether at least one member has participated in an adult literacy program.

^a Expenditures measured in 1000 Cedis.

^b At least one adult with this level of education and none with more.

To investigate these possibilities further Table 5 presents the statistics from Table 4 stratified by adult literacy program availability, participation status and education group. Two interesting findings emerge. First, communities with adult literacy programs generally appear to be poorer than those without. This holds whether we compare non-participant households across communities with and without literacy programs or compare participants and non-participants combined across communities. One interpretation of this is that less developed communities are more likely recipients of adult literacy programs than more developed ones. This underscores the potential importance of unobservable community characteristics that affect the placement of programs even after the level of development or the schooling level of the community are taken into account.

A second important finding is that for all but the post middle education group participant households that live in communities *without* an adult literacy program have substantially

Table 5: Per Adult Equivalent Expenditure by Participation, Program Availability and Education Level within Household

Program Available	Participant	Mean ^a	Min	Max	Std. Dev	N
Complete Sample						
No	No	1,547	170	26,486	1,683	598
	Yes	1,681	270	11,110	1,562	104
Yes	No	1,339	118	12,240	1,004	1,990
	Yes	1,220	183	9,287	1,035	527
	All	1,369	118	26,486	1,189	3,219
Post Middle ^b						
No	No	2,298	256	26,486	3,326	72
	Yes	871	428	1,695	456	8
Yes	No	1,536	208	6,860	1,060	209
	Yes	962	183	2,657	551	34
	All	1,629	183	26,486	1,835	323
Middle ^b						
No	No	1,632	198	7,615	1,360	204
	Yes	1,435	270	11,110	1,655	41
Yes	No	1,388	170	6,009	899	802
	Yes	1,089	236	7,246	783	188
	All	1,385	170	11,110	1,017	1,235
Primary ^b						
No	No	1,474	260	6,072	1,118	69
	Yes	1,895	670	6,884	1,795	11
Yes	No	1,349	247	6,198	999	246
	Yes	1,151	252	8,510	1,126	63
	All	1,355	247	8,510	1,073	389
None ^b						
No	No	1,285	170	9,133	1,236	253
	Yes	2,003	346	6,710	1,488	44
Yes	No	1,224	118	12,240	1,082	733
	Yes	1,377	195	9,287	1,203	242
	All	1,292	118	12,240	1,161	1,272

Note. Participation status reflect whether at least one member has participated in an adult literacy program.

^a Expenditures measured in 1000 Cedis.

^b At least one adult with this level of education and none with more.

higher average consumption than participant households that live in areas with an adult literacy program. The differences are 46, 64 and 32 percent for the no education, primary and middle school groups, respectively. Furthermore, these households constitute more than sixteen percent of all the households that have adult members who have participated in an adult literacy program. As discussed above our instrumental variable estimations essentially ignore this subgroup of participants who appears to do very well compared to other participants.

With the substantial number of individuals who have participated in an adult literacy program, yet live in a community where no program is available, and these participants' overall higher welfare it is worthwhile examining possible explanations for how and why they came to participate. The most obvious explanation is that people travel to neighbouring communities to participate when one is not available in their own community. Second, individuals who have participated somewhere else could migrate in search of better opportunities. Finally, the community questionnaire could have mis-coded the presence of an adult literacy program. Starting with the latter it is difficult to imagine why there would be a correlation between how wealthy a community is and coding errors in the community questionnaire; nonetheless, there are three communities in which eight households (out of twenty) have participated, but where the community questionnaire does not show an adult literacy program. This is, of course, also a possible outcome if individuals travel to nearby communities to participate. Unfortunately there is no information in the GLSS 4 about neighbouring communities or where or when somebody participated in a program, which means that we cannot determine the extent to which this has taken place. We are in a better position to examine migration.²⁴ While the non-participants are similar with respect to migration, fewer participants in areas without a program are born in their current place of residence than participants in areas with a program. Furthermore, substantially fewer have always lived in the village or town they are currently living in and are more likely to have moved away from their current residence for a year or more. Hence, we cannot rule out that the better performance of the participants in communities without a program is due to a combination of both participation in neighbouring communities and selective migration. For both possible explanations it is, however, the case that these participants might be more motivated, which could explain why these participants do better on average both in terms of the consumption of their households and their skill levels as discussed above.

5 Welfare Effects of Participation

The descriptive analyses indicate that while there is only a small effect of attending an adult literacy program on literacy and numeracy the effect on welfare is sizeable. The problem with the cross-tabulations is that they do not take account of the problems of potential endogenous program placement and self-selection into participation and may therefore be biased. Hence, this section presents estimates of the effects of participation on welfare, which is the main outcome of interest. We first present the results with community fixed effects and compare them to the OLS estimates. This is followed by a reduced form analysis and finally by the instrumental variables community fixed effects results.

²⁴The tables are available upon request.

Tables 6 and 7 show the results for the community fixed effects models for the individual and household samples, respectively. When using the full samples the estimated effect of participation in an adult literacy program is equivalent to a more than five percent increase in consumption for both the individual level and household level estimations. Furthermore, this effect is statistically significant for both samples. It is, however, likely that this overall effect masks substantial differences in the effect of participation across different types of households. Hence, as for the descriptive statistics in Tables 4 and 5, we divide the samples into groups depending on the highest education level completed by an adult in the household. The idea behind this is that the marginal effect of participation should be stronger if the human capital level of the household is lower.

The most interesting results are the estimates for the households without completed education. They show an increase in consumption of more than ten percent for the individual level estimation and almost fourteen percent for the household level estimation and both estimates are strongly statistically significant. This effect is substantial, especially considering that most of the literature has found modest or no effect of literacy programs. It is worth keeping in mind, however, that the Ghanaian literacy programs take substantially longer to complete than most and teaches other topics than literacy as detailed in the Introduction. A more suitable comparison might therefore be the return to education in Ghana, which Canagarajah and Thomas (1997) found to be between four and six percent per year of schooling completed. Given the length of the program and the effort required by participants these returns are comparable.

The effect of participation is substantially lower for the other groups and declines with increasing levels of completed education. For primary education households the estimated effect of participation is just over three percent, while the effect of participation for the middle education households is around two percent, although none of these effects are statistically significant. The effect for the “Post Middle” group is negative and large, although again not statistically significant. In interpreting these results it is worth keeping in mind that the samples are relatively small. This might especially be a problem for the “Primary” group since there are only 389 households in that sample but they are spread over 135 communities. Hence, it is possible that the statistical insignificance for this group is mainly due to the small sample size combined with a large number of community fixed effects.²⁵

Comparison of the community fixed effects results with the standard OLS results provides an indication of whether endogenous program placement is a significant problem. Appendix Tables A-1 and A-2 show the equivalent results to Tables 6 and 7 except that community fixed effects are not included. The OLS results show that the estimated average effect of participation in an adult literacy program is about a ten percent increase in consumption per adult equivalent, while the OLS effect for the “No Education” group is over 20 percent. In other words, the OLS estimates are twice the size of the community fixed effects estimates. The large differences between the OLS and fixed effects estimates indicate that endogenous program placement is a real concern in this case and lead to substantial biases in the estimated effects of participation. Furthermore, it appears that programs are allocated, at least

²⁵The “Post Middle” group consists of only 323 households of which 42 have had at least one member participate in an adult literacy program, while in the “Middle” group there are 1235 households with 229 participating.

Table 6: Individual Participation's Effect on Household Welfare - Community Fixed Effects

Variables	Complete Sample	Level of Completed Education in Household ^a			
		Post Middle	Middle	Primary	None
Attended literacy program	0.052** (0.020)	-0.057 (0.055)	0.019 (0.026)	0.031 (0.043)	0.108*** (0.028)
Female	0.020* (0.010)	-0.011 (0.020)	-0.020 (0.015)	0.012 (0.024)	0.044*** (0.015)
Aged 30-44	0.006 (0.015)	0.079** (0.036)	-0.013 (0.023)	-0.063 (0.039)	0.030 (0.029)
Aged 45-59	0.021 (0.016)	0.035 (0.036)	-0.027 (0.023)	-0.036 (0.045)	0.066** (0.030)
Aged 60-99	0.054** (0.021)	0.005 (0.043)	-0.017 (0.032)	-0.078 (0.072)	0.119*** (0.034)
Primary education	0.024*** (0.008)	-0.011 (0.016)	-0.008 (0.010)	-0.013 (0.023)	
Middle education	0.033*** (0.010)	-0.003 (0.023)	-0.011 (0.014)		
Post middle education	0.039*** (0.013)	-0.012 (0.026)			
Owns land	0.044 (0.027)	0.086 (0.104)	0.059 (0.037)	0.092 (0.087)	-0.018 (0.057)
Non-farming household	0.070 (0.046)	0.143 (0.112)	0.119 (0.092)	0.062 (0.167)	-0.077 (0.072)
Percent with primary education	0.052 (0.039)	0.155 (0.264)	-0.001 (0.082)	0.338** (0.145)	
Percent with middle education	0.179*** (0.030)	0.161 (0.151)	0.339*** (0.077)		
Percent with post middle education	0.380*** (0.067)	0.630*** (0.191)			
Household size	-0.089*** (0.008)	-0.077*** (0.016)	-0.084*** (0.010)	-0.089*** (0.025)	-0.112*** (0.012)
Number of adults in household	0.022 (0.014)	0.069** (0.029)	0.022 (0.021)	0.076 (0.056)	-0.015 (0.034)
Constant	14.023*** (0.038)	13.751*** (0.193)	14.030*** (0.083)	13.822*** (0.157)	14.075*** (0.064)
Observations	6713	883	2849	779	2202
Communities	166	127	161	135	162
R-squared	0.19	0.21	0.21	0.16	0.27

Note. Robust standard errors in parentheses. Dependent variable is log of per adult equivalent expenditure per year.

^a At least one adult with this level of education and none with more within household.

* Statistically significant at 10%.

** Statistically significant at 5%.

*** Statistically significant at 1%.

Table 7: Household Participation's Effect on Household Welfare - Community Fixed Effects

Variables	Complete Sample	Level of Completed Education in Household ^a			
		Post Middle	Middle	Primary	None
Attended literacy program	0.055*** (0.021)	-0.108 (0.104)	0.024 (0.035)	0.031 (0.069)	0.139*** (0.027)
Owens land	0.048* (0.026)	0.029 (0.120)	0.052 (0.038)	0.096 (0.091)	0.008 (0.049)
Non-farming household	-0.027 (0.044)	0.016 (0.125)	0.025 (0.072)	0.001 (0.158)	-0.104 (0.075)
Average age 30-34	-0.053** (0.026)	-0.021 (0.105)	-0.063 (0.040)	-0.086 (0.093)	-0.082 (0.056)
Average age 35-39	-0.014 (0.031)	0.272** (0.134)	-0.070* (0.039)	-0.038 (0.096)	-0.008 (0.061)
Average age 40-49	-0.040 (0.031)	0.113 (0.135)	-0.084* (0.047)	-0.192** (0.091)	0.027 (0.055)
Average age 50-59	0.034 (0.035)	0.104 (0.144)	0.014 (0.060)	-0.184 (0.124)	0.038 (0.054)
Average age 60-99	0.075* (0.038)	0.197 (0.220)	-0.031 (0.090)	-0.078 (0.184)	0.072 (0.057)
Percent with primary education	0.121*** (0.037)	0.537** (0.268)	0.028 (0.075)	0.272 (0.183)	
Percent with middle education	0.251*** (0.032)	0.325* (0.196)	0.357*** (0.073)		
Percent with post middle education	0.404*** (0.066)	0.752*** (0.255)			
Household size	-0.118*** (0.006)	-0.095*** (0.019)	-0.103*** (0.010)	-0.118*** (0.020)	-0.144*** (0.010)
Number of adults in household	0.036*** (0.013)	0.064* (0.036)	0.028 (0.020)	0.089 (0.055)	0.021 (0.030)
Constant	14.191*** (0.036)	13.756*** (0.251)	14.147*** (0.083)	14.093*** (0.203)	14.238*** (0.061)
Observations	3219	323	1235	389	1272
Communities	166	127	161	135	162

Note. Robust standard errors in parentheses. A household is considered to have attended if at least one of its members has participated in an adult literacy program.

^a At least one adult with this level of education and none with more within household.

* Statistically significant at 10%.

** Statistically significant at 5%.

*** Statistically significant at 1%.

partly, based on where they would generate the highest return.

5.1 Reduced Form Results

While community fixed effects control for endogenous program placement there is still the potential issue of self-selection into participation based on unobservable characteristics that could also influence the welfare of the household. As we discuss above, finding suitable instruments is a challenge once we include community fixed effects. To provide an idea of how the instruments, exposure interacted with a set of individual and household characteristics, influence welfare Tables 8 and 9 show reduced form estimations with the instruments included instead of participation in adult literacy program. These results are shown only for the “No Education” sample for four models with an increasing number of variables included.²⁶

For the sample of individuals the main statistically significant effects are from the interactions between exposure and being in age group 45 to 59 and household size. The effects for the other two age groups relative to the 18 to 29 age groups are substantially smaller. This seems to indicate that the effect of having an adult literacy program in the community is mainly concentrated in the middle aged group.

The results for the sample of households show a strong effect of exposure interacted with average age of adults being 40 to 49. The estimates for other average age groups interacted with exposure indicate an effect which is almost as large in size, although none of the other age groups interacted with exposure are statistically significant. Finally, note that the interaction variables are jointly statistically significant for the household level estimations but not for the individual level estimations.

5.2 Instrumental Variables Estimations

An important aspect of the instruments is their ability to explain the decision to participate. Tables 10 and 11 show the estimates for individual and household participation together with the χ^2 test statistics for all identifying instruments being jointly equal to zero. In both cases, the instrumental variables perform well for the complete sample and the “No Education” households. The best performance is for the individual sample with only “No Education” households, where the identifying instruments are jointly statistically significant at less than the one percent level, while the corresponding level for the sample of households is worse at the eight percent significance level.

The instruments perform substantially worse for the other three subgroups and are far from being statistically significant.²⁷ A major reason for this poor performance is likely to be the low number of observations, which is exacerbated by our use of community fixed effects which both restricts the number of available instruments and lowers the number of degrees of freedom. This highlights the trade off between controlling for endogenous program placement and controlling for self-selection into program participation when evaluating programs: The more finely we define a community the harder it becomes to find instruments that can be used to deal with unobservable characteristics that influence both participation and the

²⁶The corresponding results for the other groups are available upon request.

²⁷No convergence was achieved for the sample of households where the highest education level was “Post Middle”.

Table 8: Individual Level Reduced Form Effects on Household Welfare for “No Education” Sample - Community Fixed Effects

Variables	Model I	Model II	Model III	Model IV
Female	0.011 (0.025)	0.009 (0.026)	0.009 (0.026)	0.003 (0.026)
Aged 30-44	0.026 (0.050)	0.023 (0.051)	0.023 (0.051)	0.004 (0.049)
Aged 45-59	0.008 (0.051)	0.001 (0.052)	0.001 (0.052)	-0.003 (0.051)
Aged 60-99	0.083 (0.059)	0.075 (0.059)	0.075 (0.059)	0.080 (0.057)
Owns land	-0.021 (0.056)	0.081 (0.089)	0.081 (0.089)	0.084 (0.086)
Non-farming household	-0.091 (0.073)	-0.070 (0.105)	-0.070 (0.105)	-0.064 (0.106)
Household size	-0.113*** (0.012)	-0.113*** (0.012)	-0.113*** (0.012)	-0.091*** (0.017)
Number of adults in household	-0.016 (0.034)	-0.017 (0.034)	-0.017 (0.034)	-0.046 (0.041)
Female × exposure	0.005 (0.004)	0.005 (0.004)	0.005 (0.004)	0.007 (0.004)
Aged 30-44 × exposure	0.002 (0.006)	0.003 (0.007)	0.003 (0.007)	0.008 (0.006)
Aged 45-59 × exposure	0.013* (0.007)	0.015** (0.008)	0.015** (0.008)	0.017** (0.007)
Aged 60-99 × exposure	0.007 (0.008)	0.009 (0.008)	0.009 (0.008)	0.009 (0.008)
Owns land × exposure		-0.021 (0.014)	-0.021 (0.014)	-0.021 (0.014)
Non-farming × exposure		-0.005 (0.018)	-0.005 (0.018)	-0.006 (0.018)
Household size × exposure				-0.005* (0.003)
Number of adults × exposure				0.006 (0.006)
Observations	2202	2202	2202	2202
Communities	162	162	162	162

Note. Robust standard errors in parentheses. Sample consists of households where no adult member has completed any level of schooling.

* Statistically significant at 10%.

** Statistically significant at 5%.

*** Statistically significant at 1%.

Table 9: Household Level Reduced Form Effects on Household Welfare for “No Education” Sample - Community Fixed Effects

Variables	Model I	Model II	Model II
Owens land	0.001 (0.048)	0.110 (0.078)	0.113 (0.078)
Non-farming household	-0.125 (0.077)	-0.104 (0.114)	-0.101 (0.114)
Average age 30-34	0.000 (0.088)	-0.015 (0.091)	-0.034 (0.089)
Average age 35-39	-0.062 (0.096)	-0.059 (0.095)	-0.076 (0.099)
Average age 40-49	-0.060 (0.088)	-0.070 (0.090)	-0.080 (0.090)
Average age 50-59	-0.004 (0.079)	-0.018 (0.082)	-0.023 (0.082)
Average age 60-99	0.012 (0.091)	-0.002 (0.094)	-0.003 (0.094)
Household size	-0.146*** (0.010)	-0.146*** (0.011)	-0.133*** (0.016)
Number of adults in household	0.028 (0.032)	0.028 (0.032)	0.005 (0.039)
Avg age 30-34 × exposure	-0.017 (0.014)	-0.013 (0.015)	-0.010 (0.014)
Avg age 35-39 × exposure	0.012 (0.013)	0.013 (0.013)	0.017 (0.014)
Avg age 40-49 × exposure	0.018 (0.013)	0.021 (0.014)	0.024* (0.014)
Avg age 50-59 × exposure	0.010 (0.012)	0.015 (0.013)	0.017 (0.014)
Avg age 60-99 × exposure	0.012 (0.014)	0.016 (0.014)	0.017 (0.014)
Owens land × exposure		-0.023* (0.013)	-0.023 (0.014)
Non-farming × exposure		-0.004 (0.020)	-0.005 (0.020)
Household size × exposure			-0.003 (0.003)
Number of adults × exposure			0.005 (0.006)
Observations	1272	1272	1272
Communities	162	162	162

Note. Robust standard errors in parentheses. Sample consists of households where no adult member has completed any level of schooling.

* Statistically significant at 10%.

** Statistically significant at 5%.

*** Statistically significant at 1%.

outcomes of interest. As we mentioned above, the standard OLS results are twice as large as the community fixed effects results indicating that endogenous program placement may indeed be a serious concern in this case. There are, however, clearly advantages to using community fixed effects beside accounting for endogenous program placement. In our data, as in most other household surveys, there is little or no information on a number of factors, such as land quality, which may affect the decision to participate and the outcomes. To the extent that most of the variation of these variables is between villages the use of community fixed effects will help alleviate the bias from these unobserved variables.

The effects of the other explanatory variables on participation is generally in line with what we would expect. Females are less likely to participate than males, although it appears that most of this effect comes from the group without any education; for those with post middle, middle school or primary education women are, in fact, more likely to participate although the effect is only statistically significant for the former. As expected, given that we measure age at the time of the survey rather than age when participating in the program, the age profile is relatively flat; it is, however, consistent with the program being in the areas for up to 15 years. The more education an individual has completed the less likely she is to participate. Neither of the variables relating to land are statistically significant.

With respect to the instruments, none of the age groups have a statistically significant effect on participation although the negative estimated effects for the two youngest groups indicate that the longer the program has been available the less age matters for whether somebody has participated, although part of that effect could come from simple age progression where those who participated early move up to another age group. The non-farming interaction with exposure is large and negative relative to the estimated direct effect on participation of being a non-farming household. The likely interpretation is not so much that non-farming households become less likely to participate the longer the program has been available, but rather that the other types of households pull further away from the non-farming ones and that the gap widens over time.

Tables 12 and 13 present the instrumental variable community fixed effects results for the effect of participation on consumption. As is clear from above, the instruments perform satisfactorily only for the complete sample and for the “No Education” group; nonetheless, the estimates for the other groups are included for completeness. Again, the most interesting results are for the “No Education” group. Using the individual level data the estimated effect of participation increases slightly after instrumentation from 0.108 to 0.117, while the household level data shows a decrease from 0.139 to 0.085. As expected, especially given the large number of community fixed effects, the standard errors for both samples increase substantially and none of these effects are statistically significant. Hence, the point estimates still indicate a substantial effect of participation in an adult literacy program on expenditure and it does not appear that there is a large effect of unobservable individual and household characteristics on the participation decision.

In summary, there is a strong effect of participation for households where no adult has completed any level of schooling with an estimated effect of between 8.5 and 14 percent increase in expenditures, depending on specification. The instruments are not strong enough to produce believable results for other households than the no education households

Table 10: Individual Participation in Literacy Program - Community Fixed Effects Logit

Variables	Complete Sample	Level of Completed Education in Household ^a			
		Post Middle	Middle	Primary	None
Female	-0.438*** (0.157)	1.715** (0.873)	-0.120 (0.284)	-0.174 (0.546)	-0.863*** (0.247)
Aged 30-44	0.778*** (0.238)	1.778 (1.455)	0.953*** (0.372)	0.646 (0.937)	0.562 (0.417)
Aged 45-59	1.096*** (0.240)	0.455 (1.145)	1.603*** (0.394)	1.487 (0.915)	0.786* (0.418)
Aged 60-99	0.815*** (0.255)	2.039 (1.405)	1.868*** (0.446)	1.428 (1.011)	-0.156 (0.432)
Primary education	-0.688*** (0.209)	0.646 (0.905)	-0.560* (0.324)	-0.388 (0.405)	
Middle education	-2.254*** (0.199)	-1.795** (0.775)	-2.012*** (0.255)		
Post middle education	-2.932*** (0.503)	-2.291*** (0.835)			
Owns land	-0.007 (0.206)	1.202 (3.005)	0.096 (0.356)	0.326 (0.880)	-0.112 (0.377)
Non-farming household	-0.194 (0.378)	1.426 (3.249)	0.355 (0.750)	.	0.776 (0.587)
Percent with primary education	-0.306 (0.410)	0.682 (4.848)	0.362 (0.940)	0.210 (1.992)	
Percent with middle education	0.547* (0.327)	-0.706 (4.514)	0.042 (0.807)		
Percent with post middle education	0.302 (0.778)	-9.396* (5.293)			
Household size	-0.035 (0.040)	1.081** (0.425)	0.007 (0.065)	-0.152 (0.197)	-0.090 (0.070)
Number of adults in household	0.029 (0.098)	-2.529** (0.996)	0.075 (0.174)	0.451 (0.490)	-0.137 (0.223)
Female × exposure	0.023 (0.022)	-0.168 (0.114)	0.030 (0.039)	0.029 (0.072)	0.020 (0.038)
Aged 30-44 × exposure	-0.016 (0.034)	-0.256 (0.205)	-0.036 (0.052)	0.138 (0.147)	-0.013 (0.061)
Aged 45-59 × exposure	-0.031 (0.035)	0.021 (0.149)	-0.058 (0.054)	0.147 (0.145)	-0.059 (0.063)
Aged 60-99 × exposure	-0.009 (0.037)	-0.271 (0.191)	-0.092 (0.061)	0.136 (0.157)	0.039 (0.065)
Primary (%) × exposure	0.071 (0.048)	-0.597 (0.674)	0.047 (0.113)	0.041 (0.227)	
Middle (%) × exposure	0.025 (0.043)	0.267 (0.733)	0.085 (0.105)		
Post middle (%) × exposure	0.058 (0.107)	1.596* (0.827)			
Owns land × exposure	0.036 (0.031)	-0.407 (0.375)	0.011 (0.054)	0.164 (0.155)	-0.008 (0.056)
Non-farming × exposure	-0.166** (0.072)	-1.167* (0.633)	-0.113 (0.125)	1.395 (179.708)	-0.568*** (0.149)
Household size × exposure	0.014** (0.006)	-0.091 (0.071)	0.009 (0.010)	0.042 (0.030)	0.018* (0.010)
Number of adults × exposure	-0.045*** (0.014)	0.227 (0.143)	-0.044* (0.024)	-0.126* (0.068)	-0.027 (0.034)
Observations	5813	287	2093	360	1598
Communities	145	37	104	49	106
χ^2 test: Instruments = 0	20.47**	10.60	10.13	8.13	20.41***
Prob > χ^2	0.039	0.477	0.429	0.521	0.009

Note. Robust standard errors in parentheses. Dependent variable is whether the individual has participated in an adult literacy program or not.

^a At least one adult with this level of education and none with more within household.

* Statistically significant at 10%.

** Statistically significant at 5%.

*** Statistically significant at 1%.

Table 11: Household Participation in Literacy Program - Community Fixed Effects Logit

Variables	Complete	Level of Completed Education in Household ^a			
	Sample	Post Middle ^b	Middle	Primary	None
Owns land	0.101 (0.235)		0.236 (0.432)	3.227** (1.353)	-0.083 (0.415)
Non-farming household	-0.103 (0.380)		0.319 (0.862)	-20.089 (1, 509.256)	0.569 (0.586)
Average age 30-34	0.100 (0.334)		0.067 (0.546)	-2.782 (1.806)	0.183 (0.676)
Average age 35-39	0.666** (0.315)		1.064** (0.491)	-3.842* (2.127)	0.594 (0.606)
Average age 40-49	0.559* (0.313)		0.728 (0.523)	-3.489* (1.816)	0.327 (0.596)
Average age 50-59	0.684** (0.341)		1.436** (0.635)	-5.687*** (2.197)	0.689 (0.578)
Average age 60-99	0.286 (0.353)		0.495 (0.937)	-2.239 (2.232)	-0.018 (0.567)
Percent with primary education	-0.984** (0.384)		-1.187 (0.997)	0.651 (2.793)	
Percent with middle education	-1.306*** (0.327)		-3.157*** (0.889)		
Percent with post middle education	-2.334*** (0.766)				
Household size	-0.029 (0.047)		0.046 (0.080)	-0.237 (0.295)	-0.096 (0.081)
Number of adults in household	0.518*** (0.113)		0.409** (0.205)	1.979** (0.906)	0.254 (0.238)
Avg age 30-34 × exposure	0.008 (0.049)		0.002 (0.078)	0.588* (0.333)	0.042 (0.101)
Avg age 35-39 × exposure	-0.019 (0.046)		-0.049 (0.071)	1.097*** (0.410)	-0.062 (0.091)
Avg age 40-49 × exposure	-0.073 (0.045)		-0.079 (0.072)	0.962*** (0.356)	-0.075 (0.092)
Avg age 50-59 × exposure	-0.022 (0.050)		-0.062 (0.087)	1.063*** (0.396)	-0.041 (0.088)
Avg age 60-99 × exposure	0.028 (0.054)		0.110 (0.115)	0.872** (0.402)	-0.017 (0.090)
Primary × exposure	0.084 (0.054)		0.119 (0.139)	-0.000 (0.311)	
Middle × exposure	0.015 (0.048)		0.089 (0.120)		
Post middle × exposure	0.130 (0.114)				
Owns land × exposure	0.032 (0.037)		-0.013 (0.065)	-0.316 (0.214)	0.017 (0.064)
Non-farming × exposure	-0.174** (0.070)		-0.135 (0.139)	-0.595 (215.033)	-0.474*** (0.150)
Household size × exposure	0.016** (0.007)		0.011 (0.012)	0.055 (0.048)	0.019 (0.012)
Number of adults × exposure	-0.048*** (0.016)		-0.050* (0.029)	-0.250** (0.126)	-0.029 (0.038)
Observations	2820		891	164	938
Communities	145		102	44	106
χ^2 test: Instruments = 0	22.78**		10.43	10.55	15.45*
Prob > χ^2	0.030		0.492	0.394	0.079

Note. Robust standard errors in parentheses. The dependent variable is whether at least one of the household's members has participated in an adult literacy program or not.

^a At least one adult with this level of education and none with more within household.

^b No convergence was obtained, so results have been excluded.

* Statistically significant at 10%.

** Statistically significant at 5%.

*** Statistically significant at 1%.

Table 12: Individual Participation's Effect on Household Welfare - IV Community Fixed Effects

Variables	Complete Sample	Level of Completed Education in Household ^a			
		Post Middle	Middle	Primary	None
Attended literacy program	0.064 (0.184)	-0.166 (0.153)	-0.129 (0.389)	-0.060 (0.374)	0.117 (0.224)
Female	0.027* (0.014)	-0.008 (0.056)	-0.009 (0.022)	0.007 (0.053)	0.045 (0.035)
Aged 30-44	0.007 (0.018)	0.159*** (0.061)	-0.021 (0.030)	-0.031 (0.082)	0.015 (0.040)
Aged 45-59	0.033 (0.023)	0.100 (0.063)	-0.018 (0.050)	-0.036 (0.132)	0.070* (0.039)
Aged 60-99	0.061*** (0.023)	0.069 (0.079)	0.001 (0.060)	-0.050 (0.136)	0.108*** (0.037)
Primary education	0.030 (0.031)	0.001 (0.109)	-0.019 (0.050)	-0.021 (0.066)	
Middle education	0.042 (0.040)	-0.013 (0.087)	-0.034 (0.079)		
Post middle education	0.051 (0.055)	-0.034 (0.084)			
Owens land	0.037** (0.017)	-0.004 (0.088)	0.072*** (0.027)	0.091 (0.103)	-0.072* (0.039)
Non-farming household	0.055* (0.031)	0.099 (0.149)	0.084 (0.055)	0.072 (0.135)	-0.115* (0.068)
Percent with primary education	0.031 (0.039)	-0.327 (0.233)	-0.019 (0.072)	0.273* (0.150)	
Percent with middle education	0.170*** (0.031)	-0.067 (0.173)	0.292*** (0.056)		
Percent with post middle education	0.312*** (0.059)	0.635*** (0.221)			
Household size	-0.090*** (0.003)	-0.059*** (0.019)	-0.067*** (0.006)	-0.093*** (0.017)	-0.121*** (0.007)
Number of adults in household	0.023*** (0.008)	0.064 (0.040)	0.005 (0.014)	0.085** (0.041)	0.012 (0.020)
Constant	14.031*** (0.043)	13.638*** (0.209)	14.044*** (0.091)	13.833*** (0.159)	14.103*** (0.094)
Observations	5813	287	2093	360	1598
Communities	145	37	104	49	106

Note. Robust standard errors in parentheses.

^a At least one adult with this level of education and none with more within household.

* Statistically significant at 10%.

** Statistically significant at 5%.

*** Statistically significant at 1%.

Table 13: Household Participation's Effect on Household Welfare - IV Community Fixed Effects

Variables	Complete Sample	Level of Completed Education in Household ^a			
		Post Middle ^b	Middle	Primary	None
Attended literacy program	0.570 (0.376)		1.214** (0.608)	0.519 (0.334)	0.085 (0.252)
Owns land	0.018 (0.031)		0.040 (0.063)	-0.043 (0.175)	-0.032 (0.050)
Non-farming household	-0.003 (0.050)		-0.015 (0.113)	0.209 (0.246)	-0.156* (0.080)
Average age 30-34	-0.059* (0.035)		-0.091 (0.072)	-0.062 (0.189)	-0.127* (0.077)
Average age 35-39	-0.042 (0.046)		-0.250** (0.108)	-0.208 (0.211)	-0.041 (0.072)
Average age 40-49	-0.036 (0.034)		-0.159** (0.078)	-0.254 (0.174)	0.033 (0.067)
Average age 50-59	0.020 (0.050)		-0.165 (0.149)	-0.270 (0.188)	0.058 (0.071)
Average age 60-99	0.052 (0.045)		-0.254 (0.184)	-0.303 (0.283)	0.037 (0.063)
Percent with primary education	0.158*** (0.053)		0.123 (0.158)	0.210 (0.297)	
Percent with middle education	0.338*** (0.070)		0.795*** (0.269)		
Percent with post middle education	0.479*** (0.095)				
Household size	-0.123*** (0.007)		-0.110*** (0.018)	-0.127*** (0.032)	-0.151*** (0.010)
Number of adults in household	0.016 (0.020)		-0.009 (0.035)	0.075 (0.086)	0.035 (0.029)
Constant	14.127*** (0.064)		13.771*** (0.239)	14.041*** (0.351)	14.312*** (0.095)
Observations	2820		891	164	938
Communities	145		102	44	106

Note. Robust standard errors in parentheses. A household is considered to have attended if at least one of its members has participated in an adult literacy program.

^a At least one adult with this level of education and none with more within household.

^b No convergence was obtained, so results have been excluded.

* Statistically significant at 10%.

** Statistically significant at 5%.

*** Statistically significant at 1%.

but the results from the standard community fixed effects estimations are interesting.²⁸ The effect of participation for households where the most educated adult has completed primary school is around 3 percent, while for households where the most educated adult has completed middle school the effect is between 1.9 to 2.4 percent. Clearly, the effects are only statistically significant for no education households, but these results show that there might be benefits to participation even for households with higher levels of human capital and in line with the standard theory of decreasing marginal return to human capital the effect of participation declines with prior level of household human capital.

6 What Explains the Effect on Welfare?

This section examines some of the potential pathways through which participation in adult literacy programs affect consumption and whether there are alternative explanations for the effect on welfare. Given that the strongest and most robust results are for the group of households where no adult member has finished even primary school this section focuses on this group. In addition, this group has the highest rate of participation and accounts for over one third of the total sample of households. The section first analyses the effects of participation on literacy and numeracy skills. It then investigates how participation affect business ownership, credit and sale of goods. Finally, the section discusses whether other governmental interventions might be responsible for the positive effect found.

6.1 Participation and Literacy and Numeracy

Tables 14 and 15 present the determinants of literacy and numeracy for individuals living in “No Education” households.²⁹ All models are linear probability models with the first column showing the results using standard OLS, the second column includes community fixed effects and the final column the community fixed effect instrumental variable results using the method described above. There is relatively little difference between the OLS and the fixed effects results for both literacy and numeracy, with the effect slightly smaller for the fixed effects estimates. According to the fixed effects estimates, participation in an adult literacy program increases the probability of being able to read by just over ten percentage points and the probability of being able to do written calculations by around seven percentage points. All of the OLS and fixed effects estimates of the effect of participation are strongly statistically significant.

While there is little difference between the OLS and the community fixed effects results using instrumental variables lead to substantial changes in the estimated effects of participation on literacy. The effect of participation on literacy becomes three times as large, at 36 percentage points, and remains statistically significant. For numeracy the point estimate remains the same as the fixed effects one, but the standard error increases dramatically making the effect far from statistically significant. One interpretation of the increase in the estimated effect on literacy is that unobserved ability is negatively correlated with participation. This could happen if the value of time for a higher ability individual was substantially

²⁸Those estimates obviously do not control for possible self-selection into participation.

²⁹The corresponding results for the other groups are available upon request.

Table 14: Effect of Individual Participation on Individual Literacy for “No Education” Sample - LPM

Variables	OLS	FE	FE-IV ^a
Attended literacy program	0.114*** (0.019)	0.111*** (0.019)	0.364*** (0.112)
Female	-0.050*** (0.009)	-0.052*** (0.009)	-0.034* (0.017)
Aged 30-44	0.014 (0.009)	0.020** (0.010)	0.018 (0.020)
Aged 45-59	0.016 (0.011)	0.010 (0.010)	0.002 (0.020)
Aged 60-99	0.011 (0.011)	0.005 (0.010)	0.018 (0.019)
Owns land	0.027** (0.011)	0.011 (0.016)	0.011 (0.019)
Non-farming household	0.046** (0.018)	0.005 (0.023)	0.051 (0.034)
Household size	0.002 (0.002)	0.001 (0.002)	0.002 (0.003)
Number of adults in household	-0.012** (0.005)	-0.009* (0.006)	0.002 (0.010)
Constant	0.046*** (0.015)	0.057*** (0.017)	-0.042 (0.047)
Observations	2202	2202	1598
Communities		162	106
R-squared	0.07		

Note. Robust standard errors in parentheses. Sample consists of all individuals living in households where none of the adult members have completed primary schooling. All models are linear probability models. Hence, the parameter for “Attended literacy program” shows the predicted increases in the probability of being able to read from having participated in an adult literacy program.

^a First stage estimated using community fixed effects logit shown in Table 10. Predicted probability of participation used as instrument for participation in linear second stage community fixed effect model.

* Statistically significant at 10%.

** Statistically significant at 5%.

*** Statistically significant at 1%.

higher than for a lower ability individual or if the return to participation was expected to be relatively low. While this explanation might be seen as supported by the slight increase in welfare for the individual level estimation when instrumenting it does not explain why there is no change in the estimated effect of participation on numeracy.³⁰ Furthermore, given the descriptive statistics for literacy and participation in adult literacy programs it is hard to

³⁰Note, also that the household level estimations show a decrease in the estimated effect of participation on consumption.

Table 15: Effect of Individual Participation on Individual Numeracy for “No Education” Sample - LPM

Variables	OLS	FE	FE-IV ^a
Attended literacy program	0.097*** (0.020)	0.074*** (0.018)	0.074 (0.115)
Female	-0.063*** (0.011)	-0.075*** (0.011)	-0.083*** (0.018)
Aged 30-44	-0.020 (0.019)	-0.014 (0.015)	-0.008 (0.020)
Aged 45-59	-0.055*** (0.019)	-0.043*** (0.016)	-0.051** (0.020)
Aged 60-99	-0.087*** (0.019)	-0.088*** (0.017)	-0.093*** (0.019)
Owns land	0.041*** (0.014)	-0.035* (0.019)	-0.069*** (0.020)
Non-farming household	0.068*** (0.025)	0.032 (0.028)	0.013 (0.035)
Household size	-0.004 (0.003)	-0.003 (0.003)	-0.004 (0.003)
Number of adults in household	-0.015** (0.006)	-0.000 (0.007)	0.008 (0.010)
Constant	0.166*** (0.025)	0.161*** (0.023)	0.165*** (0.048)
Observations	2202	2202	1598
Communities		162	106
R-squared	0.06		

Note. Robust standard errors in parentheses. Sample consists of all individuals living in households where none of the adult members have completed primary schooling. All models are linear probability models. Hence, the parameter for “Attended literacy program” shows the predicted increases in the probability of being able to do written calculations from having participated in an adult literacy program.

^a First stage estimated using community fixed effects logit shown in Table 10. Predicted probability of participation used as instrument for participation in linear second stage community fixed effect model.

* Statistically significant at 10%.

** Statistically significant at 5%.

*** Statistically significant at 1%.

imagine that there is sufficient bias from selection on unobservables and measurement error to explain the estimated effect.

A substantial part of the problem is likely to be the instruments. Different sets of instruments make the first stage instruments perform substantially worse but do not change the estimated effect of program participation on literacy much.³¹ This reinforces the point

³¹This is only the case for literacy. For welfare and numeracy there are large changes and the estimates

made above that using community fixed effects to control for endogenous program placement makes it more difficult to also take account of self-selection into the programs and this problem is exacerbated when analysing sub-samples, which limits the number of available instruments and observations even further.

Despite these issues it seems clear that participating in an adult literacy program do have positive, albeit small, effects on literacy and numeracy. Given the large effects of participation on welfare, it seems unlikely that these effects are explained solely by the increase in literacy and/or numeracy.³² Therefore, we now turn to the effects of participating in an adult literacy programs on other aspects that might increase household welfare.

6.2 Business Ownership, Credit and Sale of Agricultural Produce

Since the Ghanaian adult literacy programs have a substantial focus on other areas than literacy and numeracy it is worthwhile attempting to further understand how participation in a program affect the households. Income data is available in the GLSS 4 but is of substantially worse quality than the expenditure data which precludes using that to understand how literacy programs work. It is, however, possible to examine whether participation affects factors that can impact income such as whether the household owns a business, its access to and use of credit and whether it sells various goods.

Table 16 presents community fixed effects lineary probability model results for the effects of participation on business ownership and various aspects of credit market participation using the household level data.³³ The outcomes examined are whether the household owns a business (not including agriculture), whether it currently has a loan, if it has had a loan anytime over the twelve months before the survey, what the source of the loan was and for what purpose the loan was taken.

A household is considered to own a business if any member of the household has worked for himself, other than on a farm or raising animals. While there is a three percent increase in the probability of someone in the household being self-employed from having participated in an adult literacy program this effect is not statistically significant. The effect of participation on whether the household owe money to someone is also positive, but again statistically insignificant and small.

For the loan source and loan purpose we use only those households that currently have a loan outstanding since there unfortunately is no information about loans that have been paid off (unless the household has a current loan). This substantially reduces the sample size; there are now only 342 households from 115 communities. For loan sources two possibilities are considered. The first is formal sources, which include state bank, private bank, cooperative, government agency, NGO, business firm or other formal. The increased likelihood of lending from a formal source after participating in a program is small at two percentage points and not statistically significant. The same is the case for having at least one loan which is not from relatives, friends or neighbours.

become too large to be believable.

³²At least that would seem to require that the returns to literacy and numeracy would be a factor ten larger than returns to schooling.

³³Community fixed effects logit results are available on request, but show marginal effects that are qualitatively similarly to the results in Table 16.

Table 16: Business Ownership, Credit and Literacy
Program Participation - Community Fixed Effects LPM

Variables	Owns a	Current	Loan Source		Loan Purpose		
	Business	Loan	Formal ^a	Not family ^b	Investment	Business	Agriculture
Attended literacy program	0.030 (0.031)	0.023 (0.029)	0.020 (0.032)	0.015 (0.063)	0.045 (0.065)	0.006 (0.057)	0.045 (0.050)
Owns land	-0.079** (0.036)	-0.019 (0.033)	-0.040 (0.040)	-0.114 (0.078)	0.132 (0.080)	0.008 (0.071)	0.124** (0.061)
Non-farming household	0.102** (0.050)	-0.095** (0.046)	-0.051 (0.056)	-0.024 (0.110)	0.001 (0.114)	0.163 (0.100)	-0.162* (0.087)
Average age 30-34	0.017 (0.051)	-0.054 (0.047)	0.010 (0.058)	-0.101 (0.113)	-0.133 (0.116)	-0.015 (0.103)	-0.115 (0.089)
Average age 35-39	-0.024 (0.050)	-0.046 (0.046)	0.028 (0.055)	-0.169 (0.107)	-0.046 (0.111)	0.015 (0.097)	-0.057 (0.084)
Average age 40-49	-0.034 (0.048)	-0.011 (0.044)	0.040 (0.052)	-0.115 (0.101)	-0.096 (0.104)	-0.029 (0.092)	-0.062 (0.079)
Average age 50-59	-0.068 (0.048)	-0.030 (0.044)	0.007 (0.051)	-0.074 (0.100)	-0.250** (0.103)	-0.157* (0.091)	-0.099 (0.079)
Average age 60-99	-0.111** (0.046)	-0.203*** (0.042)	-0.003 (0.054)	-0.245** (0.106)	-0.068 (0.109)	-0.103 (0.096)	0.041 (0.083)
Household size	0.015** (0.007)	0.006 (0.007)	-0.028*** (0.008)	-0.001 (0.015)	0.018 (0.016)	0.016 (0.014)	0.000 (0.012)
Number of adults	-0.003 (0.021)	-0.016 (0.019)	0.078*** (0.026)	0.023 (0.050)	0.068 (0.051)	0.023 (0.045)	0.043 (0.039)
Observations	1272	1272	342	342	342	342	342
Communities	162	162	115	115	115	115	115

Note. Robust standard errors in parentheses. Sample consists of households where no adult member has completed primary school. A household is considered to have attended if at least one of its members has participated in an adult literacy program. All models are linear probability models with community fixed effects. Hence, the parameter for “Attended literacy program” shows the predicted increases in the probability from having participated in an adult literacy program.

^a At least one loan obtained from a formal institution, which include state bank, private bank, cooperative, government agency, NGO, business firm and other formal.

^b At least one loan obtained from a source other than relative, friend or neighbour.

* Statistically significant at 10%.

** Statistically significant at 5%.

*** Statistically significant at 1%.

The last three columns show whether participating in an adult literacy program has an effect on the likelihood of obtaining a loan for investment purposes, which consists of two possible uses, business expansion and agriculture.³⁴ Neither of these effects are statistically significant. The effect on business expansion is essentially zero, while there is a much larger effect on the likelihood of using a loan for agricultural investment. The latter increases by 4.5 percentage points and while it is not statistically significant this is hardly surprising given the low number of degrees of freedom after controlling for other characteristics and for community fixed effects.

To examine whether participation lead households to be more engaged in market activities Table 17 shows community fixed effects linear probability model results for the effects of

³⁴Agriculture investments include land, equipment and inputs.

participation on whether the household sell various agricultural goods. The five groups of goods are livestock; grains and cash crops; roots, fruits and vegetables; other produce and processed produce.³⁵ For the first four the household is asked if it has sold any of the goods in the particular category during the twelve months prior to the survey, while for the last category the question is only asked for the two weeks prior to the survey.

Table 17: Sale of Agricultural Goods - Community Fixed Effects
LPM

Variables	Livestock ^a	Grains and Cash Crops ^b	Roots, Fruits and Vegetables ^c	Other Produce ^d	Processed Produce ^e
Attended literacy program	0.073** (0.029)	0.030 (0.029)	0.039* (0.023)	0.043* (0.025)	0.013 (0.023)
Owens land	0.034 (0.033)	0.135*** (0.033)	0.116*** (0.027)	0.015 (0.029)	-0.018 (0.026)
Non-farming household	-0.083* (0.046)	-0.488*** (0.045)	-0.114*** (0.037)	-0.112*** (0.040)	-0.076** (0.036)
Average age 30-34	-0.042 (0.047)	-0.023 (0.047)	0.018 (0.038)	0.038 (0.041)	-0.002 (0.037)
Average age 35-39	-0.007 (0.046)	0.016 (0.046)	0.047 (0.037)	0.021 (0.040)	0.007 (0.037)
Average age 40-49	-0.007 (0.044)	0.006 (0.044)	0.005 (0.035)	0.013 (0.038)	0.008 (0.035)
Average age 50-59	0.014 (0.044)	-0.060 (0.044)	-0.010 (0.035)	0.010 (0.038)	0.043 (0.035)
Average age 60-99	-0.022 (0.042)	-0.059 (0.042)	0.005 (0.034)	-0.057 (0.037)	-0.007 (0.033)
Household size	0.010 (0.007)	-0.006 (0.007)	-0.005 (0.005)	-0.004 (0.006)	0.013** (0.005)
Number of adults	0.049** (0.019)	0.071*** (0.019)	0.031** (0.016)	0.019 (0.017)	0.005 (0.015)
Observations	1272	1272	1272	1272	1272
Communities	162	162	162	162	162

Note. Robust standard errors in parentheses. Sample consists of households where no adult member has completed primary school. A household is considered to have attended if at least one of its members has participated in an adult literacy program. All models are linear probability models with community fixed effects. Hence, the parameter for “Attended literacy program” shows the predicted increases in the probability from having participated in an adult literacy program. For all groups of goods, except for “Processed Produce” the relevant period covered is 12 months. For “Processed Produce” only the last two weeks before the survey are covered.

^a Draught animals (donkey, horse, bullock) cattle (including cows), sheep, goats, pigs, rabbits, chicken, other poultry, other livestock, fish, crab and other.

^b Cocoa, coconut, coffee, cotton, kenef, rubber, wood, groundnut/peanut, maize, rice, sorghum/millet/guinea corn, beans/peas, tobacco, sugar cane and other crops.

^c Avocado pear, bananas, cola nut, mango, oil palm, oranges, pawpaw, plantains, other fruit trees, cassava, cocoyam, onion, swt. potatoes/potatoes, yam, garden eggs/egg plant, leafy vegetables, okro, pepper, tomatoes, other vegetables and pineapple.

^d hunting (including snail collection), honey, drinks (palm wine/akpeteshie, pito, mmedaa, etc), fruit/berries, milk and other dairy products, eggs, hides, wool, skin and mushrooms.

^e Maize flour, flour from other grains, husked/polished rice, home-brewed drink, cassava flour, shelled groundnuts, processed fish, gari, sheabutter, other nuts.

* Statistically significant at 10%.

** Statistically significant at 5%.

*** Statistically significant at 1%.

³⁵A more detailed description of each category is given in the footnotes to the table.

The largest and most statistically significant impact from participation is the increased likelihood that a household engaged in selling of goods in the livestock category (which also includes output from fishing). Households that have participated in an adult literacy program are seven percentage points more likely to have sold some type of livestock over the twelve months prior to the survey. There are also statistically significant effects of participation on the probability that a household have sold roots, fruits and vegetables and other produce over the last year, but for those two categories the effect is smaller at around a four percentage point increase. Interestingly, there is no statistically significant effect of participation on whether the household sells grain and cash crops, although the effect is still positive.

The effect on sale of processed produce is small and far from statistically significant. This is surprising given that one would expect these goods to be higher value goods and to be goods that require more investment and human capital which can be gained through participation in an adult literacy program. A possible explanation for the small, insignificant effect is that only thirteen percent of all households report selling these goods, which may be a result of the short period covered for these goods as mentioned above. It is worth noting that the share of households who sell these goods is almost twice as high among participants as among non-participants (18 vs 10 percent, respectively).

The conclusion is that there is not *one* factor that explains the large, positive effect of participation on household consumption. It does appear that households that have participated are more likely to be engaged in market activities, owning a business and especially getting a loan to invest in agriculture, although none of these effects are statistically significant. There are, however, significant effects on the likelihood of a household selling at least some types of agricultural good, but even here the increases are not large. Hence, as we discuss below, understanding how the adult literacy programs affect household welfare is an important area for future research.

6.3 Other Government Interventions

Clearly, given the available data it is difficult to disentangle how participating in an adult literacy program increases welfare. Part of the effect is likely through skills acquisition, although the effect appears to be too small to explain the entire increase in consumption. Furthermore, while there are positive effects of participation on factors that might be related to business and agriculture these effects are small and only statistically significant for the sale of some types of goods. This makes it more important to examine whether other government programs, interventions or other community characteristics might be responsible for the observed effect. This could, for example, be the case if other programs or interventions were rolled out at the same time and to the same areas as the adult literacy programs. Table 18 therefore shows correlation coefficients for a variety of government programs, interventions and community characteristics for the 166 communities in the base data set.

In addition to adult literacy programs the community characteristics include whether there is a motorable road close to the community, whether there is a bank, daily market, hospital, health post, family planning clinic or agricultural extension center in the community. While there are many community characteristics that are statistically significantly correlated the only characteristic that adult literacy program presence is statistically signifi-

Table 18: Correlation between Community Characteristics

Variables	Motorable Road	Bank	Daily Market	Hospital	Health Post	Family Planning	Agricultural Extension
Motorable road	1.000						
Bank	0.149* (0.056)	1.000					
Daily market	0.176** (0.023)	0.458*** (0.000)	1.000				
Hospital	0.053 (0.497)	0.356*** (0.000)	0.301*** (0.000)	1.000			
Health post	0.230*** (0.003)	0.439*** (0.000)	0.347*** (0.000)	0.101 (0.195)	1.000		
Family planning	0.139* (0.076)	0.433*** (0.000)	0.289*** (0.000)	0.171** (0.028)	0.661*** (0.000)	1.000	
Agricultural extension	0.147* (0.059)	0.381*** (0.000)	0.363*** (0.000)	0.163** (0.037)	0.558*** (0.000)	0.511*** (0.000)	1.000
Literacy program	0.139* (0.074)	-0.108 (0.168)	-0.075 (0.335)	-0.038 (0.624)	-0.016 (0.839)	0.021 (0.791)	0.105 (0.181)

Note. Level of significance in parentheses. Correlation coefficients and level of significance are based on the 166 communities in the base data set.

* Statistically significant at 10%.

** Statistically significant at 5%.

*** Statistically significant at 1%.

cantly correlated with is whether there is a motorable road nearby the community and even that correlation is small at 0.14. The correlation between the availability of an adult literacy program and whether there is a bank in the community is negative and around 0.1, while the correlation with the presence of an agricultural extension program is around the same size but positive. Neither correlation is statistically significant. Hence, it is unlikely that other government programs, interventions or community characteristics are responsible for the positive effect of participation in adult literacy programs.

7 Conclusion

This paper examines the effect of adult literacy program participation on household consumption in Ghana. We use community fixed effects to deal with possible endogenous program placement combined with instrumental variables to account for self-selection into program participation. We find substantial, positive and statistically significant effects on consumption for households where no adult members have completed any formal education. For other households the effects are smaller and not statistically significant and become smaller the more educated the household is. Based on the results our preferred estimated effect of

participation in an adult literacy program is an approximately ten percent increase in per adult equivalent consumption for no education households. For comparison Canagarajah and Thomas (1997) find that the return to education in Ghana is between four and six percent per year. Given the length of the program and the effort required by participants combined with the focus on skills directly applicable to improving participants' welfare these returns are approximately equal.

Another way of looking at the effectiveness of the program is to perform a simple cost-benefit analysis.³⁶ The average cost per participant to the government of Ghana is USD 33.40 (Oxenham 2002). The opportunity cost of participation is based on 21 months of participation at ten hours per week with time valued at the average wage by sex of individuals who have not completed any formal schooling and who reported wage labour.³⁷ Benefits are the net present value of the increase in consumption from when the participants "graduate" from the program until and including age 55 using our preferred estimate of ten percent increase per year. Hence, for, say, a 30 year old participant, we use the net present value of increased consumption from age 32 up to and including age 55. To simplify and keep the results conservative we assume only one adult equivalent in the household; obviously the impacts will be greater for larger families since the results above are per adult equivalent, not only for the participant. We use two levels of pre-participation expenditure: The lower poverty line of 700,000 Cedis per year and the upper poverty line of 900,000 Cedis per year.³⁸ The lowest internal rate of return based on these assumptions is 9.2 percent for a 40 year old male participant who began at the lower poverty line, while the highest is close to twenty percent. These social rates of return are very respectable, especially considering that they do not include other potential benefits from participation than the impact on future productivity and the conservative nature of the assumptions.

The adult literacy programs in Ghana consist of several modules and hence determining what makes the program effective is an important topic for future research. While participants are significantly more likely to be able to read and do written calculations than non-participants, the literacy and numeracy rates for individuals without formal education after participation are not even close to those of individuals who have completed primary school (who have relatively low rates because of the poor quality of schooling). Furthermore, there are no statistically significant effects on variables such as whether the household owns a business or obtains a loan, although participants are significantly more likely to sell some types of agricultural goods. It would therefore be tempting to conclude that the modules on income generating activities are more important for the positive effect of participation than the actual literacy and numeracy skills. While this is certainly a possibility, it is also possible that some or all of the positive effect comes from some other attribute of the program,

³⁶The primary aim here is to illustrate the scale of benefits relative to the total cost of an adult participating in a literacy program, not to conduct a complete cost-benefit analysis, which would require data on many other outcomes besides earnings. For example, we do not include possible effects on health, fertility or the education of children. See, for example, Blunch (2006, 2009) for a discussion of literacy's effect on these outcomes.

³⁷As described above most programs run three times a week with each session lasting up to three hours; adding one hour for transport lead to ten hours a week.

³⁸Table A-3 shows both the net benefits with a discount rate of five percent and the internal rates of returns (the discount rate at which the net present value of the benefits equal the combined costs).

such as an improvement in the participants' network, or even from the combination of attributes. Furthermore, the fact that the effects for households with more educated members are smaller than for the no education households, but still positive, seems to point towards a more standard increase in human capital rather than the income generating modules, especially since one might expect these to be complementary to household human capital. It is, however, clear that it is not other government programs and interventions that drives the effect; there is no significant correlation between having an adult literacy program in the community and all of the other community characteristics except for whether there is a motorable road and that correlation is small.

Part of the explanation for the difficulty in determining the pathways through which program participation affects welfare, is that, in addition to literacy and numeracy, there are up to 28 themes and these can vary by area, but we only have information on participation, with no information on the provider or the timing of the program. A promising direction for future research would be to run randomized experiments with varying combinations of modules to determine which ones are most important. It is already clear, however, that, despite the disappointing results from previous literacy programs, appropriately designed adult literacy programs can be an important component in the effort to improve the livelihood of those that have not participated in the formal education system.

A OLS Estimates and Cost-Benefit Analysis

Table A-1: Individual Participation's Effect on Household Welfare - OLS

Variables	Complete	Level of Completed Education in Household ^a			
	Sample	Post Middle	Middle	Primary	None
Attended literacy program	0.112*** (0.029)	-0.105 (0.096)	0.046 (0.045)	0.002 (0.059)	0.202*** (0.043)
Female	0.056*** (0.010)	0.022 (0.040)	-0.014 (0.012)	0.044* (0.026)	0.123*** (0.025)
Aged 30-44	-0.033 (0.024)	0.121* (0.064)	-0.024 (0.029)	-0.043 (0.052)	-0.067* (0.037)
Aged 45-59	-0.017 (0.016)	0.036 (0.053)	-0.074*** (0.021)	-0.060 (0.057)	0.013 (0.031)
Aged 60-99	0.070*** (0.019)	0.005 (0.062)	-0.104** (0.045)	-0.092 (0.063)	0.167*** (0.036)
Primary education	0.038*** (0.007)	-0.015 (0.019)	-0.029** (0.011)	-0.005 (0.019)	
Middle education	0.062*** (0.007)	0.005 (0.020)	-0.025 (0.016)		
Post middle education	0.080*** (0.009)	0.008 (0.033)			
Owns land	0.116*** (0.020)	0.104 (0.086)	0.148*** (0.036)	0.239*** (0.057)	0.031 (0.044)
Non-farming household	0.299*** (0.035)	0.427*** (0.122)	0.307*** (0.057)	0.172** (0.064)	0.183*** (0.050)
Percent with primary education	0.271*** (0.043)	0.474** (0.210)	0.121 (0.097)	0.410*** (0.119)	
Percent with middle education	0.436*** (0.030)	0.611*** (0.137)	0.530*** (0.063)		
Percent with post middle education	0.589*** (0.061)	1.114*** (0.184)			
Household size	-0.085*** (0.010)	-0.033* (0.018)	-0.076*** (0.011)	-0.097*** (0.020)	-0.108*** (0.012)
Number of adults in household	-0.006 (0.014)	0.017 (0.042)	0.022 (0.021)	0.022 (0.052)	-0.058* (0.034)
Constant	13.895*** (0.050)	13.210*** (0.169)	13.844*** (0.073)	13.884*** (0.153)	14.072*** (0.087)
Observations	6713	883	2849	779	2202
R-squared	0.24	0.27	0.22	0.27	0.28

Note. Robust standard errors in parentheses.

^a At least one adult with this level of education and none with more within household.

* Statistically significant at 10%.

** Statistically significant at 5%.

*** Statistically significant at 1%.

Table A-2: Household Participation's Effect on Household Welfare - OLS

Variables	Complete	Level of Completed Education in Household ^a			
	Sample	Post Middle	Middle	Primary	None
Attended literacy program	0.094*** (0.028)	-0.195* (0.101)	0.031 (0.047)	-0.017 (0.074)	0.202*** (0.045)
Owns land	0.140*** (0.020)	0.139* (0.074)	0.157*** (0.035)	0.232*** (0.056)	0.093** (0.039)
Non-farming household	0.203*** (0.034)	0.330*** (0.095)	0.217*** (0.051)	0.130** (0.058)	0.138** (0.053)
Average age 30-34	-0.079* (0.044)	-0.097 (0.116)	-0.099** (0.039)	-0.058 (0.115)	-0.093 (0.067)
Average age 35-39	-0.077 (0.051)	0.036 (0.121)	-0.119** (0.056)	-0.123 (0.104)	-0.026 (0.073)
Average age 40-49	-0.123*** (0.035)	-0.014 (0.126)	-0.149*** (0.041)	-0.279*** (0.094)	-0.025 (0.076)
Average age 50-59	-0.049 (0.034)	0.123 (0.126)	-0.078 (0.074)	-0.210* (0.102)	-0.028 (0.060)
Average age 60-99	0.096** (0.038)	-0.137 (0.215)	-0.174* (0.098)	-0.034 (0.119)	0.116** (0.054)
Percent with primary education	0.289*** (0.041)	0.374* (0.205)	0.135 (0.092)	0.325* (0.162)	
Percent with middle education	0.456*** (0.030)	0.600*** (0.143)	0.509*** (0.066)		
Percent with post middle education	0.619*** (0.053)	1.053*** (0.188)			
Household size	-0.115*** (0.007)	-0.046** (0.019)	-0.099*** (0.010)	-0.123*** (0.018)	-0.143*** (0.011)
Number of adults in household	-0.006 (0.011)	0.008 (0.037)	0.018 (0.018)	0.028 (0.057)	-0.065** (0.025)
Constant	14.153*** (0.049)	13.467*** (0.188)	14.030*** (0.068)	14.182*** (0.197)	14.327*** (0.079)
Observations	3219	323	1235	389	1272
R-squared	0.30	0.29	0.29	0.33	0.32

Note. Robust standard errors in parentheses. A household is considered to have attended if at least one of its members has participated in an adult literacy program.

^a At least one adult with this level of education and none with more within household.

* Statistically significant at 10%.

** Statistically significant at 5%.

*** Statistically significant at 1%.

Table A-3: Cost-Benefit Analysis
for Adult Literacy Programs

	Females	Males
	Cost	
Direct cost:	33.40	33.40
Opportunity Cost:	42.97	56.48
Total Cost:	76.37	89.88
	Benefits	
Lower poverty line:		
30 year old	160.98	160.98
40 year old	115.48	115.48
Upper poverty line:		
30 year old	206.98	206.98
40 year old	148.48	148.48
	Net Benefits	
Lower poverty line:		
30 year old	84.61	71.10
40 year old	39.11	25.60
Upper poverty line:		
30 year old	130.61	117.10
40 year old	72.11	58.60
	Internal Rate of Return	
Lower poverty line:		
30 year old	14.7	12.2
40 year old	12.3	9.2
Upper poverty line:		
30 year old	19.4	16.3
40 year old	17.6	14.1

Note. All figures are in USD with an exchange rate of 6000 Cedis to one USD.

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