Assessing the Effects of an Education Policy on Women's Wellbeing : Evidence from Benin.

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June 5, 2018

PRELIMINARY VERSION. PLEASE, DO NOT CIRCULATE

Abstract

In this paper, we examine the impact of an education policy on women's wellbeing in Benin. Taking advantage of the increase in school constructions in the 1990s in this country, we first assess the causal impact of this program on primary school attendance and on child marriage, using a regression kink design (RKD). Then, we study the causal impact of education on tolerance of domestic violence. We find that the program decreases the probability to be married before 15 years old, but we do not find any impact on tolerance of violence. Drawing on a change in trend of primary enrollment in other countries in West Africa, we replicate the analysis to Côte d'Ivoire, Guinea, Liberia, Mali, Niger, Senegal and Sierra Leone. The probability to be married before 15 years old decreases for almost every countries studied. Evidence concerning the probability to tolerate domestic violence is more mixed.

JEL **Classification: I25, J12.**
Keywords: Education, Marriage, Women, Sub-Saharan Africa. .

1 Introduction

Over the past decades, the economic literature has been devoting attention to the relationship between women's well-being and economic development (Duflo (2012)). Women's well-being is multifaceted. Yet, in societies where marriage and motherhood are still considered the main milestones of a woman's life, women's well-being within their household is a key issue, especially in low or medium-income countries with no safety nets but the family. One of the most intuitive vectors for improving this dimension of women's welfare is education. Education is notably expected to improve a woman's welfare within her household. First, it could impact how and when she enters the marriage market: marrying as a child - ie before turning 15 - doesn't bode well for a woman's well-being. Access to education is expected to postpone her entry in marital life. Second, once married, it could later impact her relationship with her husband and her status in her family environment. A common proxy for the latter is whether she declares she tolerates intimate partner violence (IPV). Education is indeed expected to increase married women's bargaining power within their household by increasing their ability to negociate access to the household's financial resources. Additionally, education is expected to improve their outside options in case of a conflictual marriage.

Exploiting the Demographic and Health Survey, as well as school construction data for Benin, we use a regression kink design (RKD) and show that a rise in school constructions increases the probability to have attended school and decreased women's probability to be married before fifteen years old. Our identification relies on the quasi-experimental variation in the number of schools built in the 1990s in Benin fostered by the African countries' pledge to reach universal primary enrollment of girls. The number of schools built exhibits a kink that is mirrored in the share of women who attended primary school, by cohort of birth. The increase in primary education does not seem

to have an impact on women's tolerance of domestic violence for Benin. Since a lot of countries of the region have implemented similar schooling program at this time, we are able to replicate the analysis for different countries in the region. We extend our analysis to Côte d'Ivoire, Guinea, Liberia, Mali, Niger, Senegal and Sierra Leone. These countries exhibit a similat change in trend in the share of women having attended primary school[1]. We find a similar decrease in the probability to be married as a child for almost every countries in our sample. Results on tolerance of domestic violence are mixed, and seem to differ according to the initial level of tolerance of domestic violence.

A vast literature has focused on one dimension of women's welfare: fertility level. Part of the literature often presents correlations but there also is causal evidence. In Nigeria, Osili and Long (2008) have found that education reduces fertility. Samarakoon and Parinduri (2015) find that education reduces the number of live births. Ozier (2016) provides evidence that the opportunity to attend secondary school reduces teen pregnancy.

The literature on the impact of education on child marriage is more scarce. In the context of Zimbabwe, Bharadwaj and Grépin (2015) have found that secondary education delays marriage, as Breierova and Duflo (2004) find for Indonesia. To the best of our knowledge, there is no paper on the impact of primary education on child marriage in Sub-saharan Africa. One difficulty that arises is that decision to marry and education is often made simultaneously and probably by a child's parents rather than herself. This aspect constraints the attempt to highlight a causality.

In contrast, the links between education and acceptance of domestic violence has seldom been studied by the economic literature and provides mixed evidence. Mocan and

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[1]In some countries of the region, like Togo or Burkina Faso, there is no sudden change in trend. The share of educated people tends to increase steadily and smoothly.

Cannonier (2012) take advantage of the variation in the access to an education program in Sierra Leone in 2001 linked to the date of birth and the regional variation of ressources. They find that education reduces women's propensity to approve of wife beating. More recently, Erten and Keskin (2018) exploited a change in compulsory schooling law in Turkey. Using a RDD, they demonstrate that increased women's schooling leads to an increase in self-reported psychological violence among rural women but find no impact on tolerance of Intimate Partner's violence (IPV).

This paper contributes to the literature on primary education and women's welfare in several ways. First, we offer causal evidence of the link between an education policy and child marriage in Benin. We also provide evidence of the link between education and IPV using a method unused in this context: the regression kink design (RKD) [2].This method allows us to extend our analysis to several countries in West Africa. We also contribute to the literature by reflecting on a way to correct age heaping, notably with methods inspired by demographic studies.

The remainder of the paper proceeds as follows. Section 2, describes the context of the increase in government spending for education in Western African countries in the 1990s, and the data used in the analysis. Section 3 presents the regression kink design. Section 4 presents the results. In section 5, we present the results for other countries and section 6 discusses the potential channels. Robustness tests are performed in section 7. Section 8 concludes.

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[2]So far, and to the best of our knowledge, the RKD has exclusively been used in a political economy literature focusing on industrialized countries, using administrative data (Landais (2015), Simonsen et al. (2010) for instance).

2 Context and Data

2.1 Education Policies in the 1990's in West Africa

In 1990, 155 countries gathered at the *World Conference for Education for All* in Jomtien (Thailand), and pledged to reach universal primary education for all children by 2015. At the end of the 1990s, this priority was reaffirmed by the international community as one of the eight Millennium Development Goals (MDG's). They were designed by world leaders to frame national policies. These two international milestones kick-started large investments in education in developing countries, including in sub-Saharan Africa, in the shape of school constructions or free primary schooling. At the continental level, the Conference of African Ministers of Education (MINEDAF), held in Dakar in 1991, endorsed the program MINEDAF VI which launched the financial efforts needed to achieve universal education in Africa.

In Benin, since the holding of the Estates General of Education in 1991, primary education has been selected as a priority of the government[3]. A reform of education, whose objective was to improve infrastructure and increase girls' enrollment in primary school, was implemented in 1992-1993. Between 1996 and 2000, more than 1500 schools were built by the State or by NGOs, as can be seen in Figure 1 and in table A1 in Appendix. During that period, total enrollment increased from around 722000 to 911000 pupils[4]. The surge in the number of pupils is mainly driven by girls enrollment and is consistent with the observed kink in the share of women who went to primary school shown in Figure 2.

Benin's efforts in terms of infrastructure came on top of an already existing legal

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[3]As presented in the National report on the Development of Education prepared for the International Bureau of Education, 2001

[4]SOURCE

Figure 1:   Number of schools built by year in Benin

framework that made primary schooling compulsory as soon as 1975. Indeed, the revolutionary regime in place at the time already considered education to be a priority. Yet, in 1990, at the time of a regime change and in a context where countries were pledging their commitment to a larger access to education, Benin reasserted that primary schooling was mandatory by enshrining it in the Constitution.

2.2   Legal Minimum Age at Marriage in West Africa

In the early years of the millenium, the fight against child brides gained momentum. To tackle the issue of early marriage, Benin passed a law in 2004 setting the legal age to marry at 18 for boys and girls. Exemptions were allowed provided that the legal guardian of the minor agreed to the match. Yet, the law imposed no sanction on transgressors. It

Figure 2: Share of women going to primary school by cohort in Benin
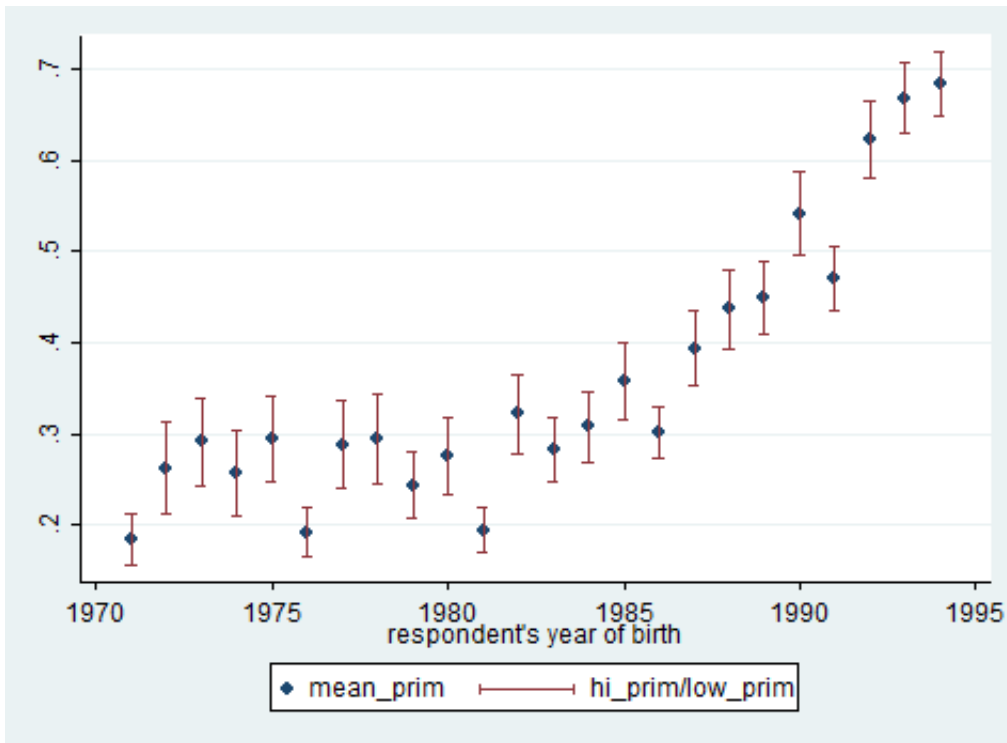
was hardly enforced in practice. As shown by Figure F2 in Appendix, there is no jump in the probability to marry before 15 when the law passed. Lack of enforcement led the government to pass another similar law in 2015, reasserting the ban on early marriage (before 18) and forced marriage. This time the bill introduced a sanction of 1 to 10 years in prison. So far, no landmark case was judged unlike what happenened in Côte d'Ivoire in 2014 when a father was sentenced to jail time and a prohibitive fine for trying to marry his 11 year old daughter.

Table 1: Legislation on Age at Marriage - Summary

	Existence of legislation	Date	Minimum Age	Exemptions	Age for boys
Benin	yes	2004, 2015	18	yes with consent of legal guardian and since 2015, a judicial decision.	18
Burkina Faso	yes	1989	17	yes	20
Mali	yes	2011	16	yes, possible exemption for marrying at 15.	18
Niger	yes	1964	15	yes	18
Senegal	yes but ambiguous	1972	16	Minimum age to have sexual intercourse while married customarily: 13	18
Guinea	yes	2011	18	No	18
Sierra Leone	yes	1972	18 or 21	21 if married under national law 18 if married under customary law.	18 or 21
Côte d'Ivoire	yes	1962	18	No	21
Liberia	yes	1973	18	End of exemption to marry between 16 and 18 with the Children's Act of 2011.	18

Note: Some countries don't have a stable legislation as to age at marriage, which may explain some discrepancy between the information in this table with other sources of data.

Source: www.girlsnotbrides.org

Table 1 summarizes legislation on the minimum age at marriage in the other countries studied.

2.3 Data

DHS Dataset

This study uses the Demographic and Health Surveys (DHS) for Benin (2011), Cote d'Ivoire (2011), Guinea (2012), Liberia (2013), Mali (2012), Niger (2012), Senegal (2010-11, 2012-13, 2014 and 2015) and Sierra Leone (2008 and 2013). The main analysis is conducted on the 2011 DHS of Benin. The DHS collects information on women aged 15-49 years old in an harmonized manner across several sub-Saharan countries. Information collected in all the surveys includes women's marital status and age at first marriage. We use it to build a measure of early marriage. Early marriage is here defined as having been married for the first time before turning 15.

The DHS also collects data on women's tolerance of IPV. The respondents are asked whether they find it justified for a husband to beat his wife in a series of five scenarii; whether a woman goes out without telling her husband, if she neglects the children, argues with him, refuses sex or burns the food. These variables will be used as our main outcome of interest. Additionally, some countries chose to collect data on the experience of violence of women as well. However, this module is optional. As a result we can't systematically study the impact of an increase in education on women's experience of violence. For instance, Benin did not include such questions in its 2011 survey.

Schools constructions Dataset

In addition to the DHS, we use an administrative database of schools constructions in Benin. It provides the number of school built per year in each of the 12 district of Benin

Table 2: Assessment of the Quality of School Data

| | Number of primary school in Benin in 2005/2006 | |
| | Source | |
	WB 2009 Report	Authors' dataset
ATACORA / DONGA	868	848
ATLANTIQUE / LITTORAL	1259	861
BORGOU / ALIBORI	881	832
MONO / COUFFO	894	828
OUEME / PLATEAU	1149	795
ZOU / COLLINES	1091	1010
Total	6142	5174

between 1970 and 2005. The districts were matched with the 2011 DHS dataset for Benin, thanks to DHS's own geolocalisation of its clusters. The resulting dataset allows us to know how many schools were built in the district of a DHS respondent when she was of schooling age.

Quality of school constructions data

We benchmark our school constructions data against the numbers provided by the 2009 World Bank Report on Schooling in Benin. Table 2 shows that, despite some measurement error, our data allows us to accurately estimate at the national and department levels the number of schools built in Benin. If anything, we may underestimate the exposure to primary schooling of children.

Descriptive Statistics

Table 3 and Table 4 provides descriptive statistics on women in our sample[5]. In Benin, Liberia, Senegal and Sierra Leone, the share of women who have been married for the first

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[5]The size of the sample differs vastly according to the country considered, because the number of aggregated waves is not the same. For Senegal, the sample pools four waves of study (2010-11, 2012-13, 2014 and 2015). For Guinea, the sample is reduced to one wave in 2012. For Sierra Leone, the sample pool a wave in 2013 and a wave in 2008. We restrict ourselves to every wave available and posterior to 2003, to have enough historical perspective after the kink in education

time before 15 is around 13%, whereas it is slightly higher for Mali (20%), Guinea (23%) and Niger (25%) . Concerning, the acceptance of domestic violence, the homogeneity of the different averages between the five different items, at the scale of one country, is striking. Senegal, Sierra Leone, Mali and Niger present a share of acceptance of around 50% for every items (except the last one, burning the food). For Cote d'Ivoire and Liberia, the mean is around 30% at least for the first two items, whereas this share is substantially higher for Guinea (around 75% except for the last item). In Benin, 11% of women condone IPV. It is considerably than in the other countries studied here.

Table 3: Descriptive Statistics

	Benin			Senegal		
	Mean	SD	Observations	Mean	SD	Observations
Marital and Domestical Violence outcome						
Married before 15 years old	0.13	0.33	16599	0.13	0.33	41663
beating justified if wife goes out without telling husband	0.08	0.27	16094	0.49	0.50	41488
beating justified if wife neglects the children	0.09	0.29	16315	0.49	0.50	41500
beating justified if wife argues with husband	0.11	0.31	16346	0.52	0.50	41482
beating justified if wife refuses to have sex with husband	0.07	0.25	16286	0.51	0.50	41142
beating justified if wife burns the food	0.06	0.24	16360	0.26	0.44	41519
Education and Birth cohort						
Enrolled to Primary School	0.37	0.48	16599	0.41	0.49	41663
respondent's year of birth	1982.20	9.01	16599	1984.37	9.40	41663
Covariates						
urban	0.43	0.49	16599	0.39	0.49	41663
Main Ethnic Group	0.44	0.50	16599	0.34	0.47	41663
	Guinee			**Sierraleone**		
	Mean	SD	Observations	Mean	SD	Observations
Marital and Domestical Violence outcome						
Married before 15 years old	0.23	0.42	9142	0.14	0.35	24032
beating justified if wife goes out without telling husband	0.83	0.38	9101	0.53	0.50	22965
beating justified if wife neglects the children	0.82	0.39	9119	0.53	0.50	22941
beating justified if wife argues with husband	0.78	0.41	9105	0.51	0.50	22972
beating justified if wife refuses to have sex with husband	0.71	0.45	9058	0.31	0.46	22654
beating justified if wife burns the food	0.47	0.50	9097	0.20	0.40	22852
Education and Birth cohort						
Enrolled to Primary School	0.33	0.47	9141	0.43	0.49	24032
respondent's year of birth	1983.28	9.59	9142	1982.77	9.81	24032
Covariates						
urban	0.39	0.49	9142	0.41	0.49	24032
Main Ethnic Group	0.39	0.49	9142	0.26	0.44	24032

Note: The table reports the mean, the standard deviation and the number of observations for a certain number of characteristics. "Urban" means living in an urban milieu at the time of the study. Sample: Women aged 15-49 years old.

Table 4: Descriptive Statistics for Mali, Cote d'Ivoire, Niger and Liberia

	Mali			Cote d'Ivoire		
	Mean	SD	Observations	Mean	SD	Observations
Marital and Domestical Violence outcome						
Married before 15 years old	0.20	0.40	10424	0.10	0.30	10060
beating justified if wife goes out without telling husband	0.55	0.50	10069	0.29	0.45	9927
beating justified if wife neglects the children	0.49	0.50	10218	0.35	0.48	9941
beating justified if wife argues with husband	0.59	0.49	10228	0.36	0.48	9911
beating justified if wife refuses to have sex with husband	0.59	0.49	10172	0.24	0.43	9846
beating justified if wife burns the food	0.26	0.44	10246	0.18	0.38	9936
Education and Birth cohort						
Enrolled to Primary School	0.26	0.44	10424	0.43	0.49	10060
respondent's year of birth	1983.51	8.90	10424	1982.86	9.23	10060
Covariates						
urban	0.31	0.46	10424	0.46	0.50	10060
Main Ethnic Group	0.33	0.47	10424	0.18	0.38	10050
	Niger			Liberia		
	Mean	SD	Observations	Mean	SD	Observations
Marital and Domestical Violence outcome						
Married before 15 years old	0.25	0.43	11160	0.13	0.33	9239
beating justified if wife goes out without telling husband	0.39	0.49	10807	0.30	0.46	9178
beating justified if wife neglects the children	0.38	0.48	10782	0.35	0.48	9189
beating justified if wife argues with husband	0.47	0.50	10762	0.36	0.48	9174
beating justified if wife refuses to have sex with husband	0.46	0.50	10660	0.12	0.33	9095
beating justified if wife burns the food	0.31	0.46	10850	0.09	0.29	9180
Education and Birth cohort						
Enrolled to Primary School	0.25	0.43	11138	0.60	0.49	9239
respondent's year of birth	1982.71	8.91	11160	1983.21	9.81	9239
Covariates						
urban	0.30	0.46	11160	0.40	0.49	9239
Main Ethnic Group	.	.	0	0.21	0.41	9239

Note: The table reports the mean, the standard deviation and the number of observations for a certain number of characteristics. "Urban" means living in an urban milieu at the time of the study. Sample: Women aged 15-49 years old.

3 Methodology

3.1 Methodology

We study the effect of an education policy on women's welfare by using a method inspired by a fuzzy regression kink design (RKD). The RKD exploits a change in slope of the likelihood of being treated at a kink point. If the outcome also exhibits a kink at the same point, then the causal impact is found by dividing the change in slope for the outcome by the change in slope for the treatment. This method has often been used in public economics (Simonsen et al. (2010), Landais (2015), Card et al. (2012) and Card et al. (2015)).

Here, we exploit the change in the trend of the number of schools built - to which the individual is exposed according to his birth cohort and to his department of residence - due to the education policy in Benin in the nineties. We can date the surge in schools construction in Benin to the middle of the 1990s. It allows us to identify cohorts who had a high probability of being treated and cohorts who are very unlikely to have benefited from the treatment. The conventional age to enter primary school is 6 years old. However, in the context of sub-Saharan Africa, it is very common for children to enter primary school beyond that point. A UNESCO report published in 2014[6] establishes that some pupils start primary school as late as aged 10. This is the reason why we apply a fuzzy RKD, where we define treatment as the number of schools built in the district since 1900 when a respondent was 10 years old.

The literature on the impact of education on age at marriage has to tackle several sources of endogeneity. First, there could be an omitted variable bias: some unobservable characteristics, such as the socioeconomic characteristics of the parents, can explain

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[6]Equipe nationale du Bénin and de Dakar (2014), p.81.

both education and child marriage. Second, there is a simultaneity issue: if going to school can delay marriage, the reverse is also true.

Rosenzweig and Wolpin (2000) have shown that even when using natural experiment, the impact is often not causally assessed. Translated to our context, when studying the impact of the education policy on child marriage, instrumenting education with exposure to school constructions would violate the exclusion restriction. Indeed, parents decide who and when their daughter marry. The decision to have her marry or to keep her in school is made simultaneously, not sequentially. As a result, we believe it is illusory to try and instrument education with exposure to school constructions when education and child marriage are decisions taken by the same person at the same moment.

On top of that, increase in schools construction can impact the probability to marry as a child, because the education policy also spurs changes in the norms of age at marriage without going through a girl's own education. This is especially credible in the beninese context, where schools constructions were accompanied by outreach campaign for girls' education.

In this paper, we suggest a way around these issues. Instead of looking at the impact of education on child marriage, we choose to remain agnostic about the channels through which the education policy impacts child marriage and we treat primary education as an outcome. Consequently, we look at two reduced forms.

We will look at the two following reduced forms:

$$
\begin{aligned}
School\,Attendance_i =& \alpha + \beta(BirthCohort_i - k) + \delta(BirthCohort_i - k) * Post \\
& + \gamma X_i + \varepsilon_i
\end{aligned}
\tag{1}
$$

$$EarlyMarriage_i = \alpha + \beta(BirthCohort_i - k) + \delta(BirthCohort_i - k) * Post$$
$$+ \gamma X_i + \varepsilon_i \qquad (2)$$

where $(BirthCohort_i - k)$ is the year of birth of individual i centered at the kink. X_i is a vector of individual specific controls: whether the woman lives in a rural or an urban milieu, dummies for ethnicity and religion. We include region fixed-effects in our regressions.

The implicit first stage is :

$$NumberofSchools_i = \alpha + \beta(BirthCohort_i - k) + \delta(BirthCohort_i - k) * Post$$
$$+ \gamma X_i + \varepsilon_i \qquad (3)$$

where $NumberofSchools_i$ is the number of schools in the department of residence when the individual is ten years old.

For the impact on the acceptance of domestic violence, the sequence "women's own education leads to less tolerance of violence" is more credible so we will instrument education by the exposure to the treatment. We will look at the reduced form :

$$ToleranceIPV_i = \alpha + \beta(BirthCohort_i - k) + \delta(BirthCohort_i - k) * Post$$
$$+ \gamma X_i + \varepsilon_i \qquad (4)$$

And then we will present the two-stage least squares equations :

$$SchoolAttendance_i = \alpha + \beta(BirthCohort_i - k)$$
$$+ \delta(BirthCohort_i - k) * Post + \gamma X_i + \varepsilon_i \qquad (5)$$

$$ToleranceIPV_i = \alpha + \beta(BirthCohort_i - k) + \delta(Schoo\widehat{lAttend}ance)$$
$$+ \gamma X_i + \varepsilon_i \tag{6}$$

3.2 Preliminary Checks

As underlined by Card et al. (2012), the key identifying assumption of the RKD is that the density of the forcing variable should be sufficiently smooth to rule out situations where individuals precisely manipulate the forcing variable.

Figure 3: Birth Year Histogram for Women
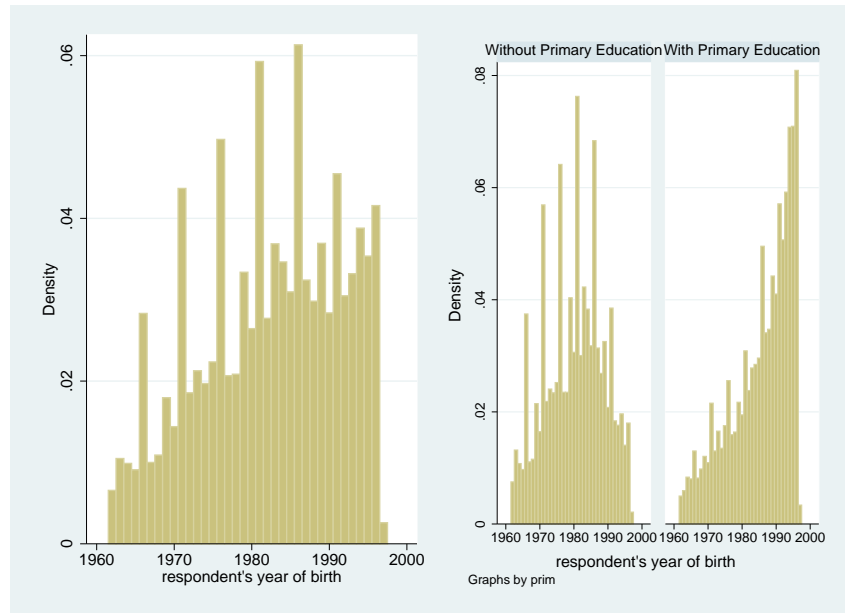
Note: The figure shows the declared birth year of women aged 15-49 at the time of the survey.

Source: DHS 2011 for Benin

In our case, the forcing variable is a respondent's year of birth. In contexts like West Africa where civil registration is not done systematically, women may not know their year of birth. In this case, the DHS manual for the investigator advises to infer their year of birth from the age they declare. Figure 3 shows an abnormal distribution of women per cohort of birth. The years where we observe peaks in the density corresponds to ages ending by 0 or 5 at the time of the survey. Despite the fact that this measurement error

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belongs to what is referred as a *partial* manipulation in McCrary (2008) and considered as very unlikely to lead to identification problems. Yet, as illustrated by the right-hand side section of figure 3, more educated women tend to make less mistakes when declaring their age than uneducated women. This is why, despite the fact that there are no reasons why women may deliberately manipulate their year of birth, we comply with what is customary done in the literature in RKD and formally test the density of our forcing variable at the kink. In figure 4, we plot the probability density function of the assignement variable centered at the kink point to detect potential manipulation. The graph shows no sign of manupulation at the kink. In a second step, we emulate Landais (2015) and following Card et al. (2012), we test the assumption of continuity of the derivative of the probability density function at the kink. We regress the number of observations by cohorts on the year of birth centered at the kink (year - k), and the interaction $(year - k) * \mathbb{1}[year > k]$. The coefficient on the interaction shown in table 5 is not statistically significant supporting the assumption that the first derivative of the pdf is continuous at the kink.

Figure 4: McCrary Test
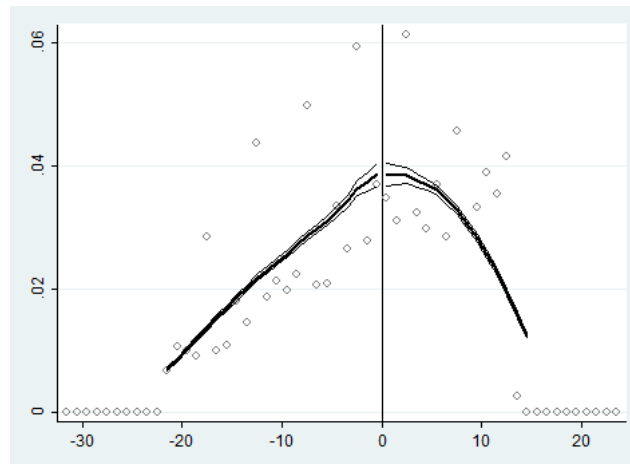
Note: The figure presents the results of the McCrary Test.There is no discontinuity at the kink. The graph assesses the validity of this assumption for the RKD design. Sample: Women aged 15-49 years old.

Source: DHS Benin, 2011.

Table 5: McCrary Test for RKD Design - Benin

	Density	
	(1)	(2)
x	0.06	0.05*
	(0.03)	(0.02)
Treat=1 × x	-0.06	-0.06
	(0.04)	(0.04)
Treat	-0.09	
	(0.26)	
Constant	6.50***	6.45***
	(0.21)	(0.12)
Number of cohorts	21.00	21.00
r2	0.22	0.22
F	1.42	2.14

Note: The dependent variable is the number of observations by cohorts. Models (1) represents the simple regression kink design. Models (2) includes also a dummy indicating whether the cohort is younger than the kink. The bandwidth is 10 years (on both sides of the kink). Sample: Eligible women aged 15-49 years old.

Source: DHS Benin, 2011.

A corollary of the validity of the identifying assumption of a RKD is that any co-variates should evolve smoothly at the kink. It is a condition easily checked graphically. Figure 5 provides evidence of the smooth evolution of selected covariates at the kink; urban milieu, main ethno-linguistic group, religious groups, regions around the main city.

Figure 5:   Distribution of Birth Year Declared and Covariates, Benin
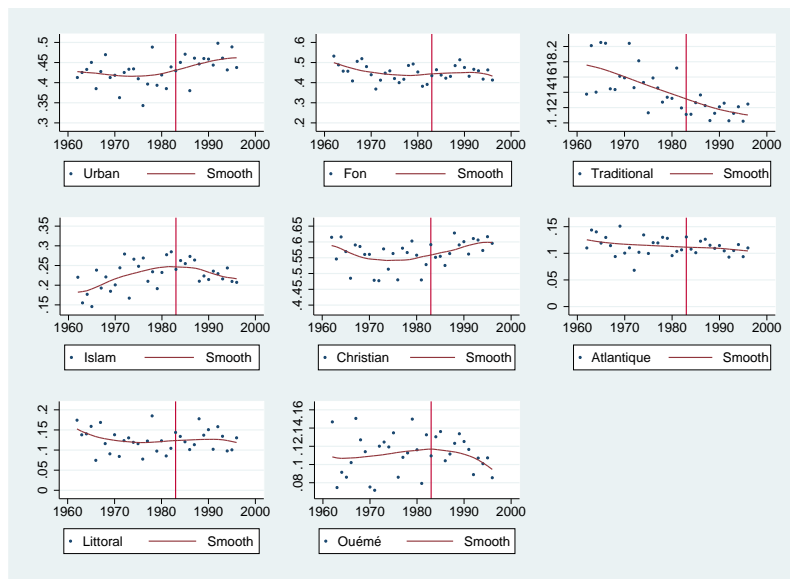
Note: The graphs test the smoothness assumptions of the covariates. For all 7 panels, year of birth, the assignment variable in our design for the estimation of the effect of education, is normalized at the kink point, 1984. The binsize is 1.

Source: DHS, Benin 2011.

3.3   Treating Age Heaping

As mentioned in the previous section, though there is age heaping for women of all educational backgrounds, the pattern is more striking among uneducated women. It could induce artifical discontinuities in our outcomes. As we are not using a RD design, it is less of a threat. Still, adopt a careful approach and even though the data pass the McCrary density test, we adopt two methods to take into account the heaping.

The first approach is the most straightforward. We simply include a dummy for the abnormal peaks in the years of birth distributions.

The second one relies on smoothing techniques commonly used in Demographics. We assume that, when there are mistakes in women's age, the declared age cannot be wrong by more than 2 years. We randomly redistribute observations in the abnormal peak years to neighbouring years of births using the following rules: 1) we redistribute 2/3 of the supernumerary observations to two years before or after, and 1/3 of the observations to 1 year before or after, 2) we redistribute 4/5 of the supernumerary observations to two years before or after, and 1/5 of the observations to 1 year before or after. Both rules yield a smoother density of observations according to the cohort of birth. To account for the difference in heaping according to the level of education, we redistribute observations for educated and uneducated women separately.

Once the redistribution is done, we run our regression on the modified distribution. In the spirit of a Monte-Carlo simulation, we repeat those steps three hundred times. We then compute the share of the tests that yielded a statistically significant coefficient of interest. The outcome of this exercise is displayed in section 4.

4 Results

4.1 First stage

We present the results of the first stage, which is the link between birth cohorts and exposure to treatment which is proxied by the number of schools built since 1900 in the district of residence at ten years old. We provide graphical evidence of it (Figure 6) and show the results of the regression in appendix.

Figure 6: Number of schools available at 10 years old by birth cohort in Benin in the department of residence
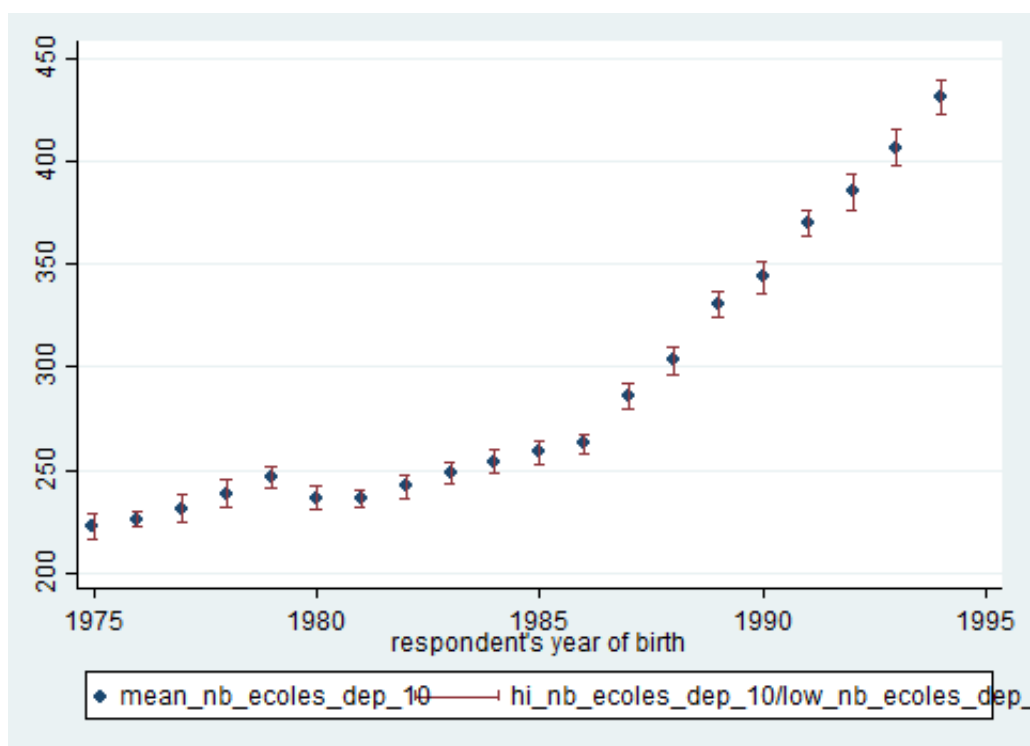
Note: The figure presents the number of schools built since 1900 when the woman is ten years old, by department of residence and year of birth in Benin.

Source: DHS Benin, 2011.

4.2 School attendance

Figure 7 provides graphical evidence of the effect of the educational program on school attendance in Benin and table 6 shows the results of a regression corresponding to equation 1. On the left-hand section of table 6, column (2) shows that, on average, an additional year of exposure to the treatment increases the probability to have attended primary school by 3.4 percentage points. On the right-hand section of the same table, the estimates in column (2) reads as one school built for 2000 children rises the probability to have enrolled to primary school by 22.4 percentage points.

Figure 7: Share of women going to primary school by cohort in Benin
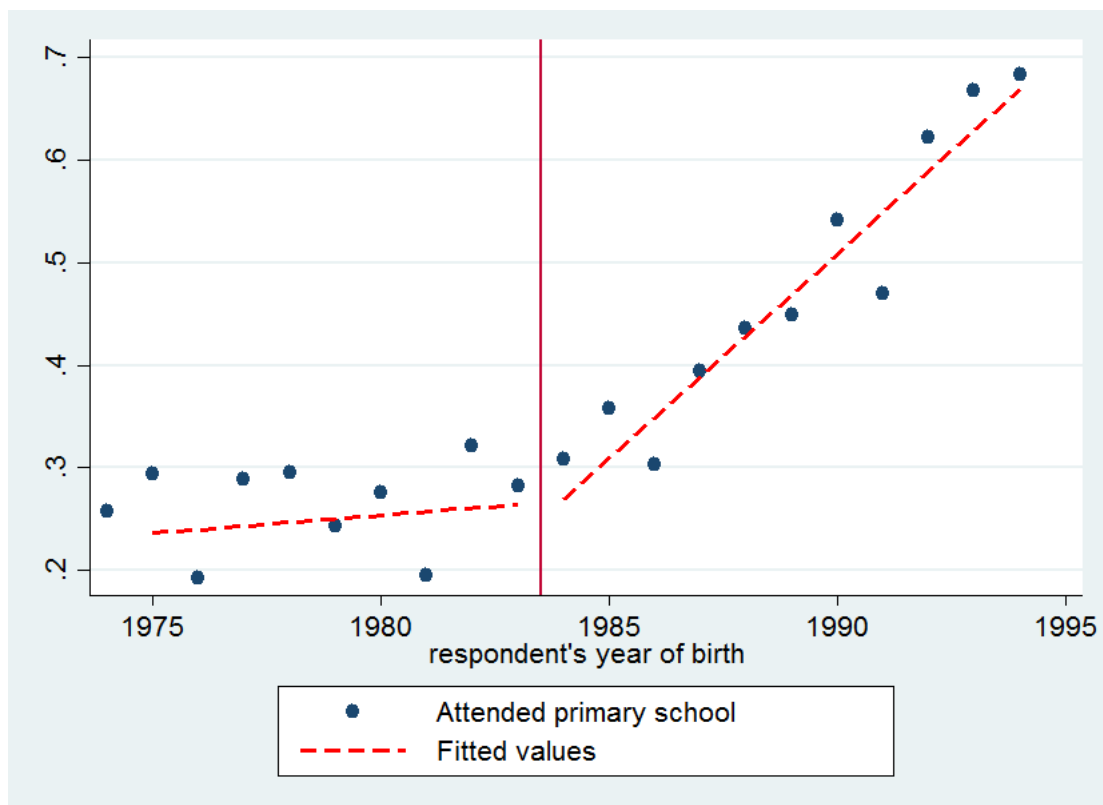
Note: The figure presents the share of women who have been to primary school, by year of birth in Benin.

Source: DHS Benin, 2011.

Table 6: Determinants of the probability to have attended primary school

	Reduced form		2nd stage	
	(1)	(2)	(1)	(2)
Normalized birth year	0.001	0.001	-0.003	-0.003
	(0.00)	(0.00)	(0.00)	(0.00)
Normalized birth year*post kink	0.034***	0.034***		
	(0.00)	(0.00)		
Number of schools			0.227***	0.224***
			(0.02)	(0.02)
Dummy for round year	No	Yes	No	Yes
controls	Yes	Yes	Yes	Yes
Mean	0.25	0.25	0.25	0.25
Number of women	11,453	11,453	11,453	11,453
r2	0.33	0.33	0.33	0.33
F	154.03	154.35	155.99	155.42

Note: The dependent variable is having attended primary school. In the left-hand part of the table, models (1) and (2) present the reduced form. We control in every regression by whether the woman lives in a rural or an urban milieu, the ethnicity and her religion. We also add a dummy for special birth years (corresponding to declared age finishing by the digit 0 or 5), to control for age heaping. District fixed effects are applied in all models. In the right-hand part of the table, models (1) and (2) present the result of the second stage. The coefficient on number of schools is to be read as one school built for 2000 children. Sample: Eligible women aged 15-49 years old.

Source: DHS Benin, 2011.

4.3 Child Marriage

Figure 8: Impact on Child Marriage
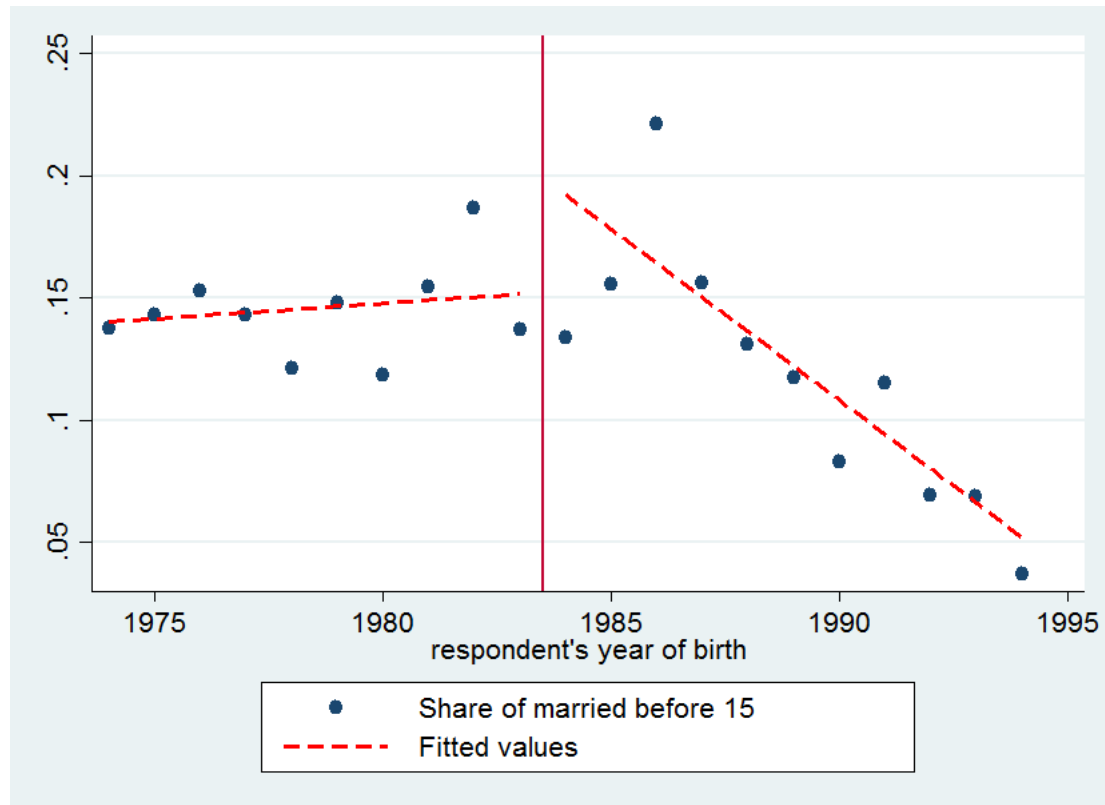
Figure 8 provides graphical evidence that having been exposed to the education policy reduces the probability to be married before fifteen years old. Results of the estimation can be interpreted in the same manner, as shown in Table 7. One additional year of exposure to the treatment decreases the probability to be married as a child by 1.5 percentage points. On the right-hand side of the table, the estimate in column (2) reads as, on average, one school built per 2000 children, make the probability to marry

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Table 7: Determinants of the probability to be married before 15 years old - Benin

	Reduced form		2nd stage	
	(1)	(2)	(1)	(2)
Normalized birth year	0.005***	0.005***	0.007***	0.007***
	(0.00)	(0.00)	(0.00)	(0.00)
Normalized birth year*post kink	-0.015***	-0.015***		
	(0.00)	(0.00)		
Number of schools			-0.102***	-0.100***
			(0.01)	(0.01)
Dummy for round year	No	Yes	No	Yes
controls	Yes	Yes	Yes	Yes
Mean	0.14	0.14	0.14	0.14
Number of women	11,453	11,453	11,453	11,453
r2	0.05	0.05	0.05	0.05
F	17.76	17.89	16.99	17.19

Note: The dependent variable is the fact to have been married or not before 15 years old. Models (1) and (2) represent the reduced form. We control in every regression with a dummy indicating whether the woman lives in a rural or an urban milieu, dummies for ethnicity, religion and wealth index. We add also a dummy for special birth years (corresponding to declared age finishing by the digit 0 or 5), to control for age heaping. Region fixed effects in all models. Models (3) and (4) present the result of second stage. Sample: Eligible women aged 15-49 years old.

Source: DHS Benin, 2011.

as a child fall by 10 percentage points.

The redistribution exercise mentionned in section 3 aiming at smoothing age heaping doesn't challenge our main result on child marriage (see Table 8).

4.4 Acceptance of Domestic Violence

In this case, the first stage is the probability to enroll in primary school according to the birth cohort. As shown by Table 9, we find no effect of primary eduction on tolerance

Table 8: Results - Redistribution Method - BENIN

	Share of significant estimation	Mean of the coefficient	Mean of standard deviation
First rule of redistribution	1	-0.0178919	0.0026238
Second rule of redistribution	1	-0.0181535	0.0026104

Note: In the first column is presented the share of estimation whose coefficient of interest was significant. It was the case in 100% of the cases. The second column presents the mean of the coefficient of interest computed on all the estimations, and the third column represents the mean of the standard deviation on all the estimations. Sample: Eligible women aged 15-49 years old.

Source:DHS Benin, 2011.

of IPV in Benin.

Table 9: Domestic Violences -BENIN

	Goes out without telling		Neglects the children		Argues with husband		Refuses sex		Burns the food	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Normalized birth year	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Normalized birth year*post kink	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.001	-0.001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	0.068**	0.071**	0.054**	0.058**	0.067**	0.070**	0.016	0.021	0.035+	0.038*
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
Dummy for round year	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
controls_BJ	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean	0.08	0.08	0.09	0.09	0.11	0.11	0.07	0.07	0.06	0.06
Number of married wife	11,453	11,453	11,453	11,453	11,453	11,453	11,453	11,453	11,453	11,453
r2	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02
F	6.70	6.53	7.16	6.95	5.36	5.20	5.05	4.90	3.88	3.77

Note: In the first column, the dependent variable is the acceptance of violence if the woman has gone out without telling her husband, in the second column, if she neglects the children, in the third column, if she argues with the husband, in the fourth column, if she refuses sex and in the sixth column if she burns the food. Model (1) is the simple regression kink design. In model (2), we add a dummy for special birth years (corresponding to declared age finishing by the digit 0 or 5).The bandwidth is 10 years on both sides of the kink. We control in every regression with a dummy indicating whether the woman lives in a rural or an urban milieu, dummies for ethnicity, religion and wealth index. We add also region fixed effects. Sample: Women aged 15-49 years old.

Source:DHS Benin, 2011.

5 Generalization

5.1 Sample of Countries

As mentioned earlier, following the Jomtien conference, many countries in the region have heavily invested in education, supported by the international community and NGOs. For this reason, several countries present a kink in the probability that women have attended primary school according to birth cohort in the 1990s, exactly like Benin. It is the case for Senegal, Guinea, Sierra Leone, Mali, Côte d'Ivoire, Niger and Liberia.

In Côte d'Ivoire, the project "Project Bad : Education IV", in partnership with the African Development Bank, was launched in 1992. The project had as main goal; to renovate and build basic education infrastructure - especially in rural areas - and secondary schools.

In Mali, following the overthrow of the dictatorship, a reform the reframed the education policy was launched in 1994. But the game changer was the project of development of basic education that instigated a high increase in school supply.

In Niger, teachers were recruited *en masse* by virtue of a law passed in 1998.

In Guinea, in 1989, the government adopted a declaration of education policy. Two programs, running successively from 1990 to 1994 and 1996 to 2000, focused on improving school infrastructure. The share of the national budget allocated to education also surged at the that time[7]. In 1997, education was defined as a national priority in the Orientation Law.

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[7]As indicated in the National Report of the Republic of Guinea, 2004

In Senegal, after the Estates General of Education were held, a law was passed in 1991 establishing a national, democratic and popular school [8]. A special effort was made to increase girls' enrollment, through awareness-raising campaigns and teachers' capacities were strenghtened.

Eventually, in Sierra Leone, despite a civil war in the 1990s, the government implemented the Universal Primary Education (UPE) scheme in late 1993. A new policy introduced in 1995, followed by a plan for action spanning from 1997 to 2006, led to an increase in schooling investment in the country. A law establishing free primary education was passed in 2000, at the end of the conflict.

The close timing in building primary school capacities allows us to apply the RKD to Côte d'Ivoire, Guinea, Liberia, Mali, Niger, Senegal and Sierra Leone. Yet, the results for those countries should be interpreted with caution as we don't have yet access to administrative data to provide evidence of a first stage. For Senegal, however, we have recovered data on the number of teachers and students in primary schools. We are able to calculate a teacher-pupil ratio for the period, that allows us to compute a first stage (as shown in Table A5 and Figure F5 in the appendix).

5.2   Results on Education and Child Marriage

The studied education policy decreases the probability to be married before 15 years old for almost every countries in our sample, as shown in Table 10 and Table 11. We find two exceptions to this pattern; Cte d'Ivoire and Liberia for which there is no effect of the education policy on child marriage. For Senegal, we are able to compute a second stage (Table A6 in Appendix).

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[8]Will follow several colloquia, such as the one of Kolda in 1993 and the one of Saint-Louis in 1995, which identified the main orientations and strategies aimed at strengthening access to education.

Table 10: Probability to be married before 15 years old

Panel : Senegal

	No correction		Without round years	
	(1)	(2)	(3)	(4)
Normalized birth year	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Normalized birth year*post kink	-0.00**	-0.00**	-0.00**	-0.00**
	(0.00)	(0.00)	(0.00)	(0.00)
Dummy for round year	No	No	Yes	Yes
Controls	No	Yes	No	Yes
Number of married women	0.14	0.14	0.14	0.14
N	29433.00	29433.00	29433.00	29433.00
r2	0.00	0.06	0.00	0.06
F	28.75	36.87	29.47	35.63

Panel : Guinea

	No correction		Without round years	
	(1)	(2)	(3)	(4)
Normalized birth year	0.01**	0.00*	0.01**	0.00*
	(0.00)	(0.00)	(0.00)	(0.00)
Normalized birth year*post kink	-0.02***	-0.01***	-0.02***	-0.01***
	(0.00)	(0.00)	(0.00)	(0.00)
Dummy for round year	No	No	Yes	Yes
controlsGN	No	Yes	No	Yes
Number of married women	0.27	0.27	0.27	0.27
N	5465.00	5457.00	5465.00	5457.00
r2	0.01	0.04	0.01	0.04
F	15.65	21.83	12.02	20.61

Panel : Sierra Leone

	No correction		Without round years	
	(1)	(2)	(3)	(4)
Normalized birth year	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Normalized birth year*post kink	-0.01***	-0.01***	-0.01***	-0.01***
	(0.00)	(0.00)	(0.00)	(0.00)
Dummy for round year	No	No	Yes	Yes
Controls	No	Yes	No	Yes
Number of married women	0.16	0.16	0.16	0.16
N	10236.00	10236.00	10236.00	10236.00
r2	0.01	0.02	0.01	0.02
F	23.38	11.71	15.57	11.27

Note: The dependent variable is the fact to have been married or not before 15 years old. Models (1) and (2) represent the simple regression kink design. Models (3) and (4) include also a dummy for special birth year (corresponding to declared age finishing by the digit 0 or 5). In models (3) and (4), we control with a dummy indicating whether the woman lives in a rural or an urban milieu, dummies for ethnicity and religion. We add also region fixed effects. Panel A presents the results for the Senegal, Panel B for Guinea and Panel C for Sierra Leone.

Source: DHS 2010-11, 2012-13, 2014 and 2015 Senegal, 2012 Guinea, and 2008-2013 Sierra Leone.

Table 11: Probability to be married before 15 years old

Panel : Republic of Mali

	No correction		Without round years	
	(1)	(2)	(3)	(4)
Normalized birth year	0.01***	0.01***	0.01***	0.01***
	(0.00)	(0.00)	(0.00)	(0.00)
Normalized birth year*post kink	-0.01**	-0.01**	-0.01*	-0.01
	(0.00)	(0.00)	(0.00)	(0.00)
Dummy for round year	No	No	Yes	Yes
Controls	No	Yes	No	Yes
Number of married women	0.19	0.19	0.19	0.19
N	6931.00	6931.00	6931.00	6931.00
r2	0.01	0.02	0.01	0.02
F	13.01	4.46	12.42	4.70

Panel : Cote d'Ivoire

	No correction		Without round years	
	(1)	(2)	(3)	(4)
Normalized birth year	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Normalized birth year*post kink	0.00	-0.00	0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Dummy for round year	No	No	Yes	Yes
controlsCI	No	Yes	No	Yes
Number of married women	0.11	0.11	0.11	0.11
N	6986.00	6967.00	6986.00	6967.00
r2	0.00	0.04	0.00	0.04
F	3.11	.	3.11	.

Panel : Niger

	No correction		Without round years	
	(1)	(2)	(3)	(4)
Normalized birth year	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Normalized birth year*post kink	-0.01**	-0.01*	-0.01**	-0.01*
	(0.00)	(0.00)	(0.00)	(0.00)
Dummy for round year	No	No	Yes	Yes
Controls	No	Yes	No	Yes
Number of married women	0.27	0.27	0.27	0.27
N	7841.00	7841.00	7841.00	7841.00
r2	0.00	0.05	0.00	0.05
F	3.26	34.83	2.51	31.59

Panel : Liberia

	No correction		Without round years	
	(1)	(2)	(3)	(4)
Normalized birth year	-0.00*	-0.00**	-0.00*	-0.00*
	(0.00)	(0.00)	(0.00)	(0.00)
Normalized birth year*post kink	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Dummy for round year	No	No	Yes	Yes
Controls	No	Yes	No	Yes
Number of married women	0.16	0.16	0.16	0.16
N	5849.00	5849.00	5849.00	5849.00
r2	0.01	0.05	0.01	0.05
F	10.88	19.82	8.56	19.17

Note: The dependent variable is the fact to have been married or not before 15 years old. Models (1) and (2) represent the simple regression kink design. Models (3) and (4) include also a dummy for special birth year (corresponding to declared age finishing by the digit 0 or 5). In models (3) and (4), we control with a dummy indicating whether the woman lives in a rural or an urban milieu, dummies for ethnicity and religion. We add also region fixed effects. Panel A presents the results for the Mali, Panel B for Côte d'Ivoire, Panel C for Niger and Panel D for Liberia.

Source: DHS 2012 Mali, 2011 Cote d'Ivoire, 2012 Niger and 2013 Liberia.

Table 12: Tolerance of IPV: refuses sex-Sierra Leone

	Reduced form		2 SLS	
	(1)	(2)	(1)	(2)
Normalized birth year	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Normalized birth year*post kink	-0.01**	-0.01**		
	(0.00)	(0.00)		
Enrolled to Primary School			-0.20**	-0.20**
			(0.08)	(0.08)
Constant	0.18***	0.18***	0.25***	0.25***
	(0.05)	(0.05)	(0.06)	(0.06)
Dummy for round year	No	Yes	No	Yes
controls	Yes	Yes	Yes	Yes
Mean	0.27	0.27	0.27	0.27
Number of married wife	10,236	10,236	10,236	10,236
r2	0.08	0.08	0.08	0.08
F	38.57	43.66	122.92	140.42

Note: Model (1) is the simple regression kink design. In model (2), we add a dummy for special birth years (corresponding to declared age finishing by the digit 0 or 5).The bandwidth is 10 years on both sides of the kink.

Source:DHS Sierra Leone, 2013.

In the 2000s, Côte d'Ivoire faced a politico-military crisis (2002-2007). As for Liberia, it faced a first civil war between 1990 and 1996-1997, and a second civil war between 1999 and 2003. The years of conflict overlap years when treated women were teenagers. It may explain the absence of significant decline in child marriage in these two countries.

5.3 Results on Domestic Violence

Concerning the impact of education on the acceptance of domestic violence, results are less striking. We do not find a significant impact of education on tolerance, except for Sierra Leone and Senegal (Table A7 in appendix). In Sierra Leone and Senegal, education decreases the probability for a woman to find violence tolerable if she refuses sex by a modest 0.4 percentage point(Table 12 and Table 13). The coefficient have the same sign but are not significant for Niger and Mali. Comparing with other countries in the region, the absence of significant effect on domestic violence for Benin may result from the intially low level of tolerance of IPV in this country.

Table 13: Tolerance of IPV: refuses sex- Senegal

	Reduced form		2 SLS	
	(1)	(2)	(1)	(2)
Normalized birth year	-0.001	-0.001	-0.001	-0.001
	(0.00)	(0.00)	(0.00)	(0.00)
Normalized birth year*post kink	-0.004+	-0.004+		
	(0.00)	(0.00)		
Enrolled to Primary School			-0.166+	-0.166+
			(0.10)	(0.10)
Constant	0.474***	0.474***	0.524***	0.525***
	(0.02)	(0.02)	(0.04)	(0.04)
Dummy for round year	No	Yes	No	Yes
controls	Yes	Yes	Yes	Yes
Mean	0.53	0.53	0.53	0.53
Number of women	29,433	29,433	29,433	29,433
r2	0.12	0.12	0.13	0.13
F	60.93	58.89	68.35	66.11

Note: Model (1) is the simple regression kink design. In model (2), we add a dummy for special birth years (corresponding to declared age finishing by the digit 0 or 5).The bandwidth is 10 years on both sides of the kink.

Source:DHS Senegal, 2010-11, 2012-2013, 2014 and 2015.

6 Channels

The negative impact of the education policy on the probability to be married before 15 could go through several channels. A first channel that was mentionned before is that mechanically, as long as a girl is in school, she remaines unmarried. A second potential channel is that more education improves women's bargaining power when facing their parents or their potential husband. This effect could be driven by her becoming literate or by the knowledge she acquired in school. It could also be happen because education provides women with credible options out of marriage through better access to financial resources outside of their household. Eventually, the education policy could spur a change in the perception of the time when girls should become wives. This change in perception could affect girls themselves but also their parents or their potential future husbands.

Considering the impact of education on the acceptance of domestic violence, the

Table 14: Determinants of the probability to be married before 15 years old - Benin

	Less or more than two years of School	
	(1)	(2)
Normalized birth year	-0.002	-0.002
	(0.00)	(0.00)
Normalized birth year*post kink	-0.003	-0.003
	(0.00)	(0.00)
Normalized birth year*Less than two years	0.011	0.011
	(0.01)	(0.01)
Normalized birth year*post kink*Less than two years	-0.023*	-0.024*
	(0.01)	(0.01)
Less than two years	0.130***	0.130***
	(0.04)	(0.04)
Dummy for round year	No	Yes
controls	Yes	Yes
Mean	0.07	0.07
Number of women	4,286	4,286
r2	0.05	0.05
F	3.57	3.51

Note: The dependent variable is the fact to have been married or not before 15 years old. Models (1) and (2) represent the reduced form. We control in every regression with a dummy indicating whether the woman lives in a rural or an urban milieu, dummies for ethnicity, religion and wealth index. We add also region fixed effects. Sample: Eligible women aged 15-49 years old.

Source: DHS Benin, 2011.

"parents' channel" appear less relevant. It is more likely that the effect goes directly through the wife herself, or indirectly, through her husband.

A mechanical channel could be that attending school - regardless of the knowledge acquired there - would keep girls away from the marriage market. We look at the existence of a differential impact of the exposure to the treatment for women who have been to school for more than two years (which is roughly the mean years of education of girls in Benin) and those who attended school for less than that. Table 14 shows the effect is stronger for women attended school for less than two years. It hints at the fact that the mechanical channel may not drive our results.

To identify whether there is a precise impact of a higher bargaining power of women, we look at the existence of a differential impact of the exposition to the treatment for

Table 15: Acceptance of Domestic Violence in case of sex refusal - Senegal

	Without the interaction		Controling for literacy	
	(1)	(2)	(1)	(2)
Normalized birth year	-0.001	-0.001	-0.001	-0.001
	(0.00)	(0.00)	(0.00)	(0.00)
Normalized birth year*post kink	-0.004+	-0.004+	-0.003	-0.003
	(0.00)	(0.00)	(0.00)	(0.00)
Normalized birth year*Literacy			-0.000	-0.000
			(0.00)	(0.00)
Normalized birth year*post kink*Literacy			0.008	0.007
			(0.01)	(0.01)
Literacy			-0.198***	-0.198***
			(0.02)	(0.02)
Constant	0.474***	0.474***	0.512***	0.512***
	(0.02)	(0.02)	(0.02)	(0.02)
Dummy for round year	No	Yes	No	Yes
controls	Yes	Yes	Yes	Yes
Mean	0.53	0.53	0.53	0.53
Number of women	29,433	29,433	29,399	29,399
r2	0.12	0.12	0.14	0.14
F	60.93	58.89	76.90	74.76

Note: The dependent variable is the fact to have been married or not before 15 years old. Models (1) and (2) represent the reduced form. We control in every regression with a dummy indicating whether the woman lives in a rural or an urban milieu, dummies for ethnicity, religion and wealth index. We add also region fixed effects. Sample: Eligible women aged 15-49 years old.

Source: DHS Senegal, 2011.

women who happen to be literate and those who don't. Even though this variable is not exogenous, a significant differential impact would be a convincing hint that bargaining power was increased through the knowledge acquired at school.

When we add this variable and interact it with the treatment in our analysis for domestic violence, we see that our coefficient of interest loses statisticial significance, as shown in Table 15. So women's literacy seems to have a significant explanatory power on the link between education and domestic violence. Interestingly, it is not the case for child marriage: the coefficient of interest is still significant, showing that this is not the main channel explaining the effect of the policy on child marriage (Table 16).

The discussion of the channels at play suggest that, when desingning an education

Table 16: Determinants of the probability to be married before 15 years old - Benin

	Literacy	
	(1)	(2)
Normalized birth year	0.007***	0.008***
	(0.00)	(0.00)
Normalized birth year*post kink	-0.016***	-0.016***
	(0.00)	(0.00)
Normalized birth year*Literacy	-0.013***	-0.013***
	(0.00)	(0.00)
Normalized birth year*post kink*Literacy	0.017***	0.018***
	(0.00)	(0.00)
Literacy	-0.103***	-0.103***
	(0.01)	(0.01)
Dummy for round year	No	Yes
controls	Yes	Yes
Mean	0.14	0.14
Number of women	11,432	11,432
r2	0.06	0.06
F	24.45	24.19

Note: The dependent variable is the fact to have been married or not before 15 years old. Models (1) and (2) represent the reduced form. We control in every regression with a dummy indicating whether the woman lives in a rural or an urban milieu, dummies for ethnicity, religion and wealth index. We add also region fixed effects. Sample: Eligible women aged 15-49 years old.

Source: DHS Benin, 2011.

policy, targetting both the supply and demand sides appear to be bear fruits in terms of women's well-being.

7 Robustness Analysis

## 7.1 Potential Confounding effects

We identified two main confounding effects that may (partially) drive our results. The first one may stem from assortative matching. Maybe what matters for child marriage or IPV is not (only) a woman's own education but the education of her partner. So if the husbands of the women in our sample are also impacted by the reform, the effect captured with the RKD may overestimate the effect of the reform going through women's own outcomes.

Elements specific to the context studied tend to go against the assumption that our effect is solely driven by husbands. First, in Benin, the mean difference in age between partners is 10 years. It means the average husband was not impacted by the reform because he was too old to have benefited from it. Second, if the data shows a positive linear trend in boys' education, figure 9 shows no kink in their mean level of education by year of birth. The absence of change in the trend of boys' education can be explained by their already greater access to schooling before (and even after) the reform. A 2002 World Bank report[9] estimated the difference in access to the first stage of primary school between boys and girls to 22 percentage points in rural areas (86% for boys versus 64% for girls).

[TBD: A thorough analysis of the profile of the partners of women in our sample is ongoing.]

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[9] The Beninese education system, performance and room for improvement for the education policy, 2002

Figure 9: Share of men having been to primary school in Benin
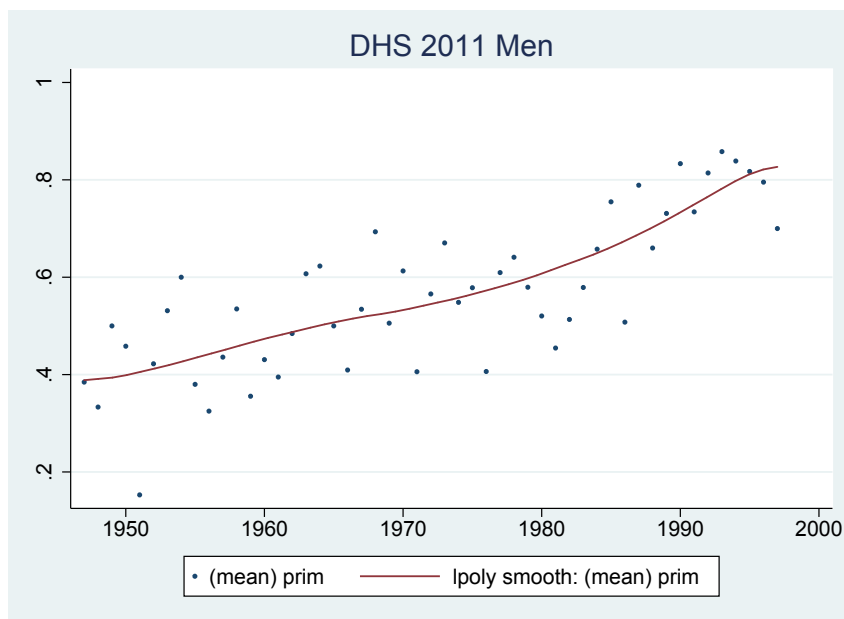
Note: The figure presents the share of men who have been to primary school, by cohort year in Benin.
Source:DHS Benin, 2011.

Table 17: Determinants of the probability to have attended primary school

	Reduced form		2nd stage	
	(1)	(2)	(1)	(2)
Normalized birth year	-0.004**	-0.004**	-0.007***	-0.007***
	(0.00)	(0.00)	(0.00)	(0.00)
Normalized birth year*post kink	0.019***	0.019***		
	(0.00)	(0.00)		
Age in year at time of survey	-0.056***	-0.055***	-0.057***	-0.057***
	(0.01)	(0.01)	(0.01)	(0.01)
Age squared	0.001***	0.001***	0.001***	0.001***
	(0.00)	(0.00)	(0.00)	(0.00)
Number of schools			0.131***	0.131***
			(0.02)	(0.02)
Dummy for round year	No	Yes	No	Yes
controls	Yes	Yes	Yes	Yes
Mean	0.28	0.28	0.28	0.28
Number of women	23,346	23,346	23,346	23,346
r2	0.33	0.33	0.33	0.33
F	277.01	276.47	.	.

Note: The dependent variable is having attended primary school. Models (1) and (2) present the reduced form. We control in every regression by whether the woman lives in a rural or an urban milieu, the ethnicity, the religion and a wealth index. We add also a dummy for special birth years (corresponding to declared age finishing by the digit 0 or 5), to control for age heaping. We add also region fixed effects. Models (3) and (4) present the result of second stage. Sample: Eligible women aged 15-49 years old.

Source: DHS Benin, 2011.

Secondly, part of our results could be driven by an age effect. It may happen if two conditions are fulfilled. The first condition is that all younger women remember more accurately than their elders their schooling level and/or their age at first marriage. The second condition needed is that elders consistently underestimate their schooling. Provided both assumptions hold, the kink in women's education would be a mix of the effect of the policy and of the age effect. To answer this concern, we pooled the two most recent waves of DHS for Benin to isolate the birth year effect from an age effect. Table 17 and table 18 show that our results are robust to the introduction of controls for age effects. The change in magnitude induced by such a control is stronger for child marriage than for primary education. It suggests that we earlier overestimated the effect of the education policy and that age effects are to be reckoned with in this type of analysis.

Table 18: Determinants of the probability to be married before 15 years old - Benin

	Reduced form		2nd stage	
	(1)	(2)	(1)	(2)
Normalized birth year	0.009***	0.009***	0.010***	0.010***
	(0.00)	(0.00)	(0.00)	(0.00)
Normalized birth year*post kink	-0.006***	-0.006***		
	(0.00)	(0.00)		
Age in year at time of survey	0.023***	0.022***	0.023***	0.023***
	(0.00)	(0.00)	(0.00)	(0.00)
Age squared	-0.000***	-0.000***	-0.000***	-0.000***
	(0.00)	(0.00)	(0.00)	(0.00)
Number of schools			-0.039***	-0.040***
			(0.01)	(0.01)
Dummy for round year	No	Yes	No	Yes
controls	Yes	Yes	Yes	Yes
Mean	0.12	0.12	0.12	0.12
Number of women	23,346	23,346	23,346	23,346
r2	0.05	0.05	0.05	0.05
F	26.32	26.39	.	.

Note: The dependent variable is the fact to have been married or not before 15 years old. Models (1) and (2) represent the reduced form. We control in every regression with a dummy indicating whether the woman lives in a rural or an urban milieu, dummies for ethnicity, religion and wealth index. We add also a dummy for special birth years (corresponding to declared age finishing by the digit 0 or 5), to control for age heaping. We add also region fixed effects. Models (3) and (4) present the result of second stage. Sample: Eligible women aged 15-49 years old.

Source: DHS Benin, 2011.

Table 19: Determinants of the School Attendance - Double difference

	School enrollment	
Number of school built between 1995 and 2000 * Treat	0.3369***	0.3088***
	(0.08)	(0.09)
Department and cohort of birth FE	Yes	Yes
Mean		
N	5,623.00	5,623.00
r2	0.19	0.19

Note: Model (1) reports estimates of the effects of the number of schools on the probability to have been to school. Model (2) reports estimates of the effects of the number of schoolson the number of years of education. All models are estimated with cohorts of birth and department fixed effects. Sample: Eligible women aged 15-49 years old.

Source: DHS Benin, 2011.

7.2   Alternative Strategy

To provide additional reassurance that the effect of the policy identified with the RKD is meaningful, we also present results using a double-difference strategy. We define the treatment group as women born between 1988 and 1992, and the control group as women born between 1978 and 1982. The treatment corresponds to the wave of school construction over the first 5 years of kink, and is defined as the department level. More precisely, we compute the sum of the number schoolds built in 1995, 1996, 1997, 1998 and 1999. Results are shown in Table 19. As a placebo, we do also the same regression, defining the placebo treatment as people born between 1978 and 1982, and the control group as people born between 1970 and 1974. As shown in Table 20, results are insignificant.

Table 20: Determinants of the School Attendance - Placebo

	School enrollment	
Number of school built between 1995 and 2000 * Placebo	0.0631	0.0601
	(0.08)	(0.09)
Department and cohort of birth FE	Yes	Yes
Mean		
N	4,735.00	4,735.00
r2	0.19	0.19

Note: Model (1) reports estimates of the effects of the number of schools on the probability to have been to school. Model (2) reports estimates of the effects of the number of schools on the number of years of education. All models are estimated with cohorts of birth and department fixed effects. Sample: Eligible women aged 15-49 years old.

Source: DHS Benin, 2011.

8   Conclusion

We show that the education policy conducted in the nineties in Benin designed to reach the MDG's, decreased early marriage. We show it also is the case for several countries in the region. The evidence of an impact of education on tolerance of domestic violence is more mixed. This work provides additional evidence of the far-reaching positive consequences of educating girls. The channel differs according to the outcome considered. Concerning the impact on domestic violence, the effect seem to be linked to an increase in women's bargaining power, due to better knowledge or improved outside options in case they may want to separate or divorce their partner. Unlike IPV, the impact on child marriage doesn't seem to be due to literacy since the impact remains significant once we control for it. Whatever the outcome considered, the impact does not seem to be linked to changes in the type of partners with whom women marry.

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Appendix

Table A1: Rythm of School Construction by Region since the 1980's

| | Region level | | | | |
	Stock 1979	1980-1989	1990-1999	2000-2005	Stock 2005
Mean	175.17	53.42	89.42	113.25	431.17
min	99	23	56	27	299
max	284	84	180	170	562
median	162	54	84.5	125	454.5
N	12	12	12	12	12

Source: PASEC.

Figure F1:

Primary education by region
All women

Sample: all women born between 1974 and 1994

Mean number of Schools built, by region
Schools built when respondents were 6

Mean number of schools built when respondents was 6 by year of birth for women born between 1974 and 1994.
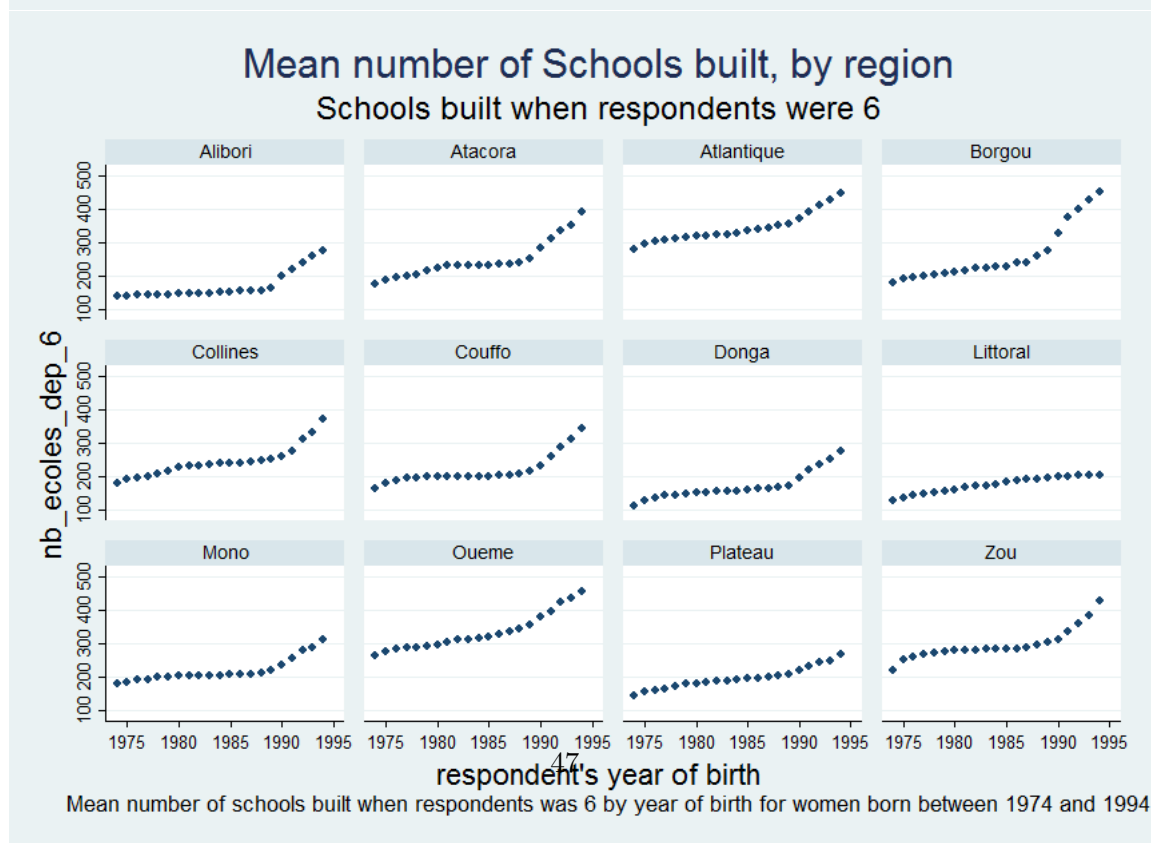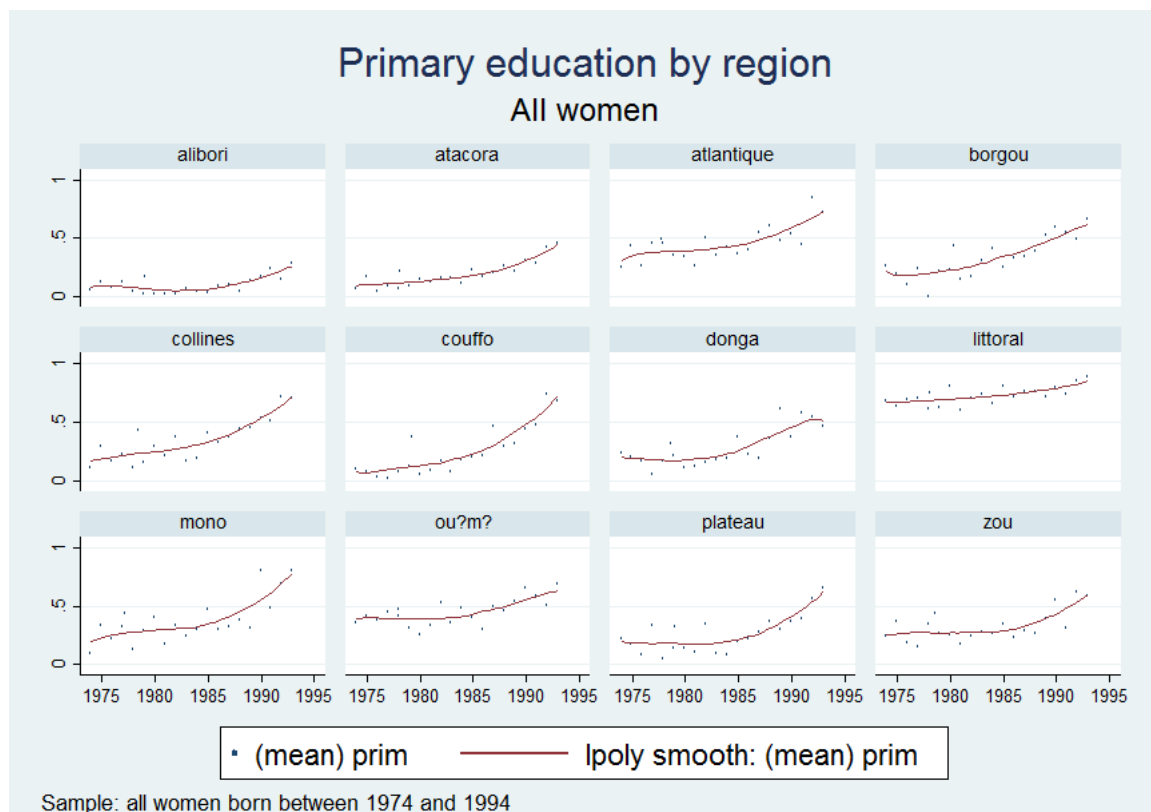
Figure F2: Probability to be married before 15
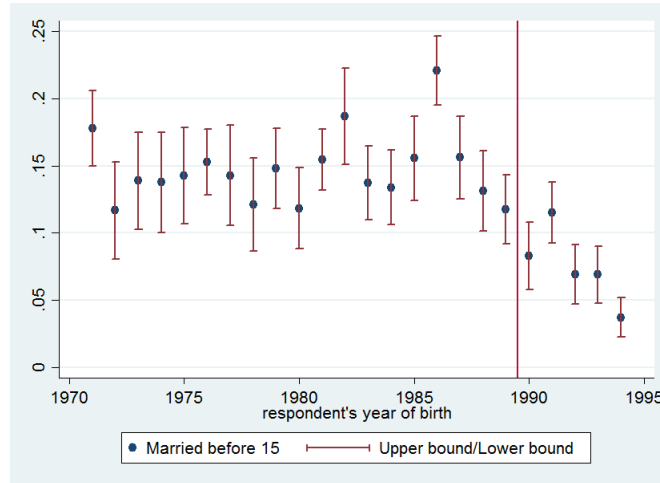
Figure F3: Stock of primary schools in 1974, 1984 and 1994 by Region
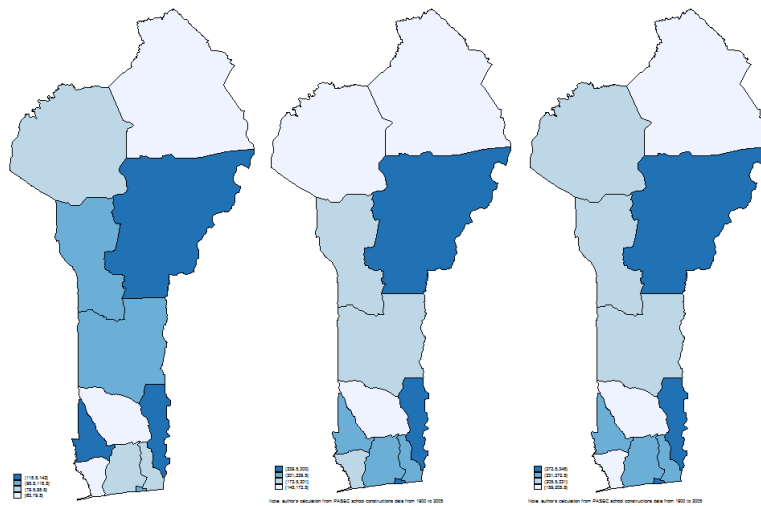
Table A2:   Stock and Number of Schools Built by Town and Region

	Stock 1970	1970-1979	1980-1989	1990-1999	2000-2005	Stock 2005
			Town level			
Mean	10.73	17.31	8.32	13.94	17.65	67.19
min	1	2	0	0	2	18
max	55	79	47	47	56	223
median	9	15	6	11	15	62
N	77	77	77	77	77	77
			Region level			
Mean	68.83	111.08	53.42	89.42	113.25	431.17
min	28	65	23	56	27	299
max	121	170	84	180	170	562
median	68.5	105.5	54	84.5	125	454.5
N	12	12	12	12	12	12

Figure F4:   Average years of education by birth cohort in Benin
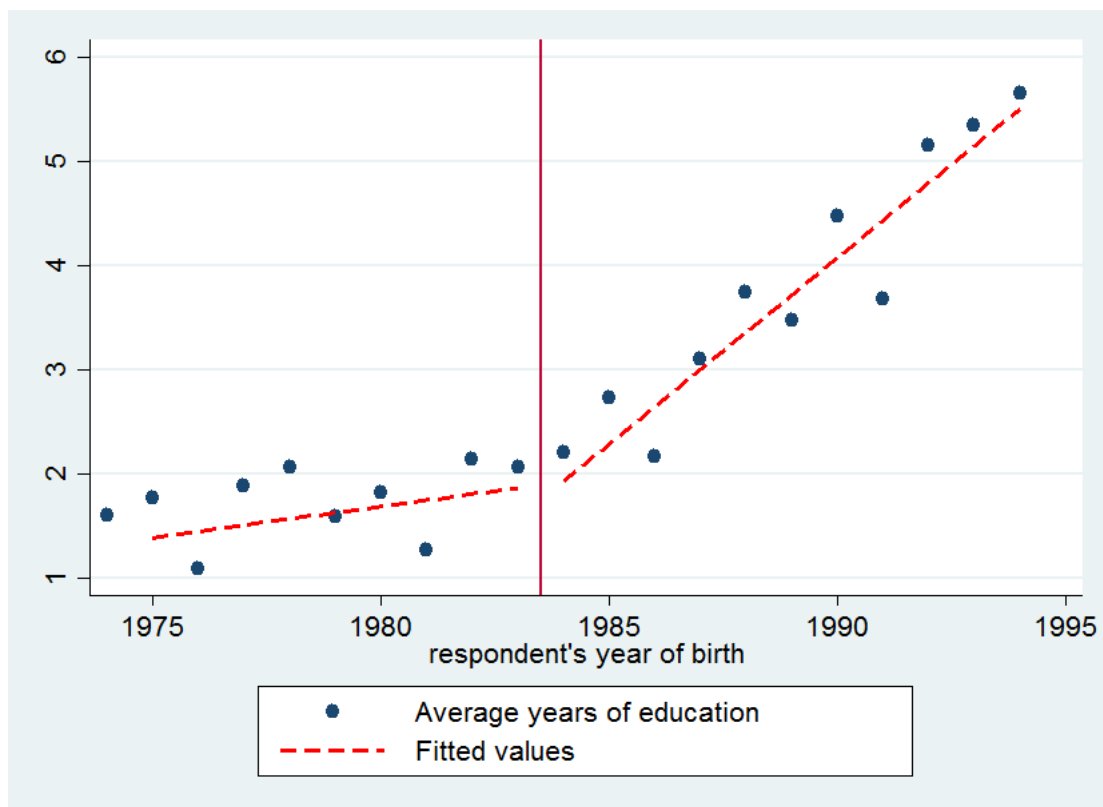
Note: The figure presents the average number of years of schooling, by year of birth in Benin.

Source: DHS Benin, 2011.

Table A3: Determinants of the numbers of years of education - Benin

	(1)	(2)
Normalized birth year	0.037***	0.037***
	(0.01)	(0.01)
Normalized birth year*post kink	0.294***	0.290***
	(0.02)	(0.02)
Dummy for round year	No	Yes
controls	Yes	Yes
Mean	1.64	1.64
Number of women	11,453	11,453
r2	0.37	0.37
F	116.66	115.94

Note: The dependent variable is the number of years of education. Models (1) and (2) represent the reduced form. We control in every regression with a dummy indicating whether the woman lives in a rural or an urban milieu, dummies for ethnicity, religion and wealth index. We add also region fixed effects. Sample: Eligible women aged 15-49 years old.

Source: DHS Benin, 2011.

Table A4: Determinants of the probability to be married before 15 years old - Benin

	Reduced form		2nd stage	
	(1)	(2)	(1)	(2)
Normalized birth year	0.001	0.001	0.004**	0.004***
	(0.00)	(0.00)	(0.00)	(0.00)
Normalized birth year*post kink	-0.017***	-0.016***		
	(0.00)	(0.00)		
post kink	0.065***	0.060***	0.040***	0.035***
	(0.01)	(0.01)	(0.01)	(0.01)
Nb of schools built at 10			-0.106***	-0.104***
			(0.01)	(0.01)
Dummy for round year	No	Yes	No	Yes
controls	Yes	Yes	Yes	Yes
Mean	0.14	0.14	0.14	0.14
Number of women	11,453	11,453	11,453	11,453
r2	0.05	0.06	0.05	0.05
F	17.23	17.33	16.51	16.67

Note: The dependent variable is the fact to have been married or not before 15 years old. Models (1) and (2) represent the reduced form. We control in every regression with a dummy indicating whether the woman lives in a rural or an urban milieu, dummies for ethnicity, religion and wealth index. We add also region fixed effects. Sample: Eligible women aged 15-49 years old.

Source: DHS Benin, 2011.

Figure F5:   Ratio of teachers to pupils at 10 years old in Senegal

Table A5: First stage - Senegal

	Literacy	
	(1)	(2)
Normalized birth year	-0.359***	-0.360***
	(0.00)	(0.00)
Normalized birth year*post kink	1.029***	1.028***
	(0.00)	(0.00)
Dummy for round year	No	Yes
controls	Yes	Yes
Mean		
Number of women	24,898	24,898
r2	0.87	0.87
F	15201.77	11946.65

Table A6: Second stage - Senegal

	School Attendance		Child Marriage	
	(1)	(2)	(1)	(2)
Teacher student ratio	0.024***	0.025***	-0.003**	-0.003**
	(0.00)	(0.00)	(0.00)	(0.00)
Normalized birth year	0.012***	0.012***	-0.002***	-0.002***
	(0.00)	(0.00)	(0.00)	(0.00)
Dummy for round year	No	Yes	No	Yes
controls	Yes	Yes	Yes	Yes
Mean	0.33	0.33	0.14	0.14
Number of women	24,898	24,898	24,898	24,898
r2	0.27	0.27	0.07	0.07
F	396.18	389.45	68.51	66.80

Note: Model (1) is the simple regression kink design. In model (2), we add a dummy for special birth years (corresponding to declared age finishing by the digit 0 or 5).The bandwidth is 10 years on both sides of the kink.

Source:DHS Sierra Leone, 2013.

Table A7: Tolerance of IPV

Panel : Senegal

	Goes out without telling		Neglects the children		Argues with husband		Refuses sex		Burns the food	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Normalized birth year	-0.00**	-0.00**	-0.00*	-0.00*	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Normalized birth year*post kink	0.00	0.00	0.00	0.00	0.00	0.00	-0.00+	-0.00+	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Dummy for round year	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean	0.49	0.49	0.49	0.49	0.51	0.51	0.53	0.53	0.26	0.26
Number of married wife	29,433	29,433	29,433	29,433	29,433	29,433	29,433	29,433	29,433	29,433
r2	0.12	0.12	0.10	0.10	0.11	0.11	0.12	0.12	0.08	0.08
F	63.29	61.16	57.87	56.69	56.92	55.20	60.93	58.89	27.24	26.26

Panel : Guinea

	Goes out without telling		Neglects the children		Argues with husband		Refuses sex		Burns the food	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Normalized birth year	-0.01***	-0.01***	0.00	0.00	-0.00*	-0.00*	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Normalized birth year*post kink	0.00	0.00	-0.01*	-0.01*	0.00	0.00	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Dummy for round year	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean	0.87	0.87	0.85	0.85	0.82	0.82	0.76	0.76	0.51	0.51
Number of married wife	5,457	5,457	5,457	5,457	5,457	5,457	5,457	5,457	5,457	5,457
r2	0.07	0.07	0.08	0.08	0.07	0.07	0.10	0.10	0.13	0.13
F	10.16	9.60	10.96	10.45	11.85	11.37	19.28	18.33	24.09	24.69

Panel : Sierra Leone

	Goes out without telling		Neglects the children		Argues with husband		Refuses sex		Burns the food	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Normalized birth year	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Normalized birth year*post kink	-0.01	-0.01	-0.01+	-0.01+	-0.01	-0.01	-0.01**	-0.01**	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Dummy for round year	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean	0.56	0.56	0.56	0.56	0.51	0.51	0.29	0.29	0.21	0.21
Number of married wife	10,236	10,236	10,236	10,236	10,236	10,236	10,236	10,236	10,236	10,236
r2	0.06	0.06	0.06	0.06	0.05	0.05	0.08	0.08	0.06	0.06
F	5.44	5.24	39.71	41.61	16.15	14.37	42.29	47.77	7.17	6.86

Note: In the first column, the dependent variable is the acceptance of violence if the woman has gone out without telling her husband, in the second column, if she neglects the children, in the third column, if she argues with the husband, in the fourth column, if she refuses sex and in the sixth column if she burns the food. Model (1) is the simple regression kink design. In model (2), we add a dummy for special birth years (corresponding to declared age finishing by the digit 0 or 5).The bandwidth is 10 years on both sides of the kink. We control in every regression with a dummy indicating whether the woman lives in a rural or an urban milieu, dummies for ethnicity, religion and wealth index. We add also region fixed effects.

Source: DHS 2010-11, 2012-13, 2014 and 2015 Senegal, 2012 Guinea, and 2008-2013 Sierra Leone.

Table A8: Tolerance of IPV

Mali

	Goes out without telling		Neglects the children		Argues with husband		Refuses sex		Burns the food	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Normalized birth year	0.00	0.00	0.00	0.00	0.00	0.00	-0.00	-0.00	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Normalized birth year*post kink	-0.00	-0.00	-0.00	0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Dummy for round year	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean	0.56	0.56	0.50	0.50	0.60	0.60	0.62	0.62	0.27	0.27
Number of married wife	6,931	6,931	6,931	6,931	6,931	6,931	6,931	6,931	6,931	6,931
r2	0.03	0.03	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02
F	3.23	3.11	1.90	1.82	3.28	3.16	3.71	3.60	1.56	1.52

Cote d'Ivoire

	Goes out without telling		Neglects the children		Argues with husband		Refuses sex		Burns the food	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Normalized birth year	0.00	0.00	-0.00	-0.00	-0.00	-0.00	-0.01**	-0.01**	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Normalized birth year*post kink	0.00	0.00	0.01*	0.01*	0.01***	0.01***	0.01**	0.01**	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Dummy for round year	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean	0.29	0.29	0.33	0.33	0.35	0.35	0.25	0.25	0.17	0.17
Number of married wife	6,967	6,967	6,967	6,967	6,967	6,967	6,967	6,967	6,967	6,967
r2	0.10	0.10	0.08	0.08	0.11	0.11	0.11	0.11	0.07	0.07
F	.	.	.	.	.	.	.	.	.	.

Niger

	Goes out without telling		Neglects the children		Argues with husband		Refuses sex		Burns the food	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Normalized birth year	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Normalized birth year*post kink	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Dummy for round year	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean	0.41	0.41	0.40	0.40	0.48	0.48	0.48	0.48	0.34	0.34
Number of married wife	7,841	7,841	7,841	7,841	7,841	7,841	7,841	7,841	7,841	7,841
r2	0.09	0.09	0.12	0.12	0.11	0.11	0.14	0.14	0.16	0.16
F	45.88	41.69	75.62	68.70	44.77	40.65	79.01	71.73	71.41	64.78

Liberia

	Goes out without telling		Neglects the children		Argues with husband		Refuses sex		Burns the food	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Normalized birth year	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Normalized birth year*post kink	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Dummy for round year	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean	0.29	0.29	0.33	0.33	0.35	0.35	0.12	0.12	0.08	0.08
Number of married wife	5,849	5,849	5,849	5,849	5,849	5,849	5,849	5,849	5,849	5,849
r2	0.05	0.05	0.06	0.06	0.05	0.05	0.04	0.04	0.03	0.03
F	24.40	23.29	38.14	37.22	40.49	39.00	13.14	13.10	8.44	8.16

Note: In the first column, the dependent variable is the acceptance of violence if the woman has gone out without telling her husband, in the second column, if she neglects the children, in the third column, if she argues with the husband, in the fourth column, if she refuses sex and in the sixth column if she burns the food. Model (1) is the simple regression kink design. In model (2), we add a dummy for special birth years (corresponding to declared age finishing by the digit 0 or 5).The bandwidth is 10 years on both sides of the kink. We control in every regression with a dummy indicating whether the woman lives in a rural or an urban milieu, dummies for ethnicity, religion and wealth index. We add also region fixed effects.

Source: DHS 2010-11, 2012-13, 2014 and 2015 Senegal, 2012 Guinea, and 2008-2013 Sierra Leone.