Web Appendix

"Education, HIV, and Early Fertility: Experimental Evidence from Kenya"

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Appendix A. Tables A1-A5.

Table A1. Accuracy of Roll Call Method

	(1)	(2)	(3)	(4)
	Dep. Var.: Dummy equal to 1 if Roll Call data is consistent with Quality Control data			
Sample:	Girls reported as having started childbearing in roll call data	Girls reported as not having started childbearing in roll call data	Girls reported as having a child in roll call data	Girls reported as not having a child in roll call data
Stand-Alone Education Subsidy (S)	0.009	0.004	0.005	0.016
	(0.033)	(0.057)	(0.040)	(0.047)
Stand-Alone HIV Education (H)	-0.040	-0.087	-0.053	0.030
	(0.040)	(0.059)	(0.044)	(0.038)
Joint Program (SH)	-0.029	-0.040	-0.059	0.023
	(0.033)	(0.063)	(0.039)	(0.041)
Observations	1144	276	931	452
Mean of Dep. Var. (Control)	0.789	0.826	0.792	0.892
p-val (Test: S = SH)	*0.303*	*0.500*	*0.162*	*0.889*
p-val (Test: H = SH)	*0.794*	*0.498*	*0.897*	*0.864*
p-val (Test: S = H)	*0.257*	*0.143*	*0.249*	*0.763*

Notes: To check the accuracy of the childbearing data obtained through the Roll Call method, a subset of girls were randomly sampled for a "Quality Control" survey administered at their home in early 2006. Girls who had been identified as having started childbearing according to the roll call were oversampled. The childbearing information collected through the home visits was obtained from the target respondent herself in 44% of the cases; from her mother in 27% of the cases; from another female relative in 10% of the cases; and from a male relative in the rest of the cases.

Table A2. Attrition in Roll Call Data

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Outcomes missing after 3 years				Outcomes missing after 5 years		
	Dropped Out of Primary School	Attendance rate (when enrolled) over 5 surprise visits	Ever Married	Ever Pregnant	Dropped Out of Primary School	Ever Married	Ever Pregnant
Panel A. Girls							
Stand-Alone Education Subsidy (S)	0.001	-0.002	-0.002	-0.005	-0.014	-0.001	-0.002
	(0.005)	(0.009)	(0.005)	(0.005)	(0.010)	(0.014)	(0.014)
Stand-Alone HIV Education (H)	-0.003	0.013	-0.001	-0.002	-0.019	-0.021	-0.024
	(0.006)	(0.009)	(0.006)	(0.006)	(0.010)*	(0.015)	(0.015)
Joint Program (SH)	0.010	0.015	0.010	0.007	-0.005	-0.008	-0.006
	(0.006)	(0.008)*	(0.007)	(0.007)	(0.012)	(0.018)	(0.018)
Observations	9482	9482	9482	9482	9482	9482	9482
Mean Attrition (Control Group)	0.037	0.131	0.038	0.044	0.076	0.123	0.132
p-val (Test: S = SH)	*0.115*	*0.037***	*0.063**	*0.061**	*0.331*	*0.642*	*0.789*
p-val (Test: H = SH)	*0.041***	*0.816*	*0.136*	*0.235*	*0.167*	*0.418*	*0.263*
p-val (Test: S = H)	*0.422*	*0.109*	*0.860*	*0.575*	*0.485*	*0.082**	*0.052**
Panel B: Boys							
Stand-Alone Education Subsidy (S)	-0.001	0.000	-0.001	-0.002	-0.001	-0.003	0.018
	(0.005)	(0.008)	(0.006)	(0.006)	(0.010)	(0.019)	(0.010)*
Stand-Alone HIV Education (H)	0.005	0.010	0.002	0.004	-0.003	-0.020	0.009
	(0.005)	(0.006)	(0.006)	(0.006)	(0.009)	(0.017)	(0.009)
Joint Program (SH)	0.005	0.002	0.005	0.002	-0.004	-0.010	0.006
	(0.007)	(0.006)	(0.008)	(0.008)	(0.012)	(0.021)	(0.010)
Observations	9797	9797	9797	9797	9797	9797	9797
Mean of Dep. Var. (Control)	0.030	0.077	0.038	0.036	0.059	0.133	0.085
p-val (Test: S = SH)	*0.380*	*0.810*	*0.354*	*0.660*	*0.824*	*0.705*	*0.231*
p-val (Test: H = SH)	*0.953*	*0.223*	*0.678*	*0.700*	*0.980*	*0.542*	*0.715*
p-val (Test: S = H)	*0.208*	*0.211*	*0.533*	*0.294*	*0.808*	*0.231*	*0.330*

*Notes: Dependent variables are dummies equal to 1 if the information is missing for the respondent. Estimates obtained through OLS regressions that include controls for year of birth, school size, randomization strata dummies and roll call dates. Standard errors clustered at the school level. ***, **, * indicate significance at 1, 5 and 10%.*

Table A3. Survey Rates during Long-Run Follow-up (after 7 years)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Identified as Dead during Regular Tracking (RT)	If not dead: Found and Surveyed during RT	If Sampled for IT: Found and Surveyed during IT	If not Dead: Found and Surveyed (RT or IT)	Final Follow-up Sample (with sampling weights)					
Panel A. Girls					Surveyed	Non-missing Grades Completed	Non-missing fertility	Non-missing HSV2 Status	Follow-up survey date	Blood draw date
Stand-Alone Education Subsidy (S)	-0.001	0.087	-0.044	0.060	0.007	0.012	0.006	0.008	-28.380	-31.575
	(0.004)	(0.016)***	(0.029)	(0.013)***	(0.014)	(0.015)	(0.014)	(0.016)	(10.992)**	(11.206)***
Stand-Alone HIV Education (H)	0.001	0.044	0.008	0.021	0.015	0.020	0.015	0.015	-20.853	-21.316
	(0.003)	(0.017)**	(0.030)	(0.014)	(0.014)	(0.015)	(0.014)	(0.016)	(10.828)*	(11.742)*
Joint Program (SH)	-0.004	0.090	0.041	0.073	0.037	0.038	0.037	0.046	-25.120	-28.026
	(0.004)	(0.017)***	(0.031)	(0.015)***	(0.014)***	(0.015)***	(0.014)**	(0.015)***	(11.318)**	(11.720)**
Observations	9482	9354	1291	9354	6016	6016	6016	6016	5719	5515
Mean (Control Group)	0.013	0.444	0.783	0.565	0.942	0.937	0.944	0.910		
p-val (Test: S = SH)	*0.401*	*0.824*	*0.006****	*0.369*	*0.024***	*0.05***	*0.022***	*0.009****	*0.765*	*0.745*
p-val (Test: H = SH)	*0.124*	*0.006****	*0.328*	*0.001****	*0.116*	*0.189*	*0.117*	*0.051**	*0.702*	*0.574*
p-val (Test: S = H)	*0.548*	*0.009****	*0.094**	*0.006****	*0.535*	*0.569*	*0.513*	*0.636*	*0.478*	*0.366*
Panel B. Boys										
Stand-Alone Education Subsidy (S)	-0.001	0.070	0.042	0.044	0.024	0.024	0.025	0.030	-25.515	-31.334
	(0.004)	(0.017)***	(0.028)	(0.015)***	(0.010)**	(0.010)**	(0.010)**	(0.014)**	(10.508)**	(10.929)***
Stand-Alone HIV Education (H)	0.003	0.003	-0.013	-0.017	-0.005	-0.004	-0.005	-0.003	-15.301	-21.297
	(0.004)	(0.018)	(0.026)	(0.015)	(0.010)	(0.010)	(0.010)	(0.014)	(10.170)	(10.815)**
Joint Program (SH)	0.000	0.062	0.046	0.040	0.020	0.022	0.021	0.039	-27.131	-30.791
	(0.004)	(0.019)***	(0.025)*	(0.016)**	(0.010)**	(0.010)**	(0.010)**	(0.014)***	(10.997)**	(11.201)***
Observations	9797	9638	1179	9638	6783	6783	6783	6783	6595	6312
Mean (Control Group)	0.016	0.554	0.845	0.670	0.969	0.964	0.969	0.918		
p-val (Test: S = SH)	*0.711*	*0.672*	*0.909*	*0.786*	*0.672*	*0.786*	*0.677*	*0.527*	*0.882*	*0.961*
p-val (Test: H = SH)	*0.467*	*0.004****	*0.033***	*0.001****	*0.018***	*0.014***	*0.015***	*0.002****	*0.269*	*0.385*
p-val (Test: S = H)	*0.267*	*0****	*0.07**	*0****	*0.007****	*0.008****	*0.005****	*0.017***	*0.344*	*0.373*

Notes: RT stands for "Regular Tracking" and IT stands for "Intensive Tracking". See Section 3.1.2 in main text for a description of the tracking procedure used.

Table A4. Checking for Differential Attrition across Treatment Arms in Long-Run Data

	(1)	(2)	(3)	(4)	(5)	(6)
	After 3 years: Ever pregnant (Roll Call Data)			After 5 years: Ever pregnant (Roll Call Data)		
Sample:	Full Sample	LR Follow-up Sample (unweighted)	LR Follow-up Sample (weighted)	Full Sample	LR Follow-up Sample (unweighted)	LR Follow-up Sample (weighted)
Panel A. Girls						
Stand-Alone Education Subsidy (S)	-0.027	-0.030	-0.022	-0.044	-0.039	-0.036
	(0.011)**	(0.013)**	(0.014)	(0.017)***	(0.018)**	(0.021)*
Stand-Alone HIV Education (H)	-0.007	-0.011	0.001	0.001	0.005	0.013
	(0.011)	(0.012)	(0.013)	(0.015)	(0.018)	(0.021)
Joint Program (SH)	-0.011	-0.017	-0.010	-0.011	-0.008	-0.008
	(0.010)	(0.011)	(0.012)	(0.016)	(0.018)	(0.020)
Sampling Weights			Yes			Yes
Observations	9072	5654	5654	8302	5341	5341
Mean of Dep. Var. (Control)	0.160	0.128	0.125	0.329	0.270	0.283
Panel B: Boys						
Stand-Alone Education Subsidy (S)	-0.002	-0.005	-0.005	0.005	0.002	0.001
	(0.003)	(0.003)*	(0.003)	(0.005)	(0.006)	(0.007)
Stand-Alone HIV Education (H)	-0.002	0.000	0.001	0.004	0.003	0.000
	(0.002)	(0.003)	(0.004)	(0.005)	(0.006)	(0.007)
Joint Program (SH)	-0.006	-0.007	-0.006	0.000	-0.002	-0.004
	(0.002)**	(0.002)***	(0.003)**	(0.005)	(0.005)	(0.006)
Sampling Weights			Yes			Yes
Observations	9433	6522	6522	8897	6317	6317
Mean of Dep. Var. (Control)	0.011	0.011	0.010	0.032	0.029	0.031

*Notes: Data Source: Roll Call Data. Estimates obtained through OLS regressions that include controls for year of birth, the timing of the roll call visits, school size and randomization strata dummies. Standard errors clustered at the school level. ***, **, * indicate significance at 1, 5 and 10%.*

Columns 1-3: Data collected through five school visits conducted at regular intervals over three academic years (2003, 2004, 2005). Columns 4-6: Include four additional school visits conducted in 2006 and 2007.

Table A5. HIV Education and Knowledge in Program Schools, After Two Years

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	HIV was mentioned in class in the last 4 weeks	HIV was ever mentioned in class	Knows that HIV kills	Knows that healthy looking individuals can have HIV	Knows that condoms can prevent pregnancy	Knows that condoms can prevent HIV infection	Mentions abstinence when asked for ways to avoid HIV infection	Mentions condoms when asked for ways to avoid HIV infection	Mentions faithfulness when asked for ways to avoid HIV infection
Panel A. Girls									
Stand-Alone Education Subsidy (S)	0.018	-0.014	0.009	0.029	-0.003	-0.010	0.022	0.039	0.037
	(0.026)	(0.018)	(0.010)	(0.019)	(0.018)	(0.019)	(0.020)	(0.020)*	(0.013)***
Stand-Alone HIV Education (H)	0.053	0.060	-0.009	0.004	0.048	0.020	0.032	0.079	0.030
	(0.025)**	(0.016)***	(0.011)	(0.018)	(0.018)***	(0.017)	(0.021)	(0.021)***	(0.012)**
Joint Program (SH)	0.086	0.064	0.023	-0.008	0.050	0.039	0.025	0.063	0.030
	(0.029)***	(0.017)***	(0.010)**	(0.017)	(0.019)**	(0.017)**	(0.023)	(0.023)***	(0.011)***
Observations	13338	13338	13340	13281	13353	13188	13318	13318	13318
Mean of Dep. Var. (Control)	0.461	0.823	0.858	0.512	0.484	0.552	0.390	0.370	0.068
p-val (Test: S = SH)	*0.016***	*0****	*0.174*	*0.048***	*0.008****	*0.01****	*0.892*	*0.284*	*0.568*
p-val (Test: H = SH)	*0.238*	*0.797*	*0.004****	*0.525*	*0.927*	*0.268*	*0.753*	*0.497*	*0.986*
p-val (Test: S = H)	*0.170*	*0****	*0.1**	*0.201*	*0.008****	*0.124*	*0.618*	*0.057**	*0.598*
p-val (Test: SH = S + H)	*0.683*	*0.452*	*0.137*	*0.125*	*0.847*	*0.249*	*0.347*	*0.067**	*0.033***
Panel B: Boys									
Stand-Alone Education Subsidy (S)	0.006	0.000	0.009	-0.005	0.049	0.018	0.026	0.007	0.016
	(0.023)	(0.018)	(0.017)	(0.009)	(0.014)***	(0.015)	(0.020)	(0.020)	(0.010)
Stand-Alone HIV Education (H)	0.002	0.053	0.001	-0.010	0.029	0.015	0.054	0.045	0.023
	(0.024)	(0.016)***	(0.017)	(0.010)	(0.014)**	(0.016)	(0.021)***	(0.021)**	(0.010)**
Joint Program (SH)	0.059	0.056	0.016	-0.006	0.051	0.046	0.067	0.000	0.015
	(0.025)**	(0.018)***	(0.018)	(0.010)	(0.015)***	(0.017)***	(0.021)***	(0.021)	(0.010)
Observations	13693	13693	13655	13667	13682	13559	13636	13636	13636
Mean of Dep. Var. (Control)	0.479	0.794	0.567	0.862	0.648	0.655	0.393	0.520	0.079
p-val (Test: S = SH)	*0.039***	*0.001****	*0.659*	*0.934*	*0.906*	*0.064**	*0.059**	*0.746*	*0.898*
p-val (Test: H = SH)	*0.03***	*0.825*	*0.362*	*0.718*	*0.152*	*0.057**	*0.548*	*0.036***	*0.469*
p-val (Test: S = H)	*0.865*	*0.001****	*0.633*	*0.629*	*0.179*	*0.850*	*0.200*	*0.056**	*0.542*
p-val (Test: SH = S + H)	*0.135*	*0.877*	*0.784*	*0.515*	*0.184*	*0.553*	*0.678*	*0.081**	*0.103*

*Notes: Data Source: Anonymous in-class survey self-administered by students in grades 7 and 8 in 2005. The overlap between those administered this survey and our study sample is only partial (and the overlap likely varies with the treatment assignment), therefore this analysis is only suggestive. Estimates obtained through OLS regressions that include controls for school size and randomization strata dummies. Standard errors clustered at the school level. ***, **, * indicate significance at 1, 5 and 10%.*

Appendix B: Model Appendix

Conditions that ensure that only one type of sex is chosen at a time (“No Mixing Condition”)

Recall that the agent j solves the problem

$$\max_{s_c,s_m,e} u(s_c+s_m) - D(\pi(s_c,s_m,a_c,a_m)) + (1-v(s_c,s_m,b_c,b_m))\theta_j y(e) - \gamma e \\ + y_0 + v(s_c,s_m,b_c,b_m)(B_m + \delta\{s_c>0\}(B_c-B_m)). \tag{3}$$

The girls are differentiated by $\theta_j \in [\theta_{min}, \theta_{max}]$ and $\gamma_j \in [\gamma_{min}, \gamma_{max}]$. As usual define $s \equiv s_m + s_c$. Recall that in the absence of any concerns about STIs or pregnancy, the utility maximizing amount of unprotected sex is $\bar{s}$, after which the pure marginal utility of more sex is negative (that is, $u' < 0$ for $s > \bar{s}$).

The FOC for an interior solution are

$$u'(s_c) = -D(1-a_m)^{s_m}(1-a_c)^{s_c}(log(1-a_c)) - (1-b_c)^{s_c}(1-b_m)^{s_m}(log(1-b_c))(\theta_j y(e) - B_c) \tag{4}$$

$$u'(s_m) = -D(1-a_m)^{s_m}(1-a_c)^{s_c}(log(1-a_m)) - (1-b_c)^{s_c}(1-b_m)^{s_m}(log(1-b_m))(\theta_j y(e) - B_c) \tag{5}$$

and finally

$$(1-v(s_c,s_m,b_c,b_m)\theta_j y'(e) = \gamma \tag{6}$$

If $s_c = 0$ then the FOC with respect to s is:

$$u'(s) = -D(1-a_m)^{s}(log(1-a_m)) - (1-b_m)^{s}(log(1-b_m))(\theta_j y(e) - B_m) \tag{7}$$

while if $s_m = 0$ then it is:

$$u'(s) = -D(1-a_c)^{s}(log(1-a_c)) - (1-b_c)^{s}(log(1-b_c))(\theta_j y(e) - B_c) \tag{8}$$

Suppose that there are some agents in the population who find it worthwhile to engage in some casual sex, will such an agent wish to add some marital sex? She will not do so if the marginal cost of marital sex is higher; that is: she will not mix, if and only if, at the level of sex that she chooses,

$$-\,D\;log\left(\frac{1-a_c}{1-a_m}\right)(1-a_c)^{s_c} < -(1-b_c)^{s_c}log\left(\frac{1-b_m}{1-b_c}\right)(\theta_j y(e)-B_c) \tag{9}$$

Consider the lowest possible education that a girl who chooses casual sex will choose, and say this corresponds to the education chosen by the girl with $\theta_j=\theta^*$. A sufficient but not necessary condition for this expression to hold is the following: at any level of s_c which will actually be chosen, we have

$$-\,D\;log\left(\frac{1-a_c}{1-a_m}\right)(1-a_c)^{s_c} < -(1-b_c)^{s_c}log\left(\frac{1-b_m}{1-b_c}\right)(\theta^* y(\underline{e})-B_c) \tag{10}$$

Assume that the parameters of the model are such that

$$D\;log\left(\frac{1-a_m}{1-a_c}\right) < log\left(\frac{1-b_c}{1-b_m}\right)(\theta^* y(\underline{e})-B_c) \tag{11}$$

What this requires is the following: for girls who choose some non-zero casual sex, the cost from increased STI risk of increasing casual sex is lower than the cost from increased pregnancy risk of increasing committed sex. This seems plausible, as girls who choose casual sex have high returns to education.

If inequality 11 holds, then what happens as s_c increases? If $a_c>b_c$, then naturally 11 implies 10. If $a_c<b_c$ then the two sides may eventually cross as $s_c\to\infty$. Hence, to ensure no mixing, we must have that nobody wants any amount of sex that exceeds this "crossing point". So denote the crossing point $\bar{s_c}$, then we need that $\bar{s}<\bar{s_c}$ where

$$-D\;log\left(\frac{1-a_c}{1-a_m}\right)(1-a_c)^{\bar{s_c}} = -(1-b_c)^{\bar{s_c}}log\left(\frac{1-b_m}{1-b_c}\right)(\theta^* y(\underline{e})-B_c) \tag{12}$$

Now consider the agent who finds it worthwhile to engage in marital sex. She will never want to add only a small amount of s_c because any gain would be marginal but the cost is discrete – the benefit of pregnancy drops from B_m to B_c. Similarly, as long as $\bar{s}$ is not too large, we can rule out that she would want to add so much sex that it would be worth it to choose mixing over simply more marital sex. Specifically, suppose that there are some agents in the population with a returns to education such that they find it worthwhile to engage in some marital sex (($\theta_j<\theta^*$). They will not add casual sex if the marginal cost of casual sex is higher than the marginal cost of marital sex; that is: they will not mix, if and only if, at the level of sex chosen,

$$D\ log\left(\frac{1-a_m}{1-a_c}\right)(1-a_m)^{s_m} < (1-b_m)^{s_m}\left[log\left(1-b_c\right)\left(\theta_j y(e)-B_c\right)-log\left(1-b_m\right)\left(\theta_j y(e)-B_m\right)\right] \tag{13}$$

Since $\theta_j < \theta^*$and by assumption $B_m \geq B_c$, a sufficient condition for 13 to hold is that:

$$D\ log\left(\frac{1-a_m}{1-a_c}\right)(1-a_m)^{s_m} < (1-b_m)^{s_m}\left[log\left(1-b_c\right)\left(\theta^* y(e)-B_c\right)-log\left(1-b_m\right)\left(\theta^* y(e)-B_c\right)\right] \tag{14}$$

which can be simplified as:

$$D\ log\left(\frac{1-a_m}{1-a_c}\right)(1-a_m)^{s_m} < (1-b_m)^{s_c} log\left(\frac{1-b_c}{1-b_m}\right)\left(\theta^* y(e)-B_c\right) \tag{15}$$

If inequality 11 holds as assumed above, then what happens as s_m increases? If $a_m > b_m$, then naturally 11 implies 10. If $a_m < b_m$ then the two sides may eventually cross as $s_m \to \infty$. Hence, to ensure no mixing, we must have that nobody wants any amount of sex that exceeds this "crossing point". So denote the crossing point $\bar{s_m}$, then we need that $\bar{s} < \bar{s_m}$ where

$$D\ log\left(\frac{1-a_m}{1-a_c}\right)(1-a_m)^{\bar{s_m}} = (1-b_m)^{\bar{s_m}} log\left(\frac{1-b_c}{1-b_m}\right)\left(\theta^* y(\underline{e})-B_c\right). \tag{16}$$

Corner Solutions and Proofs

Corner solutions to the individual's utility maximization problem

First, consider the corner where the individual chooses no education ($e = 0$), which yields the following optimization condition:

$$\frac{\partial U(s, e=0)}{\partial s} = u'(s) - \frac{\partial \pi(s,a)}{\partial s} D + \frac{\partial v(s,b)}{\partial s}[B - \theta y(e=0)] = 0.$$

The other corner is where the individual abstains from any level of unprotected sex ($s = 0$), which yields the following optimization problem:

$$\frac{\partial U(s=0,e)}{\partial e} = (1-v(s=0,b))\theta y'(e) - \gamma = \theta y'(e) - \gamma = 0.$$

Comparative statics with respect to the intensive margin

Lemma 1: For an interior solution, an increase in γ (the cost of education) reduces e and increases s. For a corner solution at $e = 0$, an increase in γ will not affect s. For a corner solution at $s = 0$, an increase in γ will reduce e.

Proof. The case for an interior solution is proven in the main text.

Now, suppose that we have a corner solution at $e = 0$. Then the first-order condition

$$u'(s) - \frac{\partial \pi(s,a)}{\partial s} D + \frac{\partial v(s,b)}{\partial s}[B - \theta y(e=0)] = 0$$

implies that

$$\frac{ds}{d\gamma} = 0.$$

Finally, suppose that we have a corner solution at $s = 0$. Then we have

$$\frac{\partial^2 U}{\partial e^2} de - d\gamma = 0$$

so that

$$\frac{de}{d\gamma} = \frac{1}{\frac{\partial^2 U}{\partial e^2}} < 0$$

as desired. ■

- **Lemma 2:** For an interior solution, an increase in a (the perceived riskiness of the relationship) reduces s and increases e. For a corner solution at $e = 0$, an increase in a will reduce s. For a corner solution at $s = 0$, an increase in a will not affect e.

Proof. First, suppose that we have an interior solution. We take the total derivative of the first-order conditions with respect to a and solve for $\frac{de}{da}$ and $\frac{ds}{da}$.

$$\frac{\partial^2 U}{\partial s^2} ds + \frac{\partial^2 U}{\partial s \partial e} de - \frac{\partial^2 \pi(s,a)}{\partial s \partial a} D da = 0 \tag{17}$$

$$\frac{\partial^2 U}{\partial s \partial e} ds + \frac{\partial^2 U}{\partial e^2} de = 0. \tag{18}$$

Solving the system of equations for $\frac{de}{da}$:

$$\frac{\partial^2 U}{\partial s^2}\left(-\frac{\frac{\partial^2 U}{\partial e^2}}{\frac{\partial^2 U}{\partial s\partial e}}de\right)+\frac{\partial^2 U}{\partial s\partial e}de-\frac{\partial^2\pi(s,a)}{\partial s\partial a}Dda=0 \tag{19}$$

$$-\frac{\frac{\partial^2 U}{\partial s^2}\frac{\partial^2 U}{\partial e^2}}{\frac{\partial^2 U}{\partial s\partial e}}+\frac{\partial^2 U}{\partial s\partial e}=\frac{da}{de}\left[\frac{\partial^2\pi(s,a)}{\partial s\partial a}D\right] \tag{20}$$

$$\frac{-\frac{\partial^2 U}{\partial s^2}\frac{\partial^2 U}{\partial e^2}+\left(\frac{\partial^2 U}{\partial s\partial e}\right)^2}{\frac{\partial^2 U}{\partial s\partial e}\frac{\partial^2\pi(s,a)}{\partial s\partial a}D}=\frac{da}{de} \tag{21}$$

$$\frac{\frac{\partial^2 U}{\partial s\partial e}\frac{\partial^2\pi(s,a)}{\partial s\partial a}D}{-detH}=\frac{de}{da} \tag{22}$$

In the final expression, the numerator is negative since $\frac{\partial^2 U}{\partial s\partial e}<0$ (as shown earlier), $\frac{\partial^2\pi(s,a)}{\partial s\partial a}>0$ (by assumption), and $D>0$ (by definition). The denominator is negative since from the second order condition $detH>0$. Therefore, the overall expression is positive: $\frac{de}{da}>0$.

Solving the system of equations for $\frac{ds}{da}$ yields:

$$\frac{\partial^2 U}{\partial s^2}ds+\frac{\partial^2 U}{\partial s\partial e}\left(-\frac{\frac{\partial^2 U}{\partial s\partial e}}{\frac{\partial^2 U}{\partial e^2}}ds\right)-\frac{\partial^2\pi(s,a)}{\partial s\partial a}Dda=0 \tag{23}$$

$$\frac{\partial^2 U}{\partial s^2}-\frac{\left(\frac{\partial^2 U}{\partial s\partial e}\right)^2}{\frac{\partial^2 U}{\partial e^2}}=\frac{da}{ds}\left[\frac{\partial^2\pi(s,a)}{\partial s\partial a}D\right] \tag{24}$$

$$\frac{\frac{\partial^2 U}{\partial s\partial e}\frac{\partial^2\pi(s,a)}{\partial s\partial a}D}{detH}=\frac{ds}{da}. \tag{25}$$

As discussed earlier, the numerator in this expression is negative, hence $\frac{ds}{da}<0$.

Now, suppose that we have a corner solution at $e=0$. Then equation 17can be rewritten as

$$\frac{\partial^2 U}{\partial s^2}ds-\frac{\partial^2\pi(s,a)}{\partial s\partial a}Dda=0$$

so that

$$\frac{ds}{da}=\frac{\frac{\partial^2\pi(s,a)}{\partial s\partial a}D}{\frac{\partial^2 U}{\partial s^2}}<0.$$

Finally, suppose that we have a corner solution at $s = 0$. Then the first order condition

$$(1 - v(s = 0, b))\theta y'(e) - \gamma = 0$$

implies that

$$\frac{de}{da} = 0$$

as desired. ■

Lemma 3 For an interior solution, an increase in b (the risk of pregnancy) decreases e. The probability of pregnancy increases. For a corner solution at $e = 0$, the probability of pregnancy increases. For a corner solution at $s = 0$, an increase in b leaves e and the probability of pregnancy unchanged.

Proof. First, suppose that we have an interior solution. As in the proof of Lemma 2, we take the total derivative of the first-order conditions with respect to b and solve for $\frac{de}{db}$.

$$\frac{\partial^2 U}{\partial s^2} ds + \frac{\partial^2 U}{\partial s \partial e} de + \frac{\partial^2 v(s,b)}{\partial s \partial b}[B - \theta y(e)]db = 0 \tag{26}$$

$$\frac{\partial^2 U}{\partial s \partial e} ds + \frac{\partial^2 U}{\partial e^2} de - \frac{\partial v(s,b)}{\partial b} \theta y'(e) db = 0.$$

Solving the system yields:

$$\frac{de}{db} = \frac{\frac{\partial^2 U}{\partial s \partial e}\frac{\partial^2 v(s,b)}{\partial s \partial b}[B - \theta y(e)] + \frac{\partial^2 U}{\partial s^2}\frac{\partial v(s,b)}{\partial b}\theta y'(e)}{detH} \tag{27}$$

After some algebra, equation 27 can be rewritten:

$$\begin{aligned}\frac{de}{db} &= \frac{\frac{\partial v(s,b)}{\partial b}\theta y'(e)\left[u''(s) - \frac{\partial^2 \pi(s,a)}{\partial s^2} D\right]}{detH} \\ &= \frac{\frac{\partial v(s,b)}{\partial b}\theta y'(e)\left[u''(s) + s\ln(1-a)(1-a)^{s-1}\right]}{detH}\end{aligned}$$

Using that θ, $\frac{\partial v(s,b)}{\partial b}$, $detH$ and $y'(e)$ are positive and $u''(s)$ and $\ln(1-a)$ are negative, we can sign $\frac{de}{db} < 0$.

To prove that $\frac{dv}{db} > 0$, recall that one of the first order conditions is

$$(1 - v(s,b)\theta y'(e) = \gamma$$

From this we get that

$$\frac{dv}{db} = \frac{-\theta y''(e)}{(\theta y'(e))^2}.$$

Since $y''(e) < 0$ and $\theta > 0$, we can sign this expression $\frac{dv}{db} > 0$.

Now, suppose that we have a corner solution at $e = 0$. Then equation 26 can be rewritten as

$$\frac{\partial^2 U}{\partial s^2}ds + \frac{\partial^2 v(s,b)}{\partial s \partial b}Bdb = 0$$

which implies that

$$\frac{ds}{db} = \frac{-B\frac{\partial^2 v(s,b)}{\partial s \partial b}}{\frac{\partial^2 U}{\partial s^2}} > 0$$

since $\frac{\partial^2 v(s,b)}{\partial s \partial b} > 0$ by assumption and $\frac{\partial^2 U}{\partial s^2}$<0. Thus the level of unprotected sex increases and the risk of pregnancy increases.

Finally, suppose that we have a corner solution at $s = 0$. Then the first order condition

$$(1 - v(s = 0, b))\theta y'(e) - \gamma = 0$$

implies that $\frac{de}{db} = 0$ and $\frac{dv}{db} = 0$. ■

• **Lemma 4:** For an interior solution, an increase in B (the benefit of pregnancy) increases s and reduces e. For a corner solution at $e = 0$, an increase in B will increase s. For a corner solution at $s = 0$, an increase in B will not affect e.

Proof. First, suppose that we have an interior solution. As in the proof of Lemma 2, we take the total derivative of the first-order conditions with respect to B and solve for $\frac{de}{dB}$ and $\frac{ds}{dB}$.

$$\frac{\partial^2 U}{\partial s^2}ds + \frac{\partial^2 U}{\partial s \partial e}de + \frac{\partial v(s,b)}{\partial s}dB = 0 \tag{28}$$

$$\frac{\partial^2 U}{\partial s \partial e}ds + \frac{\partial^2 U}{\partial e^2}de = 0.$$

Solving the system of equations for $\frac{de}{dB}$:

$$\begin{aligned}
\frac{\partial^2 U}{\partial s^2}\left(-\frac{\frac{\partial^2 U}{\partial e^2}}{\frac{\partial^2 U}{\partial s \partial e}}de\right) + \frac{\partial^2 U}{\partial s \partial e}de + \frac{\partial v(s,b)}{\partial s}dB = 0 \\
-\frac{\frac{\partial^2 U}{\partial s^2}\frac{\partial^2 U}{\partial e^2}}{\frac{\partial^2 U}{\partial s \partial e}} + \frac{\partial^2 U}{\partial s \partial e} = -\frac{dB}{de}\frac{\partial v(s,b)}{\partial s} \\
\frac{\frac{\partial^2 U}{\partial s \partial e}\frac{\partial v(s,b)}{\partial s}}{detH} = \frac{de}{dB}.
\end{aligned} \tag{29}$$

The numerator is $[-\theta \frac{\partial v(s,b)}{\partial s} y'(e)]\frac{\partial v(s,b)}{\partial s}$, which is negative since θ, $\frac{\partial v(s,b)}{\partial s}$, and $y'(e)$ are all defined to be positive. So, the overall expression is negative: $\frac{de}{dB} < 0$.

Solving the system of equations for $\frac{ds}{dB}$:

$$\begin{aligned}
\frac{\partial^2 U}{\partial s^2}ds + \frac{\partial^2 U}{\partial s \partial e}\left(-\frac{\frac{\partial^2 U}{\partial s \partial e}}{\frac{\partial^2 U}{\partial e^2}}ds\right) + \frac{\partial v(s,b)}{\partial s}dB = 0 \\
\frac{\partial^2 U}{\partial s^2} - \frac{\left(\frac{\partial^2 U}{\partial s \partial e}\right)^2}{\frac{\partial^2 U}{\partial e^2}} = -\frac{dB}{ds}\frac{\partial v(s,b)}{\partial s} \\
\frac{\frac{\partial^2 U}{\partial s \partial e}\frac{\partial v(s,b)}{\partial s}}{-detH} = \frac{ds}{dB}.
\end{aligned} \tag{30}$$

The numerator, as previously argued, is negative. So, the overall expression is positive: $\frac{ds}{dB} > 0$.

Now, suppose that we have a corner solution at $e = 0$. Then equation 28 can be rewritten as

$$\frac{\partial^2 U}{\partial s^2}ds + \frac{\partial v(s,b)}{\partial s}dB = 0$$

so that

$$\frac{ds}{dB} = -\frac{\frac{\partial v(s,b)}{\partial s}D}{\frac{\partial^2 U}{\partial s^2}} > 0.$$

Finally, suppose that we have a corner solution at $s = 0$. Then the first order condition

$$(1 - v(s = 0, b))\theta y'(e) - \gamma = 0$$

implies that

$$\frac{de}{dB} = 0$$

as desired. ■

• **Lemma 5:** For an interior solution, an increase in θ (the index of return to education) reduces s and increases e. For a corner solution at $e = 0$, an increase in θ will reduce s. For a corner solution at $s = 0$, an increase in θ will increase e.

Proof. First, suppose that we have an interior solution. To prove Lemma 5, we take the total derivative of the first-order conditions with respect to θ and solve for $\frac{de}{d\theta}$ (which will turn out to be positive) and $\frac{ds}{d\theta}$ (which will turn out to be negative).

$$\begin{aligned}
\frac{\partial^2 U}{\partial s^2} ds + \frac{\partial^2 U}{\partial s \partial e} de - \frac{\partial v(s,b)}{\partial s} y(e) d\theta &= 0 \\
\frac{\partial^2 U}{\partial s \partial e} ds + \frac{\partial^2 U}{\partial e^2} de + (1 - v(s,b)) y'(e) d\theta &= 0.
\end{aligned}$$

Solving the system of equations for $\frac{de}{d\theta}$, first we solve for ds in the second equation:

$$\begin{aligned}
\frac{\partial^2 U}{\partial s \partial e} ds &= -\frac{\partial^2 U}{\partial e^2} de - (1 - v(s,b)) y'(e) d\theta \\
ds &= \frac{-\frac{\partial^2 U}{\partial e^2} de - (1 - v(s,b)) y'(e) d\theta}{\frac{\partial^2 U}{\partial s \partial e}}.
\end{aligned}$$

Then we plug into the first equation:

$$\frac{\partial^2 U}{\partial s^2} \left[\frac{-\frac{\partial^2 U}{\partial e^2} de - (1 - v(s,b)) y'(e) d\theta}{\frac{\partial^2 U}{\partial s \partial e}} \right] + \frac{\partial^2 U}{\partial s \partial e} de - \frac{\partial v(s,b)}{\partial s} y(e) d\theta = 0$$

$$\left[\frac{\frac{\partial^2 U}{\partial s^2} \frac{\partial^2 U}{\partial e^2} - \left(\frac{\partial^2 U}{\partial s \partial e} \right)^2}{\frac{\partial^2 U}{\partial e^2}} \right] ds + \left[\frac{-\frac{\partial^2 U}{\partial s^2} (1 - v(s,b)) y'(e) - \frac{\partial v(s,b)}{\partial s} y(e) \frac{\partial^2 U}{\partial s \partial e}}{\frac{\partial^2 U}{\partial e^2}} \right] d\theta = 0$$

$$\frac{\frac{\partial^2 U}{\partial s^2} (1 - v(s,b)) y'(e) + \frac{\partial v(s,b)}{\partial s} y(e) \frac{\partial^2 U}{\partial s \partial e}}{-detH} = \frac{de}{d\theta}. \tag{31}$$

The denominator is negative (concavity condition). The first term of the numerator is negative since $\frac{\partial^2 U}{\partial s^2} < 0$ by a second-order condition and $(1 - v(s,b)) y'(e) > 0$ by initial assumptions. The second term of the numerator is also negative since $\frac{\partial v(s,b)}{\partial s} y(e) > 0$ by initial assumptions and $\frac{\partial^2 U}{\partial s \partial e} = -\theta \frac{\partial v(s,b)}{\partial s} y'(e) < 0$ (also by initial assumptions). Since the numerator is composed of two negative terms, it too is negative. The overall expression then, with the negative numerator and denominator, is positive: $\frac{de}{d\theta} > 0$.

Solving the system of equations for $\frac{ds}{d\theta}$, first we solve for ds in the second equation:

$$\frac{\partial^2 U}{\partial e^2} de = -\frac{\partial^2 U}{\partial s \partial e} ds - (1 - v(s,b)) y'(e) d\theta \tag{32}$$

$$de = \frac{-\frac{\partial^2 U}{\partial s \partial e} ds - (1 - v(s,b)) y'(e) d\theta}{\frac{\partial^2 U}{\partial e^2}}. \tag{33}$$

Then we plug into the first equation:

$$\frac{\partial^2 U}{\partial s^2} ds + \frac{\partial^2 U}{\partial s \partial e} \left[\frac{-\frac{\partial^2 U}{\partial s \partial e} ds - (1 - v(s,b)) y'(e) d\theta}{\frac{\partial^2 U}{\partial e^2}} \right] - \frac{\partial v(s,b)}{\partial s} y(e) d\theta = 0$$

$$\left[\frac{\frac{\partial^2 U}{\partial s^2} \frac{\partial^2 U}{\partial e^2} - \left(\frac{\partial^2 U}{\partial s \partial e} \right)^2}{\frac{\partial^2 U}{\partial e^2}} \right] ds + \left[\frac{-\frac{\partial^2 U}{\partial s \partial e} (1 - v(s,b)) y'(e) - \frac{\partial v(s,b)}{\partial s} y(e) \frac{\partial^2 U}{\partial e^2}}{\frac{\partial^2 U}{\partial e^2}} \right] d\theta = 0$$

$$\frac{\frac{\partial^2 U}{\partial s \partial e} (1 - v(s,b)) y'(e) + \frac{\partial v(s,b)}{\partial s} y(e) \frac{\partial^2 U}{\partial e^2}}{det H} = \frac{ds}{d\theta}. \tag{34}$$

The concavity condition asserts that the denominator is positive. The first term of the numerator is negative since $\frac{\partial^2 U}{\partial s \partial e} = -\theta \frac{\partial v(s,b)}{\partial s} y'(e) < 0$ and $(1 - v(s,b)) y'(e) > 0$ by initial conditions. The second term of the numerator is also negative since $\frac{\partial v(s,b)}{\partial s} y(e) > 0$ by initial assumptions and $\frac{\partial^2 U}{\partial s^2} < 0$ by a second-order condition. The numerator, composed of two negative terms, is negative. The overall expression, with the positive denominator, is negative: $\frac{ds}{d\theta} < 0$.

Now, suppose that we have a corner solution at $e = 0$. Then equation (18) can be rewritten as

$$\frac{\partial^2 U}{\partial s^2} ds - \frac{\partial v(s,b)}{\partial s} y(e) d\theta = 0$$

so that

$$\frac{ds}{d\theta} = \frac{\frac{\partial v(s,b)}{\partial s} y(e)}{\frac{\partial^2 U}{\partial s^2}} < 0.$$

Finally, suppose that we have a corner solution at $s = 0$. Then equation 32 can be rewritten as

$$\frac{\partial^2 U}{\partial e^2} de + (1 - v(s,b)) y'(e) d\theta = 0$$

so that

$$\frac{de}{d\theta} = -\frac{(1 - v(s, b))y'(e)d\theta}{\frac{\partial^2 U}{\partial e^2}} > 0$$

as desired. ■

Comparative statics with respect to choice of relationship type

We first prove Lemma 8, which states that when γ (the cost of education) decreases or increases, θ_t (the threshold return to education above which girls choose casual relationships) moves in the same direction increases.θ_t is the value of θ which satisfies $U_c = U_m$. That is,

$$\begin{aligned} &u(s_c) - \pi(s_c, a_c)D + v(s_c, b_c)B_c + (1 - v(s_c, b_c))\theta_t y(e_c) - e_c\gamma \\ = &u(s_m) - \pi(s_m, a_m)D + v(s_m, b_m)B_m + (1 - v(s_m, b_m))\theta_t y(e_m) - e_m\gamma. \end{aligned}$$

We take the total differential with respect to $\theta_t, \gamma, s_m, e_m, s_c, e_c$:

$$\begin{aligned} &\frac{\partial U_c}{\partial s_c} ds_c + \frac{\partial U_c}{\partial e_c} de_c + (1 - v(s_c, b_c))y(e_c)d\theta_t - e_c d\gamma \\ = &\frac{\partial U_m}{\partial s_m} ds_m + \frac{\partial U_m}{\partial e_m} de_m + (1 - v(s_m, b_m))y(e_m)d\theta_t - e_m d\gamma. \end{aligned}$$

Taking into account the first-order conditions and solving for $\frac{d\theta_t}{d\gamma}$, we get:

$$\frac{e_m - e_c}{(1 - v(s_m, b_m))y(e_m) - (1 - v(s_c, b_c))y(e_c)} = \frac{d\theta_t}{d\gamma}. \tag{35}$$

The denominator is simply $\frac{dU_m}{d\theta} - \frac{dU_c}{d\theta}$, which is negative. The numerator is also negative, which confirms that $\frac{d\theta_t}{d\gamma} > 0$

Finally, we prove Lemma 9, which states that when a_c (the perceived chance of infection from an unprotected sex act in a casual relationship) increases and a_m does not change, θ_t (the threshold return to education above which girls choose casual relationship) increases.

Proof. We take the total differential with respect to $\theta_t, a_c, s_m, e_m, s_c$, and e_c:

$$\begin{aligned} &\frac{\partial U_c}{\partial s_c} ds_c + \frac{\partial U_c}{\partial e_c} de_c + (1 - v(s_c, b_c))y(e_c)d\theta_t - \frac{\partial \pi}{\partial a_c} D da_c \\ =& \frac{\partial U_m}{\partial s_m} ds_m + \frac{\partial U_m}{\partial e_m} de_m + (1 - v(s_m, b_m))y(e_m)d\theta_t \end{aligned} \tag{36}$$

$$\frac{-\frac{\partial \pi}{\partial a_c} D}{(1 - v(s_m, b_m))y(e_m) - (1 - v(s_c, b_c))y(e_c)} = \frac{d\theta_t}{da_c}. \tag{37}$$

As above, the denominator is negative. The numerator is negative since $\frac{\partial \pi}{\partial a_c} D > 0$. Hence, $\frac{d\theta_t}{da_c} > 0$.

■

Appendix C: Numerical Example

The following is a numerical example that shows that the set of results we observe in our data can be obtained under reasonable circumstances. It is neither a calibration nor a test of the model; instead, it is simply a numerical example to show that the model *can* deliver similar results to our empirical data.

Assume the following functional forms:

- $u(s) = 3.8s - 0.5s^2$
- $y(e) = 2\log(e + 1)$

We assume the following baseline parameter values: $D = 10$, $B_c = 2.5$, $B_m = 3.5$, $a_c = a_c^* = 0.04$, $a_m = a_m^* = 0.03$, $b_c = 0.15$, $b_m = 0.22$, $y_0 = 3$ and $\gamma = 0.31$. For θ, the return to education, we consider that the population is evenly distributed across four types: $\theta = 1.8, 2, 2.2$, and 2.4. With these baseline parameter values, we roughly match the pregnancy and STI rates observed in the control group.

We consider that the education subsidy program lowers the cost of education, γ, from 0.31 to 0.24. The HIV education program increases the perceived risk of contracting an STI when engaging in casual sex, a_c, from 0.04 to 0.052, while leaving a_m unchanged.

The chosen functional form for u: $u(s) = 3.8s - 0.5s^2$, implies that there is a satiation point for unprotected sex at $s = 3.8$, after which $u'(s) < 0$. This satiation point is sufficiently low to ensure that the cross derivative is positive at the optimum. Indeed, as shown in the main text, the cross derivative condition is $s < \frac{-1}{\ln(1-a)}$. Since the highest value of a we consider is 0.051, this condition is satisfied for any $s < 19.1$, and the satiation point $s = 3.8$ satisfies the condition.

In what follows, we first numerically solve the model for an interior solution for each θ type under each treatment (control, stand-alone education subsidy, stand-alone HIV education, or joint program), and then calculate the resulting STI rates, pregnancy rates, education attainment and utility levels for each type and for the overall population. We then solve for the corner solutions and show that the interior solution is optimal for all types.

Interior Solution

We first solve for the θ_t threshold under which committed relationships are preferred and above which casual relationships are preferred. As predicted, the education subsidy lowers the threshold while the HIV education program increases it:

	θ_t threshold
Control	2.06
Stand-Alone Education Subsidy	1.90
Stand-Alone HIV Education	2.33
Joint Program	2.16

Table 1: *Values of threshold θ_t under each program (interior solution)*

Thus, in the control group, half the population chooses a committed relationship (those with $\theta = 1.8$ and $\theta = 2$), and the other half chooses casual relationships. The education subsidy induces the type 2 girls (those with $\theta = 1.8$) to switch to casual relationships. The HIV education program induces the type 3 girls (those with $\theta = 2.2$) to switch from casual to committed relationships. The joint program induces no switching.

The following table provides STI rates that obtain for each θ type under each treatment, assuming an interior solution. For reference, bold indicates that the type of relationship chosen is casual (as per the threshold values estimated above). The last column shows the population average (which is simply the average across types since we assume the four types are equally prevalent.)

	$\theta = 1.8$	$\theta = 2$	$\theta = 2.2$	$\theta = 2.4$	Population
Control	0.0944	0.0902	**0.1032**	**0.0965**	0.0961
Stand-Alone Education Subsidy	0.0909	**0.1044**	**0.0975**	**0.0896**	0.0956
Stand-Alone HIV Education	0.0944	0.0902	0.0852	**0.0915**	0.0903
Joint Program	0.0909	0.0858	**0.0926**	**0.0843**	0.0884

Table 2: *STI rates by θ-type under each program (interior solution)*

As in our data, the two stand-alone programs have a minimal impact on the STI rate, while the joint program reduces it substantially.

The table also illustrates how the two stand-alone programs each have an ambiguous effect on STI rates, as they affect different types in different directions. For example, the education subsidy program decreases the STI rate among girls who do not switch types of relationship. However, among those induced to switch from committed to casual relationships (the subgroup with $\theta = 1.4$), the education subsidy program increases STI rates. The population effect thus depends on the magnitude of the changes in STI rates, as well as the relative sizes of the population types. Under our parameter assumptions, the effect is slightly negative. In contrast, for the joint program, the STI rate unambiguously decreases for all types as there is no switching.

The following table provides the pregnancy rates by treatment and type. As above, bold indicates that casual relationships are chosen.

	$\theta = 1.8$	$\theta = 2$	$\theta = 2.2$	$\theta = 2.4$	Population
Control	0.5548	0.5376	**0.3519**	**0.3324**	0.4442
Stand-Alone Education Subsidy	0.5404	**0.3553**	**0.3353**	**0.3120**	0.3858
Stand-Alone HIV Education	0.5548	0.5376	0.5163	**0.3176**	0.4816
Joint Program	0.5404	0.5189	**0.3209**	**0.2957**	0.4190

Table 3: *Pregnancy rates by θ-type under each program (interior solution)*

The stand-alone education subsidy program clearly reduces the pregnancy rate, while the stand-alone HIV education program slightly increases it. The joint program decreases the pregnancy rate, but not as much as the stand-alone education subsidy.

The next table provides the education attainment by treatment and type:

	$\theta = 1.8$	$\theta = 2$	$\theta = 2.2$	$\theta = 2.4$	Population
Control	4.17	4.97	**8.20**	**9.34**	6.67
Stand-Alone Education Subsidy	5.89	**9.74**	**11.19**	**12.76**	9.90
Stand-Alone HIV Education	4.17	4.97	5.87	**9.57**	6.14
Joint Program	5.89	7.02	**11.45**	**13.099.36**	9.36

Table 4: Levels of education chosen by θ-type under each program (interior solution)

Analogously, the stand-alone education subsidy increases overall educational attainment, while the stand-alone HIV education program slightly decreases it. The joint program increases educational attainment, but not as much as the education subsidy alone.

Finally, we show the utility levels for each type under each treatment group. This is needed to rule out the corner solutions (which we solve below).

	$\theta = 1.8$	$\theta = 2$	$\theta = 2.2$	$\theta = 2.4$
Control	12.41	12.72	**13.21**	**13.81**
Stand-Alone Education Subsidy	12.75	**13.24**	**13.88**	**14.57**
Stand-Alone HIV Education	12.41	12.72	13.07	**13.54**
Joint Program	12.76	13.13	**13.61**	**14.32**

Table 5: Utility levels by θ-type under each program (interior solution)

Ruling out Corner Solutions

Corner 1: $s = 0$ **and** $e \geq 0$

The first-order condition with respect to e can be written as follows:

$$\begin{aligned} U(s=0,e) &= 2\theta \log(e+1) - e\gamma \\ \frac{\partial U(s=0,e)}{\partial e} &= \frac{2\theta}{e+1} - \gamma = 0 \\ e &= \frac{2\theta}{\gamma} - 1. \end{aligned}$$

Plugging in the parameter values for θ and γ, we can easily compute the levels of education chosen by each type under each treatment and plug those back in the utility function. We obtain the following utility levels for each type under each treatment:

	$\theta = 1.8$	$\theta = 2$	$\theta = 2.2$	$\theta = 2.4$
Control	5.54	6.54	7.58	8.66
Stand-Alone Education Subsidy	6.39	7.49	8.64	9.82
Stand-Alone HIV Education	5.54	6.54	7.58	8.66
Joint Program	6.39	7.49	8.64	9.82

Table 6: Utility levels by θ-type, under each program (corner solution with s=0)

Comparing the utility levels in Table 6 to those in Table 5, it is clear that the corner solution with $s = 0$ is dominated for all types under all treatments.

Corner 2: $s \geq 0$ **and** $e = 0$

The first-order condition with respect to s can be written as follows:

$$\begin{aligned} U(s,e=0) &= -0.5s^2 + 3.8s - [1-(1-a)^s]\,D + [1-(1-b)^s]\,B + C \\ \frac{\partial U(s,e=0)}{\partial s} &= -s + 3.8 + (1-a)^s \ln(1-a)D - (1-b)^s \ln(1-b)B = 0. \end{aligned}$$

Clearly this is independent of the type θ, and therefore all types adopt the same sexual behavior. What's more committed relationships dominate under all treatments, therefore everyone chooses committed relationships and the same level of unprotected sex. The resulting utility level is 10.30 for everyone under all treatments. Comparing this to utility levels in Table 5, it is clear that the corner solution with $e = 0$ is dominated by the interior solution for all types under all treatments.