Baseline Report: Quantitative Analysis

EXTERNAL IMPACT EVALUATION OF THE MILLENNIUM VILLAGES PROJECT, NORTHERN GHANA

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Report

Baseline Report – Quantitative Data Analysis

Table of Contents

Tables

Figures

The Household Count

A 'Household Count' was performed on all households in the project and control clusters before the Household Survey. Data were collected using android phones and then exported into a database for sampling purposes. The household count module collects the following information: number of households, total population, under five population, and geographic location of households. This information was used to design the sampling frame of the survey. The data also includes an ID for the household, which is a randomised number assigned to mask the original household identifier. The original census data, prior to anonymisation, also contains names of head of households and geographic GPS coordinates of the house where the interview took place.

From this household listing, 750 households were randomly selected proportionally to village population size in the MV areas. Similarly, 750 households were selected in the near CV areas and another 750 in the far CV areas.

People in Northern Ghana often live in households that live in compounds with other related households. The definition of households in the household count is the restricted household, which consists of a nuclear family with its head separately considered from other households in the same compound.

Note that the information captured in the household count data was collected by enumerators in a rapid assessment and is not as accurate as the information collected in the household roster section of the household questionnaire. However, we compared mean household size and number of children as reported in the census count and in the household roster and found small differences. The average number of household members is 7.15 in the census against 6.74 for the same households in the household roster (P-value=0.004). The average number of children is larger in the census (1.29) compared to the roster (1.09) (P-value=0.000). It is reasonable that a more accurate and larger average is found in the household roster compared to the census. The difference is small and there appears to be no difference when data from the MV and CV sites are compared.

The number of listed households was 12,005, of which 3,901 were listed in the project areas and 8,104 in the control areas.

Note that only 712 of the selected 750 households were interviewed in the project areas. After several attempts and repeated visits to interview the originally selected households, the team decided to collect data only on the available 712 households and no replacement strategy was implemented. Similarly, only 1,466 of the originally selected 1,500 households in the control group were found at the time of the interviews. The total sample size of the survey therefore stands at 2,178 households, of which 32.7% resides in the project areas.

This means that 18.2% and 18.1% of all households were interviewed in project and control areas, respectively.

The vast majority of households have less than 10 members (80%). There are however some very large households and despite the restricted household definition adopted, there are 473 households with more than 15 members.

Table 1. Average household size and number of children under 5 in the household count

	Project	Control	Near control	Far control
Household size	6.80	6.71 (0.269)	6.45*** (0.000)	6.98* (0.069)
Children under 5	1.33	1.18*** (0.000)	1.11*** (0.000)	1.25** (0.010)

Timing of Data Collection

The survey questionnaires were conducted at different time of the year. Table 2 and Table 3 were built using the date of the interview reported in the data file for each interview. Note that the data files on education tests conducted by ISSER do not report the date of interview. However, ISSER reports that data collection took place over just two weeks between 14 November and 2 December 2012. Prior to data collection, the household count and detailed household member listings took place in order to establish sampling frames and identify eligible/target beneficiaries for the household, adult, and blood/anthropometric surveys. The timing was as follows: MV HH Count was conducted between January and February 2012, the MV Detailed Household Member Listings/Registers was conducted in March 2012; the household count for the control localities in the Builsa District was conducted in June 2012; the Detailed Household Member Listings/Registers in Builsa District was conducted over June and July 2012; the household count in the control localities of West Mamprusi was conducted over June and July 2012; finally the Detailed Household Member Listings/Registers in West Mamprusi was conducted in July 2012.

Table 2. Surveys in the MV areas

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Community						100%							
Facilities	30%	60%	10%										
Households					66%	25%	5%	4%					
Adults				42%	40%	16%	1%			1%			
Anthropometry					71%	29%							
Blood tests					68%	32%							
Education tests											90%	10%	

Table 3. Surveys in the Control areas

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Community											100%		
Facilities										5%	60%	10%	25%
Households								22%	77%	1%			
Adults								40%	53%	6%			
Anthropometry								25%	69%	6%			
Blood tests								32%	52%	16%			
Education tests											90%	10%	

Note: percentages for the facility and community surveys are approximations.

We observe several gaps in the data collection in the project and control areas. Several of the outcome variables considered by the evaluation are seasonal in the sense that they are affected directly or indirectly by rainfall patterns. In the MV and CV areas, there is only one rainy season occurring between June and September. Patterns of production and consumption, infection, and disease change considerably during the rainy season. It is therefore unfortunate that, particularly for the household and adult surveys, anthropometric tests and blood tests, were conducted before the rainy season in the project areas and then during or after the rainy season in the control areas.

Household Interviews

The evaluation design set the sample size to 750 households in the MV sites and 1,500 households in the CV sites for a total of 2,250 households. Household interviews took place from May to December 2012 after conducting a household census in the selected sites. The survey team led by the Earth Institute (EI) followed a protocol whereby households not found are visited up to three times before being dropped out of the sample but no replacements are made for those households that are not eventually found. This resulted in a reduction of the baseline sample size to 5.1% in the project group and to 2.3% in the control group. Table 4 reports the number of individuals covered by the survey and only considers household members to be individuals who have lived in the household for at least six months over the last year.

Table 4. Planned and actual household interviews

	MV	CV	CV Near	CV Far	ALL
Planned interviews	750	1500	750	750	2250
Actual interviews	712	1466	738	728	2178
Individuals	5,059	10,120	5,006	5,331	15,179

Note that the data provided by the EI do not report information on the households that were not interviewed and the reasons for not interviewing them, despite the fact that some information should have been collected in the cover page or the household questionnaire.

Demographic Characteristics

Table 5. Demographic characteristics

	MV	CV	CV Near	CV Far
Household size	7.1	6.9	6.6**	7.2
	(0.135)	(0.103)	(0.126)	(0.163)
Number of under-5	1.0	1.0	0.9	1.1
Female-headed	0.09	0.12	0.11	0.12*
household	(0.011)	(0.008)	(0.011)	(0.012)
Polygamous	0.22	0.21	0.18*	0.23
	(0.016)	(0.011)	(0.014)	(0.016)

Migration

We found that of all individuals interviewed only 170 (1.1%) of the whole population had moved at anytime in the past year. The reason for moving was marriage in 80% of cases whilst work and school were also mentioned. The average number of individuals moved in the household was statistically significantly larger in MV areas but the differences are very small.

Table 6. Average number of individuals moving in the household

	MV	CV	CV Near	CV Far
Number of in-migrants	0.10	0.07**	0.07*	0.07
per household	(0.53)	(0.31)	(0.29)	(0.32)

Nearly 5% of individuals moved out of the household for some time during the year preceding the interview. In 50% of cases, they moved for working reasons and in 20% of cases to attend school. There is a slightly larger number of migrants from the MV areas. The characteristics and reasons for migrating from the two areas are almost identical.

Table 7. Number and type of out-migrants

	MV	CV	CV Near	CV Far
Number of out-	0.46	0.30**	0.28**	0.32**
migrants per house	(0.93)	(0.83)	(0.76)	(0.89)
Percentage female	52.6	55.5	58.1	53.2
	(50.0)	(49.7)	(49.5)	(50.0)
Average age	22.3	23.4	23.6	23.2
	(12.2)	(13.4)	(12.8)	(14.0)
Percentage migrating	51.4	48.8	54.8	43.3
for work	(50.1)	(50.0)	(49.9)	(49.7)
Percentage migrating	18.5	18.2	19.0	17.6
for schooling	(38.9)	(38.7)	(39.4)	(38.2)

Education

We look at the following variables: the percentage of the population over five years of age who ever attended school; average number of school years for all population over five years of age; average number of school years for population over five years of age that ever attended school; net attendance in primary school; net attendance in Junior High School (JHS); net attendance in Senior High School (SHS); whether the school provided meals; and the average distance to school in minutes. Net attendance rates are calculated using a denominator for the children in the age range of the official school age for each school level and a denominator for the number

of children within the age range attending that school level. For example, the NAR in primary is the number of children age six to 11 attending primary divided by the number of children age six to 11 in the population. Note that the use of other indicators such as GER or general attendance rate would produce different figures because of the large numbers of late entrants and repeaters.

There are significant differences in attendance rates. These differences are likely to be the results of the data being collected at different times of the year. The school calendar in basic education normally states that school starts in early September. Interviews in control villages were conducted mostly in September whilst they were mostly conducted in May and June in the MVP areas. This implies that for a given age range, children in control areas had more opportunity to start schooling and be in schools.

Table 8. Summary of education indicators

	MV	CV	CV Near	CV Far
% over-5 ever attended school	49.9 (50.0)	53.5*** (49.9)	57.1*** (49.5)	50.1 (50.0)
Average years of schooling	1.9 (3.0)	1.9 (3.2)	1.7** (3.0)	2.2** (3.4)
Average years of schooling (ever attending school pop.)	3.9 (3.4)	4.3*** (3.6)	4.1** (3.5)	4.5*** (3.6)
NAR primary	60.5 (48.9)	68.9*** (46.3)	65.3** (47.6)	72.4*** (44.7)
NAR JHS	9.7 (29.7)	15.4** (36.1)	13.9 (34.3)	17.0** (37.6)
NAR SHS	5.0 (21.9)	6.8 (25.2)	7.4 (26.2)	6.3 (24.3)
Percentage school meals	33.5 (47.1)	19.9*** (40.0)	16.2*** (36.9)	23.4*** (42.1)
Average distance to school (minutes)	33.1 (38.0)	31.8 (35.9)	28.1*** (27.8)	34.9 (41.2)

Time Use

The questionnaire collected information on the time spent on a series of household chores by each household member over the week preceding the interview. We added the time spent by all household members and compared the averages across the groups. Water collection is the only task for which there are no differences across groups. There are large differences in caring for children and the elderly and moderate differences for fetching wood and cooking, and then minor differences in cleaning. Some of these results might be driven by outliers or errors in reporting, but seasonal patterns may also be at play.

Table 9. Total household time spent on task (minutes per day)

	MV	CV	CV Near	CV Far
Fetching wood	170	211**	197**	225***
	(214)	(265)	(263)	(266)
Collecting water	182	185	173	198
	(246)	(230)	(182)	(270)
Cleaning	106	126**	118*	134**
	(138)	(176)	(122)	(218)
Cooking	191	235***	233**	238**
	(201)	(239)	(215)	(261)
Taking care of	172	251***	254***	248***
children	(282)	(425)	(433)	(416)
Taking care of elderly	61	144***	199***	89*
and sick relatives	(273)	(559)	(700)	(356)

Economic Shocks

Table 10. Households affected by economic shocks

	MV	CV	CV Near	CV Far
Drought %	76.0	83.0**	86.4***	79.1
	(42.7)	(37.6)	(33.8)	(40.7)
Floods %	57.2	54.7	63.0**	46.3***
	(49.5)	(49.8)	(48.3)	(49.9)
Severe storm %	63.2	62.3	65.9	58.8*
	(48.3)	(48.5)	(47.5)	(49.3)
Livestock death %	86.5	73.6***	75.7***	71.4***
	(34.2)	(44.1)	(42.9)	(45.2)
Crop failure %	72.5	63.2***	64.6**	61.8***
	(44.7)	(48.2)	(47.8)	(48.6)

Water, Sanitation, and Energy

We adopted the Millennium Development Goals (MDG) definition of access to safe drinking water as the proportion of the population using an improved drinking water source. Water sources include: piped water into dwelling, plot or yard; public tap/standpipe; borehole/tube well; protected dug well; protected spring; rainwater collection, and bottled water. It does not include unprotected wells, unprotected springs, water provided by carts with small tanks/drums, tanker truck-provided water, and bottled water or surface water taken directly from rivers, ponds, streams, lakes, dams, or irrigation channels.

Table 11. Water access

	MV	CV	CV Near	CV Far
Households with	73.2	72.2	70.6	73.9
improved water %	(44.3)	(44.8)	(45.6)	(43.9)
Distance to water	32	27**	29*	25**
source (minutes)	(42)	(31)	(35)	(26)
Households treating	11.7	15.8**	16.0**	15.7**
water %	(32.1)	(36.5)	(36.7)	(36.4)

We adopt the MDG definition of improved sanitation facility. The proportion of the population using an improved sanitation facility is the percentage of the population with access to facilities that hygienically separate human excreta from human contact. Improved facilities include flush/pour flush toilets or latrines connected to a sewer, septic tank or pit; ventilated improved

pit latrines; pit latrines with a slab or platform of any material which covers the pit entirely, except for the drop hole, and composting toilets/latrines. Unimproved facilities include public or shared facilities of an otherwise acceptable type, flush/pour flush toilets or latrines which discharge directly into an open sewer or ditch, pit latrines without a slab, bucket latrines, hanging toilets or latrines which directly discharge in water bodies or in the open and the practise of open defecation in the bush, field or bodies or water.

Table 12. Sanitation facilities

	MV	CV	CV Near	CV Far
Improved sanitation facility %	10.1 (30.2)	10.4 (30.5)	12.5 (33.1)	8.2 (27.5)

Table 13. Energy use

	MV	CV	CV Near	CV Far
Households using firewood for cooking %	98.5 (12.3)	98.0 (14.2)	98.0 (14.2)	97.9 (14.2)
Households using batteries for lighting %	88.6 (31.8)	84.7** (36.1)	87.4 (33.2)	81.9** (38.6)

Housing Conditions and Assets

We looked at the percentage of houses with finished walls (cement, stone, bricks, or wood planks), finished floors (wood, vinyl, asphalt, ceramic, cement, and carpets), and finished roofs (metal, wood, cement, ceramic, and shingles).

Table 14. Housing conditions

	MV	CV	CV Near	CV Far
Finished walls %	20.2 (40.2)	20.8 (40.6)	25.5** (43.6)	18.1** (36.8)
Finished floors %	42.1 (49.4)	50.1** (50.0)	47.4** (50.0)	52.9*** (50.0)
Finished roofs %	36.7 (48.2)	38.5 (48.7)	45.1** (49.8)	31.9* (46.6)

We considered a limited number of household assets. Several household assets such as computers, cameras, televisions, generators, refrigerators, and vehicles were not considered because very few households own them.

Table 15. Housing conditions

	MV	CV	CV Near	CV Far
Table	61.9	51.8***	48.6***	55.1**
	(48.8)	(50.0)	(50.0)	(50.0)
Bed	41.1	43.1	43.6	42.6
	(49.2)	(49.5)	(49.6)	(49.5)
Kerosene lamp	21.6	20.0	17.9*	22.1
	(41.2)	(40.0)	(38.3)	(41.5)
Radio	48.6	48.4	45.0	51.9
	(50.0)	(50.0)	(49.8)	(50.0)
Mobile phone	58.7	49.0***	52.6**	45.3***
	(49.3)	(50.0)	(50.0)	(49.8)
Animal cart	16.9	10.6**	10.7**	10.6**
	(37.5)	(30.8)	(30.9)	(30.8)
Bicycle	81.3	75.9**	75.9**	76.0**
	(39.0)	(42.8)	(42.8)	(42.7)
Motorbike	10.9	10.7	12.7	8.7
	(31.3)	(30.9)	(33.4)	(28.1)
Total value of assets	183	156*	154*	160
($PPP)	(328)	(353)	(241)	(438)

Savings

Table 16. Household savings

	MV	CV	CV Near	CV Far
Household has a bank	15.6	10.8**	11.4**	10.2**
account %	(36.3)	(31.0)	(31.8)	(30.2)
Household is member	15.0	8.5***	8.8**	8.1***
of *susu* %	(35.8)	(27.8)	(28.4)	(27.3)
Average savings	23	15*	11**	19
($PPP)	(116)	(93)	(55)	(120)

Credit

Table 17. Loans, credit sources, and use

	MV	CV	CV Near	CV Far
Any loan over last 12	4.9	3.3*	3.8	2.9**
months %	(2.2)	(1.8)	(1.9)	(1.7)
Loan size ($PPP)	200	258	135*	388*
	(198)	(421)	(93)	(574)
Microfinance source	2.9	1.2**	1.2**	1.2**
	(1.1)	(1.7)	(1.1)	(1.1)
Informal source	0.8	2.1**	1.9*	2.3**
	(1.4)	(0.9)	(1.4)	(1.5)
Agricultural use	1.8	1.4	1.7	1.1
	(1.3)	(1.2)	(1.3)	(1.0)
Business use	2.5	1.8	1.9	1.8
	(1.6)	(1.3)	(1.4)	(1.3)

Land and Agriculture

Table 18. Land and land use

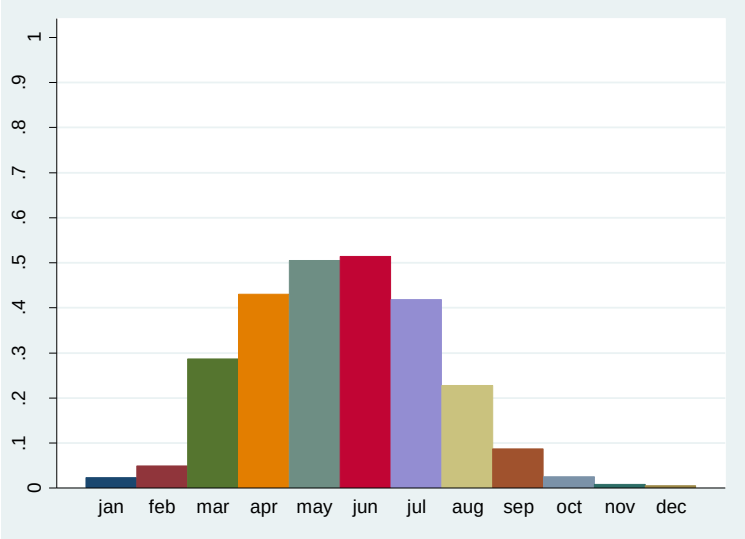
	MV	CV	CV Near	CV Far
Land owned	4.8	4.5	4.4	4.7
(hectares)	(6.5)	(6.0)	(4.7)	(7.0)
Cultivated land	3.4	3.0**	3.2	2.7***
(hectares)	(2.7)	(2.5)	(2.3)	(2.7)
Number of plots	2.9	2.6***	2.5***	2.7**
	(1.2)	(1.2)	(1.2)	(1.2)

Expenditure Data

Food security

Figure 1 shows the percentage of households reporting not having enough food to meet family needs by month. The period from April to July is the 'hungry' period. The bias introduced by interviewing households at different time of the year is obvious in this figure.

Figure 1. Percentage of households reporting not having enough food by month



Despite the pattern above, quite remarkably there are no large differences in the answers to food security questions even though the surveys were conducted in the hungry and the harvest periods, respectively, in the project and control areas. This is particularly remarkable in the case of the following question: How many days in the last 30 days did you not have enough food to meet your family's needs? This obtained very similar responses in the project and control areas despite being asked in the 'hungry' and in the 'harvest' seasons, respectively (also contrasts with the results of Figure 1 – MV survey was in May-June and CV survey was in August-September).

Table 19. Food security

	MV	CV	CV Near	CV Far
Not enough food in any month over last year %	82.2 (38.3)	84.6 (36.1)	80.4 (39.8)	88.9** (31.5)
Days with not enough food over last 30 days	12.2 (10.4)	13.1 (10.5)	12.8 (10.2)	13.3* (10.8)
Any day a child went hungry the whole day %	16.4 (37.1)	14.8 (35.5)	12.2** (32.7)	17.4 (38.0)
Ever reduced meal size %	74.4 (43.7)	75.9 (42.8)	68.6** (46.5)	83.4*** (37.4)

Benford's Law and expenditure

We compared the patterns of first digits of quantities of purchased and own-consumed food items to a theoretical Benford distribution. First digits tend to follow the distribution quite closely when quantities of consumed or produced food items are considered. The difference between the observed distribution and the theoretical Benford distribution is tested using a chi-square test and a Kuiper's test. Additionally, a number of measures of the distance of the empirical distribution to the Benford distribution are presented.

Figure 2. Observed and Benford distributions compared: food purchases

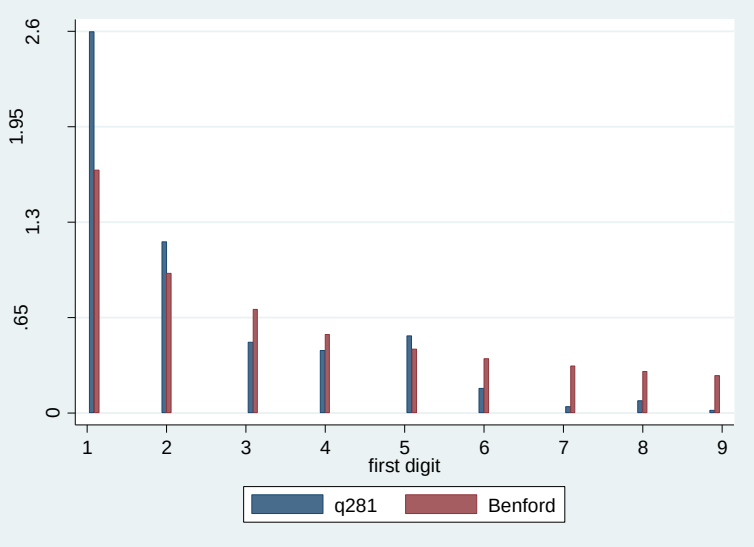


Figure 3. Observed and Benford distributions compared: food purchases

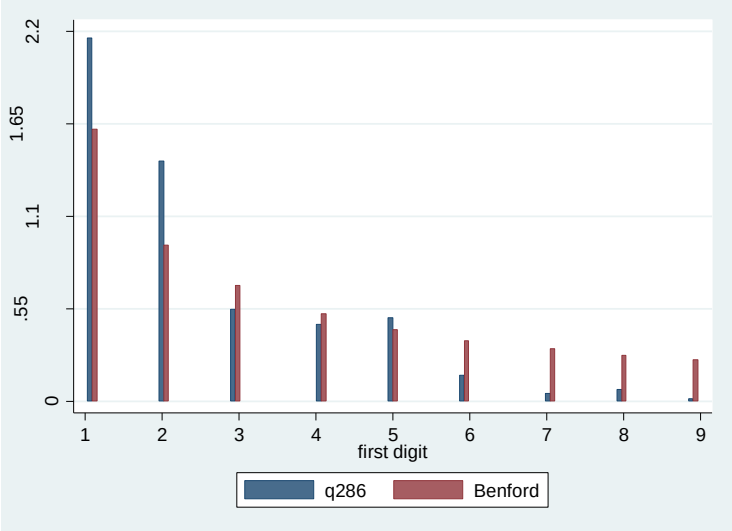


Table 20 compares the tests of equality of the two distributions of the MV data with data collected by the ISSER survey in 2009 and by the GSS in 2005. Only observations from rural households from the Northern, Upper East, and Upper West regions were considered in order to make them more comparable with the MV datasets. Similar to the MV datasets, the expenditure modules of ISSER and GSS also employ a variety of local units of measurement for the items purchased. The recall periods used however are very different. The GSS employed diaries with repeated visits and a recall of 15 days. We only used data from the first visit. The GSS did not collect food quantities purchased but only their value. The ISSER questionnaire employed a 30-day recall. The MV questionnaire employed a recall consisting of the quantity purchased and consumed in a typical month for the months it was purchased or consumed.

Table 20. Quality analysis of expenditure data based on Benford's Law of three different datasets

	Obs	M distance	D* distance	Chi-square	Kuiper's test
Purchases					
GSS 2005	-			-	-
ISSER 2009	12,585	0.093	0.124	2,110.2***	16.9***
EI 2012	29,298	0.201	0.171	7,414.0***	36.1***
MV areas	9,282	0.170	0.183	2,272.8***	19.3***
CV areas	6,108	0.172	0.187	5,181.2***	30.5***
Own consumption					
GSS 2005	4,769	0.104	0.146	1,095.0***	11.3***
ISSER 2009	3,679	0.044	0.092	455.7***	7.6***
EI 2012	19,107	0.101	0.151	4,222.0***	26.9***
MV areas	6,108	0.117	0.156	1,516.8***	14.9***
CV areas	12,999	0.115	0.153	2,794.2***	22.3***

In all cases, the Benford and observed distributions are very different at 1% statistical significance. Values of statistical tests increase with sample sizes and therefore cannot be used to compare the quality of the different datasets against the Benford's benchmark. For comparison purposes, we use the maximum distance (m) and the Euclidean distance (D*). Based on these two measures, the MV data appear to be less accurate than the ISSER data but of

comparable quality to the GSS data. More importantly, we calculate the different measures separately for the MV and CV sites of the EI survey because the surveys were conducted at different times of the year and by slightly different teams of enumerators. We find no differences in the quality of MV and CV data based on these measurements.

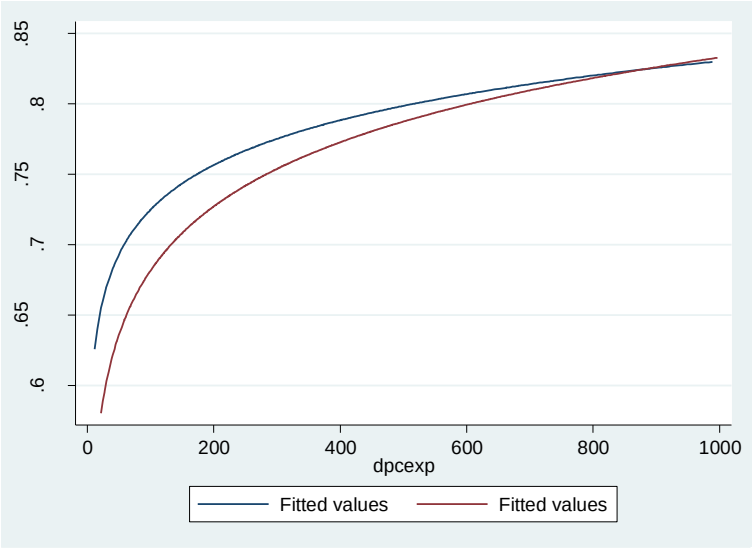
Table 21. Poverty indicators

	Poverty headcount	Poverty gap	Squared poverty gap	Gini coefficient
EI survey	56.6	26.2	15.6	0.46
MV villages	59.7	28.8	17.6	0.48
CV villages	55.1	25.0	14.7	0.44
CV Near	53.4	24.5	14.4	0.45
CV Far	56.8	25.4	15.0	0.43

Table 22. Expenditure variables

	MV	CV	CV Near	CV Far
Per capita expenditure	549	564	585	542
($PPP)	(653)	(529)	(558)	(497)
Food share	0.78	0.77	0.77	0.77
	(0.17)	(0.17)	(017)	(0.18)
Share of own	0.65	0.66	0.65	0.68
produced food	(0.27)	(0.25)	(0.26)	(0.23

Figure 4. Food share Engel curves in MV and CV areas



F-test 5.43**

Income data

Employment Rates

Table 23. Main occupation of household members

	MV	CV	CV Near	CV Far
Employment rate %	77.5	78.1	79.1	77.2
(age 15 to 59)	(41.8)	(41.3)	(40.7)	(41.9)
Child employment %	24.2	20.0**	22.0	18.0***
rate (age 6 to 14)	(42.8)	(40.0)	(41.4)	(38.4)
Farmers %	91.0	95.2***	93.8**	96.6***
	(28.6)	(21.3)	(24.1)	(18.2)
% doing paid work	2.8	2.1**	2.3*	2.0**
	(16.6)	(14.4)	(14.8)	(13.9)

Micro enterprises

Table 24 reports the percentage of household running a microenterprise and the three main enterprise types.

Table 24. Household enterprises

	MV	CV	CV Near	CV Far
% of households with	20.4	18.2	14.6**	21.8
a microenterprise	(40.3)	(38.6)	(35.4)	(41.3)
Of which trading %	46.6	40.2	36.9*	42.0
	(50.0)	(49.1)	(48.4)	(49.5)
Of which retailing and	19.3	17.1	20.8	15.0
services %	(39.8)	(37.7)	(40.7)	(35.8)
Of which agricultural	20.5	22.5	26.9	19.9
processing %	(40.5)	(41.8)	(44.5)	(40.0)

Note: agricultural processing refers to agroprocessing codes in the household questionnaire including the processing of cassava, oils, and other grains.

Figure 5. Observed and Benford distributions compared: food purchases

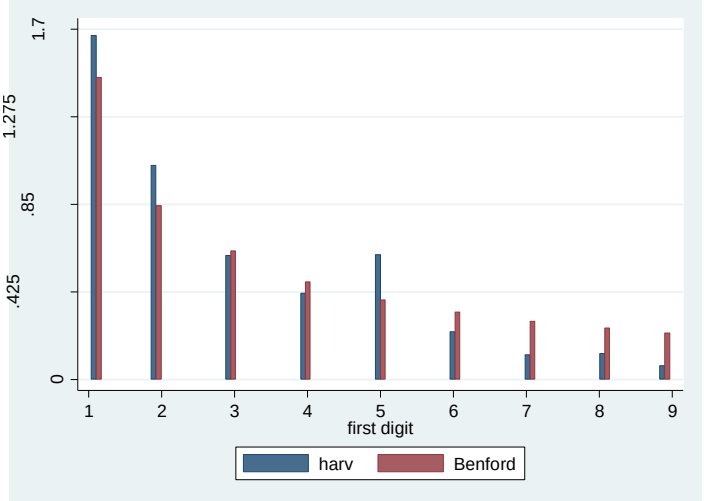


Table 25. Quality analysis of expenditure data based on Benford's Law of three different datasets

	Obs	M distance	D* distance	Chi-square	Kuiper's test
Harvested q					
GSS 2005	8,254	0.028	0.041	257.2***	4.2***
ISSER 2009	3,327	0.033	0.070	223.5***	5.6***
EI 2012	7,528	0.045	0.086	761.6***	9.7***
MV areas	2,651	0.048	0.084	280.7***	5.9***
CV areas	4,877	0.057	0.092	509.9***	7.7***

Table 26. Income

	MV	CV	CV Near	CV Far
Per capita income	157	151	131	171
($PPP)	(466)	(742)	(431)	(959)
Farming share	61.3	66.0**	68.8**	63.5
	(33.9)	(32.9)	(31.2)	(34.2)
Livestock share	26.3	21.2***	21.1**	21.4**
	(30.4)	(26.5)	(26.6)	(26.5)
Labour share	4.9	4.3	3.8	4.9
	(17.5)	(16.6)	(14.8)	(18.3)
Business share	6.3	6.4	4.5**	8.4*
	(18.9)	(18.5)	(15.2)	(21.2)
Transfers share	0.8	0.6	0.4*	0.9
	(6.5)	(3.8)	(2.9)	(4.6)

Note: negative shares and shares above 1 were dropped before calculating averages.

Table 27. Agricultural income and input use

	MV	CV	CV Near	CV Far
Agricultural profits	600	501	608	392
($PPP)	(1827)	(1617)	(2203)	(569)
Marketed surplus %	21.9	24.6**	24.2*	24.9**
	(23.4)	(27.0)	(28.5)	(25.5)
Seeds inputs ($PPP)	13.4	14.1	13.5	14.7
	(45.2)	(68.6)	(90.9)	(33.3)
Chemical fertiliser	28.8	34.7*	29.6	39.8**
($PPP)	(77.5)	(72.0)	(69.7)	(74.0)
Herbicides and	24.8	15.7***	17.7**	13.7***
pesticides ($PPP)	(39.0)	(28.4)	(31.9)	(24.3)
Labour inputs ($PPP)	25.8	9.6***	10.1***	9.1***
	(71.1)	(22.1)	(25.5)	(18.3)

Social Networks

In 50% of cases when help is sought or provided, it consists of advice in general or in relation to farming. In 30% of cases, it consists of giving or receiving gifts. In only a few cases it consists of borrowing or other economic related reasons.

Table 28. Social networks

	MV	CV	CV Near	CV Far
Any important people	76.0	83.5***	78.0	89.0***
living elsewhere? %	(37.1)	(42.7)	(41.4)	(31.3)
Of which distant	55.2	64.6***	68.1***	60.9**
relatives %	(49.7)	(47.8)	(46.6)	(48.8)
Of which friends %	21.2	20.6	14.9**	26.5**
	(40.8)	(40.5)	(35.6)	(44.2)
Asked for any help over	45.0	45.7	38.7**	53.0**
last 12 months? %	(49.0)	(49.8)	(48.7)	(50.0)
Provided any help over	53.0	50.4	41.8***	59.3**
last 12 months? %	(50.0)	(50.0)	(49.3)	(49.1)

Trends Analysis

Table 29. Trends in employment income ($PPP)

	MV	CV	CV Near	CV Far
Employment income	218	226	136	317
at baseline	(1916)	(1791)	(1548)	(2004)
Employment income	164	132	59*	205
at baseline -1	(1032)	(1476)	(471)	(1382
Employment income	140	95	40*	151
at baseline -2	(1541)	(864)	(393)	(1158)

Table 30. Trends in enterprises income ($PPP)

	MV	CV	CV Near	CV Far
Enterprise income at	750	1001	591	1279*
baseline	(2445)	(1459)	(1284)	(2984)
Enterprise income at	266	284	248	308
baseline -1	(318)	(377)	(398)	(365)
Enterprise income at	192	262	212	296*
baseline -2	(219)	(392)	(412)	(370)

Data on agricultural production could not be used because they are not sufficiently clean. There are a lot of incongruent values among prices and quantities.

Note that cows include local and improved cows. Similarly, goats include local and improved goats, whilst chicken includes chicken and guinea fowls. Note also that these are the most common animals and that the trend data were not collected for all animals as in the case of the baseline.

Table 31. Trends animal holdings and value

	MV	CV	CV Near	CV Far
Cows at baseline	3.2	2.6*	2.7	2.5*
	(7.3)	(5.9)	(5.8)	(6.0)
Cows at baseline -1	3.8	2.7**	2.6**	2.9
	(11.5)	(6.8)	(6.2)	(7.4)
Cows at baseline -2	3.2	2.3	2.0**	2.7
	(12.5)	(10.7)	(6.2)	(14.0)
Goats at baseline	4.4	4.3	4.6	4.0
	(4.9)	(4.8)	(4.6)	(4.9)
Goats at baseline -1	5.7	4.7**	4.9*	4.3**
	(7.7)	(6.9)	(7.3)	(6.4)
Goats at baseline -2	4.5	3.5**	3.3**	3.7*
	(6.6)	(7.1)	(6.9)	(7.4)
Chickens at baseline	12.2	12.5	12.2	12.9
	(12.2)	(14.7)	(13.9)	(15.4)
Chickens at baseline -1	15.4	14.6	13.0**	16.2
	(22.6)	(20.8)	(18.0)	(23.3)
Chickens at baseline -2	12.6	9.7**	8.0**	11.5
	(26.6)	(18.8)	(15.2)	(21.8)
Value at baseline	1,209	1,136	1,226	1,041
($PPP)	(3501)	(2673)	(2862)	(2458)
Value at baseline -1	1,028	1,005	1,068	938
($PPP)	(2284)	(2548)	(2583)	(2511)
Value at baseline -2	744	683	706	660
($PPP)	(2130)	(2447)	(2542)	(2345)

Malaria and Anaemia

Mosquito nets

The table below reports the share of households having at least one mosquito net, the average number of mosquito nets among those households having a mosquito net, and the fraction of sample households whose wall**s** were sprayed using insecticide.

Table 32. Mosquito nets

	MV	CV	CV Near	CV Far
Household has a	81.3	90.2	94.7	85.7
mosquito net %	(39.0)	(29.7)	(27.4)	(35.0)
Average number of	2.9	2.8	2.8	2.8
mosquito nets	(1.5)	(1.4)	(1.4)	(1.4)
Someone sprayed the	41.1	50.1	49.3	50.8
walls %	(49.2)	(50.0)	(50.0)	(50.0)

Anaemia

Blood samples were taken from 381 children in MV areas and 409 children in CV areas representing 53% and 28% of children in MV and CV areas, respectively. Following DHS standards, mild anaemia is calculated as the ratio of children with haemoglobin below 11 g/dL, moderate anaemia is haemoglobin below 10 g/dL, and severe anaemia is haemoglobin below 7 g/dL.

Table 33. Prevalence of anaemia among children under 5

	MV	CV	CV Near	CV Far
Haemoglobin	10.0	9.5***	9.4***	9.5***
	(1.51)	(1.41)	(1.52)	(1.30)
Mild anaemia	74.0	84.3***	84.8**	83.7**
	(0.44)	(0.36)	(0.36)	(0.37)
Moderate anaemia	45.7	61.9***	63.1***	60.6***
	(0.50)	(0.49)	(0.48)	(0.49)
Severe anaemia	3.9	5.2	6.9*	3.4
	(0.19)	(0.22)	(0.25)	(0.18)
Observations	385	420	217	203

[a] Haemoglobin is a protein in blood cells carrying oxygen and is measured in grams per decilitre (g/dL).
[b] Prevalence rates. The DHS classifies anaemia as mild (<11 g/dL), moderate (<10 g/dL), and severe (<7 g/dL).

Table 34. Haemoglobin by age

	MV	CV
Age 0	9.8	9.7
	(1.45)	(1.20)
Age 1	9.3	9.3
	(1.55)	(1.38)
Age 2	10.0	9.2***
	(1.42)	(1.43)
Age 3	10.3	9.5***
	(1.41)	(1.47)
Age 4	10.4	9.6**
	(1.54)	(1.39)

Malaria

Blood samples were taken from 805 children under the age of five (385 from the MV villages and 420 from the control villages). Thick and thin smear tests were performed to assess for the presence or absence of infection, parasite species, and parasite density.

The protocols for the tests are as follows:

1. Each subject's blood sample is drawn by finger or heel prick with a lancet. Blood is transferred directly to one Hemocue microcuvette for haemoglobin quantification and to two microscopy slides. Two slides per subject are prepared, one thick and one thin. The slides are stained using Giemsa.

2. Each thick smear slide is examined by two independent readers at 100x magnification, looking for the asexual blood stage form of the malaria parasite. The presence of any parasites makes the slide positive. A minimum of 100 microscopy fields needs to be counted on the thick smear before classifying a slide as negative. If there is discordance between the two readings (one is negative and one is positive), a third independent reader examines the smear. These readings are recorded as the variables positive_1, negative_1, positive_2, negative_2, positive_3, negative_3.

3. If a thick slide is positive, the corresponding thin slide is examined for species identification and parasite count. Thus, all thin slides that are examined are already known to be positive.

4. If a smear is positive, the lab technician will count the number of parasites per number of white blood cells or leukocytes. This is done to measure the density of parasites in a standard volume of blood, and can often be correlated with the presence and severity of

malaria symptoms. Low-density parasitemia is frequently asymptomatic in areas of intense malaria transmission. This parasite count is done following the steps below:

a. The number of parasites is counted on one tally counter and the number of white blood cells on the other, field by field.
b. If after counting 200 white blood cells less than 10 parasites have been found, counting should continue up to 500 white blood cells.
c. The number of parasites is registered in the 'leukocytescount200' or 'leukocytescount500' variables, depending on the number of white cells counted.
d. Once counting is completed, the number of parasites relative to the number of white blood cells is calculated and expressed as 'parasites per microlitre of blood' using the following formula:

$$\frac{Number\ of\ parasite\ counted \times 8000}{Number\ of\ white\ blood\ cells} = \text{parasites per microlitre}$$

5. The positive thin slide is also examined to determine which species of malaria parasites are found in the blood sample (*Plasmodium falciparum, Plasmodium vivax, Plasmodium ovale, Plasmodium malariae).* A sample can have more than one type of malaria species (mixed infection). P. vivax is extremely rare in West Africa. The parasite species is recorded as a binary variable (pfalciparum, pmalariae, povale, pvivax).

6. In addition to the blood stage asexual forms of the parasite, or trophozoites, sometimes the sexual forms or gametocytes can be seen in thin blood smears. If they are identified, a slide is classified as positive for gametocytes, and the examiner proceeds to count the number of gametocytes against the number of white blood cells, and the density expressed as a ratio in the same way as it is done with the asexual forms of the parasite. Gametocyte density is an indication of the degree of infectiveness of a subject for the Anopheles mosquito, and consequently to other humans. The results are recorded in the variables (gametocytes_plus_ve, gametocytes_minus_ve, gametocytescount).

Table 35 reports malaria incidence and the severity of malaria for affected children as measured by the standardised difference (standardised by the standard deviation) in the count of parasites per blood microlitre. A child is classified as affected by malaria if the first and second tests are positive or if the third test is positive (malaria incidence). We calculated the severity of malaria using the formula above to calculate the number of parasites per microlitre in those cases where the test is positive. We then standardised the parasite count by the standard deviation in the sample in order to calculate the difference in standard deviations between the MV and CV areas.

Table 35. Incidence and severity of malaria among children under 5

	MV	CV	CV Near	CV Far
Malaria incidence	0.223	0.249	251	.246
	(0.417)	(0.433)	(0.435)	(0.432)
Observations	381	410	215	195
Severity of malaria	0.231	0.508*	0.428	0.600*
among the infected	(0.713)	(0.178)	(0.827)	(0.827)
Observations	85	101	54	47

Malaria incidence is slightly large in the control group, which could be the result of a seasonal bias. The difference however is small and not statistically significant, which could be the result of a small sample size. There is a small difference in the severity of malaria (measured by parasites per microlitre of blood), which is 0.3 standard deviations larger in the control group with respect to the project group.

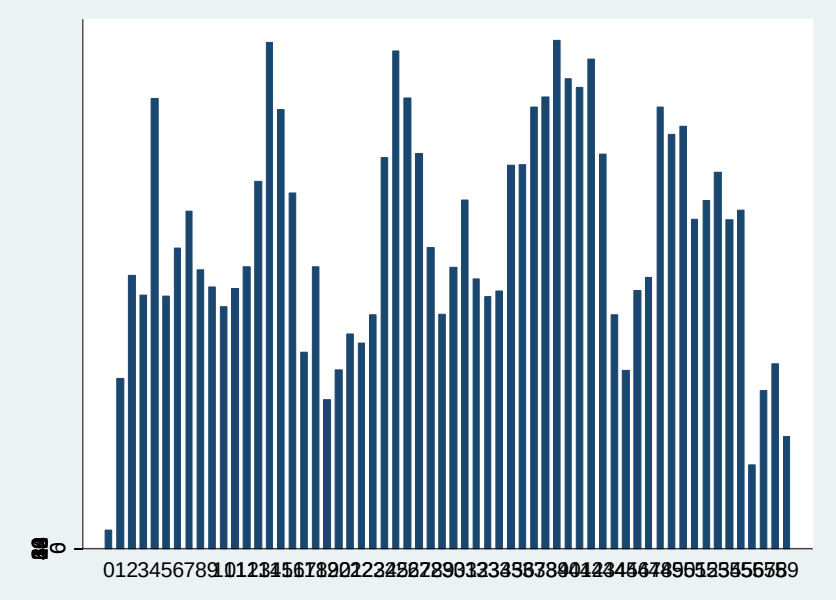
Anthropometrics

Data quality

The survey measured more than 2,000 children from project and control villages corresponding to about 8% of eligible children in MV areas and 90% of eligible children in CV areas.

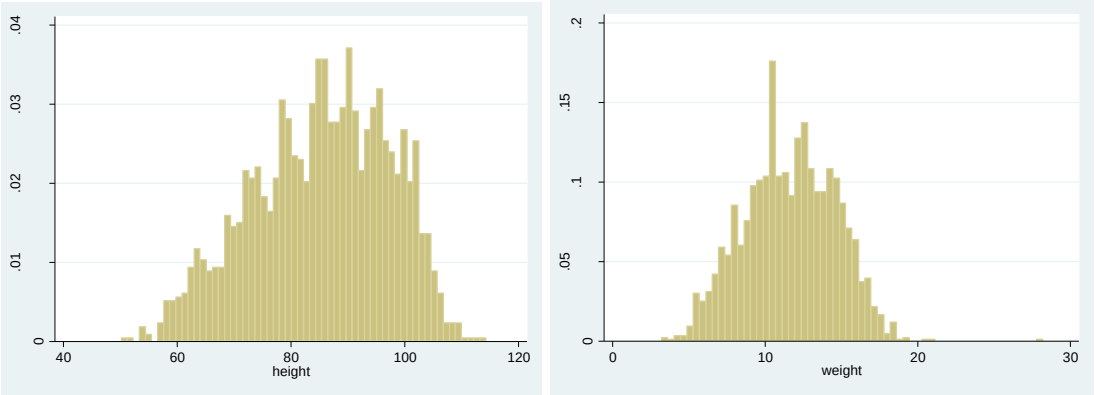
We follow the recommendations of the World Health Organisation (WHO) for data quality analysis of anthropometric data. First, the data show considerable age heaping. This is rather surprising because age is calculated from the date of birth. One possibility is that respondents do not know dates of birth. They provide an age for the child and work backward, possibly with the help of the enumerator, to provide the month and year of birth. Figure 6 shows the strong preference for reporting ages such as 3, 12, and 24. Because Z-scores are calculated in reference to a population of a given age, the misreporting of age results in a miscalculation of the Z-scores.

Figure 6. Age 'heaping' in the anthropometric module



Another source of error is height and weight heaping, which is the result of reporting measurements with values ending in .0 or .5. Measurements were taken twice for the same child and the average of the two measurements is reported. Despite the double measurement, the histograms of Figure 7 shows there was considerable heaping in reporting height and weight.

Figure 7. Height and Weight 'heaping'



One indicator of quality is the proportion of observations with Z-scores above six or below six, where a fraction of 1% is seen as an indicator of poor quality. Height-for-age and weight-for-age are slightly above this benchmark. There are no significant differences between the project and the control groups.

Another indicator of quality is the percentage of observations above admissible ranges set by the WHO (-5/3 for HAZ; -5/5 for WAZ; and -4/5 for WHAZ). This percentage does not appear to be particularly large with the exception of HAZ. In the case of HAZ the proportion is larger in the CV areas.

Table 36. Proportions of observations with inadmissible values

	MV	CV	CV Near	CV Far
HAZ	0.014	0.013	0.008	0.018
Proportion <-6 and >6	(0.121)	(0.115)	(0.089)	(0.133)
HAZ proportion	0.039	0.070**	0.071**	0.069**
outside WHO values	(0.195)	(0.256)	(0.258)	(0.254)
WAZ	0.005	0.008	0.005	0.011
Proportion <-6 and >6	(0.070)	(0.090)	(0.069)	(0.105)
WAZ proportion	0.008	0.013	0.008	0.018
outside WHO values	(0.090)	(0.115)	(0.089)	(0.133)
WHZ	0.015	0.011	0.005*	0.017
Proportion <-6 and >6	(0.121)	(0.105)	(0.069)	(0.128)
WHZ proportion	0.021	0.021	0.010*	0.032
outside WHO values	(0.145)	(0.145)	(0.097)	(0.133)
Observations	608	1,353	630	723

A final indicator of data quality is the standard deviation of the Z-scores against standard observed values (1.10-1.30 for HAZ; 1.00-1.20 for WAZ; and 0.85-1.10 for WHZ). All standard deviations are larger than the benchmarks though not by large amounts and are always larger in the CV areas.

Average Z-scores are always larger in the CV area, a factor that could be explained by seasonality. The difference is statistically significant only in the case of weight-for-age. Strangely, the percentage of severely malnourished children is larger in the control areas but no significant difference exists in prevalence rate of moderate undernutrition.

Table 37. Z-scores across MV and CV areas

	MV	CV	CV Near	CV Far
Height-for-age Z-score	**-1.22 (1.64)**	**-1.29 (1.39)**	**-1.17 (1.67)**	**-1.27 (1.61)**
Moderate malnutrition <-2	0.27 (0.44)	0.28 (0.45)	0.28 (0.45)	0.27 (0.44)
Severe malnutrition <-3	0.07 (0.26)	0.13*** (0.34)	0.13** (0.33)	0.13*** (0.34)
Weight-for-age Z-score	**-0.89 (1.26)**	**-0.85 (1.36)**	**-0.76* (1.36)**	**-0.92 (1.36)**
Moderate malnutrition <-2	0.14 (0.35)	0.16 (0.37)	0.16 (0.37)	0.17 (0.37)
Severe malnutrition <-3	0.03 (0.23)	0.05** (0.17)	0.05 (0.21)	0.06* (0.24)
Weight-for-height Z-score	**-0.29 (1.11)**	**-0.23 (1.19)**	**-0.16* (1.23)**	**-0.29 (1.15)**
Moderate malnutrition <-2	0.04 (0.21)	0.05 (0.23)	0.05 (0.21)	0.06 (0.24)
Severe malnutrition <-3	0.00 (0.04)	0.01* (0.09)	0.01** (0.10)	0.01 (0.08)

ISSER Data

Background

At the initial stages of the design of the MV evaluation, the independent evaluation team observed that the EI questionnaires did not contain any education outcomes beyond attendance and completion. It was suggested that test scores on basic reading and arithmetic skills should be obtained in addition to cognitive tests. This suggestion was supported by the PRG who also recommended conducting field experiments to collect data on time preferences and risk attitudes. Itad sub-contracted the Institute of Statistical, Social and Economic Research (ISSER) for this task. Collaboration with ISSER was sought because several of the survey instruments had been previously designed, tested, and administered by ISSER/Yale for their panel study.

Some of the instruments however were developed jointly by ISSER and the evaluation team, namely a questionnaire on income expectations, time preferences, reading, and maths tests for children who ever attended JHS. The final instruments comprised of the following modules:

- Adult wage expectations (from ISSER)
- Adult survival expectations (from ISSER)
- Farmers income expectations (new)
- Farmers time preferences (new)
- Children wage expectations (from ISSER)
- Children cognitive tests:
    - Digit Span exercises (forward and backward) (from ISSER)
    - Raven's matrices (from ISSER)

- Children test scores:
    - Easy Maths (from ISSER)
    - Easy English (from ISSER)
    - Advanced Maths (new)
    - Advanced English (new)

Field operations

Survey fieldwork took place in November 2012. A total of 40 enumerators were recruited and trained from a pool of experienced field enumerators. Efforts were made to recruit enumerators speaking the local languages but in some cases enumerators had to rely on interpreters and the help of EI staff in order to localise households and conduct the interviews. Training took place from 7-12 November and involved presentations, role plays, and mock interviews. A pre-test was conducted as part of the training and the challenges faced were helpful in clarifying the final field protocol for the study. Enumerators were taken through the ethical requirements of the survey and signed all the necessary confidentiality forms in accordance with IRB requirements.

The enumerators were divided into eight groups of four enumerators and one supervisor. Four teams were assigned to each district and the total workload was allocated almost equally to the teams. Each team was provided with the household listing of all assigned households as well as maps to aid with locating the communities. In addition, enumerators were given toffees and pens as token gifts for the children after interviews. The fieldwork took a total of 18 days for all teams from 14 November to 2 December 2012. Additional days were allocated for mop up for teams that did not complete the interviews within the allocated days.
Dr Paul Issahaku was hired as a survey monitoring consultant and made a number of interesting qualitative observations about the survey work:

- Communities were cooperative with enumerators, there was a warm reception by the chiefs and elders, and respondents eagerly participated in the surveys, with a number of isolated individuals very willing to assist enumerators identify households for the interviews and mothers wanting their children to be tested.

- The timing of the survey was not particularly good because it occurred during the heat of electioneering campaigns when politicians were in the villages competing with enumerators for people's time and attention. In some villages, despite several explanations about the survey, some people took enumerators for politicians' foot soldiers and wanted to find out whether they belonged to Party A or Party B.

- The education test seemed difficult for a sizable proportion of children. A good number of children had delayed entry to school and felt blocked during the interviews.

- Some household heads stopped farming and, as a result, they claimed not to be able to respond to the crop production and sale module of the income expectation questionnaire.

- A good number of individuals found it near impossible to guess daily wages for rural and urban workers with different educational qualifications. They seemed out of touch with the concept of wage labour and its rural-urban disparities as they never travelled outside their communities and never engaged in wage work.

- In some cases, it was difficult to determine or confirm the ages of some individuals.

- Due to illiteracy, some individuals had little grasp of the concept of probability or proportionality used in the expectations questions. Other respondents felt that they were only subsistence farmers but not large-scale commercial farmers and that expectations and time preference questions do not apply to them because they do not produce to sell. They also expressed the belief that their yield is determined by natural factors over which they have little control. So, although they attempted to answer the questions, some did not see the need to guess the yield whether in a good or bad year.

- In a pilot exercise, we tested instruments to measure risk attitudes by employing hypothetical gambles. We eventually decided not to collect data on risk attitudes because most respondents were strongly opposed to the idea of, even hypothetically, gambling.

The household roster

The EI provided information on geographical identification of 2,206 households with name, age, and sex of all household members resulting from the listing exercise in both project and control areas. Out of the 2,206 households targeted, 2,146 were successfully interviewed, representing a response rate of 97.3%. Reasons why the 60 households were not interviewed include permanent relocation, death of the household head leading to dissolution of the household, temporal absence of the household, and reintegration of split households. The distribution of the household response rates by the status of village is shown in Table 38. The distribution shows no systematic differentials in the response rates.

Table 38. Completion rates of ISSER survey

Status of village	Survey completed	Survey not completed	Total
Treatment (West Mamprusi)	98.6	1.4	100.0
Control (West Mamprusi)	96.3	3.7	100.0
Treatment (Builsa)	97.2	2.8	100.0
Control (Builsa)	97.7	2.3	100.0
Total	97.3	2.7	100.0

Also note that ISSER interviewed 29 households in the control areas that were not interviewed by the EI survey. As a result, there is full information (ISSER survey and EI survey) for 2,120 of the originally selected 2,256 households and for a total of 14,899 individuals.

Education and cognitive tests

Cognitive tests consisted of:

- A short set of 12 Raven's coloured progressive matrices of varying, but not increasing, difficulty.

- A digit span test (forward and backward) consisting of the following:

    - The enumerator reads each digit span only once at an even rate of one digit per second
    - The child repeats the sequence of numbers exactly

- There are eight sets of two digits of increasing difficulty and children can score a maximum of 16
- After scoring in steps of two the test stops if the child misses both digits
- In the backward test the child has to repeat the series in reverse and there are only seven sets of two for a maximum score of 14

The education tests consisted of:

- An easy maths test based on eight arithmetic questions of increasing difficulty that included simple additions, subtractions, divisions, and multiplications. The questions are multiple answers and the student circles the right answer among four different options.
- An easy English test consisting of eight multiple answer questions related to a three-line story the child reads before taking the test.
- An advanced maths test consisting of 25 multiple answer questions of increasing difficulty. The test was designed based on the JHS teaching syllabus for mathematics of the Ghanaian Ministry of Education. The test was largely based on the syllabus for the first grade of JHS. Topics include: numbers and numerals, fractions, sets, shapes, perimeters and areas, powers, algebraic expressions, measures of time, money and capacity, percentages, averages, and probability. The test is designed in such a way that a student who completed JHS1 should be able to answer most, if not all, the questions in the test.
- An advanced English test consisting of 20 questions. The test was designed based on the Junior High School teaching syllabus for English language of the Ghanaian Ministry of Education. The test was largely based on the syllabus for the first grade of JHS and student having completed JHS1 should be able to pass the test comfortably. Questions cover English grammar, understanding of a story on mosquitoes and malaria, and the ability to complete sentences.

Not all household individuals took the tests. The eligibility criteria by age and schooling level of the various tests are in Table 39.

Table 39. Eligibility conditions for education tests

Module	Eligibility
Raven's Matrices	All children aged 5-19 years
Digit Span (Backward and Forward)	All children aged 5-19 years
Easy Maths and Easy English test	All children aged 9-19 years who ever attended primary school
Advance Maths and Advance English test	All children aged 12-19 years who ever attended Junior High School

Based on the EI census list of 2,206 households, there were 6,128 eligible children aged 5 to 19. However, it was agreed that in cases where there were more than five eligible children in the household, the interview was to be restricted to the five youngest children in order of availability. This reduced the number of eligible children to 4,815. Further adjustments following a number of households that could not be interviewed and revisions of ages reported by the EI led to a final sample of 4,821 eligible children.

Not all children were interviewed for a number of reasons, which were categorised as the following: travelling or not available, test attempted but interrupted because too difficult, child refused, child was ill, and other reasons. Valid tests and reasons for not taking the test are reported in Table 40. Means calculated from the valid tests are likely to be biased because of the censoring occurring as many children (up to 20% of the eligible) did not complete the test or refused to take it. Both cases are likely to represent zero or near zero scores. One option is considering these values as zeros in calculating the overall means. Another option is modelling self-selection into the test based on covariates and then adjusting the means by the inverse Mill's ratio.

Table 40. Response rates by test (percentages over the sample in brackets)

	Eligible children	Valid tests	Not available	Interrupted	Refused	Ill	Other
Raven's	4821	3502 (72.6)	837 (17.4)	112 (2.3)	254 (5.3)	54 (1.1)	62 (1.3)
Digit span forward	4821	3390 (70.3)	837 (17.4)	97 (2.0)	362 (7.5)	54 (1.1)	81 (1.7)
Digit span backward	4821	3387 (70.3)	837 (17.4)	118 (2.5)	377 (7.8)	54 (1.1)	48 (1.0)
Easy Maths	2768	1762 (63.7)	647 (23.4)	158 (5.7)	136 (4.9)	29 (1.1)	36 (1.3)
Easy English	2768	1343 (48.5)	647 (23.4)	432 (15.6)	183 (6.6)	29 (1.1)	134 (4.8)
Advanced Maths	880	411 (46.7)	399 (45.3)	21 (1.4)	6 (0.7)	16 (1.8)	27 (3.1)
Advanced English	880	421 (47.8)	399 (45.3)	11 (1.3)	18 (1.8)	18 (1.8)	27 (3.1)

The distributions of the three cognitive tests are very different and show increasing difficulty. The Raven's scores are normally distributed and a small fraction of children are able to complete more than 50% of the test successfully. Some 15% of children are scoring zero on the forward digit span – the distribution is otherwise normal. Again, few children are able to complete more than 50% of the test. The backward digit span is heavily skewed to the left with more than 40% of children scoring zero and virtually no children able to complete more than 50% of the test.

Figure 8. Distribution of cognitive tests scores

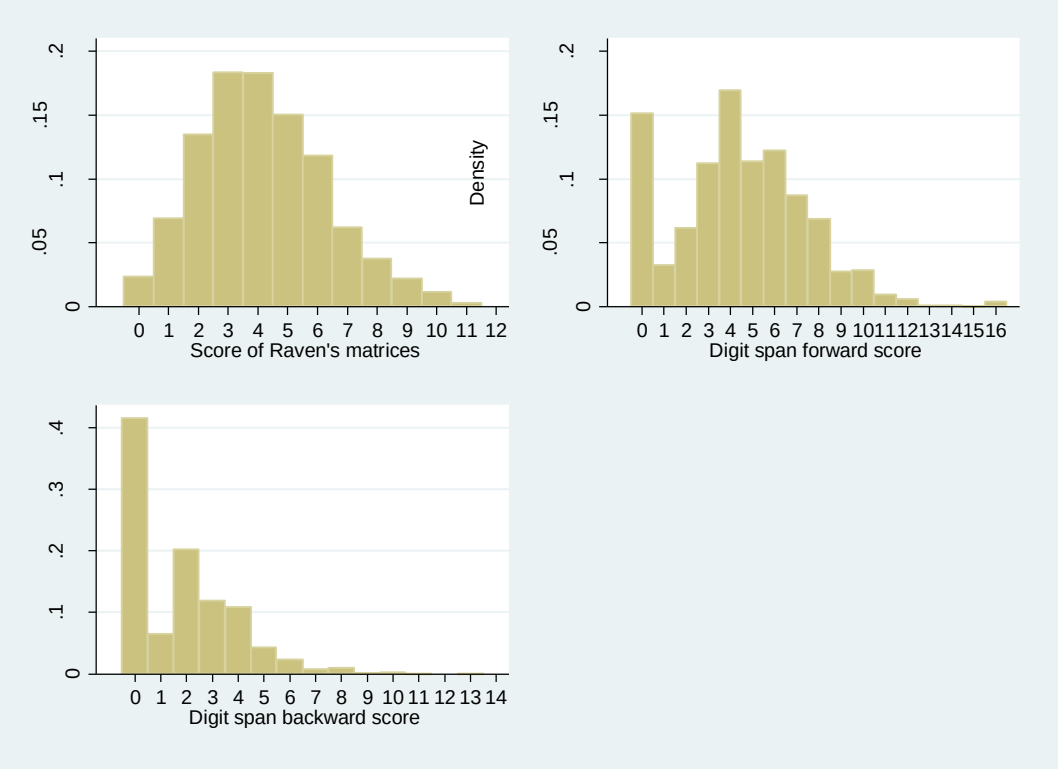


Table 41. Cognitive test scores

	MV	CV	CV Near	CV Far
Raven's matrices	4.1	4.2	4.0	4.3**
(min 0 – max 12)	(2.1)	(2.2)	(2.2)	(2.2)
Observations	1177	2319	1124	1195
Forward digits span	4.4	4.5	4.2**	4.7**
(min 0 – max 16)	(3.0)	(3.0)	(3.0)	(3.0)
Observations	1083	2278	1074	1083
Backward digits span	1.8	1.8	1.6**	1.9
(min 0 – max 14)	(1.8)	(2.0)	(2.0)	(2.0)
Observations	1102	2259	1088	1171

The distributions of test scores are well shaped. The simple maths and English tests are clearly accessible as most students score more than the random score of two (if students answered two questions randomly then they should get on average a score of two). The advanced maths test is clearly the most difficult with a distribution skewed towards zero.

Figure 9. Distribution of education test scores

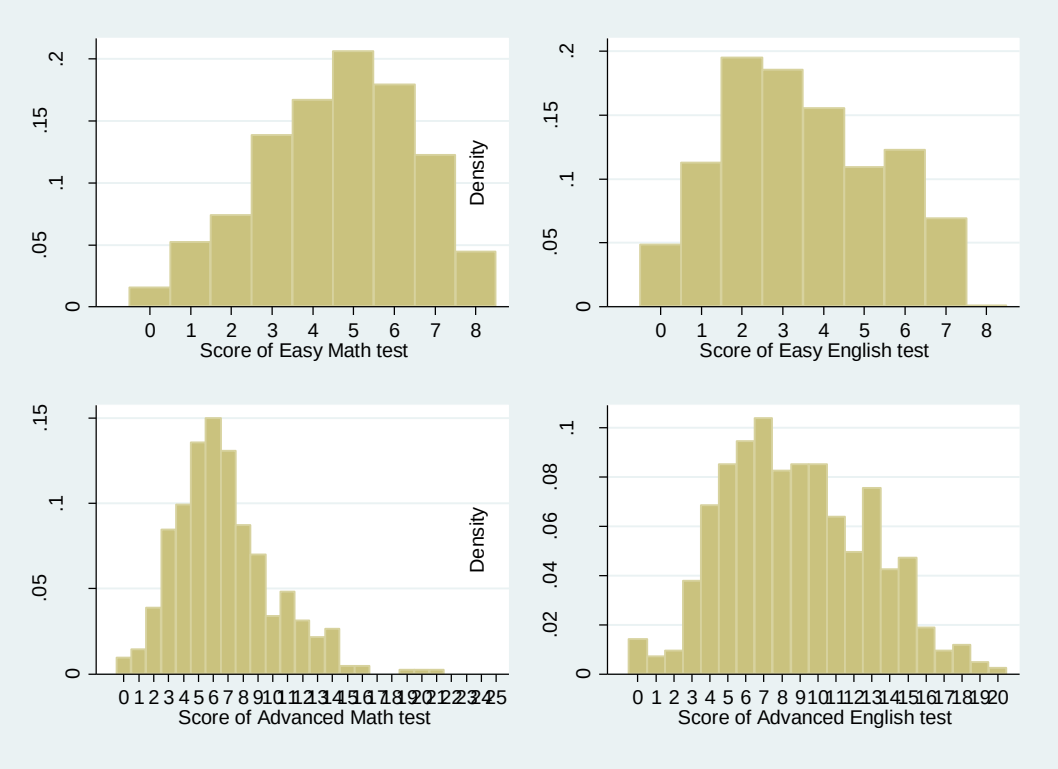


Table 42. Education test scores

	MV	CV	CV Near	CV Far
Easy maths test	4.5	4.6	4.6	4.6
(min 0 – max 8)	(1.8)	(1.9)	(1.9)	(1.9)
Observations	580	1168	546	622
Easy English test	3.2	3.6**	3.6**	3.5**
(min 0 – max 8)	(1.9)	(1.9)	(2.0)	(1.9)
Observations	452	880	400	480
Advanced maths	6.3	6.9	6.7	7.0
(min 0 – max 25)	(3.4)	(3.3)	(3.5)	(3.1)
Observations	110	292	136	156
Advanced English	8.3	9.0	8.9	9.0
(min 0 – max 20)	(4.0)	(3.9)	(3.9)	(4.0)
Observations	112	300	141	159

Wage expectations

Wage expectation questions were originally designed for adults having a household decision model in mind where parents decided on the education of their children by considering wage opportunities both in and outside the area for different levels of education. It was decided to administer the same questions to a sample of children aged 12 to 19 that took the cognitive and education tests. There are a total of 1,178 valid responses on wage expectations.

As in the case for adults, many children showed little understanding of wages in their areas as they are not engaged in wage work and do not travel to other areas. Many children provided

unreasonable responses such as 500 cedis when the mean wage is between 5 and 10 cedis. We dropped some of these very extreme values from the sample by dropping all observations that were four standard deviations further from the mean after a logarithmic transformation.

The uncertainties of expectations can be seen in the high values of the standard deviations. The variance also increases as the expectation becomes more uncertain as it enquires about Accra rather than the local market. Interestingly, children in the control groups have expected wages that are twice the size of those in the project group. This could be partly a result of different wage structure in the two areas, but the differences are visible also for Accra wages which suggests this is a true difference in expectations based on different information sources.

Table 43. Wage expectations (children)

	MV	CV	CV Near	CV Far
Daily wage primary	4.42	7.93***	7.26***	8.54***
	(2.82)	(13.02)	(11.18)	(14.15)
Daily wage secondary	6.01	15.68***	15.11***	16.21***
	(3.68)	(28.07)	(29.13)	(27.08)
Daily wage primary	12.00	17.50**	18.74***	16.41**
Accra	(11.75)	(25.48)	(27.09)	(23.96)
Daily wage secondary	17.04	33.07***	37.45***	29.27***
Accra	(11.29)	(51.09)	(60.43)	(41.03)

The survey protocols recommended that in each household the head of household should be interviewed and that in his/her absence any other adult who was involved in generating income through farming. Not all adults interviewed were able to provide a response to the wage expectations questions. Only about 95% of adults were able to provide an expectation for the wages in their area and 88% for wages in Accra. The differences in expectations and the standard deviations of the expectations are smaller for adults. Control areas consistently display much higher wage expectations.

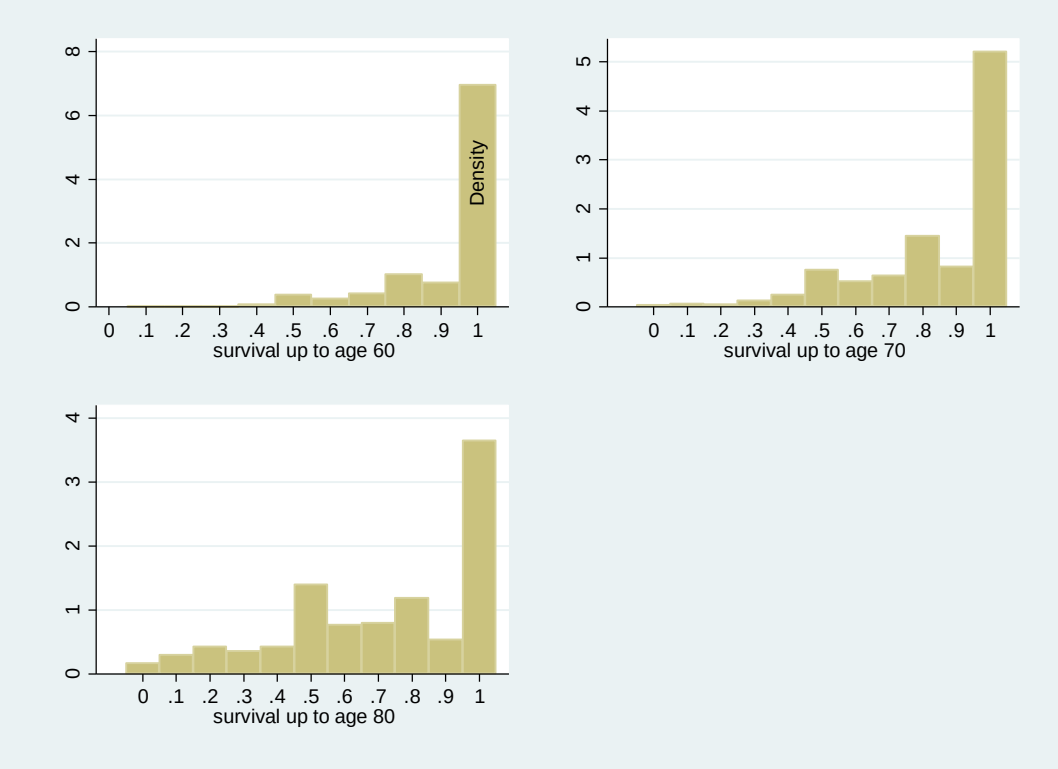
Table 44. Wage expectations (parents)

	MV	CV	CV Near	CV Far
Daily wage primary	4.94	6.91***	6.68***	7.15***
	(3.06)	(8.24)	(7.84)	(8.65)
Daily wage secondary	6.72	13.13***	12.28***	14.03***
	(5.53)	(20.43)	(20.54)	(20.29)
Daily wage primary	12.26	18.80***	18.07***	19.57***
Accra	(10.77)	(25.96)	(24.32)	(27.57)
Daily wage secondary	18.19	30.49***	30.14***	30.85***
Accra	(16.73)	(42.79)	(44.20)	(41.30)

Survival expectations

Each adult respondent interviewed was asked to rate on a scale from 0 to 10 the likelihood of being alive at age 60, 70, and 80. Respondents older than 59 would only express probabilities of surviving age 70 and 80, whilst respondents older than 70 would only express the likelihood of surviving until age 80. Respondents aged 79 and above would not answer this question. Interestingly, female respondents, after controlling for age, express a survival expectation which is 4-5% less than male respondents. This could be explained by selectivity issues related to the circumstances of the interview.

Figure 10. Distribution of survival expectations



Strangely there are differences, albeit small, between survival expectations in project and control villages, which are mainly driven by lower survival expectations from nearby control villages.

Table 45. Survival expectations

	MV	CV	CV Near	CV Far
Up to age 60	0.93	0.91***	0.89***	0.92
	(0.14)	(0.16)	(0.17)	(0.14)
Up to age 70	0.87	0.83***	0.81***	0.84**
	(0.18)	(0.23)	(0.24)	(0.21)
Up to age 80	0.74	0.71*	0.69**	0.73
	(0.28)	(0.29)	(0.29)	(0.28)

Time preferences and income expectations

The MVP could affect time preferences in different ways. Overall the project should decrease 'impatience' by:

- Increasing the investment and bequest motives for saving (investment motivations may make people less impatient).
- Improving survival expectations (people who live longer are less impatient).
- Increasing income and wealth (poorer people are more impatient because need to satisfy basic needs).

- Improving education (foresight and planning skills are correlated with education).

We opted for using hypothetical lotteries rather than real rewards because hypothetical rewards have the advantage of allowing the interviewer to play with several amounts, large amounts, and different time horizons at the same time. Hypothetical lotteries have the disadvantage of not providing incentives for the respondent to focus on the game, however reviews comparing the results of hypothetical and real lotteries have not found significant differences (Frederick, Loewenstein et al. 2002).

We opted for employing the 'matching task' method rather than the more common 'choice task' method. Whilst in the choice task method respondents are presented with alternative choices, in the matching task method the respondent fills the blank to equate two inter-temporal choices. For example, the respondent will state the amount of money in three months that is equivalent to a given amount of money now. This method has a number of advantages. First, with just one answer the indifference point is identified (rather than employing multiple questions as in the choice task). Second, there is no anchoring problem because it is the respondent that provides the initial amount. Anchoring occurs when a choice is affected by the previous choice, which is a common problem of choice task experiments (Frederick, Loewenstein et al. 2002).

There is a risk in employing the matching task method of obtaining 'coarse' answers whereby the respondent responds quickly by applying simple heuristic rules to the sum initially offered. We avoided this effect by designing a game that simulates a real life situation. The time preference game is based on a hypothetical transaction of agricultural output. The amount involved in the transaction is the expected amount as stated by the respondent. This makes the game realistic and removes the 'magnitude effect' by basing the game on an amount that is meaningful to the respondent (the magnitude effect is the bias produced by the fact that people tend to apply larger discount rates to smaller amounts – the reasons for this behaviour are not well understood). The amount initially stated will be probed by bargaining. The interviewer will encourage the respondent to accept a smaller amount until an agreement between the two is reached. This responds to the need of approximating real life price negotiations and to the need of removing unrealistic initial responses. The respondent will be forced to find the minimum amount he is willing to accept in exchange for a delayed payment.

The game was conducted over four different time horizons: one month, three months, six months, and one year. Different time horizons were used to detect hyperbolic discounting: people's tendency to discount more heavily choices that are made over time horizons that are closer in time to the time of the interview. Heavy hyperbolic discounting is a sign of impatience and of poor saving/planning skills (Ashraf, Karlan et al. 2006). In order to avoid that the respondent applies simple heuristics to the different choices made (for example preferring 110 to 100 over a month and 130 to 100 over three months) we used a titration procedure, whereby the different time horizon is not presented in an ordered fashion, but follows the pattern: three months, one month, six months, and one year.

Income expectations

We employed income expectation questions for two reasons. First, by asking the expected agricultural output we obtain a starting amount to be used in the time preference game that is sufficiently large and meaningful to the respondent. Secondly, we want to be able to disentangle

the effect of income expectations from stated time preferences. We calculated income expectations by eliciting subjective probabilities.

Respondents were asked to answer the following two questions:

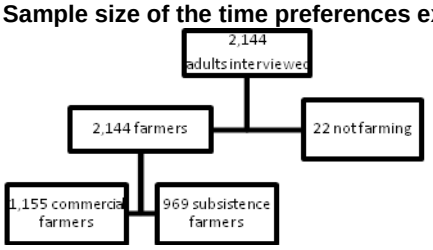
1. Suppose this is a very bad year. What is the minimum quantity that you expect to produce?
2. Now suppose this is a very good year. What is the maximum quantity that you expect to produce?

At this point the enumerator would calculate the midpoint of the quantities expressed above (the difference between the maximum and minimum amounts divided by two). The respondent was then asked the following question:

3. On a scale from 0 to 10 (where 0 is 'no chance' and 10 is 'absolutely certain') how likely is it that you will produce at least the midpoint quantity this year?

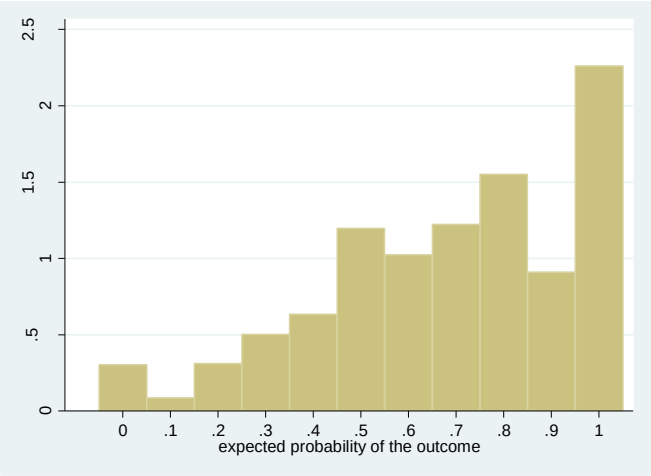
There were two problems in conducting this exercise. First, the question applies only to farmers, which excludes some 1% of the sample that does not do any farming. In addition, the expectations were elicited for crops that are sold, in a context where up to 50% of farmers are subsistence farmers and do not sell any crop. As a result, while one adult was selected for the interview from each household, only about half of commercial farmers responded to the expectation and time preference game. We are left therefore with a sample of 1,155 commercial farmers' expectations and time preferences (Figure 11). Note also that 60 farmers did not responded to the time preferences interviews, so that we are left with a sample of 1,095 valid time preferences responses.

Figure 11. Sample size of the time preferences experiment



The second problem is that the household survey was conducted in November when many of the crops produced and sold by the farmers had already been realised. The survey had been planned for the month of August, but when Edoardo Masset and the ISSER team visited the area to conduct the education survey it was found that the EI had not yet started the household survey in the control communities, which was a prerequisite for conducting the ISSER survey. The EI survey was eventually conducted over the months of September-October and the ISSER survey was conducted soon after in the month of November. Because many of the farmers had already realised their cash crop at the time of the interview many responses are unlikely to be 'probabilities' but certainties. This explains for example the large number of zero and 100% expectations in Figure 12.

Figure 12. Expected probability of the average agricultural output



Farmers in MV areas have obviously higher expectations compared to farmers in the control areas. There are a number of possible explanations. First, cropping patterns in the areas may differ (for example millets in MV and beans in CV) which could result in different harvest times and therefore suffer the 'certainty' bias discussed above. Second, different crops have different variances: for example millet is less risky than rice, which again could explain the difference. Third, since the expectation survey was conducted after the programme had started some of the activities, such as the formation of cooperatives and the distribution of fertiliser, there is a possibility that farmers' expectations in MV areas were positively affected.

Table 46. Income expectations

	MV	CV	CV Near	CV Far
Subjective probability of midpoint outcome	0.74 (0.22)	0.65*** (0.28)	0.67*** (0.27)	0.63*** (0.30)

Time preferences

We obtained time preferences from commercial farmers by asking the following questions: Suppose that you are selling the midpoint amount of your production (reported in the income expectation section), what payment would you accept if the trader asked you to delay payment by one month? The same question was then repeated for three months, six months, and one year. The initial response was not accepted by the enumerators who would bargain on the amount until reaching the minimum acceptable amount for delaying. Hence, for each farmer (and time horizon) there is an immediate response and a response obtained after bargaining.

Note also that some farmers responded only for some of the time horizon questions, probably showing signs of fatigue. There were 1,124 respondents for the first question (out of the 1,155 interviewed); 1,121 for the second question; 1,113 for the third; and 1,095 for the fourth question.

The responses were used to calculate implicit discount rates. If a is the initial amount (the midpoint value of the agricultural product) and b is the amount claimed by the respondent to accept a delay of n months, then the discount rate ρ can be calculated from the following expression:

$$a = \frac{b}{(1+\rho)^n}$$

The monthly discount rate is: $\rho = e^{\frac{lnb-lna}{n}} - 1.$

We removed outliers by dropping those observations larger than four times the standard deviation after a logarithmic transformation of ρ. The poor households do not appear to be too impatient. First, many households report zero discount rates by accepting the offer made or accepting it after bargaining with the enumerator. Table 47 shows the percentages of zero discount rates (only for the agreed final amount but the difference with the first offer is not large). The fraction of farmers with zero discount rate however decreases with the time horizon. Second, discount rates are not very high as can be seen in the table. There seem to be evidence of hyperbolic discounting as households are discounting at a decreasing rate as the time horizon increases.

Table 47. Discount rates and 0 discount rates for the whole sample

	% Monthly discount rate is zero	Monthly discount rate
1-month horizon	0.33	0.087
3-month horizon	0.14	0.075
6-month horizon	0.07	0.071
12-month horizon	0.06	0.055

The first question administered employed a three-month horizon and no differences are visible across groups. When other horizons are used there are higher discount rates in MV areas compared to project areas that are mostly driven by differences with the nearby control villages.

Table 48. Time discount rates

	MV	CV	CV Near	CV Far
1-month horizon	0.101	0.080**	0.071**	0.089
	(0.138)	(0.132)	(0.106)	(0.153)
3-month horizon	0.088	0.073	0.072	0.073
	(0.088)	(0.132)	(0.136)	(0.128)
6-month horizon	0.081	0.066**	0.063**	0.070
	(0.097)	(0.085)	(0.080)	(0.060)
12-month horizon	0.060	0.052**	0.050**	0.054
	(0.049)	(0.047)	(0.046)	(0.048)

The Community Questionnaire

	MV	CV	P-value	CVN	P-value	CVF	P-value
Hand dug wells No.	6.9	7.4	0.746	7.1	0.893	7.6	0.667
Bore hole wells No.	2.6	2.9	0.655	2.8	0.856	3.1	0.548
Dug out wells No.	0.3	0.4	0.492	0.4	0.672	0.4	0.390
Electricity %	0.0	0.0		0.0		0.0	
Irrigated land %	1.0	1.1	0.187	1.2	0.154	1.1	0.173
Primary school	85.7	92.6	0.265	94.1	0.254	91.2	0.486
Distance to nearest primary Km	2.1	2.4	0.596	2.5	0.523	2.2	0.814
JHS	65.7	73.5	0.413	73.2	0.488	73.5	0.488

Distance to nearest JHS Km	4.1	5.3	0.321	6.0	0.189	4.6	0.675
SHS	22.9	10.3*	0.089	8.8	0.115	11.8	0.230
Distance to nearest primary Km	16.9	17.7	0.774	20.4	0.328	15.0	0.575
Health centre	25.7	11.8*	0.072	2.3**	0.007	20.6	0.620
Distance to nearest health centre Km	10.5	19.0**	0.003	21.7***	0.000	16.5*	0.072
CHPS	40.0	50.0	0.340	52.9	0.286	47.1	0.561
Distance to nearest CHPS Km	8.3	8.1	0.943	8.0	0.893	8.3	0.998
Market	51.4	48.5	0.783	47.1	0.722	50.0	0.907
Distance to nearest market Km	7.1	9.6	0.172	11.0	0.089	8.2	0.509
Motorable road	57.1	73.5*	0.093	70.6	0.252	76.5	0.091
Distance to nearest road Km	13.1	5.6**	0.015	8.2	0.232	3.4**	0.007
Bank	31.4	10.3**	0.007	8.8**	0.019	11.8**	0.049
Distance to nearest bank Km	19.5	22.9	0.427	22.0	0.553	23.8	0.424

	MV	CV	P-value	CVN	P-value	CVF	P-value
Population with health insurance %	47.8	64.6**	0.001	55.1	0.148	74.1***	0.000
Children vaccinated against tuberculosis (BCG) %	80.2	82.8	0.537	79.4	0.886	86.2	0.270
Children vaccinated against whooping cough (DPT) %	87.3	83.3	0.274	79.0**	0.040	87.6	0.936
Children vaccinated against polio (OPV) %	88.9	85.9	0.316	82.1**	0.029	89.7	0.819
Children vaccinated against measles	80.8	86.1	0.208	82.1	0.802	90.1*	0.066
Children vaccinated against yellow fever %	77.9	82.8	0.399	76.2	0.771	87.4	0.074

	MV	CV	P-value	CVN	P-value	CVF	P-value
Faming main activity %	100.0	98.5	0.476	100.0	.	97.1	0.314
Maize main crop %	45.7	28.8*	0.091	30.3	0.197	27.3	0.118
Millet main crop %	51.4	65.2	0.183	66.7	0.208	63.6	0.316
Shea butter main non agricultural activity %	87.5	83.1	0.579	80.0	0.431	86.2	0.884
Extension officer visits the community %	62.3	50.0	0.219	41.2*	0.073	58.8	0.736
Cooperative in the community %	26.6	6.0**	0.001	0.0***	0.000*	12.1	0.096

	MV	CV	P-value	CVN	P-value	CVF	P-value
NPK fertiliser	41.7	42.3	0.607	40.9	0.440	43.6	0.122
Sulphate fertiliser	37.8	37.6	0.858	37.0	0.491	38.2	0.723
Male wage	4.7	4.7	0.781	4.4*	0.075	5.0	0.302

Female wage	4.4	4.1	0.171	3.7**	0.007	4.4	0.989
Child wage	3.3	2.9	0.167	3.0	0.240	2.9	0.173
Cow	67.3	665	0.860	626	0.410	702	0.611
Sheep	124	104	0.500	102	0.604	105	0.659
Goat	64	72	0.081	72	0.114	72	0.125
Guinea fowl	12	12	0.872	12	0.468	13	0.323
Chicken	10.9	9.5	0.019	9.4	0.475	9.6**	0.031
Gari	2.4	2.7	0.268	2.9	0.155	2.6	0.571
Rice	4.4	4.0	0.329	3.9	0.184	4.1	0.535
Beans	8.2	5.0**	0.011	5.5*	0.075	4.6**	0.025
Groundnut	8.0	8.0	0.997	6.5	0.321	9.1	0.660
Okra	4.7	4.3	0.718	4.4	0.851	4.2	0.626
Milk	1.5	1.2	0.228	1.1	0.317	1.2	0.417
Eggs	5.3	4.9	0.723	5.1	0.846	4.9	0.727

Trends

	MV	CV	P-value	CVN	P-value	CVF	P-value
NPK fertiliser	0.146	0.126*	0.088	0.124*	0.078	0.128	0.211
Sulphate fertiliser	0.134	0.133	0.948	0.137	0.770	0.129	0.757
Male wage	0.199	0.244**	0.039	0.247**	0.032	0.233	0.143
Female wage	0.212	0.246*	0.081	0.251	0.100	0.240	0.196
Child wage	0.222	0.227	0.847	0.212	0.698	0.242	0.410
Cow	0.211	0.168*	0.054	0.178	0.256	0.158*	0.064
Sheep	0.178	0.187	0.610	0.200	0.256	0.174	0.856
Goat	0.163	0.177	0.387	0.197**	0.042	0.158	0.754
Guinea fowl	0.210	0.195	0.440	0.208	0.939	0.183	0.242
Chicken	0.212	0.199	0.243	0.202	0.621	0.183	0.141
Gari	0.204	0.217	0.575	0.223	0.535	0.212	0.763
Rice	0.147	0.200*	0.038	0.203*	0.081	0.198	0.105
Beans	0.204	0.198	0.760	0.236	0.184	0.157*	0.053
Groundnut	0.202	0.183	0.424	0.212	0.757	0.161	0.138
Okra	0.215	0.184	0.438	0.246	0.545	0.130**	0.027
Milk	0.235	0.163	0.162	0.193	0.447	0.140	0.099
Eggs	0.173	0.210	0.232	0.179	0.846	0.222	0.159

	MV	CV	P-value	CVN	P-value	CVF	P-value
Major drought affecting crops/animals %	60.0	58.8	0.910	58.8	0.922	58.8	0.922
Major floods %	11.4	22.1	0.191	20.6	0.306	23.5	0.190
Disease/epidemic affecting a large number of people %	11.4	30.9**	0.029	32.3**	0.036	29.4*	0.065
Major interruption in water supply (wells drying up, etc.) %	65.7	67.6	0.845	73.5	0.488	62.8	0.738
Insects destroying crops %	48.6	49.9	0.973	52.9	0.722	50.0	0.907
Major animal disease/epidemic %	71.4	78.3	0.422	73.5	0.848	79.4	0.479
Major epidemic affecting crops %	25.7	30.4	0.604	38.2	0.271	23.5	0.836

	MV	CV	P-value	CVN	P-value	CVF	P-value
CBO/NGO	25.7	16.5	0.241	12.1	0.159	26.5	0.944
Church/Prayer Group or Burial Society	57.1	52.2	0.619	50.0	0.559	61.8	0.701
Women's Group	48.6	69.6**	0.028	67.6	0.112	82.3**	0.003
Saving group	31.4	26.1	0.551	23.5	0.470	26.5	0.656
Youth Group	45.7	50.0	0.669	47.1	0.913	61.8	0.187
Political Group	40.0	58.7*	0.050	70.6**	0.010	55.9	0.192
Health Committee	17.1	23.9	0.415	20.6	0.719	35.3*	0.088
School Committee	51.4	47.8	0.419	52.9	0.902	52.9	0.901
Parent-Teacher Assoc.	51.4	58.2	0.494	62.8	0.394	66.7	0.208
Sports Club	34.3	35.9	0.869	44.1	0.410	26.5	0.488

The Adult Questionnaire

The adult survey followed the DHS approach of interviewing women of reproductive age from each sampled household. The protocols establish that the target population is every woman aged 15-49 plus one randomly selected male in each household. The adult surveys were conducted prior to the household survey both in the project and the control areas. As a result, some households and adults interviewed by the adult survey were not interviewed by the household survey and vice versa. Table 49 illustrates reporting the numbers of households and individuals covered by the adult survey by group.

Table 49. Households where the adult interviews were conducted

	MV	CVN	CVF	TOTAL
Adults and households interviewed	616	693	672	1977
Adults interviewed but not the households	8	7	17	32
Total households interviewed	624	700	689	2013
Households not interviewed	96	45	56	197

Table 50. Adult interviews

	MV	CVN	CVF	TOTAL
Number of males interviewed whose household was also interviewed	503	581	542	1626
Male adults interviewed but not the households	5	10	15	30
Total male interviews	508	591	557	1656
Number of females interviewed whose household was also interviewed	847	985	999	2831
Female adults interviewed but not the households	10	11	42	63
Total female interviews	857	996	1041	2896

Table 51. Contraception and health visits

	MV	CV	CV Near	CV Far
% using any contraceptive method[a]	0.10 (0.30)	0.10 (0.30)	0.09 (0.29)	0.11 (0.32)
% visited for family planning	0.25 (0.43)	0.30** (0.46)	0.23 (0.42)	0.36*** (0.48)
% visited by health visitor for care	0.35 (0.48)	0.40** (0.49)	0.34 (0.47)	0.46*** (0.50)

a Note that the percentage includes pregnant women as well, if these women are removed the percentage using contraceptives is larger.

Table 52. Child health

	MV	CV	CV Near	CV Far
% taking vitamin A last 6 months	0.62 (0.48)	0.63 (0.49)	0.57** (0.50)	0.67** (0.47)
% taking deworming treatment last 6 months	0.34 (0.47)	0.33 (0.47)	0.28** (0.45)	0.38* (0.48)
Diarrhoea last 2 weeks	0.18 (0.39)	0.23** (0.42)	0.25** (0.44)	0.22* (0.41)
Fever last 2 weeks	0.27 (0.44)	0.28 (0.45)	0.30 (0.46)	0.26 (0.44)
Cough last 2 weeks	0.23 (0.42)	0.25 (0.43)	0.24 (0.43)	0.25 (0.43)
% tested for malaria if ill	0.44 (0.50)	0.38 (0.49)	0.47 (0.50)	0.31** (0.46)

Table 53. Malaria knowledge

	MV	CV	CV Near	CV Far
% believes mosquito bites	0.95 (0.21)	0.97*** (0.16)	0.97** (0.17)	0.98*** (0.15)
% believes drinking unsafe water	0.76 (0.92)	0.79** (0.40)	0.77 (0.42)	0.82*** (0.38)
% believes standing in the sun	0.78 (0.42)	0.80** (0.40)	0.78 (0.41)	0.83*** 90.38)
% believes witchcraft	0.45 (0.50)	0.49** (0.50)	0.52*** (0.50)	0.46 (0.50)
% believes eating sweets	0.55 (0.50)	0.62*** (0.49)	0.61*** (0.49)	0.62*** (0.48)

Table 54. Literacy

	MV	CV	CV Near	CV Far
Can read 'The child is playing with the ball'	0.17 (0.38)	0.18 (0.38)	0.18 (0.39)	0.18 (0.39)
Can read 'Farming is hard work'	0.17 (0.37)	0.18 (0.38)	0.18 (0.39)	0.18 (0.38)
Can answer 9+4	0.90 (0.30)	0.94*** (0.24	0.94*** (0.24)	0.94*** (0.24)
Can answer 4*5	0.85 (0.36)	0.88** (0.32)	0.89*** (0.31)	0.86 (0.34)

Table 55. Mortality rates

	All	MV	CV	CV Near	CV Far
Neonatal	35.9	28.8	39.5	52.4	28.1
Post-neonatal	25.5	17.0	30.1	35.5	25.5
Infant	61.4	45.9	69.6	87.9	53.6
Child	22.9	17.1	24.5	26.5	22.8
Under-5	82.8	62.2	92.4	112.1	75.1

Seasonality

The balance tests show several statistically significant differences between project and control groups. As anticipated, these differences are in many cases the result of a seasonal bias arising from conducting the surveys in the project area in the dry season and in the control area in the

rainy season. Regressions were run of the outcome indicators on monthly dummies ignoring the project/control divide thus looking for obvious seasonal patterns. The output of this work is omitted because the monthly dummies vary by survey and would deserve a lengthy separate discussion. The following observations were made:

- There are seasonal differences in education. Attendance rates are higher in the control group. These differences are not easy to explain. Censoring is one possibility. For a given age, children in the control group had a higher chance of attending school because they were interviewed two or three months later and, more importantly, were interviewed at the beginning of the new school year (September and October). Another possibility is the way the question was framed by enumerators. Questions explicitly ask for attendance during the academic year over the period 2011-2012. This should leave no room for misunderstandings, but enumerators may have asked something different or respondents could have interpreted the question differently. This seems to be the case as reported attendance becomes particularly low during the school break time (July and August).

- There are large differences in time spent in collecting water, cleaning, cooking, and care. Time spent is much larger in the control areas. Differences are very large and follow a clear pattern. Most likely these differences are the result of the school break and resulting employment of children in household chores and the seasonal working patterns for adults.

- Income and expenditure data are not affected by seasonal patterns. Fortunately, the de-seasonalised questions prevented this.

- Results on food security are puzzling. Households consistently report that the months of the MV survey are the hungry months, whilst in the months of the CV survey food security is not an issue. However, when responding to the question of days with insufficient food over the last month there are no differences between the project and the control group.

- There are differences in the use of mosquito nets. Use is much larger in the control villages. This is likely to be a seasonal effect because there are fewer mosquitoes in the dry season of the MV survey and therefore households do not see the need for bed nets as in the rainy season.

- There are significant differences in anaemia levels. This is in line with the seasonal analysis of secondary data. We tried to model malaria in order to account for the seasonal effect. After accounting for characteristics using a Oaxaca decomposition, the difference between project and control villages is even larger. Anaemia levels are difficult to model however and it is unlikely that these differences can be adjusted.

- There are differences in the incidence of malaria. However, the differences are not large and not statistically significant. This could be a consequence of the small size of the sample.

- Anthropometric indicators are slightly better, as expected, in the control areas, however, the differences are never statistically significant.

Balance Tests

	MV	CV-MV	P-value	CVN-MV	P-value	CVF-MV	P-value	CVN-CVF	P-value
Demographics									
Household size	7.1	-0.20	0.250	-0.46**	0.023	0.06	0.779	-0.51**	0.013
Number of under-5	1.0	0.01	0.912	-0.07	0.204	0.08	0.140	-0.16***	0.006
Female-headed household	0.09	0.02	0.101	0.02	0.260	0.03*	0.086	-0.01	0.560
Polygamous	0.22	-0.01	0.436	-0.04*	0.070	0.01	0.637	-0.05**	0.020
Migration									
Number of in-migrants per household	0.10	-0.03*	0.059	-0.03*	0.094	-0.03	0.137	0.00	0.817
Number of out-migrants per house	0.46	-0.16***	0.000	-0.18***	0.000	-0.14**	0.002	-0.04	0.412
Percentage female	0.53	0.03	0.417	0.06	0.211	0.01	0.882	0.05	0.304
Average age	0.22	1.13	0.232	1.32	0.251	0.96	0.387	0.35	0.782
Percentage migrating for work	0.51	-0.03	0.474	0.03	0.441	-0.08*	0.061	0.11**	0.016
Percentage migrating for schooling	0.19	0.00	0.928	0.01	0.883	0.00	0.776	0.18	0.694
Education									
% over-5 ever attended school	0.50	0.04***	0.000	0.07***	0.000	0.00	0.845	0.54***	0.000
Average years of schooling	1.9	0.06	0.305	-0.17**	0.015	0.27***	0.000	-0.44***	0.000
Average years of schooling (ever attending school pop.)	3.9	0.43***	0.000	0.24**	0.035	0.60***	0.000	-0.36**	0.002
NER primary	0.61	0.08***	0.000	0.05**	0.028	0.12***	0.000	-0.07**	0.001
NER JHS	0.10	0.06**	0.009	0.04	0.125	0.07**	0.003	-0.03	0.202
NER SSS	0.05	0.02	0.202	0.02	0.146	0.01	0.419	0.01	0.501
Percentage school meals	0.34	-0.14***	0.000	-0.17***	0.000	-0.10***	0.000	-0.07***	0.000
Average distance to school (minutes)	33.1	-1.26	0.243	-4.99***	0.000	1.86	0.127	-6.85***	0.000
Time use in the household (minutes)									
Fetching wood	170	41.30***	0.000	27.13**	0.039	55.62***	0.000	-29.50**	0.040
Collecting water	182	3.52	0.744	-8.99	0.468	16.17	0.193	-25.16**	0.037

	MV	CV-MV	P-value	CVN-MV	P-value	CVF-MV	P-value	CVN-CVF	P-value
Cleaning	106	19.71**	0.009	11.64	0.180	27.87**	0.001	-16.22*	0.079
Cooking	191	44.10***	0.000	41.36**	0.001	46.87***	0.000	-5.51	0.660
Taking care of children	172	79.62***	0.000	82.43***	0.000	76.79***	0.000	5.64	0.780
Taking care of elderly and sick relatives	61	83.3***	0.000	138.07***	0.000	28.00	0.271	110.08***	0.000
Shocks									
Drought %	0.76	0.07***	0.000	0.11***	0.000	0.03	0.129	0.08***	0.000
Floods %	0.57	-0.02	0.279	0.06**	0.024	-0.11***	0.000	0.17***	0.000
Severe storm %	0.63	-0.01	0.699	0.03	0.296	-0.04*	0.083	0.07**	0.005
Livestock death %	0.87	-0.13***	0.000	-0.11***	0.000	-0.15***	0.000	0.04*	0.061
Crop failure %	0.73	-0.09***	0.000	-0.08**	0.002	-0.11***	0.000	0.03	0.263
Water and sanitation									
Households with improved water %	0.73	-0.01	0.646	-0.03	0.272	0.01	0.757	-0.03	0.158
Distance to water source (minutes)	32	-5.45**	0.001	-3.66**	0.047	-7.27***	0.000	3.61**	0.026
Households treating water %	0.12	0.04**	0.009	0.04**	0.019	0.04**	0.031	0.00	0.863
Improved sanitation facility %	0.10	0.00	0.854	0.02	0.140	-0.02	0.242	0.10**	0.008
Energy use									
Households using firewood for cooking %	0.99	-0.01	0.419	0.00	0.495	-0.01	0.472	0.00	0.970
Households using batteries for lighting %	0.87	-0.04**	0.012	-0.01	0.501	-0.07***	0.000	0.06**	0.003
Housing conditions									
Finished walls %	0.20	0.01	0.754	0.05**	0.013	-0.04*	0.051	0.09***	0.000
Finished floors %	0.42	0.08***	0.000	0.05**	0.043	0.11***	0.000	-0.05**	0.037
Finished roofs %	0.37	0.02	0.396	0.08**	0.001	-0.05*	0.060	0.13***	0.000
Assets									
Table	0.62	-0.09***	0.000	-0.12***	0.000	-0.06**	0.021	-0.06**	0.014
Bed	0.41	0.02	0.386	0.02	0.340	0.01	0.583	0.01	0.685
Kerosene lamp	0.23	-0.02	0.373	-0.04*	0.078	0.00	0.819	-0.04**	0.043
Radio	0.49	0.00	0.943	-0.04	0.169	0.03	0.206	-0.07**	0.008
Mobile phone	0.59	-0.10***	0.000	-0.06**	0.019	-0.13***	0.000	0.07**	0.006
Animal cart	0.17	-0.06***	0.000	-0.06***	0.000	-0.06***	0.000	0.10	0.940

	MV	CV-MV	P-value	CVN-MV	P-value	CVF-MV	P-value	CVN-CVF	P-value
Bicycle	0.81	-0.05**	0.005	-0.05**	0.013	-0.05**	0.015	0.00	0.972
Motorbike	0.11	0.00	0.862	0.02	0.274	-0.02	0.159	0.04**	0.012
Total value of assets ($PPP)	183	-26.73*	0.090	-29.63	0.103	-23.81	0.191	-5.82	0.753
Credit and savings									
Household has a bank account %	0.16	-0.05**	0.001	-0.04**	0.015	-0.05**	0.002	0.01	0.453
Household is member of *susu* %	0.15	-0.07***	0.000	-0.06***	0.000	-0.07***	0.000	0.01	0.629
Average savings ($PPP)	23	-8.15*	0.078	-12.11**	0.023	-4.14**	0.437	-7.97	0.100
Any loan over last 12 months %	0.05	-0.02*	0.074	-0.01	0.267	-0.02**	0.045	0.01	0.333
Loan size ($PPP)	200	58.07	0.432	-64.89	0.431	188.71**	0.026	-253.00**	0.014
Microfinance loan	0.03	-0.02**	0.004	-0.02**	0.012	-0.02**	0.013	0.00	0.989
Informal loan	0.01	0.01**	0.033	0.01	0.122	0.01**	0.031	0.00	0.573
Agricultural use	0.02	0.00	0.472	0.00	0.910	0.00	0.255	0.01	0.279
Business use	0.03	-0.01	0.278	-0.01	0.389	-0.01	0.306	0.00	0.860
Land									
Land owned (hectares)	4.8	-0.25	0.394	-0.40	0.241	-0.11	0.745	-0.30	0.372
Cultivated land (hectares)	3.4	-0.43***	0.000	-0.18	0.185	-0.68***	0.000	0.50***	0.000
Number of plots	2.9	-0.28***	0.000	-0.39***	0.000	-0.17**	0.008	-0.22**	0.001
Food security									
Not enough food in any month over last year %	0.82	0.02	0.151	-0.02	0.348	0.07**	0.001	-0.09***	0.000
Days with not enough food over last 30 days	12.2	0.88	0.103	0.62	0.322	1.10*	0.071	-0.48	0.434
Any day a child went hungry the whole day %	0.16	-0.02	0.322	-0.04**	0.025	0.01	0.594	-0.05**	0.005
Ever reduced meal size %	0.74	0.01	0.451	-0.06**	0.009	0.09***	0.000	-0.015***	0.000
Expenditure									
Per capita expenditure ($PPP)	549	14.18	0.585	35.55	0.237	-7.52	0.803	43.06	0.120
Food share	0.78	-0.01	0.168	-0.01	0.343	-0.01	0.148	0.00	0.621
Share of own produced food	0.65	0.02	0.184	0.00	0.754	0.03**	0.045	-0.02*	0.078
Employment									

	MV	CV-MV	P-value	CVN-MV	P-value	CVF-MV	P-value	CVN-CVF	P-value
Employment rate % (age 15 to 59)	0.78	0.01	0.515	0.02	0.162	0.00	0.814	0.02**	0.010
Child employment % rate (age 6 to 14)	0.24	-0.04**	0.003	-0.02	0.175	-0.06***	0.000	0.04**	0.012
Farmers %	0.91	0.04***	0.000	0.03***	0.000	0.06***	0.000	-0.03***	0.000
% doing paid work	0.03	-0.01**	0.006	-0.01*	0.058	-0.01**	0.005	0.00	0.358
% of households with a microenterprise	0.20	-0.02	0.229	-0.06**	0.005	0.01	0.474	-0.07***	0.000
Of which trading %	0.47	-0.06	0.159	-0.10*	0.091	-0.05	0.359	-0.05	0.345
Of which retailing and services %	0.19	-0.02	0.537	0.01	0.744	-0.04	0.268	0.06	0.168
Of which agricultural processing %	0.21	0.02	0.597	0.06	0.176	-0.01	0.896	0.07	0.128
Income									
Per capita income ($PPP)	157	-17.94	0.545	-36.92	0.290	1.33	0.970	-38.26	0.323
Agricultural profits ($PPP)	600	-98.95	0.203	8.13	0.927	207.52**	0.021	501.46**	0.011
Marketed surplus %	0.22	0.03	0.260	0.02*	0.089	0.03**	0.031	0.00	0.653
Seeds inputs ($PPP)	0.13	0.73	0.795	0.16	0.960	1.31	0.687	14.12	0.748
Chemical fertiliser ($PPP)	28.8	5.92*	0.081	0.84	0.831	11.09**	0.005	-10.25**	0.007
Herbicides and pesticides ($PPP)	24.8	-9.16***	0.000	-7.18***	0.000	-11.17***	0.000	3.99**	0.007
Labour inputs ($PPP)	25.8	-16.25***	0.000	15.73***	0.000	-16.75***	0.000	1.02	0.401
Social networks									
Any important people living elsewhere? %	0.76	0.08***	0.000	0.02	0.311	0.13***	0.000	-0.11***	0.000
Of which distant relatives %	0.55	0.09***	0.000	0.13***	0.000	0.06**	0.004	0.07***	0.000
Of which friends %	0.21	0.00	0.713	-0.06***	0.000	0.05**	0.001	-0.12***	0.000
Asked for any help over last 12 months? %	0.45	0.01	0.694	-0.06**	0.002	0.080***	0.000	-0.14***	0.000
Provided any help over last 12 months? %	0.53	-0.03	0.133	-0.11***	0.000	0.063**	0.002	-0.18***	0.000
Mosquito nets									
Household has a mosquito net %	0.81	0.09***	0.000	0.13***	0.000	0.04**	0.011	0.09***	0.000
Average number of	2.9	-0.15**	0.040	-0.14*	0.069	-0.15*	0.075	0.00	0.990

	MV	CV-MV	P-value	CVN-MV	P-value	CVF-MV	P-value	CVN-CVF	P-value
mosquito nets %									
Someone sprayed the walls %	0.41	0.09***	0.000	0.08**	0.002	0.10***	0.000	-0.02	0.566
Anaemia									
Haemoglobin	10.0	-0.48***	0.000	-0.57***	0.000	-0.46***	0.000	-0.11	0.434
Mild anaemia	0.74	0.10***	0.000	0.11**	0.002	0.10**	0.007	0.01	0.769
Moderate anaemia	0.46	0.15***	0.000	0.17***	0.000	0.15**	0.001	0.03	0.593
Severe anaemia	0.04	0.02	0.282	0.03*	0.066	0.00	0.900	0.03	0.112
Malaria (children under-5)									
Malaria incidence %	0.22	0.03	0.396	0.03	0.440	0.02	0.538	0.00	0.907
Standardised severity among the infected	0.23	0.28*	0.060	0.20	0.255	0.37**	0.043	-0.17	0.470
Nutrition (children 6 to 59 months)									
Height-for-age Z-score	-1.29	0.06	0.427	0.12	0.217	0.02	0.841	0.10	0.307
Moderate malnutrition <-2	0.27	0.01	0.671	0.02	0.525	0.00	0.894	0.01	0.599
Severe malnutrition <-3	0.07	0.06***	0.000	0.05**	0.003	0.06**	0.001	-0.01	0.698
Weight-for-age Z-score	-0.89	0.04	0.557	0.13	0.104	-0.04	0.617	0.17	0.033
Moderate malnutrition <-2	0.14	0.02	0.255	0.02	0.405	0.02	0.253	-0.01	0.779
Severe malnutrition <-3	0.03	0.02**	0.028	0.01	0.219	0.03**	0.011	-0.01	0.229
Weight-for-height Z-score	-0.29	0.06	0.281	0.13*	0.055	0.00	0.960	0.23*	0.059
Moderate malnutrition <-2	0.04	0.01	0.341	0.00	0.798	0.02	0.170	-0.01	0.286
Severe malnutrition <-3	0.00	0.01*	0.068	0.01**	0.040	0.01	0.238	0.00	0.412
Family planning and child care									
Currently using any birth control method	0.10	0.00	0.726	0.00	0.628	0.01	0.386	-0.02	0.158
Visited by health worker for family planning	0.25	0.04**	0.013	-0.02	0.369	0.11***	0.000	-0.13***	0.000
Visited a health facility for own care or children	0.35	0.04**	0.042	-0.01	0.559	0.12***	0.000	-0.13***	0.000
Vitamin A last 6 months	0.62	0.02	0.404	-0.05**	0.042	0.05**	0.026	0.10***	0.000
Deworming last 6 months	0.34	-0.01	0.503	-0.06**	0.022	0.04*	0.089	-0.09***	0.000
Child health									
Diarrhoea last 2 weeks	0.18	0.05**	0.009	0.07**	0.001	0.04*	0.084	0.04*	0.070
Fever last 2 weeks	0.27	0.02	0.425	0.03	0.142	-0.01	0.769	0.04*	0.063
Cough last 2 weeks	0.23	0.02	0.328	0.02	0.328	0.02	0.456	0.01	0.782

	MV	CV-MV	P-value	CVN-MV	P-value	CVF-MV	P-value	CVN-CVF	P-value
Malaria tested if ill	0.44	-0.08*	0.076	0.03	0.602	-0.13**	0.015	0.16**	0.001
Knowledge of causes of malaria									
Mosquito bites	0.95	0.02**	0.001	0.02**	0.014	0.02***	0.000	-0.01	0.213
Drinking unsafe water	0.76	0.03	0.29	0.01	0.623	0.06***	0.000	-0.05**	0.003
Standing in the sun	0.78	0.03**	0.039	0.01	0.722	0.05**	0.001	-0.05**	0.001
Witchcraft	0.45	0.04**	0.008	0.07***	0.000	0.01	0.437	0.05**	0.003
Eating sweets	0.55	0.06***	0.000	0.06**	0.001	0.07***	0.000	-0.01	0.617
Literacy tests									
Can read 'The child is playing with the ball'	0.17	0.01	0456	0.01	0.448	0.01	0.447	0.00	0.997
Can read 'Farming is hard work'	0.17	0.01	0.339	0.01	0.298	0.01	0.492	0.00	0.713
Can answer 9+4	0.90	0.04***	0.000	0.04***	0.000	0.04***	0.000	0.00	0.676
Can answer 4*5	0.85	0.03**	0.002	0.04**	0.001	0.01	0.228	0.03**	0.018
Standardised test scores									
Raven's matrices	1.91	0.03	0.386	-0.03	0.474	0.09	0.031	-0.12**	0.005
Forward digit span	1.48	0.01	0.725	-0.09	0.045	0.10**	0.015	-0.19***	0.000
Backward digit span	0.92	-0.01	0.693	-0.08*	0.052	0.05	0.240	-0.13**	0.002
Easy Maths	2.40	0.07	0.191	0.06	0.332	0.07	0.200	-0.02	0.787
Easy English	1.65	0.20***	0.000	0.23**	0.001	0.18**	0.006	0.05	0.439
Advanced Maths	1.90	0.16	0.117	0.10	0.419	0.21	0.100	-0.10	0.380
Advanced English	2.08	0.17	0.117	0.16	0.210	0.19	0.131	-0.03	0.808
Expected wages (children)									
Wage primary	4.42	3.51***	0.000	2.85***	0.000	4.13***	0.000	-1.28	0.174
Wage secondary	6.01	9.67***	0.000	9.10***	0.000	10.20***	0.000	-1.09	0.592
Wage primary Accra	11.99	5.51***	0.000	6.75***	0.000	4.42**	0.007	2.33	0.222
Wage secondary Accra	17.04	16.03***	0.000	20.41***	0.000	12.23***	0.000	8.18**	0.032
Expected wages (parents)									
Wage primary	4.94	1.96***	0.000	1.73***	0.000	2.21***	0.000	-0.48	0.296
Wage secondary	6.72	6.40***	0.000	5.56***	0.000	7.31***	0.000	-1.75	0.123
Wage primary Accra	12.26	6.55***	0.000	5.81***	0.000	7.31***	0.000	-1.49	0.314
Wage secondary Accra	18.19	12.30***	0.000	11.95***	0.000	12.66***	0.000	-0.71	0.773
Survival expectations									
Up to age 60	0.93	-0.03**	0.002	-0.04***	0.000	-0.01	0.309	-0.03**	0.002
Up to age 70	0.87	-0.04***	0.000	-0.06***	0.000	-0.03**	0.028	-0.03**	0.010

	MV	CV-MV	P-value	CVN-MV	P-value	CVF-MV	P-value	CVN-CVF	P-value
Up to age 80	0.73	-0.02*	0.068	-0.04**	0.008	-0.01	0.606	-0.03**	0.036
Income expectations									
Subjective probability	0.74	-0.09***	0.000	-0.07***	0.000	-0.11	0.000	0.04*	0.060
Time discount rates									
1-month horizon	0.101	-0.021**	0.011	-0.030**	0.002	-0.012	0.212	-0.018*	0.080
3-month horizon	0.081	-0.009	0.221	-0.009	0.298	-0.009	0.313	0.000	0.984
6-month horizon	0.081	-0.014**	0.011	-0.018**	0.006	-0.010	0.115	-0.008	0.238
12-month horizon	0.060	-0.008	0.009	-0.010**	0.004	-0.005	0.128	-0.005	0.187