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Evaluating the Employment Benefits of Education and Targeted Interventions to Reduce Child Marriage

EVALUATING THE EMPLOYMENT BENEFITS OF EDUCATION AND TARGETED INTERVENTIONS TO REDUCE CHILD MARRIAGE

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ABSTRACT

Purpose: This study sets out to identify effective interventions to reduce child marriage, to estimate their economic benefits achieved through enhanced productivity and to undertake a benefit/cost analysis of the interventions.

Methods: We model the effects of a set of identified child marriage and education interventions for 31 low and middle-income countries,[1] focusing on the reduction in child marriage rates and increasing secondary school attendance and completions. These lead to higher productivity which generates increased GDP per capita. The comparison of these benefits with the costs of the interventions generates benefit-cost ratios (BCRs).

Results: Both types of interventions have significant effects on marriage rates for girls aged 15–17 years which fall from 13.2% in 2015 to 5.2% in 2050. Both interventions lead to sharp increases in school attendance and secondary completion which is 19.3% points higher by 2030. The productivity improvement is 22.7% by 2030. The average BCR for the 31 countries is 7.4 (standard deviation of 1.0) at a 3% discount rate.

Conclusions: The results indicate that there are substantial economic gains to reducing child marriage by specific child marriage and education interventions.

Implications and Contribution

Programs to reduce child marriage can start with the community or with the school. Some programs seek to change community attitudes, to improve girls' life skills and to provide incentives to families, while others set out to make schools more effective in educating and retaining girls. This paper shows that both approaches can be effective, and that when applied together can sharply reduce child marriage, with a high benefit-cost ratio.

INTRODUCTION

Child marriage is defined as a legal or customary union that occurs before the age of 18, although laws can vary between countries and genders [1]. It is illegal in most countries and is also a violation of a number of UN human rights conventions.[2] Even so, in the 55 developing countries for which data are available, over 30% of girls are married before they turn 18 years of age [2].

A complex range of factors contribute to child marriage and are well documented in the literature. One of the most significant is prevailing social and cultural norms [1,3–5], often arising from the complex relationship between religious beliefs and socio-cultural practices [6]. Another is poverty, as is attested by higher prevalence rates in the poorest regions [7]. Where resources are limited, girls suffer more from truncated educational opportunities and are married early as a safeguard against premarital sex [1]. Poor parents justify marrying girls early to 'secure' their economic future [8], or regard them as an economic commodity and a way of settling familial debts or disputes [9]. Hence, changing community norms is paramount in reducing child marriage rates as well as ameliorating the effects of poverty and improving girls' life skills and educational levels to enable them to be economically independent.

Child marriage has a range of adverse inter-related health, education and economic impacts, on which there is an extensive literature. This demonstrates a strong correlation between child marriage, lower educational outcomes and reduced levels of literacy [10–14]. Child marriage is highest among the least educated [1]. It is also an important reason for early dropout from school [15]. Although estimates vary by country, child marriage and pregnancies typically account for 15–33% of dropouts [12,16]. Similarly, delayed marriage leads to higher skill levels [10,14,16]. Low education outcomes lead to reduced economic participation [17], including the exclusion from paid employment [3, 18]. The ability to complete secondary education increases girls' learning and their earnings potential, generating better employment outcomes and productivity gains [19]. For adolescent girls being in school and being married is almost completely mutually exclusive [19]. Not only is the education of early-married mothers poor, but also that of their children [20–23].

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[1] The data necessary to model the child marriage impact are available only for 31 such countries. These are as follows: Low-income country group: Afghanistan, Burkina Faso, Congo (Dem. Rep.), Ethiopia, Haiti, Madagascar, Malawi, Mali, Mozambique, Nepal, Niger, Tanzania, Uganda, Zimbabwe. Middle-income country group: Bangladesh, Cameroon, Cote d'Ivoire, Egypt, Ghana, India, Kenya, Morocco, Myanmar, Nigeria, Pakistan, Peru, South Africa, Sudan, Uzbekistan, Vietnam, Zambia.

[2] The Universal Declaration of Human Rights (1948), The Convention on Consent to Marriage, Minimum Age for Marriage, and Registration of Marriages (1962), The Convention on the Elimination of All Forms of Discrimination against Women (1979), The Convention on the Rights of the Child (1989) and The International Conference on Population and Development Programme of Action (1994) [3:2].

Given existing knowledge of the causes and implications of child marriage, this paper reviews the evidence on the cost and effectiveness of specific child marriage interventions. It also discusses the evidence base for a set of education options which, by reducing secondary school dropout rates, act to reduce marriage rates. The reduction in marriage rates and related improvements in education lead to employment and productivity benefits. Given the diversity of impacts of child marriage, there is a wide range of economic and social benefits from reducing its incidence. This study focuses on one specific class of economic benefits, those arising from the employment and productivity benefits of improved schooling outcomes. We recognise that this assumption may understate the true social BCR, and that other benefits should be considered in a more complete analysis.

Substantial efforts have been made by researchers to develop, implement and evaluate programs to prevent child marriage and to mitigate its harmful effects. Not least of these are studies led by Malhotra, Kalamar and Wodon. Malhotra's systematic analysis of the efforts to discourage child marriage identified five core approaches that are being implemented; their findings on the lessons learned so far has been cited by several studies [7,8,20]. This study builds on the contributions of these researchers and uses their approach [24] to identify interventions that mobilise communities, enhance access to education and improve life skills.

To our knowledge, there has been no previous cost-benefit analysis of interventions for child marriage, nor has there been an evaluation of the productivity benefits of reducing child marriage. The recent study by Wodon et al. valued the welfare benefit of ending child marriage at $556 billion per annum, as the welfare benefit from reduced population growth by 2030 [7]. However, that study did not consider the interventions required to eliminate child marriage, and hence did not provide any cost-benefit analysis.

METHODOLOGY

Modelling framework

There are several components of the modelling framework used here (see Figure 1). First, we use parameters derived from the literature to estimate the impact of interventions on the child marriage rate, as well as the costs of the interventions. As shown in Figure 1, three of those interventions have direct impacts on the child marriage rate, while four have indirect impacts through the effect of educational interventions on school attendance, and hence on child marriage rates. The second step is to estimate, for the direct interventions, the impact of reduced child marriage on educational outcomes, notably early dropout, years of schooling and extent of completion of secondary schooling. The third step is to estimate one key element of the economic benefit of the better educational outcomes for the girls concerned: higher productivity and access to better employment, leading to higher levels of GDP per capita. The results of these analyses are brought together in a cost-benefit analysis.

Figure 1. Modelling framework: Estimating the benefit-cost ratios for the interventions to reduce child marriage.
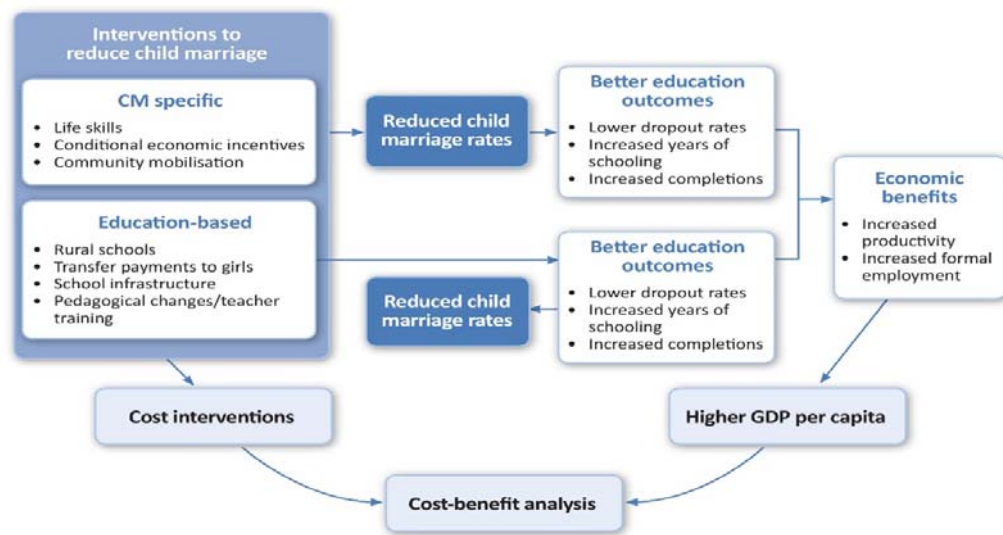
For girls who stay longer in school because of the educational interventions, we assume that reduced dropout occurs in the same proportion among those who would otherwise have been married or unmarried out of school. We define β as the proportion of girls of this age who are not in school who are married. Hence the reduction in

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child marriage is equal to β times the reduction in dropout. We also apply this β parameter to apportion both a share of the total costs of the educational interventions, and a share of the benefits of the improved educational outcomes from these, to child marriage reductions. In the modelling reported here, we use estimated country-specific values β for 2018 throughout the simulation period, while recognising that in more complete analysis these values would be calculated for each country in each period.

Choice and characteristics of interventions

Specific child marriage interventions
In the peer-reviewed literature search, Pub Med and Web of Science were searched from 2006 onwards and only from English language sources. The initial search for ("child marriage" or "early marriage") produced 502 results in Web of Science and 547 in Pub Med. These results were refined to the terms (impact* or intervention* or trial* or evaluation*) resulting in 172 results in Web of Science and 244 in Pub Med. These two sets were combined (416 articles) and 80 duplicates were removed leaving 336 possibly relevant articles. The abstracts of this set were reviewed and 62 were identified (30 in Web of Science and 32 in Pub Med). A final set of 14 articles was chosen. The range of reasons for excluding articles included being related to prevalence and not interventions, or being focused on the determinants of child marriage rather than interventions to prevent child marriage.

The grey literature was searched on Google Scholar, university library catalogues, and the websites of relevant national and international agencies. We then hand-searched the literature based on citations in the identified articles in both the peer-reviewed and grey literature.

Two of the papers identified in the literature search were review articles of interventions [24, 25].

Malhotra et al. [25] identified 23 evaluated child marriage prevention programs. They identified five main effective strategies (often combining multiple strategies) for delaying marriage or preventing child marriage. The strategies identified were: (1) empowering girls with information, skills and support networks (generally termed life skills); (2) educating and mobilizing parents and community members (community mobilisation); (3) enhancing the accessibility and quality of formal schooling for girls (economic options); (4) offering economic support and incentives for girls and their families (economic incentives and subsidies); and (5) fostering and enabling legal and policy framework.

Kalamar et al. [24] assessed and ranked the intervention studies according to comprehensive criteria. High quality intervention studies were those that were detailed, rigorous and well designed, which included intervention impact measurement, and employed randomization and pre-post comparisons.

These two reviews provided a framework for selecting interventions. Malhotra et al. [25] identified the main effective strategies and Kalamar et al. [24] provided an evaluation benchmark for each study. A final list of six articles closest to meeting these criteria and used in the modelling was extracted from the formal search process and is presented in Table 1, which includes costs and outcomes that were available of interventions.

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Table 1

Results of literature search: Interventions to delay marriage and reduce child marriage rates

Study; program; country	Targeting	Main intervention components	Costs	Method	Impact/Outcomes
Zibani in Sewall-Menon & Bruce (2012) [26]; Ishraq; Upper Egypt	Disadvantaged out-of-school, rural adolescent girls aged 12–15	Life skills Community mobilisation	Life skills costs per girl $17.99 Admin costs pro rata $13.50 Total costs $31.50	Monitored & evaluated with surveys of intervention villages & control villages with no intervention	No results at time of study but indicators developed & program scaled-up.
Brady et al. (2007) [27]; Ishraq; Upper Egypt	Disadvantaged out-of-school, rural adolescent girls in 4 rural villages – 2 in Ishraq, 2 control	Social norms Safe spaces		Longitudinal surveys of girls aged 13–15	Marriage rates at endline among non-participants in program villages are higher than in control villages (22% vs 16%). Rate of 13–29 months participating 12 %, with full-time participants 5%.
Erulkar & Methungi (2009) [28]; Berhane Hewan; Ethiopia	Married & unmarried girls aged 10–19.	Community mobilisation Girls' education incentives Conditional economic incentives, e.g. chickens or goat	Cost of materials such as pencils, notebooks $US4 Provision of goat/pregnant ewe (at cost of $US20) if girl unmarried at age 18	Baseline & endline (2 years later) of 2 villages with similar SES profiles – 1 program & other control; Chi-square tests, proportional hazards models & logistic regressions	Improvements in girls' school enrolment, age at marriage, etc. Particularly for girls 10–14 in program rather than in control area, more likely to be in school (odds ratio, 3.0) & less likely to have ever been married (0.1). But, girls aged 15–19 in intervention, elevated likelihood of having been married by endline (2.4).
Erulkar (2014) [29]; Berhane Hewan; Sub-Saharan Africa	Girls aged 10–14	Community mobilisation Girls' education incentives Conditional economic incentives, e.g. chickens or goat	Full model costs in Ethiopia $44 per girl Full model costs in Tanzania $117 per girl	Quasi-experimental research design, with population-based surveys before & after implementation, in intervention & control sites	*In Ethiopia:* Education support, 94% less likely to get married at endline. 2 chickens for every year unmarried, girls 15–17yrs were 50% likely. Full model, girls aged 15–17 yrs, were two-thirds less likely to be married. *In Tanzania:* With goats, girls 5–17 yrs, two thirds less likely to be married. Full model positive effect among both groups of girls.
Erulkar et al. (2017) [30]; Berhane Hewan Burkina Faso, Ethiopia & Tanzania	Cross section of men, women adolescent males & females	Community mobilisation Girls' education incentives Conditional economic incentives	Conditional cash transfer cost in: Ethiopia $32 Tanzania $107 Average $69.50	Population-based base line & endline surveys of girls aged 12–17 & parents of girls	*In Ethiopia:* among girls aged 15–17, with conditional asset transfer half the risk of being married at endline compared to baseline RR = 0.57 *In Tanzania:* RR = 0.52 Community dialogue in Burkina Faso ARR =.33 (0.19,0.50)*** Community sensitization in Tanzania 0.74 (0.43, 1.27) Community dialogue in Ethiopia 0.81 (0.60,1.09) Education promotion in Ethiopia 0.78 (0.46, 1.31) ARR: Adjusted for age, religion, ethnicity and socioeconomic status
Pande et al. (2006), Pande et al. (n.d.) [31,32]; Life skills course in rural Maharashtra; India	Girls aged 12–18 not in school or working	1-year program with life skills as one-hour sessions each weekday evening		Logistic regression analysis of data collected from program & control (randomly selected) villages	Steady decrease in proportion of marriage in girls 11–17 yrs between 1997 & 2001 in intervention. No significant change in control. Randomly selected control 4 times more likely married before 18 than those on full program. Pre-18 marriage rate only 9% for full participants & almost a third for control group.

We selected the studies of cost and effectiveness from Table 1, which met the criteria suggested by Kalamar et al. [24] and conformed to the framework of interventions provided by Malhotra et al. [25], to model the direct child marriage interventions.

Table 2 provides details of the sources for the intervention programs considered for inclusion in the child marriage modelling.

Table 2
Sources of evidence for intervention programs considered for modelling

Intervention programs	Source of evidence
Life Skills	Ishraq (Sewall-Menon & Bruce 2012 [33]; Brady et al. 2007 [29]); Maharashtra Life Skills (Pande et al. 2006 [31]; Pande et al. n.d. [32])
Community Mobilisation	Berhane Hewan (Erulkar et al. 2017 [30]; Erulkar and Methungi 2009 [28]).
Conditional Economic Incentives	Berhane Hewan (Erulkar et al. 2017 [30]; Erulkar 2014 [29];
Education Incentives	Conn (2016) [34]; Snilstveit et al. (2016) [35]
Legal & Policy Framework	Outside the domain of this study

The life skills, community mobilisation and conditional economic incentives which form part of the specific child marriage interventions and together with the education incentives are discussed below.

The *'Life Skills'* programs were represented by the Maharashtra program [31,32] and the 'Life Skills' component of the Ishraq program [27,33], which includes education about marriage, pregnancy, violence against women and other topics [33]. The most detailed information for community mobilisation and conditional economic incentives was available for the Berhane Hewan program [28,30].

In the Maharashtra *Life Skills* program, the pre-18 marriage rate for those girls who participated fully in the life skills program was only 9%, compared with the control group of almost one-third, a reduction of over 70% [32]. Moreover, the odds ratio of the control group to marry before 18 was 4.0, compared with those who fully attended the life skills course [31]. For the Life Skills component of the Ishraq program evaluated by Brady et al. [29], the marriage rate at endline among non-participants in Ishraq program villages (control group) was 22%, compared with the rate among those participating full time for 13 to 29 months of 5%, a 77% reduction. Pande et al. [31] and Brady et al. [27] both acknowledge the likelihood of selection bias in these comparisons and other unobserved variables. Accordingly, we used 35% as representing a conservative effectiveness rate, based on the data, together with two sensitivity rates of 25% and 45%. The cost of the Life Skills interventions was based on the Ishraq program and was $31.50[3] per girl ($17.99 plus pro-rata administrative costs of $13.50) [33].

Community mobilisation interventions seek to change the social norms by persuading parents and the community more generally to delay marriage and create a supportive environment for those girls who choose to do so [25], and these are widely used. The best study of the costs and impact of such interventions is by Erulkar et al. [30] conducted in Burkina Faso, Ethiopia and Tanzania. The study compared girls in the intervention programs with a control group for each country at base line and end line. The program conducted in Burkino Faso was highly effective at reducing marriage for 15–17 year olds compared with the control group. The adjusted risk ratio for girls never married at the study endline was 0.33 (0.19, 0.60) significant at 99.9%. Unfortunately, the ratios for the other two countries were not significant at 95%. However, both showed reductions in the marriage rate with adjusted odds ratios of 0.74 (0.43, 1.27) and 0.81 (0.60, 1.09) for Tanzania and Ethiopia, respectively. The average of the results for the three countries was 0.64 indicating a reduction in the marriage rate of 36%. Given the uncertainty attached to the results we reduced the percentage by one third to 24% for modelling purposes and sensitivity tested at 14% and 34%. The average cost per girl for the three countries of $14 [30] was used in the model.[3]

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[3] Adjusted by country-specific GDP per capita to allow for different cost levels in each country.

The *Conditional Economic Incentives* intervention we used incorporated an animal reward (goat or live chickens) for not marrying. It was part of the same program referred to above [30]. This program was highly effective at delaying marriage for girls aged 15–17. The more reliable data was for Ethiopia and Tanzania. The odds ratio for the program in Ethiopia was 0.57 (0.35, 0.90) and for the program in Tanzania, 0.52 (0.30, 0.91), a reduction of 45%. The nature of the reward structure of the intervention left it less open to selection bias. Nonetheless, we reduced the modelled effectiveness by one third to 30% and sensitivity tested for 20% and 40%. The cost of these programs per girl was $32 in Ethiopia and $107 in Tanzania [30]. We took the average of the two, $69.50.[3,4]

The education interventions
The education interventions, with an impact on child marriage rates, were derived from a meta-analysis undertaken by Conn [34], which was itself a meta-analysis of seven meta-analyses. In all the meta-analyses combined 49 different types of interventions, and within each type of intervention there were multiple studies that each, in turn, apply the intervention differently.

The meta-analysis [34] measured the impact of education interventions, in terms of standard deviations, to both increase secondary school access (reduce dropout rates, increase enrolment) and improve learning. The particular interventions selected and their impact are sourced from one component meta-analysis [35], which considered 26 interventions. These included interventions at the child, household, school, teacher and system level. It included school-based health programs, cash transfers, school infrastructure, teacher training and incentives and public private partnerships. We selected only those that had an impact on access, which we assumed had a direct impact on marriage rates [36, 37]. Those selected had favourable impacts on improving enrolment, attendance, and completion, or reducing dropouts in excess of 0.1 standard deviations. These are summarised in Table 3 in terms of their standard deviations.

Table 3
Selected effective interventions for improving adolescent access to education

Intervention	Impact (standard deviations)
Increase the provision of school in rural areas to give rural girls greater access to schools.	0.38, 95% CI[−0.29, 1.04] 2 studies
Improve educational infrastructure such as the provision of girl's latrines.	0.11, 95% CI[0.01, 0.20] 4 studies
Cash transfers to encourage girls to remain in school.	0.12, 95% CI[0.01, 0.22] 28 studies
Pedagogical changes/teacher training	0.13, 95% CI[−0.02, 0.28] 2 studies

Source: Snilstveit et al. [35].

In modelling the costs of the educational interventions, they are expressed as percentages of the cost of the education programs for each country. They are respectively 10%, 5%, 10% and 10% for the above interventions [19].The estimates of these costs are based on UNICEF sources.[5]

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[4] Each of the costs used in the analysis is the average per girl from each intervention program. Where given, for instance in the Ishraq program [33], administration costs represent over 40% of the total. It would be expected that when conducted on a larger scale this administrative cost component would fall. If it was to be halved in this case the average per girl would fall to $24.75 from $31.50, a reduction of over 20%. Providing the effectiveness rates were to be maintained, this would have a significantly positive effect on the BCR.

[5] - New community schools – UNICEF [38] Table G.2 cost $11 per student per year for construction, authors doubled these costs to account for smaller class sizes; $22 is approximately 10% of costs in LIC.

- Cash transfers – UNICEF [38] $50 per student per year or 17% of costs in LIC and 8% of costs in LMIC.

- Improved school infrastructure, latrines – UNICEF [38] Table H.2 $4624 cost of latrines in school of 500 is approximately $10 per year; or 3% of annual per student costs in LIC countries;

- Teacher training and pedagogical changes – UNICEF [38] table H.2 shows almost zero costs for improved pedagogy after initial training; Conn [34] estimated $23 for training in the Philippines or 10% of primary costs there (taken from projection model used by the Education Commission [39]).

Education and productivity modelling
Here we draw on earlier work, with colleagues, reported in [2]. The education modelling starts with a standard cohort model of demographic educational attainment, drawing on earlier work of UNESCO [40,41]. This module projects to completion a matrix of pupils by grade, age gender and marital status over time, dependent on the initial intake, flows to a next grade based on promotion or transition and to the same grade in the next year based on repetition rates. The data was compiled from multiple international databases, household surveys, national sources or, where missing, estimated based on data from other countries. The second component is an intervention module, developed from the Simulations for Equity in Education model [38]. Here changes to education outcomes are driven from the bottom up by assumptions about intervention coverage and effectiveness and drop out risk factors, such as poverty, girl sex, language and minority status via the intermediate drivers of education progress – intake, progression, and repetition. The cost of the interventions consists of the cost of the interventions themselves and the cost of educating the additional number of students attending through to the final year of secondary school.

In the application of the education model here, the direct child marriage interventions lead to higher attendance at school, and completions. The educational interventions have direct schooling outcomes through the model, and lead to reduced child marriage as discussed above.

The literature distinguishes various channels through which improved education outcomes influence economic activity. Both increased years of schooling and better quality schooling lead to higher productivity and higher earnings in a given form of employment, while completing secondary school offers a better prospect of formal employment. The employment model, reported in [2] and used here, draws on parameter estimates from the literature, together with some new empirical work, on the impact of better education on the type and level of employment [42–44],and the vast, multi-country literature on the impact of the level and quality of employment on productivity and growth [45–47]. The impact of better schooling is traced, for each country, through the effects on the future employment paths of the 20–24 years cohort and through the impact on GDP resulting from those improved employment paths.

RESULTS

Reduction in child marriage rates
Child marriage rates were estimated for these two sets of interventions, specific child marriage and education interventions, relative to a base case without interventions. The child marriage interventions show results for three combinations of effectiveness levels—conditional economic incentives (EI) 30%, Community mobilisation (ComM) 24% and Life Skills (LS) 35%, and +/- 10% for the effectiveness of each intervention as shown in Figure 2. Based on the mid-range estimates, EI 30%, ComM 24%, LS 35%, marriage rates for women aged 15–17 fell by over half for countries studied—from 13.2% in 2017 to 5.2% in 2050 (see Figure 2). The decline in the base case is mainly due to demographic factors. Of the decline relative to the base case, about 45% is due to the child marriage interventions and 39% due to the education interventions. The sensitivity analysis indicates that the marriage rates show a similar pattern of decline for a range of child marriage intervention levels.
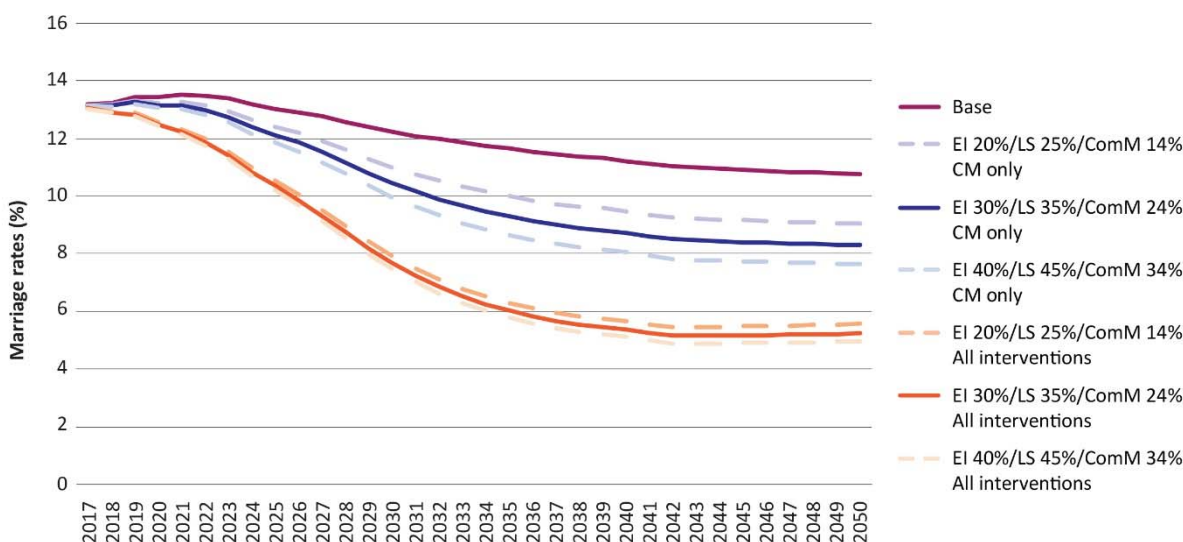
Figure 2. Marriage rates, various intervention levels, 15–17 year old girls, selected developing countries, (n=31), 2015 to 2050. EI is conditional economic incentives, ComM is community mobilisation and LS is life skills. Source: Author estimates.

Better schooling outcomes and increased productivity

Table 4 presents schooling and productivity effects for the education and specific child marriage interventions. These result in the share of girls aged 20–24 years completing secondary education increasing by 24.9 percentage points in low-income countries and 14.8 in middle-income countries, by 2030. Overall the increase is 19.3 percentage points, a substantial lift in completion rates. The education interventions had the larger effect, shifting the percent completing by 13.1 percentage points compared with 5.5 for the child marriage interventions

Table 4

Simulation results: education and productivity gains from specific child marriage and educational interventions for girls (all figures are unweighted averages for the countries covered)

	Low income (n=14)	Middle income (n=17)	Total (n=31)
(i) Change in educational outcomes relative to the base case in 2030			
Share of 20–24 year olds girls who have completed year 12 (percentage points increase)			
Child marriage (CM) interventions	7.9	3.4	5.5
Education interventions (CM only)	15.7	10.9	13.1
Total	24.9	14.8	19.3
(ii) Productivity effect for 20–24 year old girls (change by 2030, %)			
Child marriage			
Additional years of schooling effect	4.4	1.1	2.6
Change in employment level and type	6.2	1.8	3.7
Total	10.8	2.9	6.4
Education interventions (CM only)			
Additional years of schooling effect	9.3	4.4	6.6
Change in employment level and type	11.4	5.6	8.2
Total	21.7	10.2	15.3
Total CM and educational interventions (CM only)			
Additional years of schooling effect	14.1	5.5	9.4
Change in employment level and type	18.2	7.4	12.2
Total	34.9	13.3	22.7

Source: Author estimates.

The improved schooling outcomes lead to increased productivity. Each additional year of schooling provides an economic return by way of increased productivity, and higher secondary completions

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increases the number of girls employed and the proportion engaged in formal employment [2]. The immediate economic effect of increased schooling is negative because it withdraws girls from the workforce, but in due course a higher proportion of the cohort enters the workforce in more productive roles. The productivity changes are shown in Table 3 for the two productivity effects and the two sets of interventions. Overall, the productivity improvement for both sets of interventions is 22.7%, of which 12.2% is a result of the education interventions and 9.4% for the child marriage interventions.

The change in employment type (increased formal employment) had a larger effect on productivity, as did the additional years of schooling. The results also show that there is a much larger productivity effect of 34.9% for low-income countries, where starting productivity is very low, compared with 13.3 % for middle-income countries.

Benefit-cost ratios
The benefit-cost ratios (BCRs) are calculated as the ratio of the net present value, at a 3% discount rate, of the GDP generated, based on increased productivity and employment, to that of the total costs of the education and specific child marriage interventions. The modelling assumed that the coverage of the interventions would be progressively increased to reach a country-specific target level by 2030 [19]. Costs per girl are assumed to increase proportionately, whereas in practice some economies of scale are likely to be achieved. The BCRs are calculated on the basis that the interventions will continue to 2030, and will provide continuing benefits after that arising from the increased lifetime productivity of the cohorts affected.

Table 5 shows the relevant BCRs by country income group for the education and the specific child marriage interventions previously discussed. Although there is significant variation between countries, average estimated BCRs are high. The unweighted average for the 31 countries is 7.4, with a bootstrap standard deviation of 1.0.

Table 5
Benefit-cost ratios for the impact of education and child marriage interventions arising from employment benefits

World Bank country income class	Benefit-cost ratio
Low income (n=14)	9.4 (1.8)
Middle income (n=17)	5.8 (1.2)
Total (n=31)*	7.4 (1.0)

Note: Bootstrap standard deviations in brackets. Source: Author estimates.

Sensitivity analysis indicated that while the ratios varied significantly with the intervention levels, they remained well above one. For instance, if the effectiveness rates for each of the child marriage interventions were increased by 10 percentage points the BCR was 7.7, declining to 7.1 when the child marriage interventions were decreased by 10 percentage points.

The BCRs were estimated to average 8.5 for low-income countries. There was a cluster of eight Sub-Saharan African countries with BCRs of 9 or more indicating a high estimated responsiveness to the interventions. Most of these countries had well above average reductions in child marriage rates and improvement in school performance, indicating a high level of projected effectiveness of these interventions for these countries. For a range of other countries, the interventions were less beneficial. The marked response of some countries, and not others, indicates the benefits of a population targeted approach to intervention delivery.

DISCUSSION

The modelling indicates that selected interventions to reduce child marriage generate significant economic benefits in relation to the cost of those interventions. The effectiveness and costs used in the model are derived from an extensive search of the literature. Each of the interventions operates either directly or indirectly through encouraging girls to increase their years of schooling and complete their secondary education. The analysis indicates that both the package of specific child marriage benefits and the relevant education have a net positive effect on the girls' lifetime productivity and likelihood of acquiring a job in the formal employment sector. The interventions act to reduce the dropout rate although in different ways. The education interventions seek to increase the availability and proximity of schools, make them more 'female friendly', improve teaching quality and provide incentives for girls to remain at school. By keeping girls at school, they reduce the likelihood of early marriage. The child marriage interventions seek to change community attitudes to early marriage, better equip girls with life skills and finally provide economic incentives to remain unmarried, which provides them with the opportunity to stay at school.

Our modelling indicated that this intervention package led to a significant reduction in child marriage rates by about half in the period to 2050 compared with the base case, with most of the reduction taking place by 2030, and an increase in productivity of over 20% by 2030, with both the child marriage and education inventions contributing to this outcome. The selection process for the interventions modelled ensured that they were the most effective, and each made an overall positive contribution to the overall BCR which varied between countries.

The study suggests that interventions which reduce child marriage through increased attendance at school and changing social attitudes to child marriage, are both important in reducing child marriage and should be pursued jointly. A more complete study would more fully address the broader systemic health, demographic and intergenerational effects of the low status of young women in many developing countries. While the knowledge of impact and costs remain imperfect, the BCRs are robust for different intervention levels. The interventions are estimated to generate economic and social benefits that are many times their costs.

LIMITATIONS

As with all modelling exercises, the results produced in this paper depend on the assumptions made in specifying the relationships between the relevant variables. Some causes of child marriage are not modelled. Moreover, the relationships between child marriage, education and employment outcomes are complex, and the direction of causation often highly interdependent. It is not possible, given the limited evidence, to capture all these relationships. Accordingly, the modelling attempts to incorporate the most important of the relationships based on the best understanding we have from the available evidence. Nonetheless, this analysis relies on a small number of studies which evaluate these relationships. This is particularly true of the specific child marriage programs. The results of these evaluation studies are broadly applied to contexts which may be very different from those where the results were produced.

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