Essays on Education and Health in Developing Countries

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ABSTRACT

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This dissertation contains three essays on development economics in the areas of education and health in developing countries.

The first chapter evaluates the impacts of girls' education support program on human capital development of 3,997 female students (9^{th} - 11^{th} grades) at 33 secondary schools located in rural Lilongwe, Malawi. We find that female students treated with one-year tuition and monthly cash stipends are more likely to attend school and have better test scores. We also find that cognitive ability in the treatment group increases by 0.215 standard deviations, and those treated also display higher aspirations for educational achievement. Moreover, there is a significant improvement in time preference (increased patience).

In the second chapter, written jointly with Cristian Pop-Eleches and Hyuncheol Bryant Kim, we address two questions: 1) How to promote demand for male circumcision and 2) What is the role of peer effects in demand for male circumcision. We randomly provided free male circumcision and transportation voucher to male students in 124 classrooms across 33 secondary schools in rural Lilongwe, Malawi. Using a two-step randomized design, we first assigned classrooms into three groups (100% Treatment, 50% Treatment, or No Treatment classrooms) and then also randomly selected half of male students in 50% Treatment classrooms for treatment. We find that our intervention substantially increased the demand for male circumcision by on average 14.2 percentage points (243%). We also find evidence of peer effects since untreated students in 50% Treatment classrooms were 3.8 percentage points (79%) more likely to get circumcised than students in No Treatment classrooms. Finally,

we provide evidence of important reinforcement effects when close friends within the same classroom receive the intervention together.

The third chapter, written jointly with Cristian Pop-Eleches and Hyuncheol Bryant Kim, explores complementarities of three HIV/AIDS prevention interventions: HIV/AIDS Education, Male Circumcision for boys, and Girls' Education Support aimed at keeping girls in school. The study is based in 33 secondary schools in rural Lilongwe, Malawi and we focus on the behaviors within the existing 124 classrooms in these schools. Our research design to study the complementarities of these interventions is based on the randomized allocation of the different mix of interventions across classrooms. Our preliminary results indicate limited evidence of complementarities among the three interventions.

Table of Contents

List of Tables

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Chapter 1

The Impact of Girls' Education Support Program on Human Capital Development: Evidence from a Randomized Evaluation in Malawian Secondary Schools

1.1 Introduction

Education has been considered one of the most important determinants of human capital development. It is argued that improved education (mostly measured by test scores of reading comprehension and mathematics) is correlated with increased wages later in life at the micro-level (Blau and Kahn 2005) and may lead to more economic growth of a country at the macro-level (Hanushek and Woessmann 2012). However, previous studies assessing causal impacts of various educational interventions on test scores are limited to explaining whether these test score gains translate into improvements in adult economic and social outcomes.

One of the few exceptions is Chetty et al. (2011) who evaluate the impact of Project STAR (Student/Teacher Achievement Ratio) in Tennessee on college attendance, earnings, retirement savings, home ownership, and marriage 20 years after the implementation of the program. They present long-term impacts of smaller student-to-teacher ratio at $K-3^{rd}$ grades on outcomes in adulthood. Barnett (1992) also presents similar results showing that the Perry pre-school program in Michigan has produced long-term impacts on adult outcomes. Interestingly, they both report that the impacts on test scores were ephemeral and fade out rapidly but nonetheless educational innovations (small classroom or pre-school education) had significant long-term impacts. For example, Krueger and Whitmore (2001) shows that the impacts of class size from the Tennessee STAR experiment on test scores become statistically insignificant by grade 8 but then they reemerge for adult outcomes (Chetty et al. 2011). However, they do not shed light on which specific factors other than test scores have affected long-term outcomes.

Recent studies emphasize the importance of cognitive and non-cognitive abilities as well as time and risk preferences as underlying mechanisms to connect educational interventions to test scores and later adulthood outcomes (Macours et al. 2012; Wydick et al. 2013;

Glewwe et al. 2013; Sutter et al. 2013). We contribute to this literature by providing a unified evaluation of several outcomes, including the first analysis of causal impacts on preferences. Our analysis attempts to capture the effect that the educational intervention has on a number of intermediate outcome variables (such as cognitive and non-cognitive skills, and time preferences) that could be potential mechanisms explaining outcomes during adulthood. The ideal way to identify possible underlying mechanism of educational interventions for outcomes in adulthood is a randomized controlled trial targeted towards experimentally changing each potential mechanism separately. While the present study was not designed to do this, it is nevertheless important to capture and describe the impact of the educational intervention on these potential mechanisms in the short run.

In this paper, we use experimental data from the girls education support program in Malawi. In 2012, 124 classrooms of grade 9, 10, and 11 across 33 public secondary schools in Lilongwe rural areas participated in the girls education support program and 62 classrooms were randomly selected as the treatment group while the remaining 62 classrooms served as the control. All female students in treatment classrooms received one-year tuition directly deposited to the school account as well as monthly stipends distributed to students. By exploiting this experimental design, we evaluate the causal impacts of the education support program on schooling outcomes (dropout and absence), test scores, cognitive/non-cognitive abilities, and time preferences. The program impacts on HIV/AIDS knowledge, sexual behaviors, marriage, and pregnancy will be discussed in detail in Chapter 3 of this dissertation.

Starting with schooling outcomes, we find that although dropout rates (both self-reported and school-reported) declined, it was statistically significant only in 9^{th} grade (starting grade of a secondary school) students whereas it is insignificant in 10^{th} and 11^{th} grade students. This is consistent with recent work by Son (2013) who finds that negative income shocks (unemployment, crop loss, drought, and Asian financial crises) in Indonesia affect school enrollment differentially across different grade levels and this impact is strongly mitigated

for students who enter the final grades of junior or senior high school.[1] The probability of remaining at the original school in the treatment group (taking both dropouts and transfer students into account) increased by 8.7 percentage points at the 99% confidence level. School absence also declined among treated students on average by 5 days per year. When we turn to examine the Malawi School Certificate Exam (MSCE) and Junior Certificate Exam (JCE) for baseline 11^{th} grade and 9^{th} grade students, respectively, program impacts on MSCE were small and statistically insignificant in the treatment group. But we find evidence that the scholarship program increased the probability to take JCE for grade 9 students in the treatment group by 17.3 percentage points. The probability to pass JCE also raised by 15.1 percentage points at the 99% confidence level and overall exam scores improved by 0.241 SD when we control for baseline characteristics. However, the improvements in JCE performance need to be interpreted cautiously because students in the treatment classrooms took the JCE more than the control group, which may cause selection bias in the first stage.

Our main findings are that cognitive and non-cognitive abilities of treatment group students improved. Cognitive ability in the treatment increased by 0.215 SD at the 99% confidence level and treated students take education more importantly with higher aspirations for educational achievement. We also find significant improvements in time preferences and annual discount rate declined by 36.7 percentage points on average among students in the treatment classrooms at the 95% significant level. This causal impact of the girls education support program on time preferences complements the previous studies on time and risk preferences, which only present correlations between preferences and interested outcomes such as demographics, education, health, and labor market outcomes.

The paper is organized as follows. In Section 1.2, we briefly review related literature on

[1]This is so called sheepskin effect. A sheepskin effect exits when the wage return to an additional year of schooling is higher if that year allows a student to complete a school level. The origin of the term relates to the fact that diplomas were once printed on sheepskin.

education support program. In Section 1.3, we present the experimental design and address potential biases to the validity of the experiment. In Section 1.4, the empirical strategy based on simple OLS models is presented, followed by the results and analysis on schooling outcomes, test scores, cognitive/non-cognitive abilities, and time preferences in Section 1.5. Finally, Sections 1.6 concludes.

1.2 A Brief Literature Review on Education Support Programs

This section provides a brief overview of the related literature, limiting the scope to only financial incentives on students from field experiments. Randomized evaluations on financial incentives for education improvements have been concentrated in developing countries. Kremer, Miguel, and Thornton (2009) evaluate the effect of a merit-based girls' scholarship program in rural Kenya. The top 15% of 6th grade female students in the program districts received the scholarship (US $20 per year) for two years. They find that the merit scholarship improved average test scores by 0.19 SD.

Colombia's school voucher program (PACES) with a merit-scholarship component provided nearly 125,000 students from poor neighborhoods with vouchers (worth US $190) between 1991 and 1997 that covered approximately half the cost of private secondary school. Angrist et al. (2002) find that treated students were more likely to attend private school with improved test scores. 7 years after the voucher program, lottery winners were more likely to graduate from high school and scored higher on college entrance exams (Angrist, Bettinger, and Kremer, 2006).

The pioneering conditional cash transfer program in Mexico, PROGRESA provided monthly cash grants (US $55 on average) to poor family, with conditionality that their

children should attend school at least 85% of the time. Schultz (2004) reported increase in school enrollment and Behrman, Sengupta, and Todd (2005) showed that participation in the PROGRESA program is associated with not only improved school enrollment but also less grade repetition, lower dropout rates, and higher school reentry rates among dropouts.

The work similar to this chapter is that of Baird, McIntosh, and Özler (2011) who used an experimental design to estimate the effects of conditional (and unconditional) cash transfers on schooling outcomes, test scores, marriage, and pregnancy for never-married girls, aged 13-22 in Malawi. They find that school enrollment and attendance as well as test scores were significantly higher among treated in-school girls but there was no impact on marriage and pregnancy among them, which is consistent with findings in this paper. A recent cash transfer program in rural Morocco shows that an unconditional cash transfer (US $80 - $130 per year) made to households of primary school age children had a very large impact on school participation despite the fact that the transfer was not conditional on regular school attendance (Benhassine et al., 2013).

In general, various financial incentives such as merit scholarship, school vouchers, and conditional cash transfers on students' education have been proved effective to improve schooling outcomes and test scores.

1.3 Background, Experimental Design and Data

1.3.1 Background: Education in Malawi

Malawi is a small landlocked country in Sub-Saharan Africa and basic education in Malawi consists of eight years of primary education (Standard 1 through 8) followed by four years of secondary education (Form 1 through 4). Unlike the universal primary education policy adopted in 1994, secondary school admission depends on performance on the Primary

School Leaving Certificate Examination (PSLCE). Secondary students have to pay school tuition and fees and these costs averaged approximately US$ 21 (Malawi Kwacha 3,500) per semester.[2] Students have to pay tuition and fees each semester and if they dont submit the payment until the first couple of weeks of each semester, then they would be unable to enroll the school and be dropped out from the school. 10^{th} grade students (Form 2) must pass the Junior Certificate Examination (JCE) at the end of their second year in secondary school in order to move on to the next grade and 12^{th} grade students (Form 4) take the Malawi School Certificate Examination (MSCE) before they graduate from secondary school. Students must pay the fee (MK 300 for JCE and MK 420 for MSCE) to take the exam and if 10^{th} grade students fail to pass JCE, then they have to repeat 10^{th} grade again either in the original school or a transferred school. If 12^{th} grade students fail to pass MSCE, then they graduate from a secondary school without the certificate and would be unable to apply for tertiary education until they pass MSCE.

1.3.2 Experimental Design

We implemented one-year education support program to 3,997 girls (9^{th} - 11^{th} grades) at 33 public schools located around rural Lilongwe, Malawi.[3] This program was part of a broader HIV/AIDS prevention program which includes HIV/AIDS education, male circumcision, and the girls education support program being implemented by Daeyang Luke Hospital in

[2]Secondary schools in Malawi run 3 semesters per year. First semester starts in September to December. Second semester is January to April and third semester is April to July. One US dollar was worth 165 Malawi kwachas (MK) in April 2012 (http://www.oanda.com/currency/converter).

[3]The target population of 9^{th} - 11^{th} grade female students was selected for a variety of reasons. As this study was designed as part of a larger HIV/AIDS prevention program, we focused on females because the HIV prevalence rate among boys of secondary schooling age is negligible. The grade range was selected so that the study population had a reasonable chance of being or becoming sexually active during the study period. Finally, a decision was made to not make any offers to 12^{th} graders who were about to graduate before the one-year follow-up survey because of budget constraint and logistical challenge for tracking after graduation.

Lilongwe, Malawi.[4] Table 1.1 shows the experimental designs for the three HIV/AIDS prevention programs, which were independently implemented. For the girls education support program, we first stratified 124 classrooms by grade and randomly assigned 62 classrooms the treatment status. All girl students in the treatment classrooms received one-year school tuition (three semesters) and monthly cash stipends (three times per semester). School tuition and fees per semester on average was 3,500 Malawi kwacha and were directly deposited to each schools account and monthly cash stipends of 300 Malawi kwacha were distributed to treated students, which is equivalent to in total around US$ 70 per year.[5] These were substantial considering that Malawian GDP per capita (2013 est.) is US$ 224 and the minimum wage per month in rural areas is around US$17 (MK 2,742).[6] School tuition and fees for the beneficiary students were transferred to school account in the beginning of each semester while enumerators visited all schools every month on announced dates to directly distribute the monthly cash stipends to the treatment group. This program has a weak conditionality on school enrollment (not school participation) and beneficiary students must be enrolled in baseline school at the time of the transfers. The intervention was immediately discontinued

[4]The partner hospital has four catchment districts: Chimutu, Chitukula, Tsabango, and Kalumba in rural Lilongwe areas. Appendix 1 shows the map for these four districts. We invited all 33 public schools (excluding private boarding schools) in these districts to participate in the girls education support program.

[5]We started the girls education support program in the third semester of academic year 2011-2012 (April, 2012) and continued the intervention in the first and second semesters of academic year 2012-2013. We increased the amount of monthly stipend from 300 Kwacha to 500 Kwacha in the second semester of academic year 2012-13 due to the huge depreciation of Malawi Kwacha. Early in 2012, the exchange rate between US Dollar and Malawi Kwacha was 165/$. However, the value of Kwacha kept being depreciated after more than 50% currency devaluation on May 7^{th}, 2012 and the exchange rate in early 2013 were 350/$. In total, a treated student in the scholarship program received 13,900 Kwacha (3,500 Kwacha * 3 semesters + 300 Kwacha * 6 times + 500 Kwacha * 3 times), which is equivalent to around US $70 per year. Kremer, Miguel, and Thornton (2009) provided 6^{th} grade girls in Kenya with scholarship of US $20 per year and Baird et al. (2010) provided conditional cash transfers of US $120 per year to 13-22 year-old females in Malawi including current schoolgirls and recent dropouts.

[6]81 percent of the employed persons in Malawi are self-employed subsistence farmer and only 8 percent of the employed persons are salaried workers (NSO 2011). The most widely used wage rates in Malawi are minimum wages. Although there is no information about how many workers are paid minimum wages, most firms seem to use them for low-skilled labor, which comprise the vast majority of the wage earners (ILO 2010).

for transfer and dropout students. The fact that the lottery was held with all 33 participating school headmasters under the supervision of the division education officer ensured that the process was transparent and helped the participating schools view the offers as fair.

Table 1.1: Experimental Designs

1) HIV/AIDS Education

	Group	Assignment	Classrooms	Students
100% Treatment	G1	Treatment	41	2,480
50% Treatment	G2	Treatment	41	1,303
	G3	No treatment		1,263
No Treatment	G4	No treatment (Control)	42	2,925
Total			124	7,971

2) Male Circumcision

	Group	Assignment	Classrooms	Students
100% Treatment	G1	Treatment	41	1,293
50% Treatment	G2	Treatment	41	679
	G3	No treatment		679
No Treatment	G4	No treatment (Control)	42	1,323
Total			124	3,974

3) Girls' Education Support

	Group	Assignment	Classrooms	Students
100% Treatment	G1	Treatment	62	2,102
No Treatment	G2	No treatment (Control)	62	1,895
Total			124	3,997

Notes: For HIV/AIDS education and Male circumcision interventions, the randomization was done in two stages. First, classrooms for each grade across 33 schools were randomly assigned to 100% treatment, 50% treatment and no treatment. Then, within 50% treatment, only half of the students were randomly assigned to treatment.

The validity of the experimental design which allows us to assess the causal inferences rests on two assumptions: successful randomization of students into treatment and control classrooms and no differences in attrition. We evaluate whether students were randomly assigned to the treatment and control groups. If students were randomly assigned, then the treatment indicator variable should not predict any predetermined baseline characteristics of the students. Table II shows baseline statistics and randomization balance for the all three

HIV/AIDS prevention programs. The age of students on average is 16.2 years old and 5.4% of the sample are orphans without both parents. 19.8% and 8.2% of the sample reported that their fathers and mothers graduated from a 2-year college or 4-year university, respectively. Moreover, 45.6%, 32.7%, and 25.1% of the sample reported that their house has electricity, refrigerator and car at home, respectively (not shown).[7] Overall, our sample exhibits higher socioeconomic characteristics than the Malawi population as a whole. As shown in columns (2) - (8) of Table 1.2, none of the demographic characteristics predict the likelihood that a student is assigned to either one of three HIV/AIDS prevention interventions. F tests for the joint significance of all the predetermined demographic variables on HIV/AIDS education, male circumcision, and girls scholarship are insignificant ($p = 0.86$, 0.77, and 0.72) in columns (2), (3), and (6) respectively, showing that randomization for each intervention was well balanced across predetermined baseline characteristics. Column (7) specifically presents the randomization balance among the sub-sample of eligible girls and most of the baseline characteristics were well balanced between treatment and control classrooms except fathers education. However, the p-value of joint F test from a regression of full set of baseline controls on treatment assignment is 0.325 and it does not reject that all baseline coefficients are jointly equal to zero in the subsample of eligible girls only, either.

[7]Malawi DHS 2010 reported that only 9.1%, 4.3%, and 2.1% of the population have electricity, refrigerator, and car, respectively. Although studenst responses in household assets may be exaggerated, the huge differences between the sample and Malawi DHS 2010 can be understood after taking into account that our sample represents the family who is able to send their daughters to a secondary school.

Table 1.2: Baseline statistics and Randomization Balance

Dependent Variable:	Avg. (s.d)	HIV/AIDS Education	Male Circumcision	Male Circumcision (eligible boys)	Male Circumcision (ineligible girls)	Education Support	Education Support (eligible girls)	Education Support (ineligible boys)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Age (year)	16.16	-0.008	0.010	-0.006	-0.007	0.000	0.003	0.001
	(1.856)	(0.006)	(0.008)	(0.007)	(0.011)	(0.008)	(0.011)	(0.008)
Orphan	0.054	-0.009	-0.016	-0.027	-0.006	-0.010	-0.037	0.013
	(0.227)	(0.025)	(0.024)	(0.037)	(0.029)	(0.024)	(0.032)	(0.035)
Father's tertiary education	0.198	0.009	0.010	-0.011	0.020	0.014	0.047**	-0.021
	(0.399)	(0.019)	(0.017)	(0.027)	(0.022)	(0.019)	(0.022)	(0.029)
Mother's tertiary education	0.082	-0.020	0.009	-0.014	0.038	0.033	-0.024	0.104***
	(0.274)	(0.027)	(0.025)	(0.038)	(0.030)	(0.024)	(0.030)	(0.037)
Father's white-collar job	0.256	-0.006	-0.006	0.027	-0.033	-0.002	-0.031	0.033
	(0.436)	(0.016)	(0.016)	(0.022)	(0.021)	(0.017)	(0.023)	(0.024)
Mother's white-collar job	0.106	0.027	0.005	-0.028	0.020	-0.031	-0.017	-0.044
	(0.307)	(0.025)	(0.024)	(0.034)	(0.029)	(0.024)	(0.027)	(0.035)
Household Assets (0-16)	7.59	0.001	0.002	0.003	0.000	0.004	0.003	0.004
	(3.455)	(0.005)	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)	(0.007)
Conventional School	0.245	0.051	-0.066	-0.011	-0.121	0.087	0.086	0.089
	(0.430)	(0.083)	(0.084)	(0.081)	(0.095)	(0.103)	(0.102)	(0.105)
p-value of joint F-test		0.855	0.768	0.720	0.735	0.720	0.325	0.172
Observations		7,957	7,957	3,964	3,993	7,957	3,993	3,964
R-squared		0.070	0.018	0.019	0.030	0.045	0.055	0.041

Notes: This sample consists of 7,971 students who were interviewed at baseline survey. Parent's tertiary education is 1 when they graduate from a 2-year college or a 4-year university. Parent's white-collar job is coded as 1 when they have a professional or government job. Household Assets are defined the total number of assets they own from 16 asset questions. Conventional school is 1 when a student is enrolled in a conventional secondary school. Columns (2) - (8) show randomization balance for three different interventions. Columns (4) and (5) show randomization balance of male circumcision intervention for eligible boys and ineligible girls while columns (7) and (8) show the balance of girls' education support program for eligible girls and ineligible boys, respectively. Robust standard errors clustered by classroom are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

1.3.3 Student Surveys and Data

The Baseline survey was conducted between January and April 2012 and 7,971 secondary students or 74.4% of total 10,715 students in the school roll-call lists completed the survey. The survey collected information on demographics, household characteristics, education, health, sexual behaviors and preferences in time and risk prior to random assignment. The follow-up survey was conducted approximately 12 months later between January and April 2013 and added cognitive and noncognitive modules on top of the baseline questionnaires. 68.1% of the baseline sample students (or 5,431 students) completed the survey and 31.9% (or 2,540 students) were lost due to attrition because of absence, transfer, or dropout. Since the selectivity of those who attrit could be linked to systematic bias, we randomly chose 15% of the lost students (or 381 students) for tracking (Thomas et al. 2001; Thomas et al. 2012). Out of 381 students, we found out 271 students and conducted the follow-up survey at their home. This resulted in an effective survey follow-up rate of 90.8%.[8] Thus, 5,702 students completed the follow-up survey in total.

Another threat to the experimental design is differential attrition pattern and we investigate whether the likelihood of remaining in the follow-up survey varies by assignment groups and baseline characteristics. Table 1.3 presents the relationship between survey attrition and baseline characteristics. In the whole sample including ineligible boys, there is no differential attrition bias across assignment groups in columns (1) and (2) as well as across baseline characteristics in columns (3) and (4). However, in the sub-sample of eligible girls only, students who received the scholarship intervention controlling for the full set of demographic characteristics used in Table II were 3.8 percentage points more likely to stay in the sample at the 90% significance level, which causes negative attrition (or retention) bias. We tested

[8]The effective survey rate (ESR) is a function of the regular follow-up rate (RFR) and home-visit follow-up rate (HFR) as follows: ESR = RFR + (1-RFR) * HFR. Overall, ESR is 90.8% (68.1% + 31.9% * 71.1%). Weight for home-visit survey is 6.67 since we did 15% random sampling from the sample attrition (Baird et al. 2012).

whether this attrition is differential by baseline characteristics and found no evidence that the survey attrition due to the girls education support program is systematically related to baseline characteristics. In order to account for the resulting attrition bias, in all of our regressions we include a whole set of background controls. In addition, in order to examine the robustness of our findings with respect to attrition from the sample, we perform a bounding exercise (Lee 2009) described in detail in footnote 21.

The Junior Certificate Examination (JCE) and Malawi School Certificate Examination (MSCE) data were obtained from the District Education Office (DEO) and test scores are normalized so that scores in the control classrooms are distributed with mean 0 and standard deviation 1.[9] JCE and MSCE have 3 core subjects: Chichewa, English, and Math and students have to take at least 3 or 5 additional subjects, respectively. 9^{th} / 11^{th} grade students (at baseline) took JCE / MSCE in June, 2013.

1.4 Estimation Strategy

The random assignment of girls education support program allows us to ensure that the assignment of the treatment is orthogonal to other characteristics of the sample that may be correlated with outcome variables. We focus on reduced-form estimation of the program impacts on schooling outcomes and exam scores. To better understand possible mechanisms underlying the impacts on schooling and examinations, we also evaluate program impacts on several channels, including child labor, health, cognitive/noncognitive abilities and time

[9]The JCE / MSCE data contain three identifying variables for each student: attending school, gender, and name. However, an exact match on these identifying variables is very difficult because of differences in the spelling of names. To deal with the issue of differently spelled names we applied probabilistic matching algorithms in the spelling of names by using reclink STATA command (de Hoop, 2011). The matching algorithm provides a match score indicating how closely two names match on a scale from 0 to 1. We used a cutoff with a match score below 0.6 (by default) and we have been conservative in the matching procedure by checking all approximate string matches manually.

Table 1.3: Relationship between survey attrition and baseline characteristics

	Whole sample				Eligible girls only			
Dependent variable	= 1 if surveyed in follow-up or home-visit surveys				= 1 if surveyed in follow-up or home-visit surveys			
	Treatment	Adjusted	Main effect	Interaction	Treatment	Adjusted	Main effect	Interaction
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Girls' Education Support	0.006	0.004		0.160	0.040*	0.038*		0.068
	(0.020)	(0.020)		(0.155)	(0.022)	(0.022)		(0.207)
Age		-0.007*	-0.000	-0.014*		-0.015**	-0.012	-0.006
		(0.004)	(0.005)	(0.007)		(0.006)	(0.008)	(0.011)
Orphan		-0.043**	-0.044	-0.003		-0.081**	-0.071	-0.025
		(0.022)	(0.034)	(0.044)		(0.039)	(0.057)	(0.079)
Father's tertiary education		-0.007	-0.025	0.028		-0.003	-0.009	0.001
		(0.017)	(0.026)	(0.034)		(0.025)	(0.038)	(0.051)
Mother's tertiary education		-0.050*	-0.043	-0.012		-0.070**	-0.069	-0.000
		(0.026)	(0.039)	(0.053)		(0.034)	(0.050)	(0.069)
Father's white-collar job		-0.016	-0.019	0.001		-0.024	-0.041	0.035
		(0.012)	(0.018)	(0.025)		(0.017)	(0.027)	(0.034)
Mother's white-collar job		-0.012	0.016	-0.054		-0.028	-0.004	-0.049
		(0.022)	(0.031)	(0.041)		(0.027)	(0.038)	(0.053)
Household Assets		-0.001	-0.004	0.006		-0.001	-0.005	0.006
		(0.002)	(0.003)	(0.005)		(0.003)	(0.004)	(0.007)
Conventional School		0.053***	-0.002	0.100**		0.049**	-0.008	0.102**
		(0.019)	(0.024)	(0.039)		(0.023)	(0.035)	(0.048)
Observations	7,971	7,957	7,957		3,997	3,993	3,993	
R-squared	0.011	0.016	0.020		0.014	0.024	0.027	

Notes: Columns (3) and (4) present results from one regression with main effects (column 3) and all covariates interacted with treatment effect (column 4). Regressions are OLS models with grade fixed effects. Robust standard errors clustered by classroom are reported in parenthesis. The weight of 6.67 is given to home-visit survey sample. Baseline values of the following variables are included as controls: age, orphan status, parents' tertiary education, parents' white-collar job, household asset ownership, and school type. *** p<0.01, ** p<0.05, * p<0.10

preferences by estimating the following simple model using ordinary least squares:[10]

$$Y_{ic} = \beta_0 + \beta_1 ES_c + \beta_2 X_{ic} + \delta_c + \varepsilon_{ic} \tag{1.1}$$

The variable $Y_{ic}$is the outcome for student i, in classroom c. The variable ES_c is an indicator for whether classroom c was assigned for education support program and the coefficient β_1 captures the average program impact. X_{ic} is a vector that includes the sociodemographic controls.[11] We also include grade fixed effects, δ_c since the randomization was implemented within grade. In some specifications we also control for the effect of the other two interventions (HIV/AIDS education and circumcision for boys) and their interactions, since they were part of the broader project. Possible interactions (complementarities) between these interventions are generally small and insignificant and they are discussed in greater detail in Chapter 3 of this dissertation.

[10]When outcome variables are binary, we have also estimated the main treatment effects using probit models, yielding consistent results.

[11]We included age, orphan status, parents tertiary education, parents white-collar job, household asset ownership, and school type in order to address any minor baseline differences between the treatment and control classrooms that exist despite the randomization. Since the randomization successfully produced treatment and control classrooms balanced across most baseline characteristics, the inclusion of these controls does not significantly change the treatment effect estimates but does sometimes improve statistical precision.

1.5 Results

1.5.1 Schooling: Dropout

Table 1.4 describes self-reported and school-reported dropout rates.[12] Both are in similar magnitude but insignificantly different from zero. When we examine dropout and transfer together in columns (5) and (6), impact estimates suggest that the probability of being enrolled in the original school increase by 8.3 percentage points at the 99% confidence level. Since not all students who transferred to other schools were actually enrolled, this estimate can be regarded as the upper bound for school dropout. Panel B, C, and D show differential dropout pattern by grade and it is suggested that dropout rates decrease as students advance higher grades. We observe significant decrease in school dropout among 9^{th} grade, which is starting grade of a secondary school, while the girls education support program does not affect 10^{th} and 11^{th} grade students school dropout rates.[13] To examine the robustness of our results, we report the coefficient both with and without the baseline controls. The inclusion of these controls does not significantly affect the estimates, as expected given that the covariates are balanced across classrooms. This robustness check approach is applied in all specifications.

[12]Kremer, Miguel, and Thornton (2009) use school participation data based on unannounced checks by NGO enumerators whereas Baird, McIntosh, and Özler (2011) use school enrollment and attendance information from official school ledgers as benchmark while collecting self-reported and teacher-reported data as well. We collected both self-reported and official school attendance data. School-reported dropout and transfer were consistent with self-reported data in the sample. 82% and 84% of school-reported dropout and transfer were exactly matched with self-reported data.

[13]When secondary-school-aged girls are not in school, they are likely to be unemployed, to get married, and to begin childbearing according to Malawi Demographic and Health Survey 2010. 63.4% of females whose ages are 15-19 years old are unemployed and only 36.5% are employed (most of female employments are agriculture farming and domestic work which do not have earned wages). 23.4% of those girls in the same age bracket get married or start cohabiting while 26% of them begin childbearing. These figures on marriage and childbearing rapidly increase when these teenage girls enter the 20-24 age bracket.

Table 1.4: Impact on School Dropout

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	drop-out (self-reported)		drop-out (school-reported)		drop-out or transfer (school-reported)	
Panel A: Whole sample						
Girls' Education Support	-0.039	-0.034	-0.032	-0.027	-0.087***	-0.083***
	(0.029)	(0.023)	(0.024)	(0.021)	(0.033)	(0.030)
Observations	2,861	2,860	2,861	2,860	2,861	2,860
Panel B: Grade 9						
Girls' Education Support	-0.101**	-0.090**	-0.060*	-0.044*	-0.124**	-0.127***
	(0.049)	(0.037)	(0.033)	(0.024)	(0.046)	(0.031)
Observations	889	889	889	889	889	889
Panel C: Grade 10						
Girl's Education Support	0.012	0.018	0.023	0.018	-0.051	-0.084**
	(0.047)	(0.030)	(0.050)	(0.036)	(0.055)	(0.041)
Observations	1,040	1,039	1,040	1,039	1,040	1,039
Panel D: Grade 11						
Girls' Education Support	-0.045	-0.017	-0.074**	-0.059*	-0.099	-0.087
	(0.050)	(0.049)	(0.033)	(0.035)	(0.068)	(0.066)
Observations	932	932	932	932	932	932
Controls	No	Yes	No	Yes	No	Yes

Notes: The dependent variable in Columns (1) and (2) are based on follow-up survey while that in Columns (3) and (4) are based on difference between baseline and follow-up surveys. Regressions are OLS models with grade fixed effects. Robust standard errors clustered by classroom are reported in parenthesis. The weight of 6.67 is given to home-visit survey sample. Baseline values of the following variables are included as controls: age, orphan status, parents' tertiary education, parents' white-collar job, household assets, and school type. *** p<0.01, ** p<0.05, * p<0.10

1.5.2 Schooling: Attendance

Although we didnt find the extensive margin on school dropout (or enrollment) overall, Table 1.5 indicates that the program has an effect on the intensive margin by reducing school absence for those enrolled in school. The average absences based on self-reported data was 3.8 days per semester (or 11.4 days per year) and treated girls are 1.6 days per semester (or 5 days per year) less likely to be absent.[14] When we control baseline school absence level, we have slightly bigger impacts shown in columns (3) and (4).

Table 1.5: Impact on School Attendance

Dependent variable	Self-reported absence			
	(1)	(2)	(3)	(4)
Girls' Education Support	-1.707***	-1.645***	-2.187***	-2.187***
	(0.345)	(0.275)	(0.437)	(0.420)
Mean in the control group	3.794		0.672	
Controls	No	Yes	No	Yes
Observations	2,715	2,704	2,700	2,689
R-squared	0.027	0.047	0.027	0.042

Notes: The dependent variable in Columns (1) and (2) are based on follow-up survey while that in Columns (3) and (4) are based on difference between baseline and follow-up surveys. Regressions are OLS models with grade fixed effects. Robust standard errors clustered by classroom are reported in parentheses. The weight of 6.67 is given to home-visit survey sample. Baseline values of the following variables are included as controls: age, orphan status, parents' tertiary education, parents' white-collar job, household asset ownership, and school type. *** p<0.01, ** p<0.05, * p<0.10

1.5.3 Test Scores: Malawi School Certificate Examination (MSCE)

In Table 1.6, we present the impact of scholarship program on the performance on the Malawi School Certificate Examination (MSCE) for 11^{th} grade students at baseline. A first outcome

[14]Baird, McIntosh, and Özler (2011) reported that conditional cash transfers increased school attendance by 10 more school days over the entire school year. The magnitude of our results on school absence (5 more school days) is half of that of Baird, McIntosh, and Özler (2011) but our girls education support program didnt impose school attendance conditionality.

we consider is simply whether students took the MSCE.[15] Column (2) suggests that students in the treatment classrooms were 2 percentage points less likely to take the MSCE but this result is statistically insignificant. Though the point estimate is negative, the upper bound of the 95% confidence interval is 7.8 percentage points increase in taking MSCE. Since there was no evidence of selection into exam taking, we were able to simply interpret effects on MSCE performance. Only 34.7% of the sample passed the MSCE and the remaining 65.3% of the students graduated without MSCE certificate.[16] Columns (3) and (4) report that there was no significant improvement on the probability to pass MSCE though the point estimates are positive and columns (5) (12) show no impact on overall scores and the three core subjects: Chichewa, English, and Mathematics.[17] One reason of no impact on MSCE may be the relatively short period between baseline and follow-up surveys. To the extent that improving exam scores especially in a difficult testing takes time, our current 1-year short term follow-up may not be able to fully capture the full range of possible effects. This hypothesis can be tested when we obtain MSCE data for baseline 9^{th} and 10^{th} grade students in the following years.

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[15]When MSCE and JCE data from Division Education Office are matched with our baseline sample, we define this match as exam taking. There are 1,186 11^{th} grade female students in the sample and MSCE data are matched with 74.1% (or 879 students) of the sample.

[16]We code MSCE passing variable as 0 for students whose MSCE data from Division Education Office are missing or are not matched with the baseline survey. If we define MSCE passing variable for only those who took MSCE (or whose MSCE data is matched), then 46.8% of the sample passed the exam.

[17]The overall score is the standardized sum of three core subject scores (Chichewa, English, and Math), each standardized on its own before the sum. Thus, the overall score has mean 0 and standard deviation of 1 of the control group.

Table 1.6: Impact on Malawi School Certificate Exam (MSCE) 2013 for 11^{th} grade students

VARIABLES	= 1 if took MSCE		= 1 if passed MSCE		Overall score		Chichewa score		English score		Math score	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Girls' Education Support	-0.026	-0.020	0.038	0.023	0.054	-0.013	0.074	0.007	0.085	0.030	-0.020	-0.076
	(0.055)	(0.048)	(0.069)	(0.061)	(0.169)	(0.134)	(0.195)	(0.158)	(0.181)	(0.125)	(0.139)	(0.131)
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Observations	1,186	1,186	1,186	1,186	851	851	853	853	867	867	865	865
R-squared	0.009	0.028	0.002	0.088	0.001	0.122	0.002	0.101	0.002	0.193	0.000	0.052

Notes: MSCE scores: 0 - fail, 1 2 - pass, 3 6 - credit, 7 8 - distinction. Chichewa, English, and Math are three core subjects. Overall and three core subject scores have been standardized to have a mean of 0 and a standard deviation of 1 in the control group. Regressions are OLS models with school district fixed effects. Robust standard errors clustered by classroom are reported in parentheses. The weight of 6.67 is given to home-visit survey sample. Baseline values of the following variables are included as controls: age, orphan status, parents' tertiary education, parents' white-collar job, household asset ownership, and school type. *** $p<0.01$, ** $p<0.05$, * $p<0.10$

1.5.4 Test Scores: Junior Certificate Examination (JCE)

Table 1.7 shows the program impact on the Junior Certificate Examination (JCE) for 9^{th} grade students at baseline. Treated girls were 15.5 percentage points more likely to take the JCE at the 99% significance level in column (2) and this result is consistent with the finding that 9^{th} grade students were more likely to stay in school, which translates into the increased probability of taking the exam one year later. We also see the improvements in JCE performances.[18] The probability of passing the JCE improved by 18.7 percentage points at the 99% confidence level and the overall scores increased by 0.241 SD at 90% level when we adjusted the treatment effect with the baseline characteristics. The improvement on the overall scores attributed to the increased scores in Chichewa subject but no significant improvement can be detected in English and Math subjects. However, these results should be taken cautiously due to the selection bias in the first stage of JCE taking. Because a higher proportion of students from treatment classrooms took the JCE, it is likely that the group of students from treatment classrooms contains a higher fraction of relatively weak students; that is, strong students are likely to take the JCE regardless of the scholarship program, but marginal students who are induced to take the exam because they received scholarship are likely to be relatively lower scoring students. Such a selection process could bias downward the effect of scholarship program on the average JCE performances we report in Table 1.7.[19]

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[18]Compared to MSCE, JCE is relatively easier to pass. 59.8% of the sample passed the exam. If we restrict the sample to those who took the exam, then 84.4% of students who took JCE passed the exam. The reason why we have impact on JCE but not on MSCE could be thought in that JCE is a low-stakes testing and MSCE is a high-stakes testing. However, both JCE and MSCE are high-stakes tests because they have important consequences for students grade promotion and graduation with certificate. We were unable to analyze low-stakes tests such as regular assessment exams from each school due to huge missing data and incompatibility across the target schools.

[19]Krueger and Whitmore (2001) reported the impact of the Tennessee STAR experiment on the ACT or SAT college entrance exam. They show that attending a small class in the early grades is associated with an increased likelihood of taking a college-entrance exam but no significant improvements in test scores can be observed arguably due to the selection bias on the extensive margin of exam taking. They use Hackman

selection correction and linear truncation model to adjust the selection issue under the assumption that the same factors that determine whether student are more likely to take the exam also determine how well they do on the test, After correction the selection problem through either Hackman selection or linear truncation models, they found significant improvements in the exam scores.

Table 1.7: Impact on Junior Certificate Exam (JCE) 2013 for 9^{th} grade students

VARIABLES	= 1 if took JCE		= 1 if passed JCE		Overall score		Chichewa score		English score		Math score	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Girls' Education Support	0.173***	0.155***	0.151**	0.187***	0.196	0.241*	0.226	0.261**	0.094	0.193	0.156	0.143
	(0.037)	(0.038)	(0.060)	(0.048)	(0.188)	(0.127)	(0.153)	(0.128)	(0.214)	(0.137)	(0.151)	(0.108)
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Observations	1,220	1,220	1,220	1,220	853	853	856	856	855	855	858	858
R-squared	0.041	0.052	0.023	0.091	0.010	0.242	0.014	0.120	0.002	0.324	0.005	0.142

Notes: JCE scores: 0 - fail, 1 - average, 2 - good, 3 - very good, 4 - excellent. Chichewa, English, and Math are three core subjects. JCE scores are standardized with mean 0 and standard deviation of 1 of the control group. Regressions are OLS models with school district fixed effects. Robust standard errors clustered by classroom are reported in parentheses. The weight of 6.67 is given to home-visit survey sample. Baseline values of the following variables are included as controls: age, orphan status, parents' tertiary education, parents' white-collar job, household asset ownership, and school type. *** p<0.01, ** p<0.05, * p<0.10

1.5.5 Cognitive Ability

We now turn to an analysis of the cognitive ability. The cognitive test score is based on 30 Ravens Matrices (18 questions from Colored Progressive Matrices and 12 questions from Standard Progressive Matrices). In Table 1.8, we see improvements of 0.215 SD in the treatment classrooms compared with the control classrooms at the 99% confidence level. When the demographic controls are included, the coefficient on cognitive ability remains similar (0.2 SD). This effect size of more than 0.2 SD is not only statistically but also economically significant compared to similar program effect size such as Baird, McIntosh, and Özler (2011) reporting that the impact of conditional cash transfers for secondary female students in Malawi on cognitive test score (based on Ravens Matrices) was 0.17 SD increase.[20]

Since we have survey attrition bias of 3.9 percentage points at the 90% level presented in Table 1.3 despite the fact that there is no differential attrition across baseline characteristics, we perform bounding exercises by assigning higher percentile scores to attrition students belong to the control classroom while assigning lower percentile scores to attrition students belong to the treatment classroom.[21] As an example, among the representative attrition

[20]Cohen (1969) describes an effect size of 0.2 SD as the difference between the heights of 15 year old and 16 year old girls in the US and an effect size of 0.5 SD corresponds to the difference between the heights of 14 year old and 18 year old girls. In education, if an intervention would raise academic outcomes by an effect size of even as little as 0.1 SD, then this could be a very significant improvement, particularly if the improvement applied uniformly to all students, and even more so if the effect were cumulative over time. Other education interventions such as building a village-based primary school in Afghanistan (Burde and Linden 2013) and girls merit-based scholarship in Kenya (Kremer, Miguel, and Thornton 2009) reported 0.65 SD and 0.19 SD increases on average test scores. An effect size of 0.65 SD from the Afghanistan primary school project is considered the largest one among many education field interventions conducted by J-PAL (Jameel Poverty Action Lab) at MIT.

[21]Among the representative attrition sample of 187 students, 59 girls have missing follow-up survey (28 in the treatment group and 31 in the control group). Initially, 59 attrition girls were assigned 50 percentile score and then we increased the percentile score assigned to 31 girls in the control group by 1 percentile while decreasing the percentile score to 28 girls in the treatment group by 1 percentile. Therefore, the second bounding practice is that 31 girls in the control group were assigned 51 percentile score and 28 in the treatment 49 percentile score. In the end, we assigned 99 percentile score to the control group girls and 1 percentile score to the treatment group girls. The findings on treatment impacts would not change until we assigned 93 percentile and 7 percentile scores to the attrition when we run the basic regression without control variables. If we used the specification with control variables, then the treatment impact would hold

sample of 187 students (15% random sampling of total 2,540 attrition students), 59 girls missed the follow-up survey (28 in the treatment group and 31 in the control group). The 90-percentile score was assigned to 31 girls in the control group while 28 girls in the treatment group were assigned the 10-percentile score. Columns (3) and (4) show that even after a bounding exercise, the findings on treatment impacts would not change, even though the size of the coefficient decreases from 0.215 SD to 0.166 SD.

Table 1.8: Impact on Cognitive Ability

Dep. Var.	Cognitive Test Score		Cognitive Test Score (bounding practice)	
	(1)	(2)	(3)	(4)
Girls' Education Support	0.215***	0.200***	0.166**	0.155**
	(0.082)	(0.065)	(0.082)	(0.064)
Controls	No	Yes	No	Yes
Observations	2,861	2,850	2,920	2,908
R-squared	0.021	0.132	0.016	0.126

Notes: The cognitive test score is based on 30 Raven's Matrices (18 questions from Colored Progressive Matrices and 12 questions from Standard Progressive Matrices). The test scores have been standardized to have a mean of 0 and a standard deviation of 1 in the control group. Columns (3) and (4) show a bounding practice. Among the representative attrition sample of 187 students, 59 girls have missing follow-up survey (28 in the treatment group and 31 in the control group). 90 percentile score was assigned to 31 girls in the control group while 28 girls in the treatment group were assigned 10 percentile score. Regressions are OLS models with grade fixed effects. Robust standard errors clustered by classroom are reported in parentheses. The weight of 6.67 is given to home-visit survey sample. Baseline values of the following variables are included as controls in the regression analyses: age, orphan status, parents' tertiary education, parents' white-collar job, household asset ownership, and school type. *** p<0.01, ** p<0.05, * p<0.10

We also take into consideration the fact that the test settings for cognitive ability were different between follow-up and home-visit surveys. Students who participated in the follow-up survey took the cognitive test at their school while those who missed the follow-up survey and later completed the home-visit survey took the test mostly at their home.[22] In order to adjust the setting difference, we randomly selected 2

even after 99 percentile and 1 percentile scores were assigned to the attrition students (Appendix 2).

[22]Duflo, Dupas, and Kremer (2011) brought attrition students to school for the test while Baird, McIntosh, and Özler (2011) administered the test to all study participants at their homes.

1.5.6 Noncognitive Ability

We measured four variables on noncognitive abilities: self-esteem, self-efficacy, aspiration for education, and importance of education. Self-esteem and self-efficacy were measured by 6 and 4 related questionnaires, respectively while aspiration for education is a dummy variable when students aim to continue on to bachelor or master degrees. Importance of education is a categorical data ranging from 1: not important at all to 5: very important. Table 1.9 shows the program impact on noncognitive abilities. Although we do not observe significant change in self-esteem and self-efficacy, we find that the scholarship program resulted in improvements in aspirations for education and importance of education.[23] When controlled baseline characteristics, educational aspirations of the treatment classrooms increased by 0.127 SD in column (6) at the 90% significant level. Importance of education was also improved by 0.112 SD in column (8) at the 95% significant level. The improvements in aspirations and importance of education were partly supported by the result that students in the treatment classrooms were more likely to study after school (not shown).

[23]One concern from psychology argues that extrinsic rewards like scholarship or cash transfers may interfere with intrinsic motivation and could thus reduce effort in some circumstances. Surveys of students in our Malawian data provide no evidence that scholarship or cash transfers weaken intrinsic motivation for education at least in the short-run.

Table 1.9: Impact on Non-cognitive Abilities

Dep. Var.	Self-esteem		Self-efficacy		Aspirations for education		Importance of education	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Girls' Education Support	0.003	0.005	-0.045	-0.034	0.152	0.144**	0.099**	0.112**
	(0.075)	(0.063)	(0.069)	(0.055)	(0.093)	(0.072)	(0.045)	(0.048)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
Observations	2,861	2,860	2,861	2,860	2,861	2,860	2,799	2,798
R-squared	0.013	0.054	0.017	0.057	0.006	0.102	0.003	0.007

Notes: Noncognitive abilities have been standardized to have a mean of 0 and a standard deviation of 1 in the control group. Self-esteem was constructed by 6 questions while self-efficacy is based on 4 related questions. Aspiration for education is coded as 1 when students aim to study 4-year university or master's degree. Importance of education (1: Not important at all 5: Very Important) is based on the difference between baseline and follow-up survey responses. All coefficients are standardized to have a mean of 0 and a standard deviation of 1 in the control group. Regressions are OLS models with grade fixed effects. Robust standard errors clustered by classroom are reported in parentheses. The weight of 6.67 is given to home-visit survey sample. Baseline values of the following variables are included as controls in the regression analyses: age, orphan status, parents' tertiary education, parents' white-collar job, household asset ownership, and school type. *** p<0.01, ** p<0.05, * p<0.10

1.5.7 Time Preference

Recent research has shown that experimentally elicited time preference of adolescents is a significant predictor on alcohol, cigarettes, BMI, saving, and proper school conduct (Sutter et al. 2013). Since time preference seems more directly related to self-control, which is an important mechanism for educational achievement, we elicit time preference in our baseline and follow-up surveys using simple versions of hypothetical choice lists that are widely used in the economics literature.[24] Table 1.10 shows hypothetical choice lists used in the baseline and follow-up surveys. Panel A presents the original format of choice lists for time preference. In the first question (Q801), students choose either 10,000 MK (US $57) in 1 month or 20,000 MK (US $114) in 3 months.[25] If 10,000 MK in 1 month is chosen, then students move to Q802 and select three choice lists with increasing payoffs whereas the other students who choose 20,000 MK in 3 months go to Q803 and select three choice lists with decreasing payoffs. In panel B, we rearranged the choice lists with monotonically increasing payoffs as if students were asked to start choosing choices from the first list to the ninth one. From the rearranged lists we calculated the future equivalent of the fixed payoff at the earlier point in time as the midpoint between the two later payoffs where a student switches from the earlier to the later payment.[26] For example, if a student ends up with the second choice list (11,000 MK in 3 months over 10,000 MK in 1 month) which is the most time-patient category in our setting, then the future equivalent equals 10,500MK. If students choose the ninth choice

[24]The use of real rewards is generally desirable, but hypothetical rewards actually have some advantages. In studies involving hypothetical rewards, respondents can be presented with a wide range of reward amounts, including losses and large gains, both of which are generally infeasible in studies involving real outcomes. The disadvantage of hypothetical choice data is the uncertainty about whether people are accurately predicting what they would do if outcomes were real.

[25]Instead of using choices between today and three months, we used choices between 1 month and 3 months in order to rule out present-biased discounting. Sutter et al. (2013) reported no strong evidence for present-biased discounting for 661 adolescents, aged 10 to 18 years in Austria.

[26]Just like Sutter el al. (2013), we calculate the discount rate with i = ln (future equivalent / initial payoff (=10,000 MK)) x 12/2 in case of a two-month delay.

list (10,000 MK in 1 month over 50,000 MK in 3 months) which is the most time-impatient category in our setting, then the future equivalent cannot be calculated and is censored by Tobit regressions.

Table 1.10: Choice Lists for Time Preference

Panel A: Original Choice Lists				
Q801		0 = 10,000 MK in 1 month (Go to Q802)	or	1 = 20,000 MK in 3 months (Go to Q803)
Q802	[1]	0 = 10,000 MK in 1 month	or	1 = 30,000 MK in 3 months
	[2]	0 = 10,000 MK in 1 month	or	1 = 40,000 MK in 3 months
	[3]	0 = 10,000 MK in 1 month	or	1 = 50,000 MK in 3 months
Q803	[1]	0 = 10,000 MK in 1 month	or	1 = 17,000 MK in 3 months
	[2]	0 = 10,000 MK in 1 month	or	1 = 14,000 MK in 3 months
	[3]	0 = 10,000 MK in 1 month	or	1 = 11,000 MK in 3 months
Panel B: Rearranged Choice Lists with monotonically increasing payoffs				
	[1]	0 = 10,000 MK in 1 month	or	1 = 10,000 MK in 3 months
	[2]	0 = 10,000 MK in 1 month	or	1 = 11,000 MK in 3 months
	[3]	0 = 10,000 MK in 1 month	or	1 = 14,000 MK in 3 months
	[4]	0 = 10,000 MK in 1 month	or	1 = 17,000 MK in 3 months
	[5]	0 = 10,000 MK in 1 month	or	1 = 20,000 MK in 3 months
	[6]	0 = 10,000 MK in 1 month	or	1 = 30,000 MK in 3 months
	[7]	0 = 10,000 MK in 1 month	or	1 = 40,000 MK in 3 months
	[8]	0 = 10,000 MK in 1 month	or	1 = 50,000 MK in 3 months
	[9]	0 = 10,000 MK in 1 month	or	undefined

Notes: Panel A shows the initial questionnaire structure for time preference module. First, students are asked whether they prefer 10,000 Malawi Kwacha in 1 month to 20,000 Malawi Kwacha in 3 months. If students choose 10,000 MK in month, then they move to three sequence questions in Q802. If they choose 20,000 MK in 3 months, then they go to three sequence questions in Q803 instead of Q802. Panel B rearranges choice lists in Panel A as payoffs are monotonically increasing. The fifth choice list in Panel B is the starting question of Q801 for time preference module.

Table 1.11 shows that time preference at the baseline is significantly correlated with gender (females are more patient) whereas there is no age effect in time preference, with such findings being consistent with Sutter et al. (2013) and Castillo et al. (2011). However, the result that more household assets are correlated to higher discount rate is different from Tanaka, Camerer, and Nguyen (2010) showing how higher household income is positively correlated to time patience in Vietnamese villages.

Table 1.12 presents interesting evidence that one-year education support program improved time patience among girls at secondary schools. The program decreased the annual

Table 1.11: Annual Discount Rates and Baseline Characteristics

Dep. Var.	Discount rate
Female	-0.268***
	(0.060)
Age	0.003
	(0.017)
Orphan	-0.011
	(0.125)
Father's tertiary education	-0.121
	(0.087)
Mother's tertiary education	0.019
	(0.130)
Father's white-collar job	-0.039
	(0.074)
Mother's white-collar job	-0.107
	(0.114)
Household asset ownership	0.021**
	(0.009)
Observations	7,905

Notes: Table 1.11 shows the correlations between baseline annual discount rates and baseline characteristics. Regression is OLS model. Robust standard errors clustered by classroom are reported in parentheses. Baseline values of the following variables are included as controls in the regression analyses: age, orphan status, parents' tertiary education, parents' white-collar job, household asset ownership, and school type. *** p<0.01, ** p<0.05, * p<0.10

discount rate by 36.7 percentage points on average and the average impact falls to 33.9 percentage points when the baseline controls are included in the regression. Since the average of annual discount rate at the follow-up survey was 538%, the program impact would be a 0.123 SD 0.137 SD decrease in the annual discount rate.[27] This may seem like a small effect but improved time preference can affect many dimensions on education achievement, health behaviors, and employment and may accumulate to substantial effects in total in the long run.

Table 1.12: Impact on Time Preference

Dep. Var.	Discount rate	
	(1)	(2)
Girls' Education Support	-0.367**	-0.339**
	(0.144)	(0.140)
Mean of Dep. Var. in control group	5.38	
Controls	No	Yes
Observations	2,822	2,821

Notes: The dependent variable is annual discount rates. Regressions are Tobit model with grade fixed effects. Robust standard errors clustered by classroom are reported in parentheses. The weight of 6.67 is given to home-visit survey sample. Baseline values of the following variables are included as controls in the regression analyses: age, orphan status, parents' tertiary education, parents' white-collar job, household asset ownership, and school type. *** p<0.01, ** p<0.05, * p<0.10

[27]The average annual discount rate of 538% for the delay of two months may seem to be considerably large. However, it is common to assume that the future discount rates in developing countries are quite high. Kohler and Thornton (2012) evaluate the impact of financial incentives (conditional cash transfers) for individuals in Malawi to maintain their HIV status for one year but find no statistical difference in reported behaviors. They consider that the offer of the financial reward one year later was too far away from the present to overcome hyperbolic discounting. Moreover, compared to Sutter et al. (2013) reporting that the annual discount rates for the delay of three weeks among 661 adolescents aged 10-18 years in Austria are 330% and 365% (with the three-week upfront-delay), annual discount rate of 538% among teenage girls in Malawi can be considered not unusual.

1.5.8 Heterogeneity of Program Impacts and Spillovers to boys

We now turn to an examination of impact heterogeneity by a number of baseline characteristics: orphan status, parents education, parents job, and household asset index. We do not find significant impact heterogeneities across outcome variables from schooling outcomes to time preferences (not shown). We also tested whether there were spillover effects to ineligible boys in the treatment classrooms. Unlike Kremer, Miguel, and Thornton (2009) who find a spillover effect of a merit-based girls scholarship program to ineligible boys in the same classroom on test scores, we do not find significant spillovers to boys on most of outcome variables (not shown).

1.6 Conclusion

The impacts of education have traditionally been measured by test scores and underlying mechanism for test score gains has been explained by simple schooling outcomes such as enrollment and attendance. This paper investigates the impacts of girls education support program among secondary students not only on schooling outcomes and test scores but also on cognitive/non-cognitive abilities and time preferences using data from a randomized controlled trial in Malawi.[28] Students who were randomly assigned to the program are less likely to be dropped out and to be absent from school. Although there are improvements in the Junior Certificate Examination scores for grade 9 students, no significant impacts in the Malawi Certificate Examination for grade 11 students can be detected. However, we find evidence that the treated students do much better on cognitive test and show modest improvements on noncognitive abilities. They also become more time patient. Researcher

[28]Since we havent included related male classmates, teachers, and parents of the target female students in the baseline survey, we are unable to analyze the general equilibrium effects of the girls education support program in a larger context. Thus, all the results reported in this paper are only partial equilibrium effects of the intervention.

who had examined only test scores would have incorrectly concluded that the education support program does not have a significant impact. Since cognitive/non-cognitive abilities and preferences are considered to be more stable and persistent than test scores, our results on improvements of those outcomes may suggest that future educational achievement as well as adulthood labor market outcomes can be affected by these improved cognitive/non-cognitive abilities and preferences. Further follow-up research using this sample of students in the coming years will try to shed light on how persistent the impacts of girls' education support program on cognitive/non-cognitive abilities and preferences are and thus will help us understand how these mechanism shape socio-economic outcomes during adulthood.

Chapter 2

Peer Effects in the Demand for Male Circumcision

with Hyuncheol Bryant Kim and Cristian Pop-Eleches

2.1 Introduction

HIV/AIDS is one of the worlds most serious health challenges and huge efforts have been put into practice worldwide to address this problem. Although HIV/AIDS treatment reached 8 million out of 34 million people living with HIV by the end of 2011, a 20-fold increase since 2003, HIV/AIDS prevention remains an important challenge since the number of new infected people in 2011 was 2.5 million, only 20% lower than in 2001 (UNAIDS 2012).

Various HIV/AIDS prevention strategies, including HIV/AIDS education, condom distribution, HIV testing, and conditional cash transfers have been implemented. Recently, male circumcision has received much attention after three studies showed that male circumcision can reduce HIV transmission risk by 50 percent (Auvert et al. 2005; Bailey et al. 2007; Gray et al. 2007). For example, the World Health Organization (WHO) strongly recommended male circumcision as a key strategy for reducing female to male transmission of HIV (WHO 2007), and there is a global mobilization for scaling up male circumcision especially in the countries with high HIV incidence of heterosexually-acquired HIV infection and low male circumcision.[1] However, the demand for male circumcision is still very low even with heavily subsidized price and proper information (Chinkhumba, Godlonton, and Thornton 2014). Major barriers are lack of information, accessibility, psychological cost including fear of pain, religious and cultural norms, and concern over a long recovery period.

In this paper, we first look at how improved access to male circumcision increases its demand. We also focus on the role that peer effect might play in increasing demand for circumcision. Specifically we study male students in secondary school in Malawi who had a reasonable chance of being or becoming sexually active.[2] In our experimental school setting,

[1] 14 priority countries in Eastern and Southern Africa (Botswana, Ethiopia, Kenya, Lesotho, Malawi, Mozambique, Namibia, Rwanda, South Africa, Swaziland, Tanzania, Uganda, Zambia, and Zimbabwe) were strongly recommended for rapid scale up of male circumcision and WHO/UNAIDS set target that 80% of males aged 15 to 49 years in these countries would get circumcised by 2015.

[2] Although neonatal male circumcision is easy and cheap, we focus on secondary school male students

we randomly assign classrooms into three groups: 100% Treatment, 50% Treatment, or No Treatment classroom. All students in 100% Treatment classroom are received free male circumcision offer with transportation support while no students in No Treatment classroom received the offer. In 50% Treatment classroom, randomly selected half of students receive the offer. Students are allowed to take-up free male circumcision at the assigned hospital, but only randomly selected subset of students was offered transportation support.

The role of peer effects in the male circumcision context is theoretically ambiguous. It may be positive if friends might provide emotional support that reduces psychological cost or private information about the benefits of the circumcision procedure. Alternatively, negative experience from male circumcision (i.e. complication or pain) might decrease a friends demand for male circumcision. Through a detailed survey of peer networks in the classroom and in school, combined with random assignment, we study how peer effects affect the demand for male circumcision.

Our paper contributes to a growing literature of role of peer effect in health intervention programs in developing countries. For example, Godlonton and Thornton (2012) find significant peer effect in the take-up of HIV testing in Malawi. A 10 percent point increase in the probability of having a neighbor within 0.5km learning his/her HIV result leads to a 1.1 percent point increase in learning ones own HIV result. Chong et al. (2013) also find that the treatment effects of online sexual education are largest when the peers were treated together. Oster and Thornton (2012) also find a strong positive peer effect on take-up of new health technology (menstruation cup) in the short term, but not in the long term.[3]

In our setting, an intervention that was mainly based on offering transportation incen-

since secondary school students are soon to be sexually active.

[3]A related literature investigates causal effects of peer in school setting using random assignment of roommates (Sacerdote 2001; Duncan et al. 2005; Eisenberg, Golberstein, and Whitlock 2014) to look at health and education outcomes.

tives is used to generate arguably exogenous variation in the cost of male circumcision. We find that male students who received a transportation incentive are around three times more likely to take-up male circumcision. In addition, untreated students in 50% Treatment classrooms were 79% more likely to get circumcised than students in No treatment classrooms, suggesting positive externality in demand for male circumcision. Additionally we find evidence of important reinforcement effects when close friends within the same classroom receive the intervention together.

2.2 Background, Experimental Design, and Data

2.2.1 Background: Male circumcision in Malawi

Malawi is located in southeast sub-Saharan Africa with the population of 15.9 million people and a low life expectancy of 55 years (UNFPA 2012). It is estimated that 10.6% of people aged 15 to 54 years are living with HIV and prevalence of male circumcision in Malawi is very low with 21.6% of men being circumcised (NSO 2011).[4]. Male circumcision is practiced for religious and cultural reasons. 93.3% of Muslims are circumcised while only 11.6% of Christians practice circumcision (Bengo et al. 2010). Culturally, 86.8% of those belonging to the Yao tribe practice male circumcision while other tribes have low levels of male circumcision (NSO 2011).[5]

The numbers of male circumcisions per year in Malawi were very small (589 in 2008, 1,234 in 2009, and 1,296 in 2010) but it has recently begun to substantially increase due to the

[4]The true prevalence of complete male circumcision is likely to be much lower than this because many of those reporting being circumcised practice incomplete circumcision which removes part of the foreskin. Incomplete circumcision may not have the protective benefits of male circumcision (Bengo et al. 2010)

[5]Most of Muslim and Yao people live in the southern region of Malawi while the majority of ethnicity in the central region to which the project catchment is belonging is the Chewa. Chewa people consist of 34.1% of the total population and only 6.2% of them practice male circumcision according to Malawi DHS 2010.

scale-up project. For the year 2011 alone, 11,881 people became circumcised (WHO 2012). However, the estimated number of male circumcision between 2008 and 2011 in total is only 0.7% of the target number (2.1 million) to achieve 80% of male circumcision prevalence in Malawi. There is an ongoing debate about the main factors explaining the low take-up of circumcision in Malawi, which range from limited access to the circumcision surgery to very low demand for male circumcision.[6] In addition, the Malawian Government recognizes the need to improve the current awareness, knowledge, and attitude on male circumcision in order to increase informed demand for circumcision among the non-circumcising population (NAC 2012).[7]

2.2.2 Experimental Design

The male circumcision program was a part of broader HIV/AIDS prevention program, which includes HIV/AIDS education, male circumcision, and conditional cash transfers. This program was implemented in a sample of 3,974 boys (9^{th} - 11^{th} grade) at 33 public schools in four rural districts in Lilongwe, Malawi. As discussed previously, the provision of the male circumcision intervention as well as the other interventions in the context of secondary schools was of interest because for this population it represents the formative years for sexual and reproductive behavior.

Table 2.1 shows the experimental design of the study. We stratified 124 classrooms of 33 schools by grade and randomly assign classrooms into three groups: 100% Treatment,

[6]Malawi Government is trying to build medical male circumcision delivery capacity within existing health facilities and to expand medical circumcision training into clinical officers and registered nurses (GOM 2012)

[7]The acceptability of male circumcision in Malawi among non-circumcised people who received information on the medical benefits was 36.8% (Bengo et al. 2010) while the median proportion of uncircumcised men willing to get circumcised from 13 studies in sub-Saharan Africa was 65% (Westercamp and Bailey 2007). However, the willingness to get circumcised does not necessarily mean actual circumcision take-uptake-up decision. The recent study to quantify the actual demand for male circumcision in Malawi shows that only 41 men or 3.3% out of 1,252 uncircumcised adult men got medical circumcision service (Chinkhumba, Godlonton, and Thornton 2014).

50% Treatment, and No Treatment classrooms. All male students in the 100% Treatment classrooms received the male circumcision offer with transportation subsidies (Group 1). No students in the No Treatment classrooms received an offer (Group 4). In 50% Treatment classroom, we randomly selected half of students at individual level for the treatment (Group 2), and the remaining students were not treated (Group 3). The experiment design that randomizes treatment across classes and also within classroom allows us to measure not only direct effect but also peer effect of the male circumcision offer. This two-step randomized design is similar to the design used in Duflo and Saez (2003) to estimate peer effects.

The male circumcision offer consists of free surgery at the assigned hospital and two complication check-ups (3-day and 1-week after surgery) at students school. For transportation subsidies, students can choose either direct pick-up service or transportation voucher which is reimbursed after circumcision surgery at the hospital. The amount of a transportation voucher varies according to the distance between the hospital and students school.[8]

Table 2.1: Experimental Design

	Group	Assignment	Classrooms	Students
100% Treatment	G1	Treatment	41	1,293
50% Treatment	G2	Treatment	41	679
	G3	No treatment		679
No Treatment	G4	No treatment (Control)	42	1,323
Total			124	3,974

Notes: The randomization was done in two stages. First, classrooms for each grade across 33 schools were randomly assigned to 100% treatment, 50% treatment and no treatment. Then, within 50% treatment, only half of the students were randomly assigned to treatment at individual level.

41 classrooms (across 24 schools) were assigned to 100% Treatment, 41 classrooms (across 25 schools) were assigned to 50% Treatment, and 42 classrooms (across 28 schools) were assigned to the No Treatment group. Free male circumcision surgery and transportation

[8]Although we set the transportation voucher amounts to reflect the minimum public transportation fees, many of rural areas do not have access to public transportation and students who live in rural areas often walk to the hospital if they choose the voucher option.

subsidies were provided to a total of 1,972 male students after the baseline survey in 2012 and the remaining 2,002 male students who were temporarily untreated (Group 3 and Group 4) received the same treatment one year later.[9]

We first collect the list of enrolled students at 33 participating schools. The baseline survey was performed to measure detailed baseline information including demographic information, HIV knowledge, sexual behaviors, and friendship network. At the end of the survey we gave students 10 kwacha (6 cents), and sold condoms with subsidized price at 5 kwacha to measure a demand for safe sex.

Table 2.2 presents a summary statistics and randomization balance. Column (1) in Table 2.2 shows the average age of students is 16.7 years old and 17% of the sample is belonging to circumcising tribes, defined as a tribe with over 20% circumcised men in 2010 Malawi DHS. 6% reported that they are religiously Muslim.[10] In general, students showed high level of HIV/AIDS knowledge (Average number of correctly answer questions are 17.32 (86.6%) out of 20 questions) but relatively low knowledge on the medical benefit of male circumcision (63.9%).[11] 45.9% of the sample has experience of HIV voluntary testing in the past and 9.2% of the students self-report that they are currently engaged in sexual relationship.

Column (2) in Table 2.2 presents a test of the randomization balance. We find that all but one observable characteristic (% Muslim) are not significantly different between the treatment and control group. Furthermore, the p-value of joint F-test from a regression of treatment on a full set of baseline characteristic is 0.285, meaning that it does not reject the null hypothesis that all baseline coefficients are jointly equal to zero.

[9] 518 and 123 students circumcised in the first and second round, respectively. The period for the second round was much shorter than the first round.

[10] There are 240 Muslim students in the sample and 84.6% of them reported that they have been circumcised before the baseline survey.

[11] Not shown, 39% believed male circumcision is very painful and 15% has a misconception that male circumcision is only for Muslim.

Table 2.2: Baseline statistics and Randomization Balance

Dependent Variable:	Avg. (S.D.)	Male circumcision offer
	(1)	(2)
Age (year)	16.65	-0.010
	(1.94)	(0.008)
Circumcision ethnicity	0.170	0.029
	(0.376)	(0.022)
Muslim	0.060	0.070*
	(0.238)	(0.040)
Orphan	0.057	-0.026
	(0.232)	(0.037)
Father's tertiary education	0.180	-0.015
	(0.384)	(0.027)
Mother's tertiary education	0.068	-0.010
	(0.253)	(0.037)
Father's white-collar job	0.239	0.027
	(0.426)	(0.023)
Mother's white-collar job	0.096	-0.030
	(0.295)	(0.034)
Household asset count (0-16)	7.38	0.003
	(3.46)	(0.006)
Conventional school	0.243	-0.002
	(0.429)	(0.079)
Repeated in primary school	0.777	0.001
	(0.416)	(0.023)
HIV/AIDS knowledge (0-20)	17.32	-0.006
	(1.73)	(0.007)
HIV testing experience	0.462	0.039
	(0.499)	(0.031)
Currently in sexual relation	0.092	-0.030
	(0.288)	(0.035)
p-value of joint F-test		0.285
Observations		3,943
R-squared		0.008

Notes: This sample consists of 3,974 male students who were interviewed at baseline survey. Circumcising ethnicity is defined as a tribe with over 20% of male population circumcised in 2010 Malawi DHS. Parents' tertiary education is 1 when parents graduate from a 2-year college or a 4-year university. Parents' white-collar job is 1 when parents have a government or professional job. Household Assets count is defined the total number of assets they have from 16 asset questions. HIV/AIDS knowledge is constructed by counting the correct answers from 20 HIV/AIDS knowledge questions. Condom Attitude is constructed by counting the appropriate answers from 18 questions. Column (2) present result of a regression of male circumcision offer on a full set of baseline characteristics. It shows randomization balance for male circumcision intervention through OLS regression with grade fixed effects. Robust standard errors clustered by classroom are in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

The follow-up survey was conducted after a year. The effective survey follow-up rate is 91.9%.[12] 67.9% of the baseline sample students (or 2,698 students) completed the school follow-up survey.[13] We implemented an intensive home follow-up survey for randomly selected 15% students (191 students) among students who did not participate in the school follow-up survey. The home survey follow-up rate was 74.9%. Table 2.3 presents the determinants of participation in the follow-up survey. Columns (1) and (2) show that there is no differential attrition across the circumcision offer (Column (1)) and other baseline characteristics (Column (2)). Columns (3) and (4) present the result of regression on baseline characteristics and interactions between baseline characteristics and the offer. We also do not find evidence of systematic attrition.

Friendship networks were measured in several dimensions. We first asked students to list three best friends within school and classroom, respectively.[14] In the analysis, we reconstructed friendship data by reordering best male friends after excluding friends without baseline survey and female friends. Table 2.4 shows summary statistics of in-class friendship networks. In Panel A, Column (1) includes an original friendship network data. Column (2) presents friendship statistics including eligible male friends and excluding female friends and those who did not participate in baseline survey. Based on eligible male friends, we reordered the remaining friendship as shown in Column (3). Around 80% of the sample students have at least two male friends among his three best friends. Panel B presents the network treatment distribution among eligible male friends. It shows substantial variation in the fraction of best male friends who got treated and the fraction of treated friends is well

[12]The effective survey rate (ESR) is a function of the regular school follow-up rate (RFR) and intensive home-visit follow-up rate (HFR) as follows: ESR = RFR + (1 RFR) * HFR. Overall, ESR is 91.9% (67.9% + 32.1% * 74.9%). We run a weighted regression with a weight 6.67 for home-visit survey since we random selected 15% students from the attrition sample (Baird et al. 2012).

[13]Main reasons for attrition were due to transfer (44.8%), absence (29.9%), or dropout (14.3%).

[14]When surveyed, we matched information with names from the roll call data to make sure the best three friends exist within school or classroom.

balanced across the baseline characteristics (not shown).

2.3 Estimation Strategy

We employ a number of empirical strategies to capture the direct effect of being assigned to the free male circumcision offer and transportation support intervention as well as possible peer effects in this setting. In each specification both OLS and probit model are used. Our first empirical strategy estimates the following model:

$$Y_{ij} = b_0 + b_1 G1_{ij} + b_2 G2_{ij} + b_3 G3_{ij} + r' X_{ij} + \delta_i + \varepsilon_{ij} \tag{2.1}$$

where Y_{ij} denote an outcome of interest such as male circumcision take-up for individual student i in classroom j. G1, G2, and G3 refer Group 1, Group 2, and Group 3, respectively. The control vector, X, includes age, circumcising ethnicity, circumcising religion (Muslim), orphan status, parents education, parents job, household assets and school type.[15] δ_i is grade fixed effects, and ε_{ij} is a random error. We also present heterogeneous treatment effects by three different priors such as knowledge on the medical benefit of male circumcision, fear of pain, and religious norms.

[15]Since the randomization successfully produced treatment and control classrooms balanced along most baseline characteristics, the inclusion of these controls does not significantly change the treatment effect estimates but does sometimes improve statistical precision.

Table 2.3: Survey attrition

Dependent variable	= 1 if surveyed in follow-up or home-visit surveys			
	Treatment	Adjusted	Main effect	Interaction
	(1)	(2)	(3)	(4)
Male circumcision	-0.022	-0.017		-0.225
	(0.018)	(0.018)		(0.206)
Age (year)		-0.002	-0.000	-0.003
		(0.005)	(0.006)	(0.008)
Circumcision ethnicity		-0.010	-0.028	0.029
		(0.023)	(0.034)	(0.047)
Muslim		-0.046	-0.015	-0.061
		(0.036)	(0.053)	(0.068)
Orphan		-0.007	0.002	-0.020
		(0.030)	(0.041)	(0.060)
Father's tertiary education		-0.009	-0.026	0.035
		(0.023)	(0.030)	(0.044)
Mother's tertiary education		-0.033	0.014	-0.083
		(0.039)	(0.054)	(0.074)
Father's white-collar job		-0.010	0.025	-0.067**
		(0.018)	(0.026)	(0.033)
Mother's white-collar job		-0.001	0.002	-0.008
		(0.033)	(0.040)	(0.061)
Household asset count		-0.000	-0.010***	0.018***
		(0.003)	(0.003)	(0.005)
Conventional school		0.050**	0.043	0.011
		(0.022)	(0.028)	(0.036)
Repeated in primary school		0.010	-0.008	0.032
		(0.016)	(0.024)	(0.031)
HIV/AIDS knowledge		0.000	-0.003	0.007
		(0.004)	(0.005)	(0.007)
HIV testing		-0.030	0.003	-0.066*
		(0.019)	(0.023)	(0.036)
Currently in sexual relation		-0.053	-0.104**	0.117*
		(0.032)	(0.047)	(0.062)
Observations	3,974	3,943	3,943	
R-squared	0.012	0.019	0.028	

Notes: Regressions are OLS models with grade fixed effects. Columns (3) and (4) present results from one regression with main effects (column (3)) and all covariates interacted with male circumcision offer (column (4)). Robust standard errors clustered by classroom are in parentheses. The weight of 6.67 is given to home-visit survey sample. *** p<0.01, ** p<0.05, * p<0.10

Table 2.4: In-class Friendship Networks: Summary Statistics

Panel A: Friendship Reconstruction

	(1) Raw count	(2) Eligible male	(3) Reordered eligible male
First-best friend	3,848	3,268	3,836
Second-best friend	3,844	3,162	3,137
Third-best friend	3,866	3,198	1,621

Panel B: Friendship link treatment status

	Cases	Percent
No friends treated	1,702	42.8%
1 friend treated	831	20.9%
2 friend treated	825	20.8%
3 friend treated	616	15.5%

Notes: Panel A Column (1) includes raw friendship data including friends without baseline survey and female friends. Column (2) excludes friends without baseline survey from Column 1. Column (3) excludes female friends from column (2). Finally, we reorder the remaining friendship data from column (3) as first, second, or third best male friends if available. Panel B present friendship statistics based on reordered eligible male best friend data (Panel A, column (4)).

In these specifications, b_3 captures possible peer effects, given that it compares average take-up of circumcision for students who are not assigned to the intervention but who are in a classroom where 50% of their male peers received this offer (group G3) to base group of students who did not receive the intervention and who are in a classroom where nobody received the intervention (group G4). In some of our specifications, we also restrict ourselves only to the 50% Treatment classrooms. The cleanest way to estimate the main direct effect of the intervention is by comparing the difference in outcomes between students in group G2 who received the intervention and students in group G3 who did not receive the intervention. Both of these groups (G2 and G3) are within the same classrooms and contain students who are exposed to the same peer effects since 50% of their peers are treated.

Next, we extend the analysis of peer effects by using our experimental variation in treatment with the data from the friendship rosters. We try to measure these effects in the restricted sample of 50% Treatment classrooms. We restricted our sample since there is no within class variation in 100% Treatment and No Treatment classrooms. The following

linear regression is estimated:

$$Y_{ij} = b_0 + b_1 Offer_{ij} + b_2 Peer_{ij} + r' X_{ij} + \delta_i + \varepsilon_{ij} \tag{2.2}$$

where $Peer_{ij}$ is a variable for male circumcision offer to friends defined as the proportion (rate) of friends who are offered male circumcision. Since receiving the offer within our 50% Treatment classrooms is randomly assigned, the proportion of ones male best friends in the classroom is also random and independent of ones own offer. Finally we extend equation (3) and interact own offer and the proportion of best friends who receive the offer:

$$Y_{ij} = b_0 + b_1 Offer_{ij} + b_2 Peer_{ij} + + b_3 Offer_{ij} * Peer_{ij} + r' X_{ij} + \delta_i + \varepsilon_{ij} \tag{2.3}$$

In this specification we try to capture potential complementarities between your offer and your friends offers. This type of peer effect could also be defined as a reinforcement effect, and is captured by the coefficient of the interaction term b_3. In our setting, it is certainly possible for such reinforcement effects to be present, if peers make a decision to get circumcised jointly.

2.4 Results

2.4.1 Main results

We first look at the impact on demand for male circumcision by estimating equation (1).[16] Table 2.5 presents the OLS (columns (1) to (2)) and Probit estimates (columns (3) to (4)).

[16]Male circumcision take-up is measured from the assigned hospital administration data. It is very unlikely for students to get circumcised in other medical facilities because there are few facilities nearby to provide male circumcision on a regular basis. One exception is Banja La Mtsogolo (BLM) located in AREA 25 of Chitukula district, which is one of four catchment districts. However, they charge around $10 for the surgery and complication check-ups, which seriously dampen the demand, especially for the secondary school students.

Dependent variables in Panel A and B are male circumcision take-up before the control group offer (first round) and overall study period (first and second round), respectively. Panel A1 and B1 present results of whole sample and Panel A2 and B2 show results of restricted sample of 50% Treatment classrooms. The coefcients are all positive and signicant, and similar across the specifications. Columns (1) to (4) of Table 2.5 present results of equation (1). As shown in column (2) of Panel A1, students assigned to 100% Treatment and 50% Treatment classrooms were 14.2 and 18.9 percentage points (296% and 394%) more likely to get circumcised than students in control classrooms, respectively. We also found that treated students were 15.4 percentage points (188%) more likely to take male circumcision compared to untreated peers among 50% Treatment classrooms shown in Panel A2. Group 3, untreated students in 50% Treatment classrooms, were 3.8 % points (79%) more likely to receive male circumcision than No treatment classroom students (Panel A1), and this result reflects the spillover effects within classroom from the other half of classmates who received the offer of male circumcision. Moreover, this increase persists (and even increases) at the end of the study period. (Panel B1). Peer effects are discussed further in Section 2.4.2.

Table 2.6 presents heterogeneous treatment effects by prior beliefs. Column (1) shows that the male circumcision offer increases male circumcision take-up by on average 14.6 percentage points (244%). Columns (2) to (4) show heterogeneous treatment effects by prior knowledge on benefit of male circumcision, prior belief on pain of male circumcision, and religious norm. Our most interesting results are in column (3): while there are lower circumcision rates among those who perceive the procedure to be painful, we also find evidence consistent with smaller responses to the circumcision intervention among those who think that circumcision is painful. This finding is consistent with those found in Chinkhumba, Godlonton, and Thornton (2014).

Next we revisit the analysis of peer effect using the second strategy which also uses the reported friend networks. We take advantage of the random assignments of male circumcision

Table 2.5: Impact on Male Circumcision Take-up

Dependent Variable:	Circumcision Take-up			
	OSL		Probit	
	(1)	(2)	(3)	(4)
Panel A1. Round 1, whole Sample				
100% Treatment (G1)	0.138***	0.142***	0.174***	0.179***
	(0.027)	(0.027)	(0.035)	(0.036)
50% Treatment (G2)	0.193***	0.189***	0.264***	0.261***
	(0.030)	(0.031)	(0.045)	(0.046)
50% No Treatment (G3)	0.041**	0.038*	0.070*	0.068*
	(0.020)	(0.021)	(0.036)	(0.036)
p-value of F-test: (100% treatment = 50% treatment)	0.1452	0.2181	0.0942	0.1822
Mean of Dep. Var. in Control		0.048		
Controls	No	Yes	No	Yes
Observations	3,974	3,952	3,974	3,952
Panel A2. Round 1, 50% Treatment classroom only				
Treatment	0.151***	0.154***	0.149***	0.146***
	(0.032)	(0.033)	(0.029)	(0.028)
Mean of Dep. Var. in Control		0.082		
Controls	No	Yes	No	Yes
Observations	1,358	1,350	1,358	1,350
Panel B1. Round 1 & 2, whole sample				
100% Treatment (G1)	0.095***	0.099***	0.114***	0.118***
	(0.029)	(0.029)	(0.034)	(0.035)
50% Treatment (G2)	0.162***	0.155***	0.199***	0.189***
	(0.030)	(0.031)	(0.039)	(0.040)
50% No Treatment (G3)	0.074***	0.066**	0.098***	0.089**
	(0.028)	(0.027)	(0.038)	(0.036)
p-value of F-test: (100% treatment = 50% treatment)	0.0738	0.1495	0.0502	0.1349
Mean of Dep. Var. in Control		0.094		
Controls	No	Yes	No	Yes
Observations	3,974	3,952	3,974	3,952
Panel B2. Round 1 & 2, 50% Treatment classroom only				
Treatment	0.088***	0.092***	0.089***	0.091***
	(0.025)	(0.026)	(0.025)	(0.025)
Mean of Dep. Var. in Control		0.158		
Controls	No	Yes	No	Yes
Observations	1,358	1,350	1,358	1,350

Notes: First two columns use OLS models and the third and fourth columns report marginal effects from Probit models. After the follow-up survey, students who didn't get MC offer in the first round (50% No Treatment and Control Groups) received the same intervention in the second round of male circumcision intervention. All columns use grade fixed effects and robust standard errors clustered by classroom are in parentheses. Control variables include age, circumcising ethnicity, circumcising religion (Muslim), orphan status, father's tertiary education, mother's tertiary education, father's white-collar job, mother's white-collar job, household assets and school type. *** p<0.01, ** p<0.05, * p<0.10

Table 2.6: Heterogeneous effects by prior beliefs

Dependent Var.	Circumcision Take up			
	(1)	(2)	(3)	(4)
MC offer	0.146***	0.144***	0.162***	0.151***
	(0.021)	(0.023)	(0.023)	(0.023)
Knowing MC benefit		0.007		
		(0.012)		
MC offer x Knowing MC benefit		0.003		
		(0.023)		
Think that MC is very painful			-0.023**	
			(0.010)	
MC offer x Think that MC is very painful			-0.038*	
			(0.021)	
Think that MC is only for Muslim				-0.014
				(0.016)
MC offer x Think that MC is only for Muslim				-0.032
				(0.029)
Observations	3,952	3,949	3,945	3,942

Notes: This table shows the heterogeneous effects on take-up of male circumcision. MC offer variable equals 1 when students get MC offer either from 100% Treatment classrooms or from 50% Treatment classrooms. All columns use grade fixed effects and robust standard errors clustered by classroom are in parentheses. Control variables include age, circumcising ethnicity, circumcising religion (Muslim), orphan status, father's tertiary education, mother's tertiary education, father's white-collar job, mother's white-collar job, household assets and school type. *** p<0.01, ** p<0.05, * p<0.10

offer to a student and his friends within a classroom to understand peer interactions for the decision to get circumcised. Table 2.7 presents the results of the equation (2) and (3). While Panel A repeats the main effects discussed earlier, we present in Panels B and C, the peer effect of having a higher proportion of friends who are treated on your own decision to get circumcised. Our preferred estimates from Panel C that estimate equation (2) are also positive and quantitatively important, but they are not statistically significant at conventional levels.

The most striking results in Table 2.7 are those in Panel D, which estimate equation (3) and provide evidence of a complementarity between a students offer and his friends offer that increase the a students take-up of circumcision. The interaction between the offer and the rate of friends who received the offer is large (about 17%), statistically significant and robust across the four specifications and suggest the existence of important reinforcement effects among school peers in our Malawian setting.

2.4.2 Impact of male circumcision on sexual behaviors

Table 2.8 presents the impact of male circumcision on a range of sexual behaviors. Columns (1) to (3) report the results on condom attitude, willingness to buy condoms, and the number of condom purchased. As mentioned earlier, we sold subsidized condoms to address the limited reliability of self-reported sexual behaviors. Our coefficients are generally imprecise and do not imply large effects, with the possible exception of reinforcement effects between own and friends' offer. In Panel B2 we observe significant and large increases in the willingness to purchase and the number of condoms purchased. Columns (4) to (11) present preliminary results on self-reported sexual behaviors (such as having a sexual partner, the age of the partner, previous sex experience) and they imply a limited impact on sexual activities. While our measures of sexual behavior suffer from well-known self-reporting biases,

Table 2.7: Externalities on Male Circumcision Uptake

Dependent Variable:	Circumcision Uptake			
	(1)	(2)	(3)	(4)
Panel A:				
MC offer	0.151***	0.154***	0.150***	0.154***
	(0.019)	(0.019)	(0.033)	(0.019)
Panel B:				
Rate of friends who got MC offer	0.043	0.038	0.038	0.035
	(0.035)	(0.034)	(0.038)	(0.036)
Panel C:				
MC offer	0.151***	0.155***	0.151***	0.154***
	(0.019)	(0.019)	(0.033)	(0.019)
Rate of friends who got MC offer	0.050	0.044	0.047	0.043
	(0.034)	(0.033)	(0.039)	(0.035)
Panel D:				
MC offer	0.086***	0.093***	0.083**	0.092***
	(0.030)	(0.030)	(0.038)	(0.030)
Rate of friends who got MC offer	-0.040	-0.040	-0.047	-0.042
	(0.036)	(0.036)	(0.040)	(0.040)
MC offer x Rate of friends who got MC offer	0.177***	0.165**	0.186**	0.169***
	(0.067)	(0.066)	(0.072)	(0.064)
Mean of Dep. Var.	0.158			
grade fixed effects	x	x		
classroom fixed effects			x	x
Controls	No	Yes	No	Yes
Observations	1,358	1,350	1,358	1,350

Notes: This analysis includes only 50% Treatment classroom sample. Robust standard errors are parentheses. Control variables include age, circumcising ethnicity, circumcising religion (Muslim), orphan status, father's tertiary education, mother's tertiary education, father's white-collar job, mother's white-collar job, household asset ownership and school type with classroom fixed effects. *** p<0.01, ** p<0.05, * p<0.10

they do not suggest that moral hazard (i.e. an increase of risky sexual behaviors after male circumcision) plays a major concern in this setting.

Table 2.8: Impacts on Sexual Behaviors

Dependent Variables:	Condom attitude (0-18) (1)	Willingness to buy condoms (2)	No. of condoms purchased (3)	Sex experience (4)	Age for first sex (5)	Currently in Sex relation (6)	Multiple sex partners (7)	Sex with friend in school (8)	Sex with friend outside school (9)	Age for last sex partner (10)	STI experience (11)
Panel A. Whole sample											
Male Circumcision	-0.011	0.011	0.053	-0.003	-0.308	-0.001	0.001	0.016	-0.042**	-0.346*	0.050
	(0.168)	(0.023)	(0.093)	(0.023)	(0.199)	(0.020)	(0.023)	(0.016)	(0.018)	(0.191)	(0.052)
Obs.	2,834	2,824	2,818	2,835	905	2,835	2,835	2,835	2,835	472	2,757
Mean of Dep. Var.	12.85	0.256	1.008	0.319	15.72	0.126	0.158	0.054	0.097	16.17	0.037
Panel B. 50% Treatment Classroom only											
Panel B1											
MC offer	-0.052	0.045	0.254	-0.038	-0.512	-0.013	-0.002	0.012	-0.021	-0.365	0.192
	(0.244)	(0.037)	(0.152)	(0.033)	(0.410)	(0.032)	(0.029)	(0.022)	(0.037)	(0.381)	(0.183)
Panel B2											
MC offer	-0.246	-0.071	-0.272	-0.120	-0.885	-0.004	-0.118*	-0.027	-0.011	-1.029	0.487
	(0.541)	(0.056)	(0.222)	(0.077)	(0.633)	(0.051)	(0.061)	(0.025)	(0.069)	(0.737)	(0.463)
% of friends who got MC offer	0.669	-0.156	-0.604	-0.105	-1.598	0.030	-0.154*	0.010	0.014	-0.662	0.098
	(0.788)	(0.114)	(0.461)	(0.129)	(1.361)	(0.098)	(0.089)	(0.044)	(0.102)	(0.837)	(0.094)
MC offer x % of friends who got MC offer	0.542	0.298**	1.361**	0.211	0.972	-0.022	0.301**	0.103	-0.025	1.541	-0.772
	(1.162)	(0.126)	(0.526)	(0.154)	(1.608)	(0.157)	(0.134)	(0.079)	(0.167)	(2.101)	(0.748)
Mean of Dep. Var.	12.82	0.267	1.065	0.319	15.58	0.121	0.167	0.052	0.095	16.26	0.108
Observations	936	932	929	936	299	936	936	936	936	152	912

Notes: This analysis includes only 50% Treatment classroom sample. Robust standard errors are parentheses. Control variables include age, circumcising ethnicity, circumcising religion (Muslim), orphan status, father's tertiary education, mother's tertiary education, father's white-collar job, mother's white-collar job, household assets and school type with classroom fixed effects. *** p<0.01, ** p<0.05, * p<0.10

2.5 Conclusion

This paper addresses two questions on demand for male circumcision: 1) How to promote demand for male circumcision and 2) What is the role of peer effects in demand for male circumcision. To do this, we implement a randomized controlled trial that randomly provided free male circumcision and transportation voucher to male students across 33 public secondary schools in Malawi. Classrooms are assigned into three groups: 100% Treatment, 50% Treatment, or No Treatment classrooms. Randomly selected half of male students in 50% Treatment classrooms were treated.

We find that our school based intervention substantially increases the demand for male circumcision by on average of 15.4 percentage points (188%). Moreover, we find evidence consistent with important positive peer effects as well as reinforcement effects among school peers in our Malawian setting.

Our findings have a number of implications for public policies related to the scale-up of male circumcision. First, while a lack of accessibility to male circumcision is major barrier, our results suggest that free male circumcision with well-designed incentives such as transportation support can increase demand for male circumcision substantially. Second, this study sheds light on the important role that peer effects play in the decision to get circumcised.

Chapter 3

Complementarities of HIV/AIDS Prevention Programs: Evidence from Secondary Schools in Malawi

with Hyuncheol Bryant Kim and Cristian Pop-Eleches

3.1 Introduction

In the last decade, significant progress has been made in understanding the role that specific interventions play in lowering new HIV/AIDS infections. Such interventions include HIV/AIDS education (Gallant and Maticka-Tyndale 2004; Duflo et al. 2006; Dupas 2011), HIV voluntary counseling and testing (The Voluntary HIV-1 Counselling and Testing Efficacy Study Group 2000; Thornton 2008), male circumcision (Auvert et al. 2005; Bailey et al. 2007; Gray et al. 2007), conditional cash transfers (Baird et al. 2010; Baird et al. 2011), and HIV treatment as prevention (Cohen et al. 2011).

However, finding the optimal combined mix of biomedical, behavioral, and structural prevention interventions to reduce HIV/AIDS vulnerability remains a key open question in the literature. Indeed, the 2008 international HIV/AIDS Conference in Mexico set the design of the right mix of proven interventions to achieve the best possible effect as a key future goal. (Hankins and de Zalduondo 2010). The purpose of this study is to evaluate the potential complementarities of three such HIV/AIDS prevention strategies: HIV/AIDS education, male circumcision for young adults, and conditional cash transfers to young women.

The potential importance of complementarities of policies and interventions in the process of development has been repeatedly emphasized by scholars and practitioners. In a nutshell, the existence of complementarities would be proven if a package of interventions implemented together is shown to have a larger impact than the sum of its parts. Complementarities could exist both at the micro-level, which is our focus in this paper, and at the macro-level. At the micro-level, the Millennium Villages Project (Sanchez et al. 2007) and the PROGRESA programs in Mexico are well known examples of initiatives that have embraced the importance of complementarities. Similar arguments have been proposed at the macro-level for understanding the industrialization process (Rosenstein-Rodan 1943; Murphy, Shleifer, and Vishny 1989) and the former communist countries transition to a market

economy (Murphy, Shleifer, and Vishny 1992; Dewatripont and Roland 1995). Despite the important role that complementarities could play, there is limited empirical evidence testing this idea. The main purpose of this study was to design an experimental setting that allows for the possible estimation of such complementarities. Our empirical strategy is twofold. The first research design was to randomly allocate a different mix of the three HIV/AIDS prevention interventions (HIV/AIDS education, male circumcision, and girls' education support) across 124 classes within 33 secondary schools in rural Lilongwe, Malawi. This random allocation of the mix of interventions allows for a simple test of possible complementarities by estimating the potential interaction effects of these policies. The second research design also uses the fact that for two of the interventions (HIV/AIDS education and male circumcision) we also experimentally varied the fraction of students who get offered this treatment within classrooms (0%, 50%, and 100%). This allows for the estimation of interaction effects within the 50% Treatment classrooms.

The setting of the study in 124 classrooms in 33 secondary schools in Malawi is of interest given the gravity of the AIDS epidemic in the region. Furthermore, secondary school students are a high interest population as these years are formative for sexual and reproductive behaviors. The basic background setting implementation and data collection in this third chapter is shared with the previous two chapters and as such it has been already described there at length.

Our preliminary analysis does not find strong evidence for the existence of complementarities for the three interventions within our context. These results are based on a wide range of outcome variables that aim to capture HIV/AIDS knowledge, as well as sexual behaviors. In our discussion we suggest possible reasons for these results but note that these preliminary findings are based only on the first short term follow-up survey. In ongoing future work we plan to continue to measure medium and longer term effects and to expand and improve our outcome measurements.

The remainder of the chapter is organized as follows: Section 3.2 provides background information on the three prevention strategies. Section 3.3 presents the experimental design followed in section 3.4 by the data section. The empirical strategy is described in section 3.5, while section 3.6 presents the main results. Section 3.7 concludes.

3.2 Background: Three HIV/AIDS Prevention Strategies: HIV/AIDS Education, Male Circumcision, and Girls' Education Support

Chapters One and Chapter Two have described the implementation of girls' education support and male circumcision within the context of 33 Malawian secondary schools. Below we will focus on the implementation of HIV/AIDS education within the same context. Our HIV/AIDS education intervention is partly based on the existing HIV/AIDS education curriculum in Malawi. The curriculum contains information about transmission mechanisms of HIV/AIDS, the biology of HIV/AIDS, as well as the potential effects that the HIV/AIDS epidemic can have on an individual, his/her family, and society in general. This curriculum also includes information on how to prevent HIV, including the use of condoms, safe sex practices, and the role of abstinence outside marriage. In addition, our intervention also included information on the medical benefit of male circumcision and the relative risk of cross-generational sexual relationships, as proposed and discussed at length in Dupas (2011). As such, our intervention was not intended to separate the relative importance of the general education component from the male circumcision and relative risk education component. Our aim was to provide the most comprehensive HIV/AIDS education.

The HIV/AIDS education was implemented between February and July, 2012 for the treatment group and between February and July, 2013 for the control group. The educa-

tion was provided by trained staff with a government certificate on HIV/AIDS education, who themselves benefited from an extensive training session provided by our project staff. The HIV/AIDS education was comprised of a 45-minute lecture and 15-minute follow-up discussion.

3.3 Experimental Design

In Table 3.1, we summarize the experimental design of the study. For the HIV/AIDS education intervention we created four groups called G1-G4. For Group G1 consisting of 41 classrooms and 2,480 students, we attempted to provide HIV/AIDS education treatment to 100% students in the classroom. In another 41 classrooms we also randomly provided HIV/AIDS education but only to 50% of the students in the classrooms (students in group G2 received treatment; students in group G3 did not receive treatment).[1] Finally, in 42 classrooms no HIV/AIDS education was given (G4). HIV/AIDS education was provided to both male and female students.

A similar experimental design was used for the male circumcision intervention: in group G1 classrooms an offer to receive male circumcision treatment was made to all the students in the classrooms. Groups G2 and G3 were part of the 50% treatment arm, an equal amount in these classrooms received the offer for male circumcision (G2 and no offer G3). The G4 group consisting of 42 classrooms and 1,323 students received no treatment.

Finally the third intervention consisting of girls' education support was implemented using a slightly different design. In 62 classrooms 100 percent of young women received one-year tuition and monthly educational stipends, and in the remaining 62 classrooms no scholarships

[1]The randomization process was implemented in two stages. First, classrooms after stratifying grade were assigned to either 100% Treatment, 50% Treatment or No Treatment. Then, within 50% Treatment classrooms, half of individual students were randomly assigned to either the treatment (G2) or no treatment (G3).

Table 3.1: Experimental Design

1) HIV/AIDS Education

	Group	Assignment	Classrooms	Students
100% Treatment	G1	Treatment	41	2,480
50% Treatment	G2	Treatment	41	1,303
	G3	No treatment		1,263
No Treatment	G4	No treatment (Control)	42	2,925
Total			124	7,971

2) Male Circumcision

	Group	Assignment	Classrooms	Students
100% Treatment	G1	Treatment	41	1,293
50% Treatment	G2	Treatment	41	679
	G3	No treatment		679
No Treatment	G4	No treatment (Control)	42	1,323
Total			124	3,974

3) Girls' Education Support

	Group	Assignment	Classrooms	Students
100% Treatment	G1	Treatment	62	2,102
No Treatment	G2	No treatment (Control)	62	1,895
Total			124	3,997

Notes: For HIV/AIDS education and Male circumcision interventions, the randomization was done in two stages. First, classrooms for each grade across 33 schools were randomly assigned to 100% treatment, 50% treatment and no treatment. Then, within 50% treatment, only half of the students were randomly assigned to treatment.

were provided. It is worth emphasizing that these three interventions (HIV/AIDS education, circumcision for young males, and education support for young women) were randomly allocated. As a result, Table 3.2 shows that students in different classrooms could have been allocated to a different mix of interventions, including 0 (G1), 1 (G2-G4), 2 (G5-G7), or all 3 (G8) of them.

Table 3.2: Random Allocation of Research Groups

Group	HIV/AIDS education	Male Circumcision	Girls' Education Support
G1	x	x	x
G2	o	x	x
G3	x	o	x
G4	x	x	o
G5	o	o	x
G6	o	x	o
G7	x	o	o
G8	o	o	o

Notes: Three HIV/AIDS prevention interventions were independently allocated to each other and as a result, students in different classrooms could have been allocated to an eight different mix of interventions, including 0, 1, 2, or all 3 of them. Since male circumcision was provided to only boys while education support to only girls, Intent-to-treat analysis for ineligible genders (e.g. boys for education support and girls for male circumcision assignments) was applied.

3.4 Data

The current project is part of the larger HIV/AIDS project implemented by us in Malawi and described in more detail in the previous two chapters of this dissertation. To summarize, a baseline survey of 7,971 male and female students was conducted in the period January and April of 2012 in 33 Malawian secondary schools in rural Lilongwe. Our response rate at baseline was 74.4% within the 124 classrooms in these schools.

In Table 3.3, we describe background baseline characteristics of our sample as well as the balance of our randomization. On average, our students are 16.2 years old. The eth-

nic/religious composition is: 50.2% are Chewa, 17.8% are Ngoni, 9.3% are Lomwe, and 9.0% are Tumbuka while 6% are Muslim. 17.7% of students are belong to circumcising ethnicity which is defined as a tribe with over 20% of male population circumcised in 2010 Malawi DHS. 19.8% and 8.2% of the sample reported that their fathers and mothers graduated from a 2-year college or 4-year university, respectively. And 25.6% and 10.6% of the sample reported that their fathers and mothers have government or professional jobs. Moreover, 42.6% of the sample reported that their house has electricity.[2] Overall, our sample exhibits higher socioeconomic characteristics than the Malawi population as a whole. During the past 12 months, 79.8% of the students have received HIV/AIDS education at their schools before our HIV/AIDS education program started. 47.1% of the sample had HIV testing experience which include comprehensive pre- and post-counseling on HIV/AIDS. These characteristics may justify high HIV/AIDS knowledge level (17.3) or 86.6% corrected answered out of 20 HIV/AIDS knowledge questions).[3]

In Columns (2), (3), and (4), we show that a randomization was successful in creating balanced groups. The difference between the intervention groups and the control groups are small and statistically insignificant along most baseline characteristics. At the same time, the P-values of the joint F tests confirm the balance of the treatment and control groups.

In Table 3.4 we present results related to the attrition between the baseline and follow-up surveys. Out of the total of 7,971 baseline students, we successfully re-interviewed 5,431 students (68.1%) in the follow-up school survey. In addition, we randomly sampled 15% of the 2,540 students who we could not re-interview at the school; we were able to successfully locate

[2]Malawi DHS 2010 reported that only 9.1% of the population has electricity at home. Although student responses in household assets may be exaggerated, the huge differences between the sample and Malawi DHS 2010 can be understood after taking into account that our sample represents the family who is able to send their children to a secondary school.

[3]In general, students showed high level of HIV/AIDS knowledge at baseline but they showed relatively low knowledge on the medical benefit of male circumcision (62.3%, not shown) and the relative risk of cross-generational sexual relationships (41.9%, not shown).

Table 3.3: Baseline statistics and Randomization Balance

Dependent Variable:	Avg. (S.D.) (1)	Male Circumcision (2)	HIV/AIDS Education (3)	Girls' Education Support (4)
Age (year)	16.2	0.004	-0.004	-0.000
	(1.86)	(0.012)	(0.011)	(0.013)
Circumcision ethnicity	0.177	0.046**	0.014	0.012
	(0.382)	(0.020)	(0.020)	(0.023)
Muslim	0.060	0.035	0.029	-0.026
	(0.239)	(0.030)	(0.028)	(0.032)
Father's tertiary education	0.198	-0.001	0.022	0.021
	(0.399)	(0.019)	(0.020)	(0.020)
Mother's tertiary education	0.082	0.009	-0.015	0.036
	(0.274)	(0.026)	(0.027)	(0.025)
Father's white-collar job	0.256	0.000	0.000	0.001
	(0.436)	(0.016)	(0.016)	(0.017)
Mother's white-collar job	0.106	0.003	0.038	-0.022
	(0.307)	(0.025)	(0.025)	(0.026)
Having electricity at home	0.426	0.012	0.046	-0.019
	(0.495)	(0.027)	(0.030)	(0.033)
Household assets (0-16)	7.59	0.003	0.005	0.001
	(3.46)	(0.006)	(0.006)	(0.007)
School travel time (min)	51.29	0.000	-0.000	-0.000
	(36.71)	(0.000)	(0.000)	(0.000)
Repeated in primary school	0.748	-0.014	-0.001	0.018
	(0.434)	(0.022)	(0.023)	(0.026)
Have no table/chair in class	0.511	0.039	-0.031	0.055
	(0.499)	(0.053)	(0.053)	(0.061)
Received HIV/AIDS education	0.798	0.018	0.037	-0.027
	(0.401)	(0.029)	(0.028)	(0.036)
Condom attitude (0-18)	11.86	0.006**	0.001	0.000
	(3.36)	(0.003)	(0.003)	(0.003)
HIV/AIDS knowledge (0-20)	17.282	-0.001	-0.002	-0.003
	(1.76)	(0.006)	(0.005)	(0.006)
HIV testing experience	0.471	0.017	-0.038	0.045
	(0.499)	(0.034)	(0.032)	(0.039)
p-value of joint F-test		0.199	0.356	0.812
Observations		7,862	7,862	7,862
R-squared		0.007	0.016	0.008

Notes: This sample consists of 7,971 students who were interviewed at baseline survey. Circumcising ethnicity is defined as a tribe with over 20% of male population circumcised in 2010 Malawi DHS. Parent's tertiary education is 1 when they graduate from a 2-year college or a 4-year university. Parent's white-collar job is coded as 1 when they have a professional or government job. Household Assets are defined the total number of assets they have from 16 asset questions. Condom Attitude is constructed by counting the appropriate answers from 18 questions. HIV/AIDS knowledge is constructed by counting the correct answers from 20 HIV/AIDS knowledge questions. Columns (2) - (4) show randomization balance for three different interventions. Robust standard errors clustered by classroom are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

and interview 271 (71.1%) of the 381 students. As a result, the 5,702 students who completed either the school follow-up or home-visit surveys give us an effective survey response rate of 90.8%. In Column (1), one can observe that young women in the education support program were 5.4% more likely to be in the endline survey. This result is significant at the 10% level and suggests that the cash transfer intervention had a positive effect on young women staying in school. However, as can be seen in Column (2), which includes retention in either the endline or home-visit survey we can observe no selected attrition for the conditional cash transfer intervention or for the other two interventions.

Table 3.4: Attrition/Retention Bias Test

Dependent Variable:	Staying in follow-up survey (1)	Staying in follow-up or home surveys (2)
MC	-0.011	-0.019
	(0.024)	(0.016)
HIV/AIDS education	0.019	0.008
	(0.026)	(0.020)
Girls' Education Support	0.054*	0.017
	(0.029)	(0.021)
p-value of joint F-test	0.081	0.358
Observations	7,971	7,971
R-squared	0.004	0.001

Notes: Out of 7,971 baseline students, 5,431 students (68.1%) stayed in endline survey and 2,540 students were lost. 15% of 2,540 lost students, or 381 students were randomly selected for home survey candidates. Out of 381 students, we found out 271 students (71.1%) and conducted home survey. Thus, 5,702 students completed endline or home surveys and its effective survey rate is 90.8% (68.1% + 31.9% x 71.1%). Weight for home survey is 6.67 since we did 15% random sampling from the attrition. Robust standard errors clustered by classroom are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

In Table 3.5 - 3.7, we further explore the relationship between survey attrition and baseline characteristics by interacting an indicator variable for being surveyed in the school follow-up or home-visit surveys with a number of baseline characteristics included in Table 3.3. The results further alleviate any concerns about potential survey attrition bias.

Table 3.5: Relationship between survey attrition and baseline characteristics

Dependent variable	= 1 if surveyed in follow-up or home-visit surveys			
	Treatment	Adjusted	Main effect	Interaction
	(1)	(2)	(3)	(4)
HIV/AIDS Education	0.001	-0.001		0.254
	(0.014)	(0.014)		(0.162)
Age		-0.007*	-0.002	-0.013
		(0.004)	(0.005)	(0.008)
Orphan		-0.043**	-0.038	-0.008
		(0.022)	(0.030)	(0.044)
Father's tertiary education		-0.007	-0.004	-0.005
		(0.017)	(0.022)	(0.031)
Mother's tertiary education		-0.050*	-0.031	-0.037
		(0.026)	(0.034)	(0.052)
Father's white-collar job		-0.016	-0.027	0.020
		(0.012)	(0.017)	(0.023)
Mother's white-collar job		-0.012	-0.028	0.029
		(0.022)	(0.031)	(0.043)
Household Assets (0-16)		-0.001	0.002	-0.005
		(0.002)	(0.003)	(0.004)
Conventional School		0.053***	0.091***	-0.075**
		(0.018)	(0.027)	(0.036)
Observations	7,971	7,957	7,957	
R-squared	0.011	0.016	0.018	

Notes: Regressions are OLS models with grade fixed effects. Columns (3) and (4) present results from one regression with main effects (column 3) and all covariates interacted with one of three HIV/AIDS prevention interventions (column 4). The weight of 6.67 is given to home-visit survey sample. Baseline values of the following variables are included as controls: age, orphan status, parents' tertiary education, parents' white-collar job, household asset ownership, and school type. Robust standard errors clustered by classroom are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 3.6: Relationship between survey attrition and baseline characteristics(continued)

Dependent variable	Male Circumcision (whole sample) = 1 if surveyed in follow-up or home-visit surveys				Male Circumcision (eligible boys) = 1 if surveyed in follow-up or home-visit surveys				Male Circumcision (ineligible girls) = 1 if surveyed in follow-up or home-visit surveys			
	Treatment	Adjusted	Main effect	Interaction	Treatment	Adjusted	Main effect	Interaction	Treatment	Adjusted	Main effect	Interaction
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Male Circumcision	-0.018	-0.014		-0.036	-0.022	-0.020		-0.115	-0.014	-0.008		0.070
	(0.015)	(0.014)		(0.128)	(0.018)	(0.018)		(0.151)	(0.022)	(0.021)		(0.197)
Age		-0.007*	-0.006	-0.003		-0.003	-0.002	-0.001		-0.015**	-0.012*	-0.006
		(0.004)	(0.005)	(0.007)		(0.004)	(0.006)	(0.008)		(0.006)	(0.007)	(0.010)
Orphan		-0.044**	-0.054*	0.023		-0.010	-0.001	-0.019		-0.082**	-0.101**	0.054
		(0.022)	(0.030)	(0.045)		(0.030)	(0.041)	(0.060)		(0.040)	(0.049)	(0.081)
Father's tertiary education		-0.007	-0.012	0.011		-0.010	-0.023	0.027		-0.001	0.001	-0.003
		(0.017)	(0.021)	(0.034)		(0.023)	(0.030)	(0.045)		(0.025)	(0.029)	(0.056)
Mother's tertiary education		-0.049*	-0.034	-0.034		-0.022	0.026	-0.084		-0.072**	-0.070	-0.005
		(0.026)	(0.033)	(0.052)		(0.039)	(0.052)	(0.073)		(0.034)	(0.043)	(0.070)
Father's white-collar job		-0.017	-0.008	-0.018		-0.007	0.028	-0.066**		-0.025	-0.032	0.022
		(0.012)	(0.015)	(0.025)		(0.018)	(0.027)	(0.033)		(0.017)	(0.020)	(0.038)
Mother's white-collar job		-0.012	-0.026	0.033		-0.003	0.001	-0.013		-0.029	-0.056*	0.077
		(0.022)	(0.026)	(0.039)		(0.033)	(0.041)	(0.061)		(0.027)	(0.032)	(0.052)
Household Assets (0-16)		-0.001	-0.005*	0.010**		-0.001	-0.010***	0.018***		-0.001	-0.002	0.001
		(0.002)	(0.003)	(0.004)		(0.003)	(0.003)	(0.005)		(0.003)	(0.004)	(0.007)
Conventional School		0.052***	0.056**	-0.012		0.054**	0.050*	0.005		0.051**	0.063**	-0.047
		(0.018)	(0.022)	(0.029)		(0.022)	(0.028)	(0.034)		(0.023)	(0.029)	(0.049)
Observations	7,971	7,957	7,957		3,974	3,964	3,964		3,997	3,993	3,993	
R-squared	0.011	0.016	0.018		0.012	0.016	0.020		0.012	0.022	0.023	

Notes: Regressions are OLS models with grade fixed effects. Columns (3) and (4) present results from one regression with main effects (column 3) and all covariates interacted with one of three HIV/AIDS prevention interventions (column 4). The weight of 6.67 is given to home-visit survey sample. Baseline values of the following variables are included as controls: age, orphan status, parents' tertiary education, parents' white-collar job, household asset ownership, and school type. Robust standard errors clustered by classroom are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 3.7: Relationship between survey attrition and baseline characteristics(continued)

Dependent variable	Girls' Education Support (whole sample) = 1 if surveyed in follow-up or home-visit surveys				Girls' Education Support (eligible girls) = 1 if surveyed in follow-up or home-visit surveys				Girls' Education Support (ineligile boys) = 1 if surveyed in follow-up or home-visit surveys			
	Treatment	Adjusted	Main effect	Interaction	Treatment	Adjusted	Main effect	Interaction	Treatment	Adjusted	Main effect	Interaction
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Girls' Education Support	0.006	0.004		0.160	0.040*	0.038*		0.068	-0.027	-0.029		0.094
	(0.020)	(0.020)		(0.155)	(0.022)	(0.022)		(0.207)	(0.025)	(0.025)		(0.173)
Age		-0.007*	-0.000	-0.014*		-0.015**	-0.012	-0.006		-0.003	0.002	-0.012
		(0.004)	(0.005)	(0.007)		(0.006)	(0.008)	(0.011)		(0.004)	(0.006)	(0.009)
Orphan		-0.043**	-0.044	-0.003		-0.081**	-0.071	-0.025		-0.008	-0.014	0.009
		(0.022)	(0.034)	(0.044)		(0.039)	(0.057)	(0.079)		(0.030)	(0.045)	(0.060)
Father's tertiary education		-0.007	-0.025	0.028		-0.003	-0.009	0.001		-0.010	-0.040	0.060
		(0.017)	(0.026)	(0.034)		(0.025)	(0.038)	(0.051)		(0.023)	(0.031)	(0.044)
Mother's tertiary education		-0.050*	-0.043	-0.012		-0.070**	-0.069	-0.000		-0.019	-0.001	-0.039
		(0.026)	(0.039)	(0.053)		(0.034)	(0.050)	(0.069)		(0.038)	(0.058)	(0.076)
Father's white-collar job		-0.016	-0.019	0.001		-0.024	-0.041	0.035		-0.006	0.007	-0.036
		(0.012)	(0.018)	(0.025)		(0.017)	(0.027)	(0.034)		(0.018)	(0.023)	(0.035)
Mother's white-collar job		-0.012	0.016	-0.054		-0.028	-0.004	-0.049		-0.005	0.020	-0.044
		(0.022)	(0.031)	(0.041)		(0.027)	(0.038)	(0.053)		(0.032)	(0.045)	(0.062)
Household Assets (0-16)		-0.001	-0.004	0.006		-0.001	-0.005	0.006		-0.001	-0.005	0.007
		(0.002)	(0.003)	(0.005)		(0.003)	(0.004)	(0.007)		(0.003)	(0.004)	(0.005)
Conventional School		0.053***	-0.002	0.100**		0.049**	-0.008	0.102**		0.056**	0.003	0.100**
		(0.019)	(0.024)	(0.039)		(0.023)	(0.035)	(0.048)		(0.023)	(0.030)	(0.048)
Observations	7,971	7,957	7,957		3,997	3,993	3,993		3,974	3,964	3,964	
R-squared	0.011	0.016	0.020		0.014	0.024	0.027		0.012	0.016	0.021	

Notes: Regressions are OLS models with grade fixed effects. Columns (3) and (4) present results from one regression with main effects (column 3) and all covariates interacted with one of three HIV/AIDS prevention interventions (column 4). The weight of 6.67 is given to home-visit survey sample. Baseline values of the following variables are included as controls: age, orphan status, parents' tertiary education, parents' white-collar job, household asset ownership, and school type. Robust standard errors clustered by classroom are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

3.5 Empirical Strategy:

Our first approach to capture potential complementarities between the three HIV prevention interventions is to estimate OLS regressions that use the randomized mix of treatments across classroom. Specifically we estimate the following individual level regressions:

$$Y_{ic} = \alpha_0+\alpha_1 MC_c+\alpha_2 EDU_c+\alpha_3 ES_c+\alpha_4 MC_c*EDU_c+\alpha_5 MC_c*ES_c+\alpha_6 EDU_c*ES_c+\alpha_4 MC_c*EDU_c*S_c+ \tag{3.1}$$

where Y_{ic} is one of our outcomes measures (such as sexual behavior, knowledge about HIV/AIDS or circumcision status); MC_c is equal to 1 if a student i is assigned to a classroom where circumcision services were offered, 0 otherwise; EDU_c is equal to 1 if a student i is assigned to a classroom where HIV/AIDS education was offered, 0 otherwise; and ES_c is equal to 1 if a student i is assigned to a classroom where girls' education support were offered, 0 otherwise. The main coefficients of interest are α_4, α_5 ,α_6 and α_7, which capture possible interaction effects of the three interventions. For example, α_4 captures possible complementarities between the circumcision and HIV/AIDS education prevention intervention, in addition to the main effects of the two interventions which are captured in the equation above by α_1 and α_2. Note that α_7 is the coefficient of the triple interaction of the three policies. Finally, X_{ic} is a set of background controls, such as age, parental education, parents job, household asset ownership and F_c are a set of grade dummies (corresponding to grade 9, 10 and 11 at the time of the baseline survey). In some of the tables, we will restrict our analysis to only two of the three interventions, in which case the coefficient of interest will only be a single interaction term.

Our second empirical strategy will also use an additional source of variation in the data and is based on the fact that for the HIV/AIDS education and circumcision interventions we

also randomized the fraction of students within classrooms who got offered these treatments (0%, 50% and 100%). Since both the HIV/AIDS education and circumcision interventions were implemented independently and randomly from each other, we can restrict our analysis to classrooms where at least one of the intervention was targeted to only 50% of the class and use the within class variation to estimate the following model:

$$Y_{ic} = \alpha_0 + \alpha_1 MC_{ic} + \alpha_2 EDU_{ic} + \alpha_3 MC_{ic} * EDU_{ic} + X_{ic} + \beta class_c + \varepsilon_{ic} \qquad (3.2)$$

where most of the variables are defined as above and $class_{ic}$ includes a series of classroom fixed effects. Note that in this estimating equation the variables MC_{ic} is equal to 1 if a student i is assigned to receive circumcision services, 0 otherwise; EDU_{ic} is equal to 1 if a student i is assigned to receive HIV/AIDS education, 0 otherwise. The main coefficient of interest (α_3) aims to capture possible complementarities between the male circumcision and HIV/AIDS education intervention.

3.6 Results

We start by first presenting the main impact of our HIV/AIDS prevention interventions on our variables of interest: measures of HIV/AIDS knowledge, circumcision uptake, as well as a wide range of sexual behaviors. Many of the sexual behavior outcomes such as frequency of sexual encounters are based on self-reporting, and thus subject to the usual self reporting biases. In addition, we follow Thornton (2008) and offer students the possibility to purchase condoms at the time of the baseline and endline surveys. [4] Furthermore, we collect data on teen pregnancy as a more objective measure of unprotected sex (see Dupas 2011).

[4]Students who participated in baseline or endline surveys were given 10 kwacha as a token of appreciation. Students could buy a set of two condoms for 5 kwacha.

In Table 3.8 we present results on the impact of the three interventions on our measure of HIV/AIDS knowledge. The HIV/AIDS knowledge score is constructed from a 20 item HIV/AIDS questionnaire and is normalized to have a mean of 0 and a standard deviation of 1 in the control group. We also present outcome variable in Columns (2)-(5), which are based on a subset of the full questions aimed at capturing knowledge along four important dimensions: 1) mother child transmission; 2) ABC policy; 3) benefits of male circumcision; 4) risk of partnering with an older partner.[5] In Panel A of Table 3.8, one can observe that the HIV/AIDS education campaign increased knowledge along most dimensions (mother child transmission; ABC policy; benefits of male circumcision). Panel B and C present similar results divided by gender, and they suggest that most of the positive impacts of the intervention on HIV knowledge are driven by changes in female students HIV/AIDS knowledge. Table 3.8 also confirms that the other two interventions, male circumcision and education support for young women had limited effects on HIV/AIDS knowledge with the possible exceptions of the male circumcision interventions which improves knowledge about the benefits of male circumcision.

In Table 3.9 we provide a summary of the main impacts on sexual behaviors. Our measures of sexual behaviors are: male circumcision uptake, condom attitude index constructed from 18 related questions, willingness to purchase condoms and number of condoms purchased, initiation of sexual activity, age at first sexual encounter, current sexual activity both within and outside school, age of partner, and pregnancy history. A visual inspection of Table 3.9 suggests no clear impacts on sexual behaviors of the three interventions.[6] While some coefficients of certain sexual behaviors are statistically significant, the usual con-

[5]ABC policy stands for Abstinence until marriage, Being faithful to one partner, Condom use always.This ABC policy was adopted first by Uganda Government in 1990s and Malawi Government emphasizes ABC policy on its HIV/AIDS education programs.

[6]This results are consistent with Baird, McIntosh, and Özler (2011) showing that there was no significant impact of conditional cash transfers to in-school girls on sexual behaviors.

Table 3.8: Impact on HIV/AIDS Knowledge

Dependent Variables:	HIV/AIDS knowledge	Mother-To-Child Transmission	ABC policy	Benefit of male circumcision	Risk of sugar daddy
	(1)	(2)	(3)	(4)	(5)
Panel A: whole sample					
HIV/AIDS Education	0.056	0.095**	0.088**	0.119***	0.035
	(0.043)	(0.040)	(0.042)	(0.039)	(0.040)
Obs.			5,695		
Male Circumcision	0.067	0.056	0.001	0.087**	-0.092**
	(0.047)	(0.048)	(0.046)	(0.042)	(0.041)
Obs.			5,695		
Girls' Education Support	-0.043	-0.080	0.009	0.068	-0.078*
	(0.046)	(0.049)	(0.047)	(0.042)	(0.042)
Obs.			5,695		
Panel B: male students					
HIV/AIDS Education	0.001	0.023	0.064	0.090**	-0.053
	(0.051)	(0.048)	(0.052)	(0.043)	(0.055)
Obs.			2,835		
Male Circumcision	0.030	0.033	-0.037	0.057	-0.090*
	(0.050)	(0.052)	(0.060)	(0.048)	(0.053)
Obs.			2,835		
Girls' Education Support	0.002	-0.099*	0.042	0.037	-0.056
	(0.057)	(0.055)	(0.058)	(0.052)	(0.059)
Obs.			2,835		
Panel C: female students					
HIV/AIDS Education	0.116*	0.174***	0.113**	0.160***	0.114*
	(0.061)	(0.057)	(0.056)	(0.059)	(0.058)
Obs.			2,860		
Male Circumcision	0.075	0.056	0.027	0.043	-0.025
	(0.071)	(0.070)	(0.065)	(0.061)	(0.066)
Obs.			2,860		
Girls' Education Support	-0.078	-0.050	-0.020	0.107*	-0.114*
	(0.067)	(0.070)	(0.059)	(0.061)	(0.060)
Obs.			2,860		

Notes: Column (1) shows standardized HIV/AIDS knowledge score which is constructed from 20 HIV/AIDS questionnaire and the following columns (2)-(5) are based on subset of the full question set. All columns use grade fixed effects and robust standard errors clustered by classroom are reported in parentheses. Control variables include age, orphan status, father's tertiary education, mother's tertiary education, father's white-collar job, mother's white-collar job, and household assets. The weight of 6.67 is given to home-visit survey sample. *** p<0.01, ** p<0.05, * p<0.10

cerns arising from multiple inference makes us hesitant to formulate definitive conclusions. However, it is worth noting a very strong and statistically significant effect that the male circumcision intervention had on the uptake of make circumcision, as discussed in greater detail in Chapter 2.

Table 3.9: Impacts on Sexual Behaviors

Dependent Variables:	Male circumcision uptake	Condom attitude (0-18)	Willingness to buy condoms	No. of condoms purchased	Sex experience	Age for first sex	Currently in Sex relation	Multiple sex partners	Sex with friend in school	Sex with friend outside school	Age for last sex partner	Time preference	Risk preference	STI experience	Pregnancy
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Panel A: male students															
HIV/AIDS Education	-0.000	-0.071	-0.009	-0.014	-0.008	-0.292	-0.009	0.025	0.002	-0.015	0.078	0.198**	0.129*	0.054	
	(0.021)	(0.183)	(0.024)	(0.100)	(0.026)	(0.194)	(0.023)	(0.024)	(0.016)	(0.017)	(0.196)	(0.078)	(0.070)	(0.056)	
Obs.	3,964	2,834	2,824	2,818	2,835	905	2,835	2,835	2,835	2,835	472	2,835	2,811	2,757	
Male Circumcision	0.143***	-0.011	0.011	0.053	-0.003	-0.308	-0.001	0.001	0.016	-0.042**	-0.346*	-0.114	0.014	0.050	
	(0.022)	(0.168)	(0.023)	(0.093)	(0.023)	(0.199)	(0.020)	(0.023)	(0.016)	(0.018)	(0.191)	(0.074)	(0.074)	(0.052)	
Obs.	3,964	2,834	2,824	2,818	2,835	905	2,835	2,835	2,835	2,835	472	2,835	2,811	2,757	
Girls' Education Support	0.016	0.191	-0.019	-0.076	-0.041	-0.303	-0.042**	-0.013	-0.038**	-0.009	-0.078	0.111	-0.075	-0.068	
	(0.025)	(0.180)	(0.024)	(0.099)	(0.027)	(0.186)	(0.021)	(0.025)	(0.015)	(0.018)	(0.199)	(0.083)	(0.072)	(0.066)	
Obs.	3,964	2,834	2,824	2,818	2,835	905	2,835	2,835	2,835	2,835	472	2,835	2,811	2,757	
Mean of Dep. Var.	0.130	12.85	0.256	1.008	0.319	15.72	0.126	0.158	0.054	0.097	16.17	4.78	3.99	0.037	
Panel B: female students															
HIV/AIDS Education		-0.069	-0.005	0.029	-0.009	0.006	0.010	0.014	0.007	0.004	-0.052	-0.067	-0.011	0.121	-0.014
		(0.187)	(0.011)	(0.056)	(0.025)	(0.207)	(0.026)	(0.014)	(0.009)	(0.013)	(0.519)	(0.088)	(0.070)	(0.146)	(0.020)
Obs.		2,859	2,843	2,823	2,860	379	2,860	2,860	2,860	2,860	253	2,860	2,844	2,797	2,850
Male Circumcision		-0.048	-0.006	-0.028	-0.013	-0.126	-0.022	-0.023*	-0.007	0.020	-0.215	-0.193*	0.017	-0.150	-0.031*
		(0.206)	(0.010)	(0.038)	(0.023)	(0.262)	(0.026)	(0.013)	(0.010)	(0.014)	(0.640)	(0.111)	(0.084)	(0.095)	(0.016)
Obs.		2,859	2,843	2,823	2,860	379	2,860	2,860	2,860	2,860	253	2,860	2,844	2,797	2,850
Girls' Education Support		0.104	0.003	-0.030	-0.030	0.023	-0.033	-0.017	-0.003	-0.001	0.410	-0.261**	-0.102	0.099	-0.017
		(0.204)	(0.011)	(0.055)	(0.025)	(0.226)	(0.025)	(0.015)	(0.009)	(0.012)	(0.483)	(0.100)	(0.073)	(0.131)	(0.018)
Obs.		2,859	2,843	2,823	2,860	379	2,860	2,860	2,860	2,860	253	2,860	2,844	2,797	2,850
Mean of Dep. Var.		11.89	0.036	0.112	0.132	16.51	0.093	0.023	0.020	0.052	20.51	4.72	3.89	0.143	0.023

Notes: Condom attitude is constructed from 18 related questions. Column (4) shows the number of condoms actually purchased by students. Students received 10 kwacha during the survey and could buy condoms at 5 kwacha per two condoms if they wanted. All columns use grade fixed effects and robust standard errors clustered by classroom are reported in parenthesis. Control variables include age, orphan status, father's tertiary education, mother's tertiary education, father's white-collar job, mother's white-collar job, and household assets. The weight of 6.67 is given to home-visit survey sample.*** p<0.01, ** p<0.05, * p<0.10

Next we describe results on complementarities between the three HIV/AIDS prevention interventions based on equation 1, using the randomized mix of treatments across classrooms. In Table 3.10 we focus on our measures of HIV/AIDS knowledge. We focus on the HIV/AIDS knowledge index as it represents the overall index of knowledge along all dimensions. Panel A, for male students, and panel B, for female students confirm that the interaction terms of the HIV prevention intervention which are meant to capture the existence of potential complementarities are generally small and statistically insignificant. These results are also confirmed in Table 3.11, 3.12, and 3.13, where we present complementarity results based on only two of the three interventions at the time. One result that is worth noting is the positive and statistically significant effect of the interaction between male circumcision and HIV/AIDS education in Table 3.12, as well as the large but imprecisely estimated coefficients of the same interaction in Table 3.10. The robustness of this potentially important complementarity result will need to be confirmed in future work.

Table 3.10: Complementarities between HIV/AIDS Education, MC, Girls' Education Support

Dependent Variables:	HIV/AIDS knowledge (1)	Mother-To-Child Transmission (2)	ABC policy (3)	Benefit of male circumcision (4)	Risk of sugar daddy (5)
Panel A: Male students					
HIV/AIDS Education	-0.078	-0.233**	0.060	0.093	-0.044
	(0.117)	(0.094)	(0.091)	(0.077)	(0.113)
Male Circumcision (MC)	-0.014	-0.047	-0.139	0.005	-0.032
	(0.101)	(0.067)	(0.122)	(0.098)	(0.113)
Girls' Education Support (ES)	0.013	-0.185**	0.037	0.043	0.013
	(0.082)	(0.084)	(0.114)	(0.102)	(0.108)
MC x HIV/AIDS Education	0.115	0.313***	0.087	0.054	-0.031
	(0.176)	(0.119)	(0.146)	(0.112)	(0.150)
MC x ES	-0.100	-0.069	0.080	0.047	-0.173
	(0.123)	(0.138)	(0.166)	(0.136)	(0.145)
HIV/AIDS Education x ES	-0.040	0.294**	-0.155	-0.081	-0.104
	(0.144)	(0.128)	(0.147)	(0.122)	(0.149)
MC x HIV/AIDS Education x ES	0.178	-0.146	0.138	0.048	0.170
	(0.209)	(0.186)	(0.217)	(0.153)	(0.193)
Obs.			2,827		
Panel B: Female students					
HIV/AIDS Education	0.041	0.232**	0.078	0.103	-0.014
	(0.118)	(0.101)	(0.105)	(0.124)	(0.103)
Male Circumcision (MC)	-0.045	0.112	-0.047	-0.001	-0.236*
	(0.119)	(0.129)	(0.123)	(0.123)	(0.120)
Girls' Education Support(ES)	-0.046	0.068	0.015	0.042	-0.244**
	(0.125)	(0.131)	(0.100)	(0.128)	(0.105)
MC x HIV/AIDS Education	0.311*	0.018	0.223	0.086	0.305*
	(0.176)	(0.146)	(0.182)	(0.176)	(0.173)
MC x ES	-0.071	-0.173	-0.083	0.149	0.291
	(0.221)	(0.244)	(0.206)	(0.172)	(0.187)
HIV/AIDS Education x ES	-0.057	-0.187	-0.073	0.073	0.141
	(0.155)	(0.140)	(0.131)	(0.154)	(0.132)
MC x HIV/AIDS Education x ES	0.022	0.140	0.079	-0.194	-0.346
	(0.281)	(0.263)	(0.258)	(0.236)	(0.245)
Obs.			2,856		

Notes: Column (1) shows standardized HIV/AIDS knowledge score which is constructed from 20 HIV/AIDS questionnaire and the following columns (2)-(5) are based on subset of the full question set. All columns use grade fixed effects and robust standard errors clustered by classroom are reported in parenthesis. Control variables include age, orphan status, father's tertiary education, mother's tertiary education, father's white-collar job, mother's white-collar job, and household assets. The weight of 6.67 is given to home-visit survey sample.*** p<0.01, ** p<0.05, * p<0.10

Table 3.11: Complementarities between MC and Girls' Education Support

Dependent Variables:	HIV/AIDS knowledge		Mother-To-Child Transmission		ABC policy		Benefit of male circumcision		Risk of sugar daddy	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Male students										
Male Circumcision(MC)	0.031	0.036	0.032	0.093	-0.032	-0.115	0.060	0.013	-0.092*	-0.038
	(0.051)	(0.080)	(0.052)	(0.063)	(0.060)	(0.090)	(0.049)	(0.067)	(0.052)	(0.086)
Girls' Education Support(ES)	-0.005	-0.001	-0.103*	-0.046	0.042	-0.036	0.044	0.000	-0.079	-0.029
	(0.057)	(0.071)	(0.054)	(0.066)	(0.055)	(0.077)	(0.053)	(0.069)	(0.054)	(0.075)
MC x ES		-0.009		-0.121		0.164		0.092		-0.106
		(0.098)		(0.103)		(0.114)		(0.092)		(0.104)
Obs.	2,827									
Panel B: Female students										
Male Circumcision(MC)	0.060	0.050	0.051	0.071	0.025	0.011	0.047	0.006	-0.052	-0.132
	(0.071)	(0.097)	(0.069)	(0.088)	(0.065)	(0.095)	(0.058)	(0.089)	(0.067)	(0.091)
Girls' Education Support(ES)	-0.071	-0.077	-0.046	-0.033	-0.016	-0.025	0.102*	0.075	-0.122*	-0.174***
	(0.070)	(0.079)	(0.070)	(0.080)	(0.063)	(0.070)	(0.061)	(0.080)	(0.063)	(0.065)
MC x ES		0.020		-0.042		0.028		0.087		0.169
		(0.141)		(0.136)		(0.130)		(0.118)		(0.132)
Obs.	2,856									

Notes: Column (1) shows standardized HIV/AIDS knowledge score which is constructed from 20 HIV/AIDS questionnaire and the following columns (2)-(5) are based on subset of the full question set. All columns use grade fixed effects and robust standard errors clustered by classroom are reported in parenthesis. Control variables include age, orphan status, father's tertiary education, mother's tertiary education, father's white-collar job, mother's white-collar job, and household assets. The weight of 6.67 is given to home-visit survey sample.*** p<0.01, ** p<0.05, * p<0.10

Table 3.12: Complementarities between MC and HIV/AIDS Education

Dependent Variables:	HIV/AIDS knowledge		Mother-To-Child Transmission		ABC policy		Benefit of male circumcision		Risk of sugar daddy	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Male students										
Male Circumcision	0.031	-0.059	0.034	-0.061	-0.030	-0.107	0.062	0.022	-0.093*	-0.109
	(0.050)	(0.066)	(0.053)	(0.067)	(0.060)	(0.088)	(0.048)	(0.071)	(0.052)	(0.075)
HIV/AIDS Education	-0.003	-0.098	0.017	-0.082	0.064	-0.017	0.094**	0.052	-0.077	-0.094
	(0.052)	(0.075)	(0.051)	(0.068)	(0.053)	(0.077)	(0.044)	(0.064)	(0.054)	(0.078)
MC x EDU		0.201*		0.211**		0.171		0.089		0.036
		(0.103)		(0.088)		(0.104)		(0.085)		(0.101)
Obs.	2,827									
Panel B: Female students										
Male Circumcision	0.079	-0.058	0.072	0.040	0.038	-0.078	0.050	0.039	-0.027	-0.082
	(0.070)	(0.095)	(0.068)	(0.101)	(0.062)	(0.094)	(0.057)	(0.086)	(0.064)	(0.091)
HIV/AIDS Education	0.102	0.013	0.152***	0.131**	0.114**	0.039	0.147**	0.140*	0.104*	0.068
	(0.067)	(0.078)	(0.055)	(0.064)	(0.057)	(0.067)	(0.062)	(0.077)	(0.062)	(0.074)
MC x EDU		0.294**		0.069		0.250**		0.024		0.120
		(0.129)		(0.105)		(0.119)		(0.118)		(0.119)
Obs.	2,856									

Notes: Column (1) shows standardized HIV/AIDS knowledge score which is constructed from 20 HIV/AIDS questionnaire and the following columns (2)-(5) are based on subset of the full question set. All columns use grade fixed effects and robust standard errors clustered by classroom are reported in parenthesis. Control variables include age, orphan status, father's tertiary education, mother's tertiary education, father's white-collar job, mother's white-collar job, and household assets. The weight of 6.67 is given to home-visit survey sample.*** p<0.01, ** p<0.05, * p<0.10

Table 3.13: Complementarities between HIV/AIDS Education and Girls' Education Support

Dependent Variables:	HIV/AIDS knowledge		Mother-To-Child Transmission		ABC policy		Benefit of male circumcision		Risk of sugar daddy	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Male students										
HIV/AIDS Education	-0.004	-0.028	0.019	-0.097	0.064	0.112*	0.091**	0.116*	-0.072	-0.054
	(0.052)	(0.082)	(0.051)	(0.062)	(0.053)	(0.065)	(0.044)	(0.059)	(0.055)	(0.084)
Girls' Education Support(ES)	-0.006	-0.028	-0.104*	-0.211***	0.041	0.085	0.041	0.064	-0.076	-0.059
	(0.057)	(0.074)	(0.054)	(0.072)	(0.056)	(0.083)	(0.052)	(0.078)	(0.056)	(0.078)
HIV/AIDS Education x ES		0.048		0.231**		-0.097		-0.050		-0.037
		(0.101)		(0.096)		(0.104)		(0.090)		(0.106)
Obs.	2,827									
Panel B: Female students										
HIV/AIDS Education	0.099	0.128	0.149***	0.216***	0.112*	0.142	0.138**	0.125	0.113*	0.108
	(0.068)	(0.091)	(0.055)	(0.074)	(0.058)	(0.087)	(0.061)	(0.090)	(0.059)	(0.086)
Girls' Education Support(ES)	-0.082	-0.054	-0.059	0.005	-0.025	0.004	0.090	0.077	-0.123**	-0.128
	(0.068)	(0.101)	(0.068)	(0.110)	(0.060)	(0.091)	(0.060)	(0.092)	(0.062)	(0.093)
HIV/AIDS Education x ES		-0.057		-0.130		-0.060		0.025		0.010
		(0.128)		(0.117)		(0.115)		(0.119)		(0.113)
Obs.	2,856									

Notes: Column (1) shows standardized HIV/AIDS knowledge score which is constructed from 20 HIV/AIDS questionnaire and the following columns (2)-(5) are based on subset of the full question set. All columns use grade fixed effects and robust standard errors clustered by classroom are reported in parenthesis. Control variables include age, orphan status, father's tertiary education, mother's tertiary education, father's white-collar job, mother's white-collar job, and household assets. The weight of 6.67 is given to home-visit survey sample.*** p<0.01, ** p<0.05, * p<0.10

Tables 3.14, 3.15, 3.16, 3.17, and 3.18, are similar in structures to the table discussed just previously; however, here the focus is on capturing the potential role of complementarities in sexual behaviors. Our preliminary interpretations of these results are consistent with finding limited complementarities between our three HIV/AIDS prevention interventions. Finally table 3.19 (for HIV knowledge) and table 3.20 - 3.21 (for sexual behaviors) are providing the results for the empirical strategies proposed in equation 2, which used variation within the classrooms where only 50% of students were treated. Remember that the 50% treatment within classroom was only implemented within the male circumcision and HIV/AIDS education interventions and as a result our analysis is limited only to potential complementarities between these two. The evidence in these two sets of tables is in line with our previous results and suggests little potential complementarity effects for our interventions in this particular Malawian school context.

Table 3.14: Complementarities on Sexual Behaviors

Dependent Variables:	Male circumcision uptake (1)	Condom attitude (0-18) (2)	Willingness to buy condoms (3)	No. of condoms purchased (4)	Sex experience (5)	Age for first sex (6)	Currently in Sex relation (7)	Multiple sex partners (8)	Sex with friend in school (9)	Sex with friend outisde school (10)	Age for last sex partner (11)	STI experience (12)	Pregnancy (13)
Panel A: Male students													
HIV/AIDS Education	-0.021	-0.002	-0.043	-0.113	0.014	-0.786**	-0.035	0.053	0.071**	-0.023	-0.165	-0.014	
	(0.018)	(0.360)	(0.047)	(0.167)	(0.056)	(0.356)	(0.046)	(0.051)	(0.031)	(0.031)	(0.287)	(0.018)	
Male Circumcision(MC)	0.133***	0.103	0.015	0.063	0.041	-0.775**	-0.002	0.070	0.071**	-0.011	-0.748***	-0.020	
	(0.034)	(0.286)	(0.045)	(0.174)	(0.046)	(0.307)	(0.032)	(0.046)	(0.031)	(0.034)	(0.285)	(0.023)	
Girls' Education Support(ES)	0.019	0.593*	-0.039	-0.130	-0.020	-0.809**	-0.054*	0.015	-0.014	0.012	-0.428	-0.014	
	(0.026)	(0.327)	(0.040)	(0.153)	(0.046)	(0.324)	(0.032)	(0.045)	(0.020)	(0.033)	(0.324)	(0.018)	
Male Circumcision x HIV/AIDS Education	0.073	0.301	0.050	0.213	-0.054	0.673	0.025	-0.082	-0.119**	-0.013	0.545	0.303	
	(0.050)	(0.485)	(0.068)	(0.246)	(0.065)	(0.491)	(0.068)	(0.068)	(0.047)	(0.057)	(0.579)	(0.299)	
Male Circumcision x ES	-0.006	-0.499	-0.008	-0.027	-0.066	0.510	-0.015	-0.109**	-0.040	-0.071*	0.944	0.005	
	(0.053)	(0.432)	(0.066)	(0.258)	(0.059)	(0.479)	(0.046)	(0.054)	(0.036)	(0.042)	(0.597)	(0.024)	
HIV/AIDS Education x ES	0.031	-0.393	0.083	0.251	-0.000	0.550	0.053	-0.016	-0.041	0.010	0.280	-0.009	
	(0.031)	(0.553)	(0.064)	(0.243)	(0.073)	(0.588)	(0.060)	(0.066)	(0.037)	(0.048)	(0.485)	(0.025)	
HIV/AIDS Education x MC x ES	-0.086	0.103	-0.090	-0.375	0.055	-0.416	-0.018	0.121	0.078	0.044	-1.143	-0.270	
	(0.069)	(0.714)	(0.099)	(0.374)	(0.090)	(0.698)	(0.088)	(0.086)	(0.057)	(0.073)	(0.898)	(0.270)	
Obs.	3,952	2,826	2,816	2,810	2,827	904	2,827	2,827	2,827	2,827	471	2,749	

Notes: All columns use grade fixed effects and robust standard errors clustered by classroom are reported in parentheses. Control variables include age, orphan status, father's tertiary education, mother's tertiary education, father's white-collar job, mother's white-collar job, and household assets. The weight of 6.67 is given to home-visit survey sample. *** p<0.01, ** p<0.05, * p<0.10

Table 3.15: Complementarities on Sexual Behaviors (continued)

Dependent Variables:	Male circumcision uptake	Condom attitude (0-18)	Willingness to buy condoms	No. of condoms purchased	Sex experience	Age for first sex	Currently in Sex relation	Multiple sex partners	Sex with friend in school	Sex with friend outisde school	Age for last sex partner	STI experience	Pregnancy
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Panel B: Female students													
HIV/AIDS Education		0.202	0.018	0.153	-0.043	-0.214	0.012	-0.023	0.009	0.017	-1.001	0.141	-0.054
		(0.369)	(0.020)	(0.123)	(0.051)	(0.378)	(0.053)	(0.035)	(0.019)	(0.022)	(0.877)	(0.181)	(0.053)
Male Circumcision(MC)		0.227	0.018	0.066	-0.018	-0.015	-0.001	-0.047	-0.003	0.064**	-0.309	0.005	-0.071*
		(0.378)	(0.024)	(0.060)	(0.048)	(0.459)	(0.055)	(0.032)	(0.018)	(0.028)	(1.215)	(0.034)	(0.041)
Girls' Education Support(ES)		0.661**	0.023	0.073	-0.073	-0.203	-0.058	-0.056**	0.001	0.016	-0.589	0.152	-0.063
		(0.310)	(0.018)	(0.047)	(0.047)	(0.408)	(0.041)	(0.027)	(0.016)	(0.015)	(0.795)	(0.154)	(0.044)
Male Circumcision x HIV/AIDS Education		0.301	-0.042	-0.217	-0.037	0.187	-0.077	0.006	-0.012	-0.057	0.678	-0.170	0.045
		(0.528)	(0.031)	(0.155)	(0.064)	(0.562)	(0.068)	(0.040)	(0.024)	(0.040)	(1.313)	(0.150)	(0.054)
Male Circumcision x ES		-0.851*	-0.052	-0.175*	0.035	0.023	0.048	0.032	-0.024	-0.065*	2.050	-0.197	0.078
		(0.459)	(0.032)	(0.091)	(0.058)	(0.676)	(0.075)	(0.033)	(0.023)	(0.035)	(1.386)	(0.183)	(0.052)
HIV/AIDS Education x ES		-0.578	-0.042	-0.228	0.085	0.579	0.053	0.061	-0.011	0.003	2.374**	-0.037	0.073
		(0.461)	(0.026)	(0.139)	(0.063)	(0.483)	(0.061)	(0.039)	(0.023)	(0.028)	(0.977)	(0.412)	(0.059)
HIV/AIDS Education x MC x ES		0.290	0.087**	0.350*	-0.010	-0.763	-0.050	-0.001	0.045	0.049	-4.338***	0.090	-0.093
		(0.717)	(0.042)	(0.181)	(0.091)	(0.963)	(0.094)	(0.055)	(0.040)	(0.049)	(1.623)	(0.408)	(0.067)
Obs.		2,855	2,839	2,819	2,856	378	2,856	2,856	2,856	2,856	253	2,793	2,846

Notes: All columns use grade fixed effects and robust standard errors clustered by classroom are reported in parentheses. Control variables include age, orphan status, father's tertiary education, mother's tertiary education, father's white-collar job, mother's white-collar job, and household assets. The weight of 6.67 is given to home-visit survey sample. *** p<0.01, ** p<0.05, * p<0.10

Table 3.16: Complementarities between MC and Girls' Education Support

Dependent Variables:	MC take-up		Condom attitude (0-18)		Willingness to buy condoms		No. of condoms purchased		Sex experience		Age for first sex		Currently in Sex relation	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Panel A: Male students														
Male Circumcision(MC)	0.142***	0.162***	-0.002	0.216	0.013	0.038	0.059	0.156	-0.002	0.019	-0.306	-0.431	-0.000	0.011
	(0.022)	(0.033)	(0.170)	(0.211)	(0.023)	(0.033)	(0.093)	(0.132)	(0.023)	(0.035)	(0.197)	(0.271)	(0.020)	(0.031)
Girls' Education Support(ES)	0.014	0.034*	0.213	0.416*	-0.024	-0.000	-0.107	-0.016	-0.040	-0.020	-0.412**	-0.529*	-0.040*	-0.029
	(0.022)	(0.019)	(0.185)	(0.248)	(0.024)	(0.031)	(0.098)	(0.123)	(0.028)	(0.034)	(0.191)	(0.281)	(0.022)	(0.029)
MC x ES		-0.041		-0.432		-0.049		-0.192		-0.042		0.266		-0.023
		(0.041)		(0.321)		(0.045)		(0.179)		(0.046)		(0.405)		(0.038)
Obs.	3,952	3,952	2,826	2,826	2,816	2,816	2,810	2,810	2,827	2,827	904	904	2,827	2,827
Panel B: Female students														
Male Circumcision(MC)			0.007	0.292	-0.005	0.001	-0.037	-0.037	-0.016	-0.023	-0.109	0.076	-0.026	-0.030
			(0.204)	(0.292)	(0.011)	(0.017)	(0.045)	(0.074)	(0.022)	(0.031)	(0.264)	(0.374)	(0.025)	(0.036)
Girls' Education Support(ES)			0.181	0.363	-0.002	0.002	-0.045	-0.045	-0.025	-0.029	-0.009	0.102	-0.029	-0.031
			(0.197)	(0.245)	(0.011)	(0.014)	(0.053)	(0.071)	(0.025)	(0.032)	(0.246)	(0.279)	(0.025)	(0.030)
MC x ES				-0.598		-0.011		-0.001		0.014		-0.395		0.007
				(0.393)		(0.020)		(0.078)		(0.045)		(0.554)		(0.051)
Obs.			2,855	2,855	2,839	2,839	2,819	2,819	2,856	2,856	378	378	2,856	2,856

Notes: All columns use grade fixed effects and robust standard errors clustered by classroom are reported in parentheses. Control variables include age, orphan status, father's tertiary education, mother's tertiary education, father's white-collar job, mother's white-collar job, and household assets. The weight of 6.67 is given to home-visit survey sample. *** p<0.01, ** p<0.05, * p<0.10

Table 3.17: Complementarities between Male Circumcision and HIV/AIDS Education

Dependent Variables:	MC take-up		Condom attitude (0-18)		Willingness to buy condoms		No. of condoms purchased		Sex experience		Age for first sex		Currently in Sex relation	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Panel A: Male students														
Male Circumcision(MC)	0.142***	0.129***	-0.007	-0.169	0.014	0.015	0.061	0.064	-0.002	0.014	-0.327*	-0.506**	0.000	-0.003
	(0.022)	(0.027)	(0.173)	(0.217)	(0.023)	(0.034)	(0.095)	(0.131)	(0.024)	(0.030)	(0.196)	(0.215)	(0.020)	(0.024)
HIV/AIDS Education	0.007	-0.007	-0.052	-0.222	-0.002	-0.001	0.012	0.015	-0.001	0.015	-0.306	-0.503*	-0.003	-0.006
	(0.017)	(0.017)	(0.183)	(0.287)	(0.025)	(0.033)	(0.101)	(0.126)	(0.027)	(0.037)	(0.194)	(0.285)	(0.023)	(0.031)
MC x EDU		0.028		0.362		-0.003		-0.006		-0.035		0.425		0.008
		(0.032)		(0.367)		(0.049)		(0.183)		(0.046)		(0.338)		(0.044)
Obs.	3,952	3,952	2,826	2,826	2,816	2,816	2,810	2,810	2,827	2,827	904	904	2,827	2,827
Panel B: Female students														
Male Circumcision(MC)			-0.013	-0.207	-0.005	-0.005	-0.030	-0.008	-0.014	0.009	-0.110	0.017	-0.022	0.028
			(0.198)	(0.247)	(0.011)	(0.016)	(0.039)	(0.046)	(0.023)	(0.030)	(0.271)	(0.350)	(0.025)	(0.037)
HIV/AIDS Education			0.003	-0.122	-0.005	-0.005	0.016	0.030	-0.011	0.005	-0.008	0.072	0.009	0.042
			(0.191)	(0.231)	(0.011)	(0.013)	(0.044)	(0.062)	(0.025)	(0.031)	(0.227)	(0.266)	(0.025)	(0.031)
MC x EDU				0.415		-0.000		-0.047		-0.051		-0.315		-0.108**
				(0.395)		(0.020)		(0.085)		(0.048)		(0.566)		(0.047)
Obs.			2,855	2,855	2,839	2,839	2,819	2,819	2,856	2,856	378	378	2,856	2,856

Notes: All columns use grade fixed effects and robust standard errors clustered by classroom are reported in parentheses. Control variables include age, orphan status, father's tertiary education, mother's tertiary education, father's white-collar job, mother's white-collar job, and household assets. The weight of 6.67 is given to home-visit survey sample. *** p<0.01, ** p<0.05, * p<0.10

Table 3.18: Complementarities between HIV/AIDS Education and Girls' Education Support

Dependent Variables:	MC take-up		Condom attitude (0-18)		Willingness to buy condoms		No. of condoms purchased		Sex experience		Age for first sex		Currently in Sex relation	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Panel A: Male students														
HIV/AIDS Education	-0.001	-0.008	-0.057	0.112	-0.002	-0.024	0.012	-0.031	-0.000	-0.013	-0.269	-0.406	-0.002	-0.024
	(0.021)	(0.028)	(0.181)	(0.240)	(0.025)	(0.033)	(0.100)	(0.127)	(0.027)	(0.041)	(0.197)	(0.252)	(0.023)	(0.031)
Girls' Education Support(ES)	0.013	0.006	0.214	0.369	-0.024	-0.044	-0.109	-0.149	-0.040	-0.052	-0.404**	-0.532**	-0.040*	-0.060**
	(0.024)	(0.032)	(0.185)	(0.224)	(0.024)	(0.032)	(0.099)	(0.130)	(0.028)	(0.035)	(0.194)	(0.217)	(0.022)	(0.026)
EDU x ES		0.014		-0.336		0.043		0.088		0.026		0.293		0.045
		(0.038)		(0.356)		(0.049)		(0.198)		(0.053)		(0.376)		(0.044)
Obs.	3,952	3,952	2,826	2,826	2,816	2,816	2,810	2,810	2,827	2,827	904	904	2,827	2,827
Panel B: Female students														
HIV/AIDS Education			-0.006	0.236	-0.005	0.003	0.021	0.085	-0.008	-0.048	0.011	-0.181	0.013	-0.007
			(0.188)	(0.278)	(0.011)	(0.016)	(0.048)	(0.090)	(0.024)	(0.036)	(0.222)	(0.321)	(0.025)	(0.041)
Girls' Education Support(ES)			0.181	0.413*	-0.001	0.007	-0.042	0.019	-0.023	-0.062*	-0.006	-0.188	-0.027	-0.046
			(0.192)	(0.229)	(0.011)	(0.015)	(0.052)	(0.040)	(0.024)	(0.032)	(0.247)	(0.344)	(0.025)	(0.035)
EDU x ES				-0.473		-0.016		-0.125		0.079*		0.398		0.039
				(0.358)		(0.021)		(0.103)		(0.047)		(0.429)		(0.049)
Obs.			2,855	2,855	2,839	2,839	2,819	2,819	2,856	2,856	378	378	2,856	2,856

Notes: All columns use grade fixed effects and robust standard errors clustered by classroom are reported in parentheses. Control variables include age, orphan status, father's tertiary education, mother's tertiary education, father's white-collar job, mother's white-collar job, and household assets. The weight of 6.67 is given to home-visit survey sample. *** p<0.01, ** p<0.05, * p<0.10

Table 3.19: Complementarities between MC and HIV/AIDS Education within 50% Treatment classrooms

Dependent Variables:	HIV/AIDS knowledge		Mother-To-Child Transmission		ABC policy		Benefit of male circumcision		Risk of sugar daddy	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Male Circumcision	0.066	-0.002	0.154**	0.046	0.055	-0.027	0.020	-0.035	-0.043	-0.104
	(0.068)	(0.081)	(0.077)	(0.087)	(0.083)	(0.101)	(0.057)	(0.074)	(0.078)	(0.098)
HIV/AIDS Education	0.050	-0.034	0.059	-0.075	0.118	0.017	0.041	-0.028	0.022	-0.055
	(0.072)	(0.100)	(0.089)	(0.127)	(0.084)	(0.107)	(0.063)	(0.086)	(0.083)	(0.114)
MC x EDU		0.153		0.244*		0.185		0.126		0.140
		(0.117)		(0.132)		(0.131)		(0.099)		(0.131)
Obs.	1,436									

Notes: This analysis includes only male students. Column (1) shows standardized HIV/AIDS knowledge score which is constructed from 20 HIV/AIDS questionnaire and the following columns (2)-(5) are based on subset of the full question set. All columns use classroom fixed effects and robust standard errors are in parentheses. Control variables include age, orphan status, father's tertiary education, mother's tertiary education, father's white-collar job, mother's white-collar job, and household assets. The weight of 6.67 is given to home-visit survey sample. *** p<0.01, ** p<0.05, * p<0.10

Table 3.20: Complementarities between MC and HIV/AIDS Education within 50% Treatment classrooms

Dependent Variables:	MC take-up		Condom attitude (0-18)		Willingness to buy condoms		No. of condoms purchased		Sex experience		Age for first sex	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Male Circumcision	0.161***	0.149***	-0.069	-0.006	0.047	0.032	0.236	0.236	-0.034	-0.026	-0.560*	-1.168***
	(0.021)	(0.024)	(0.229)	(0.266)	(0.038)	(0.049)	(0.158)	(0.199)	(0.037)	(0.047)	(0.294)	(0.320)
HIV/AIDS Education	0.003	-0.013	0.047	0.126	-0.024	-0.042	0.030	0.031	-0.009	0.001	-0.601**	-1.403***
	(0.022)	(0.025)	(0.236)	(0.339)	(0.041)	(0.051)	(0.174)	(0.226)	(0.039)	(0.052)	(0.272)	(0.387)
MC x EDU		0.029		-0.144		0.033		-0.001		-0.018		1.463***
		(0.032)		(0.374)		(0.064)		(0.269)		(0.063)		(0.442)
Obs.	2,010	2,010	1,436	1,436	1,427	1,427	1,425	1,425	1,436	1,436	466	466

Notes: This analysis includes only male students. All columns use classroom fixed effects and robust standard errors are in parentheses. Control variables include age, orphan status, father's tertiary education, mother's tertiary education, father's white-collar job, mother's white-collar job, and household assets. The weight of 6.67 is given to home-visit survey sample. *** p<0.01, ** p<0.05, * p<0.10

Table 3.21: Complementarities between MC and HIV/AIDS Education within 50% Treatment classrooms (continued)

Dependent Variables:	Currently in Sex relation		Multiple sex partners		Sex with friend in school		Sex with friend outside school		Age for last sex partner		STI experience	
	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
Male Circumcision	-0.008	-0.039	-0.002	-0.023	0.013	0.054*	-0.017	-0.041	-0.473	-0.549	0.182	0.067
	(0.030)	(0.039)	(0.033)	(0.041)	(0.022)	(0.028)	(0.031)	(0.036)	(0.319)	(0.367)	(0.185)	(0.075)
HIV/AIDS Education	-0.037	-0.075*	0.037	0.011	-0.002	0.049	-0.026	-0.056	-0.285	-0.368	0.129	-0.013
	(0.034)	(0.042)	(0.038)	(0.048)	(0.026)	(0.034)	(0.028)	(0.038)	(0.310)	(0.438)	(0.137)	(0.065)
MC x EDU		0.070		0.048		-0.093**		0.055		0.175		0.259
		(0.053)		(0.059)		(0.041)		(0.047)		(0.532)		(0.263)
Obs.	1,436	1,436	1,436	1,436	1,436	1,436	1,436	1,436	239	239	1,400	1,400

Notes: This analysis includes only male students. All columns use classroom fixed effects and robust standard errors are in parentheses. Control variables include age, orphan status, father's tertiary education, mother's tertiary education, father's white-collar job, mother's white-collar job, and household assets. The weight of 6.67 is given to home-visit survey sample. *** p<0.01, ** p<0.05, * p<0.10

3.7 Discussion and Conclusion

This paper provides new insight in the role that complementarities of three HIV/AIDS interventions has in the specific context of secondary schools in Malawi. Our preliminary analysis showed limited evidence for the existence of such complementarities. Below we briefly discuss possible explanations for these results. One reason may be the relatively short period between baseline and endline surveys. To the extent that changing behaviors related to HIV/AIDS takes time, our current follow-up may not be able to capture the full range of possible effects. Secondly, it is possible that many of the self-reported measures of sexual behavior suffer from well-known measurement error problems. Thirdly, given the relatively infrequent sexual relationships of students within classrooms reported in our surveys, it is also possible that the particular complementarity between circumcision and girls' education support program may not play an important role for this specific population.

Finally, the results presented in this chapter are preliminary, and further analysis will be needed in order to substantiate some of the effects presented here. These results are based on the first short term follow-up; we expect to continue to measure the longer term effect of these interventions in the coming years. The continuation of this study will include improved tracking of the sample through: a) household surveys; b) school-based friends and peers questionnaires designed to collect information on marriages and births for the sample that attrited since baseline; and c) a wider range of outcome variables using medical, experimental, and self-reported measures.

Bibliography

Angrist, Joshua, Eric Bettinger, Erik Bloom, Elizabeth King, and Michael Kremer. 2002. "Vouchers for Private Schooling in Colombia: Evidence from a Randomized Natural Experiment." *American Economic Review* 92 (5):1535–1558.

Angrist, Joshua, Eric Bettinger, and Michael Kremer. 2006. "Long-Term Educational Consequences of Secondary School Vouchers: Evidence from Administrative Records in Colombia." *American Economic Review* 96 (3):847–862.

Auvert, Bertran, Dirk Taljaard, Emmanuel Lagarde, Joelle Sobngwi-Tambekou, Rémi Sitta, and Adrian Puren. 2005. "Randomized, controlled intervention trial of male circumcision for reduction of HIV infection risk: the ANRS 1265 Trial." *PLoS medicine* 2 (11):e298.

Bailey, Robert C, Stephen Moses, Corette B Parker, Kawango Agot, Ian Maclean, John N Krieger, Carolyn FM Williams, Richard T Campbell, and Jeckoniah O Ndinya-Achola. 2007. "Male circumcision for HIV prevention in young men in Kisumu, Kenya: a randomised controlled trial." *Lancet* 369 (9562):643–656.

Baird, Sarah, Ephraim Chirwa, Craig McIntosh, and Berk Özler. 2010. "The Short-Term Impacts of a Schooling Conditional Cash Transfer Program on the Sexual Behavior of Young Women." *Health Economics* 19 (S1):55–68.

Baird, Sarah, Joan Hamory Hicks, Michael Kremer, and Edward Miguel. 2012. "Worms at Work: Public Finance Implications of a Child Health Investment." *Unpublished Working Paper* .

Baird, Sarah, Craig McIntosh, and Berk Özler. 2011. "Cash or Condition? Evidence from a Cash Transfer Experiment." *Quarterly Journal of Economics* 126 (4):1709–1753.

Barnett, W Steven. 1992. "Benefits of Compensatory Preschool Education." *Journal of Human Resources* 27 (2):279–312.

Behrman, Jere R, Piyali Sengupta, and Petra Todd. 2005. "Progressing through PROGRESA: an Impact Assessment of a School Subsidy Experiment in Rural Mexico." *Economic Development and Cultural Change* 54 (1):237–275.

Bengo, Joseph Mfutso, Kondwani Chalulu, FCSECSA Jobiba Chinkhumba, Lawrence Kazembe, Kenneth M Maleta, Francis Masiye, and Don Mathanga. 2010. *Situation Analysis of Male Circumcision in Malawi.* Blantyre, Malawi: University of Malawi College of Medicine.

Benhassine, Najy, Florencia Devoto, Esther Duflo, Pascaline Dupas, and Victor Pouliquen. 2013. "Turning a Shove into a Nudge? A Labeled Cash Transfer for Education." *NBER Working Paper* (w19227).

Blau, Francine D and Lawrence M Kahn. 2005. "Do Cognitive Test Scores Explain Higher US Wage Inequality?" *Review of Economics and Statistics* 87 (1):184–193.

Burde, Dana and Leigh L Linden. 2013. "Bringing Education to Afghan Girls: A Randomized Controlled Trial of Village-based Schools." *American Economic Journal: Applied Economics* 5 (3):27–40.

Castillo, Marco, Paul J Ferraro, Jeffrey L Jordan, and Ragan Petrie. 2011. "The Today and Tomorrow of Kids: Time Preferences and Educational Outcomes of Children." *Journal of Public Economics* 95 (11):1377–1385.

Chetty, Raj, John N Friedman, Nathaniel Hilger, Emmanuel Saez, Diane Whitmore Schanzenbach, and Danny Yagan. 2011. "How Does Your Kindergarten Classroom Affect Your Earnings? Evidence from Project STAR." *Quarterly Journal of Economics* 126 (4):1593–1660.

Chinkhumba, Jobiba, Susan Godlonton, and Rebecca Thornton. 2014. "The Demand for Medical Male Circumcision." *American Economic Journal: Applied Economics* 6 (2):152–77.

Chong, Alberto, Marco Gonzalez-Navarro, Dean Karlan, and Martin Valdivia. 2013. "Effectiveness and spillovers of online sex education: Evidence from a randomized evaluation in Colombian public schools." *NBER Working Paper* (18776).

Coates, TJ, OA Grinstead, SE Gregorich, MD Sweat, MC Kamenga, G Sangiwa, D Balmer, and C Furlonge. 2000. "Efficacy of voluntary HIV-1 counselling and testing in individuals and couples in Kenya Tanzania and Trinidad: a randomised trial." *Lancet* 356 (9224):103–112.

Cohen, Jacob. 2013. *Statistical power analysis for the behavioral sciences.* Routledge Academic.

Cohen, Myron S, Ying Q Chen, Marybeth McCauley, Theresa Gamble, Mina C Hosseinipour, Nagalingeswaran Kumarasamy, James G Hakim, Johnstone Kumwenda, Beatriz Grinsztejn, Jose HS Pilotto et al. 2011. "Prevention of HIV-1 infection with early antiretroviral therapy." *New England journal of medicine* 365 (6):493–505.

De Hoop, Jacobus. 2011. "Selective Schools and Education Decisions: Evidence from Malawi." *Unpublished working paper, Free University of Amsterdam* .

Dewatripont, Mathias and Gerard Roland. 1995. "The Design of Reform Packages under Uncertainty." *American Economic Review* 85 (5):1207–1223.

Duflo, Esther, Pascaline Dupas, and Michael Kremer. 2011. "Peer Effects, Teacher Incentives, and the Impact of Tracking: Evidence from a Randomized Evaluation in Kenya." *American Economic Review* 101:1739–1774.

Duflo, Esther, Pascaline Dupas, Michael Kremer, and Samuel Sinei. 2006. "Education and HIV/AIDS Prevention: Evidence from a Randomized Evaluation in Western Kenya." *World Bank Policy Research Working Paper 4024* .

Duflo, Esther and Emmanuel Saez. 2003. "The Role of Information and Social Interactions in Retirement Plan Decisions: Evidence from a randomized experiment." *Quarterly Journal of Economics* 118 (3):815–842.

Duncan, Greg J, Johanne Boisjoly, Michael Kremer, Dan M Levy, and Jacque Eccles. 2005. "Peer Effects in Drug Use and Sex among College Students." *Journal of Abnormal Child Psychology* 33 (3):375–385.

Dupas, Pascaline. 2011. "Do Teenagers Respond to HIV Risk Information? Evidence from a Field Experiment in Kenya." *American Economic Journal: Applied Economics* 3:1–34.

Eisenberg, Daniel, Ezra Golberstein, and Janis L Whitlock. 2014. "Peer Effects on Risky Behaviors: New evidence from College Roommate assignments." *Journal of Health Economics* 33:126–138.

Gallant, Melanie and Eleanor Maticka-Tyndale. 2004. "School-based HIV prevention programmes for African youth." *Social Science & Medicine* 58 (7):1337–1351.

Glewwe, Paul, Phillip H. Ross, and Bruce Wydick. 2013. "Developing Aspirations: The Impact of Child Sponsorship on Self-Esteem and Life Expectations." *Unpublished working paper* .

Godlonton, Susan and Rebecca Thornton. 2012. "Peer Effects in Learning HIV Results." *Journal of Development Economics* 97 (1):118–129.

Government of Malawi. 2012. *National Policy on Voluntary Medical MAle Circumcision*. Lilongwe, Malawi: Ministry of Health.

Gray, Ronald H, Godfrey Kigozi, David Serwadda, Frederick Makumbi, Stephen Watya, Fred Nalugoda, Noah Kiwanuka, Lawrence H Moulton, Mohammad A Chaudhary, Michael Z Chen et al. 2007. "Male Circumcision for HIV Prevention in Men in Rakai, Uganda: a Randomised Trial." *Lancet* 369 (9562):657–666.

Hankins, Catherine A and Barbara O de Zalduondo. 2010. "Combination Prevention: a Deeper Understanding of Effective HIV Prevention." *AIDS* 24:S70–S80.

Hanushek, Eric A and Ludger Woessmann. 2012. "Do better schools lead to more growth? Cognitive skills, economic outcomes, and causation." *Journal of Economic Growth* 17 (4):267–321.

International Labour Organization (ILO). 2012. *Employment Diagnostic Analysis on Malawi*. Lilongwe, Malawi: Government of Malawi.

Kremer, Michael, Edward Miguel, and Rebecca Thornton. 2009. "Incentives to Learn." *Review of Economics and Statistics* 91 (3):437–456.

Krueger, Alan B and Diane M Whitmore. 2001. "The effect of attending a small class in the early grades on college-test taking and middle school test results: Evidence from Project STAR." *Economic Journal* 111 (468):1–28.

Lee, David S. 2009. "Training, Wages, and Sample Selection: Estimating Sharp Bounds on Treatment Effects." *Review of Economic Studies* 76 (3):1071–1102.

Macours, Karen, Norbert Schady, and Renos Vakis. 2012. "Cash Transfers, Behavioral Changes, and Cognitive Development in Early Childhood: Evidence from a Randomized Experiment." *American Economic Journal: Applied Economics* 4 (2):247–273.

Murphy, Kevin M, Andrei Shleifer, and Robert W Vishny. 1989. "Industrialization and the Big Push." *Journal of Political Economy* 97 (5):1003–1026.

———. 1992. "The Transition to a Market Economy: Pitfalls of Partial Reform." *Quarterly Journal of Economics* 107 (3):889–906.

National AIDS Commission (NAC) Malawi. 2012. *Malawi Vountary Medical Male Circumcision Communication Strategy 2012-2016*. Lilongwe, Malawi: NAC.

National Statistical Office (NSO). 2011. *Welfare Monitoring Survey*. Lilongwe, Malawi: Government of Malawi (GOM).

NSO and ICF Macro. 2011. *Malawi Demographic and Health Survey 2010*. Zomba, Malawi: National Statistical Office (NSO), and ICF Macro.

Oster, Emily and Rebecca Thornton. 2012. "Determinants of Technology Adoption: Peer Effects in Menstrual Cup Take-up." *Journal of the European Economic Association* 10 (6):1263–1293.

Rosenstein-Rodan, Paul N. 1943. "Problems of Industrialisation of Eastern and South-Eastern Europe." *Economic Journal* 53:202–211.

Sacerdote, Bruce. 2001. "Peer Effects with Random Assignment: Results for Dartmouth Roommates." *Quarterly Journal of Economics* 116 (2):681–704.

Sanchez, Pedro, Cheryl Palm, Jeffrey Sachs, Glenn Denning, Rafael Flor, Rebbie Harawa, Bashir Jama, Tsegazeab Kiflemariam, Bronwen Konecky, Raffaela Kozar et al. 2007. "The African millennium villages." *Proceedings of the National Academy of Sciences* 104 (43):16775–16780.

Schultz, T. Paul. 2004. "School Subsidies for the Poor: Evaluating the Mexiacan Progresa Poverty Program." *Journal of Development Economics* (74):199–250.

Son, Hyelim. 2013. "Human Capital Investment When Sheepskin Effects Matter: Evidence from Income Shocks in Indonesia." *Job Market Paper, Department of Economics, Columbia University* .

Sutter, Matthias, Martin G Kocher, Daniela Glatzle-Rutzler, and Stefan T Trautmann. 2013. "Impatience and Uncertainty: Experimental Decisions Predict Adolescents' Field Behavior." *American Economic Review* 103 (1):510–531.

Tanaka, Tomomi, Colin F Camerer, and Quang Nguyen. 2010. "Risk and Time Preferences: Linking Experimental and Household Survey Data from Vietnam." *American Economic Review* 100 (1):557–571.

Thomas, Duncan, Elizabeth Frankenberg, and James P Smith. 2001. "Lost but Not Forgotten." *Journal of Human Resources* 36 (3):556–592.

Thomas, Duncan, Firman Witoelar, Elizabeth Frankenberg, Bondan Sikoki, John Strauss, Cecep Sumantri, and Wayan Suriastini. 2012. "Cutting the costs of attrition: Results from the Indonesia Family Life Survey." *Journal of Development Economics* 98 (1):108–123.

Thornton, Rebecca L. 2008. "The demand for, and impact of, learning HIV status." *American Economic Review* 98 (5):1829–1863.

UNADIS. 2012. *Global Report: UNAIDS Report on the Global AIDS Epidemic: 2012*. Joint United Nations Programme on HIV/AIDS.

UNFPA. 2012. *State of the World Population 2012*. UNFPA.

Westercamp, Nelli and RC Bailey. 2007. "Acceptability of male circumcision for prevention of HIV/AIDS in sub-Saharan Africa: a review." *AIDS and Behavior* 11 (3):341–355.

World Health Organization (WHO). 2007. *New data on male circumcision and HIV prevention: policy and programme implications: WHO/UNAIDS Technical Consultation Male Circumcision and HIV Prevention: Research Implications for Policy and Programming, Montreux, 6-8 March 2007: conclusions and recommendations*. WHO.

World Health Organization(WHO). 2012. *Progress in Scaling up Voluntary Medical Male Circumcision for HIV Prevention in East and Southern Africa: January-December 2011.*

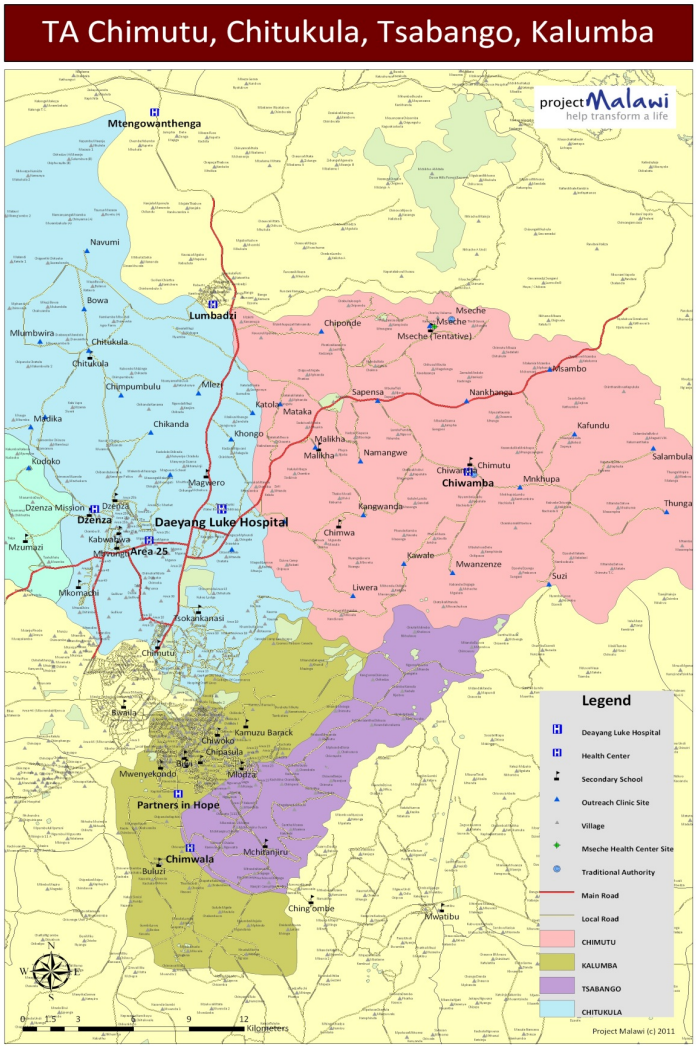
Wydick, Bruce, Paul Glewwe, and Laine Rutledge. 2013. "Does international child sponsorship work? A six-country study of impacts on adult life outcomes." *Journal of Political Economy* 121 (2):393–436.

Appendix A

Chapter 1 Appendix

A.1 Map of Project Areas

Figure A.1: Map of Project Areas

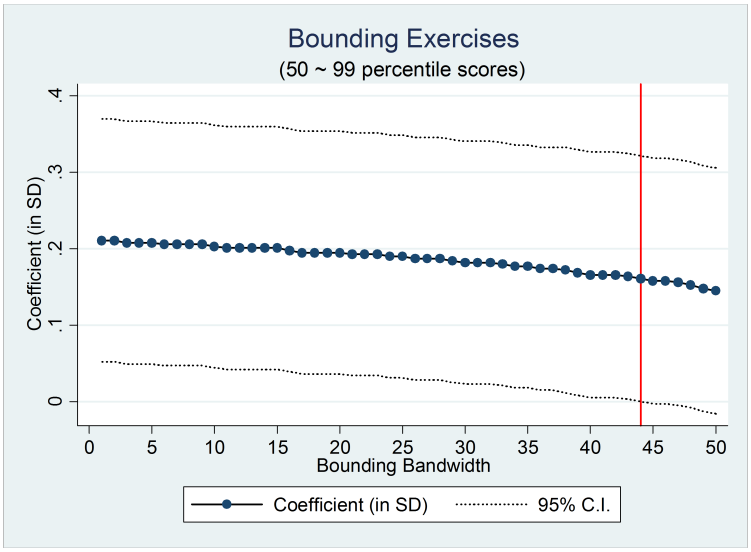


A.2 Bounding Exercises for Cognitive Ability

Initially, we assigned 50 percentile cognitive test score to the attrition sample and then we increased the percentile score assigned to attrition students of the control group by 1 percentile while decreasing the percentile score to attrition students of the treatment group by 1 percentile. Therefore, the second bounding practice is that attrition students in the control group was assigned 51 percentile score and those in the treatment group 49 percentile score. In the end, we assigned 99 percentile score to the control group attrition and 1 percentile score to the treatment group attrition.

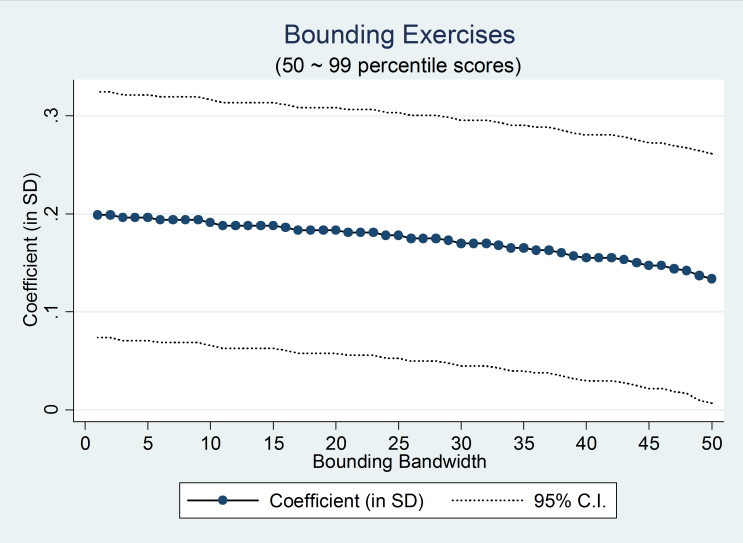
1) Regression without baseline controls: The findings on cognitive ability would not change until we assigned 93 percentile and 7 percentile scores to the attrition.

Figure A.2: Bounding excercises 1



2) Regression with baseline controls: The findings on cognitive ability would not change even when we assigned the highest 99 percentile and the lowest 1 percentile scores to the attrition.

Figure A.3: Bounding excercises 2



This figure plots the change of coefficients on cognitive ability in Table VIII with different bounding exercises. To construct these figures, we bin bounding exercises into fifty different bounding bandwidths and plot the standard deviation of cognitive ability for each bandwidth. The dashed lines show upper and lower intervals of the 95% confidence level.

A.3 Test setting effect

The settings for cognitive ability test were different between follow-up and home-visit surveys. Table A1 presents that follow-up survey sample took the cognitive test at their school while the test was administered mostly at home for home-visit survey. The impact on cognitive ability in Table 8 was derived from both 30 questions of follow-up survey sample (1) and home-visit survey sample (3), which does not adjust the setting difference.

Table A.1: Setting Effect of Cognitive Score

		Follow-up survey sample	Home-visit survey sample
Test Location	School	(1) 30 questions	N/A
	Home	(2) 30 questions	(3) 30 questions
		(4) 5 questions	(5) 5 questions

In order to adjust the test setting difference, we randomly select 2% of the students who completed follow-up survey and visited them again and administered the cognitive ability test with additional 5 new questions at their home. Table A.2 shows that there is no evidence of significant test setting effect on cognitive ability through diff-in-diff estimation.

Table A.2: Setting adjustment: diff-in-diff estimation

	Cognitive Test Score	
	(1)	(2)
30 questions vs. 5 questions	-0.022	-0.022
(1) - (4) or (3) - (5)	(0.021)	(0.022)
follow-up vs. home-visit	0.071	0.073
(1) - (3) or (4) - (5)	(0.045)	(0.048)
30 questions x follow-up	-0.005	-0.005
((1)-(4)) - ((3)-(5))	(0.043)	(0.044)
Controls	No	Yes
Observations	370	370
R-squared	0.044	0.192

Notes: 2% random sample for follow-up survey and home-visit survey samples were weighted with 50 and 6.67, respectively. Regressions are OLS models with grade fixed effects. Robust standard errors are clustered by classroom. The weight of 6.67 is given to home-visit survey sample. Baseline values of the following variables are included as controls in the regression analyses: age, orphan status, parents' tertiary education, parents' white-collar job, household asset ownership, and school type. *** p<0.01, ** p<0.05, * p<0.10