Female Genital Cutting and Education: Causal Evidence from Senegal*

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Abstract

This paper finds that, in contexts where female genital cutting (FGC) improves marriage outcomes, this practice curbs girls' education. We use across ethnic group variation in exposure to a law that banned the practice of FGC in Senegal to investigate whether education and FGC work as substitutes in the marriage market, and to estimate the causal effect of FGC on girls' education. We find that the ban, which is interpreted as an increase in the cost of FGC, decreased the prevalence of the practice, which later increased educational investments received by girls. The results provide widespread support for the substitution hypothesis and suggest that parental decisions on whether to cut their daughters depend highly on the relative cost of alternative pre-marital investments. On the other hand, the findings dismiss alternative mechanisms to explain why the law raised educational investments such as better health or less adolescent girls leaving school to get married.

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1 Introduction

UNICEF (2016) estimates that more than 200 million women worldwide have undergone Female Genital Cutting (FGC)[1]. This cultural practice is considered by the United Nations a human rights violation[2] and although the evidence investigating its lasting effects on physical and psychological health is inconclusive (see for example Wagner (2015)), complications such as excessive bleeding, urine retention, genital tissue swelling, infections and problems with wound healing during the practice of the cut are frequent (Berg et al., 2014). Often practiced under poor hygienic conditions, FGC could be particularly risky in countries like Senegal, Mauritania or Mali, where most of the cuts occur during the first year of life of the girls (Yoder and Wang, 2013).

As a result, there is worldwide pressure to governments of countries where FGC is prevalent to eradicate this practice. In the last decades, many of them passed laws criminalizing FGC and launched media campaigns and social programs aiming to tackle this tradition (Shell-Duncan et al., 2013). However, despite the large amounts of resources invested, the reduction in the prevalence of FGC has not met the expectations[3] (UNICEF, 2016). Currently, FGC continues to be a social norm in many countries and the World Health Organization (WHO) estimates that 3 million girls undergo FGC every year (Bellemare et al., 2015).

Different authors characterize FGC as a pre-marital investment that improves marital outcomes (Wagner, 2015; Mackie, 1997; Chesnokova and Vaithianathan, 2010; Allen et al., 2015; Molitor, 2014). Overall, these studies suggest that among ethnic groups practicing FGC, cut girls are perceived as purer, more loyal, and meager. In consequence, marriage payments received by the parents of the bride, also known as bride price, are usually larger for cut brides and these girls are also more likely to get married. Wagner (2015) finds empirical evidence consistent with this argument: Using DHS data from 13 African countries, this study shows that conditional on ethnic group, village and age, cut women are more likely to be married. Mackie (1997) documents that in some societies, FGC works as a precondition of marriage. Chesnokova and Vaithianathan (2010) and Molitor (2014) propose theoretical models where the expectation that FGC will lead to a better marital outcome perpetuates the practice as social norm. Allen et al. (2015) document that infibulation, the most aggressive type of FGC[4], is practiced among some ethnic groups of

[1] Although the practice has also been termed as Female Genital Mutilation, or Female Circumcision, we opt for the more general term cutting. It is defined as the ritual cutting of some or all of the external female genitalia for reasons unrelated with health http://www.who.int/mediacentre/factsheets/fs241/en/

[2] See http://www.un.org/womenwatch/daw/csw/csw52/statements_missions/Interagency_Statement_on_Eliminating_FGM.pdf

[3] The prevalence of FGC among girls aged 15-19 in countries where this practice exists decreased from 51% in 1981 to 37% in 2015.

[4] Infibulation or Type III FGC is defined as the narrowing of the vaginal opening through the creation of a covering seal. The seal is formed by cutting and sewing over the outer, labia, with or without removal of

Senegal to ensure bride's virginity at marriage. In some aspects, the effects of FGC on marriage market outcomes resemble those of educational investments, which have been found to causally increase bride price in Zambia and Indonesia (Ashraf et al., 2016), and more generally, to improve the quality of the match in the marriage market (Chicoine, 2018; Hahn et al., 2018; Boulier and Rosenzweig, 1984). Furthermore, through improving labor market outcomes, education could also work in some societies as a livelihood strategy for women that remained unmarried.

In this context, one could argue that FGC and educational investments may work as substitutes in the marriage market and given the high relative price of education, FGC might reduce educational investments. In this study, we use the introduction of a ban on FGC in January 1999 in Senegal as a natural experiment to test this substitution hypothesis and to estimate, for the first time in the literature, the causal effect of FGC on educational investments received by girls. Our difference-in-difference strategy relies on comparing girls born before and after the approval of the law that belong to ethnic groups where the practice of FGC is traditional with girls from ethnic groups where FGC was never practiced.

The results show that the introduction of the law, which is interpreted as an increase in the cost of FGC, led to a significant reduction in the probability of experiencing FGC. The exogenous variation in the probability of being cut generated by the ban is then used to assess the causal effect of FGC on educational outcomes. The results of the study suggest that every 10 percentage points reduction in the prevalence of FGC (prevalence in the sample is 32%) leads to a significant reduction of 2.6 percentage points in the probability of never attended school (mean in the sample is 36%). On the other hand, we find little effects of FGC on the intensive margin of educational investments. Although FGC decreases substantially the number of girls that receive 1 or 2 years of education, it does not seem to have any effect on the probability of achieving 3 or more years of education. Consistent with the substitution hypothesis, we also find that the positive effect of reducing the prevalence of FGC on educational investments is larger among those households that are economically constrained and in areas where the value of FGC in the marriage market is larger. We also investigate two alternative mechanisms for explaining the harmful effect of FGC on education. Firstly, FGC may reduce returns to education through lastingly affecting girls' health. Secondly, in a context where parents aim to marry their daughter as soon as possible after menarche and where girls traditionally drop out from school if they get married, FGC might lead to early school dropout through facilitating early marriage. We examine both mechanisms and find no evidence supporting them.

The results of different falsification tests suggest that estimates are unlikely driven by pre-ban differential trends in FGC or educational investments across different ethnic groups or by larger levels of underreporting of FGC among younger cohorts of girls. The

the clitoris or inner labia.

results are also robust to the use of different analytical samples, regression specifications, the exclusion of areas where an NGO implemented a large anti-FGC project and to a placebo test examining the effects of the law on the educational investments received by boys without any sister born after the introduction of the law.

This study makes three contributions to the literature. Firstly, we add to the emerging literature that investigates whether legal changes can be effective instruments to address harmful traditional practices in many developing countries (Fenske, 2012; Crisman et al., 2016; Garcia-Hombrados, 2017), a topic that has recently gathered the attention of researchers and policy makers (Acemoglu and Jackson, 2017). The results suggest that laws banning FGC could contribute to reducing this practice and raising human capital investments received by girls in countries where this practice is prevalent. Secondly, the paper provides the first estimates on the causal effect of FGC on educational investments. Finally, the study contributes to the literature that explores the nature, origin and persistence of this practice (Bellemare et al., 2015; Becker, 2018; Novak, 2016; Poyker, 2016; Wagner, 2015) through providing key insights into how parental decisions on FGC are sensitive to changes in the relative prices of an alternative pre-marital investment.

This study is structured as follows. Section 2 presents the conceptual framework linking education, female genital cutting and marriage markets. Then, section 3 discusses the tradition of FGC in Senegal and summarizes the key aspects of the law that banned its practice. Next, we introduce the data used in the analysis in section 4 and the empirical strategy in section 5. Section 6 presents the results of the analyses on the effects of the law and the estimated impact of FGC on educational investments. Section 7 examines the robustness of the results to different falsification tests. Section 8 discusses further the substitution hypothesis and investigates alternative mechanisms for explaining the effect of FGC on education. Section 9 concludes.

2 Conceptual framework

The effects of education on labor market outcomes for women in low- and middle-income countries have been widely investigated in the economics literature (see for example Chicoine (2018) or Duflo (2001)). Although the magnitudes differ across settings and degrees of education, the evidence worldwide shows that receiving more education leads to higher levels of labor force participation, agricultural productivity and wages earned by women. Senegal is not an exception and the positive effects of education on labor market outcomes for women in both rural and urban areas of the country have been documented by Marchetta and Sahn (2016). The role of women's education in the marriage market has also been studied by several authors. The economics literature points to two main effects of girl's education on marriage market outcomes in developing countries. Firstly,

consistent with the assortative mating hypothesis formulated in Becker (1973); Boulier and Rosenzweig (1984), Chicoine (2018) and Hahn et al. (2018) show that more educated women in Philippines, Ethiopia and Bangladesh marry more educated and productive husbands; although education does not seem to increase the probability of marriage (Wagner, 2015; Chicoine, 2018). Secondly, Ashraf et al. (2016) use data from Indonesia and Zambia to prove that, in societies where the practice of bride price is prevalent, education increases the payments transferred to bride's family at marriage. Consistently, Hotte and Lambert (2018) show that in Senegal, better education is associated with a higher bride price.

Despite the practice of polygamy is widespread across the main ethnic groups in Senegal, approximately 32% of girls aged 15-49 surveyed in the DHS rounds 2010, 2012, 2014, 2015 and 2016 remained unmarried. Although the proportion of unmarried girls is smaller among older girls, figure A1 in the appendix reveals that approximately 10%-12% of girls in their 30's and 40's remain unmarried. In a context in which a non-negligible share of women marry late or do not marry over their life course and where FGC increases the probability of marriage, educational investments could minimize potential welfare losses associated with the reduced probability of getting married for uncut girls through improving their job market outcomes. Additionally, educational investments could also compensate the reductions in the "quality" of the husband or in the marriage payments received by parents of uncut daughters that get married. If the relative price of FGC over education is smaller, then FCG is more likely in the face of financial constraints. In the resulting equilibrium parents opt for FGC, which crowds out education as pre-marital investment. On the other hand, if the cost of FCG increases relative to education, some parents may react by abandoning this practice and investing more in girls' education to reduce potential losses of uncut girls in the marriage market.

Table 1 shows adjusted correlations between various educational variables, marriage outcomes and FGC for the sample of women aged 15 to 49 using rounds 2010, 2012, 2014, 2015 and 2016 of the Senegalese Demographic and Health Survey (DHS). Columns 1 and 2 show that on average and conditional on ethnic group, age and village, women who were cut while girls are less educated. The statistical associations between FGC, education and marriage are reported in columns 3 and 4. The estimates show that, holding constant educational level, FGC is associated with a higher probability of marriage and with a lower age at cohabitation. These results, which are consistent with those found by Wagner (2015), are perceived as beneficial by many parents in developing countries (Wahhaj, 2015). The opposite relations hold for education: conditional on FGC status, higher levels of education are associated with a lower probability of marriage and a higher age at cohabitation. Finally, the analysis reported in column 5 examines the assortative mating hypothesis. The coefficients show that, conditional on FGC status, the education of the girl is positively associated with the years of education of her partner. This positive

Table 1: Education, FGC and marriage (girls aged 15-49):

VARIABLES	(1) FGC(0/1)	(2) FGC (0/1)	(3) Married (0/1)	(4) Age at cohabitation	(5) Partner Years of educ
FGC			0.036***	-0.562***	-0.366***
			(0.008)	(0.096)	(0.096)
Years of educ.	-0.005***		-0.023***	0.247***	0.437***
	(0.001)		(0.001)	(0.009)	(0.013)
Educ. categories					
Primary educ.		-0.018***			
		(0.005)			
Secondary or higher educ.		-0.053***			
		(0.006)			
No educ (ommitted)					
Year of birth FE	Yes	Yes	Yes	Yes	Yes
DHS cluster FE	Yes	Yes	Yes	Yes	Yes
Ethnic group FE	Yes	Yes	Yes	Yes	Yes
Age at survey	Yes	Yes	Yes	Yes	Yes
Mean dep. var	0.39	0.39	0.681	18.1	1.86
Observations	38,527	38,527	38,485	27,749	25,189
R-squared	0.699	0.699	0.430	0.263	0.388

Note: Descriptive statistics for the variables and sample used are provided in table A1 in the appendix. Standard errors are clustered at the DHS village level. Every regression includes as control variables age, village of residence fixed effects, ethnic group fixed effects and year of birth fixed effects. ***p<0.01;**p<0.05;*p<0.1

association between the education of spouses is consistent with Becker's prediction. On the other hand, the estimates reveal that, holding constant educational level, FGC is negatively associated with the educational level of the husband, suggesting that parents with girls that undergo FGC might search for other spouse characteristics. The lack of information on marriage payments and labor market outcomes in the DHS questionnaires does not allow us to test the association in the data between bride price, FGC, education and the wages of the women and their husbands[5].

Previous literature shows that both education and FGC increase bride price and could also improve some marriage market outcomes that are perceived as beneficial. Although we lack key information and despite the statistical associations displayed above cannot be interpreted as causal, the correlation analyses reported in table 1 show that both FGC and education are associated with marriage market outcomes that are perceived as positive

[5]According to the Murdock Ethnographic Atlas, bride price is the most prevalent marriage arrangement among the 6 largest ethnic groups in Senegal.

by parents: FGC with a higher probability of marriage and early marriage; and education with a higher educational level of the husband. These results are consistent with the assumptions behind the substitution hypothesis outlined in this section.

In appendix B, we present a theoretical model that reflects the role of education and FGC in the marriage market observed in the data. The model is inspired by previous theoretical work conducted by Molitor (2014) and Chesnokova and Vaithianathan (2010) that modeled FGC as a pre-marital investment that improves the consumption of cut girls in the future through improving her marriage market outcomes. However, the extend and objective of our model is different. While these papers use structural models seeking to explain FGC perpetuation over time, our model focuses on the marriage market aiming to understand parental investment decisions when the relative price of pre-marital investments change. Consistent with the conceptual framework described in this section, the model predicts that the law, which is interpreted as a relative increase in the cost of cutting, would lead to a decrease in the prevalence of FGC and to an increase in the educational investments received by girls as substitution.

3 Female Genital Cutting in Senegal and the introduction of the ban

The practice of FGC is widespread in West African countries, where its prevalence ranges between 3% in Niger and 99% in Guinea. In Senegal, approximately 25% of women aged 15-49 declared having undergone FGC (Allen et al., 2015). The practice is embedded in the tradition of many ethnic groups such as the Soninke, Mandingue, Diola and the Poular, while it is sparse among the Wolof and the Serer people. Unlike in most East African countries (e.g. Kenya, Egypt or Tanzania), FGC in Senegal is mainly conducted during infancy or early childhood. Yoder and Wang (2013) show that in this West African country, 61% of the cuts occur before the girls turn one year old and excisions after early childhood are infrequent. In our data, less than 3% of the girls (accounting for less than 10% of the cut girls) underwent FGC after the age of 6. These patterns do not change substantially across ethnic groups. The DHS data used in this study show that the first year of life is the most common age at cutting among all ethnic groups in Senegal, and the percentage of girls that experienced FGC after the age of 6 ranges between 0% and 7% across them.

The WHO defines four types of FGC depending on the extent of genital tissue cutting. The Type I or cloridectomy is the partial or total removal of the clitoris. Type II FGC or excision is the partial or total removal of the clitoris and the labia minora, with or without excision of the labia majora. Type III or infibulation is the more aggressive practice, and consists of the narrowing of the vaginal opening through the creation of a covering

seal. Type IV includes other harmful procedures to the female genitalia for non-medical procedures. Although most FGC conducted in Senegal could be classified as type II FGC, type III cuttings are also existent among Soninke and Maninke girls (Allen et al., 2015). Regardless of the specific FGC type, most of the cuts are performed by traditional practitioners with little knowledge of female anatomy using crude unsterile instruments and without anesthetics (UNICEF, 2013; Berg et al., 2014).

Increasingly aware of the health risks and discriminatory nature of FGC, tackling this practice has been at the top of Senegal's policy agenda for decades. The flagship measure of the Senegalese government against FGC was the approval of the Law No. 99-05 that sanctions those who provoke sexual mutilations or give instructions for their commission with six months to five years of prison, or hard labor for life if cutting results in death. The law was enacted the 29th of January 1999, following the anti-FGC speech of the US first lady Hillary Clinton in Senegal and 9 months of intense campaign led by different Senegalese organizations of the civil society. Details about the context and enforcement of this law are provided in Shell-Duncan et al. (2013). The study concludes that although some politicians and social groups lobbied against the new regulation, the government made an effort to raise awareness about the launching of the law[6]. Indeed, using 2004 data from remote rural locations, the authors find that knowledge of the existence of the law was widespread. Most of the people learned of the law listening to radio broadcasts, in community meetings or through word of mouth, although the knowledge of key aspects of the anti-FGC legislation was superficial [7]. Following the introduction of the ban, the government conducted some high-profile arrests and convictions of FGC perpetrators, which received large media coverage. Although not many people were prosecuted for breaking the law (Kandala and Komba, 2015), the strategy of the government expanded a lasting fear of prosecution (Shell-Duncan et al., 2013). The authors also suggest that the law was particularly effective in communities where the practice of FGC had been actively contested while in more traditional communities the impact could have been smaller due to the existence of underground FGC. The effectiveness of the law is examined empirically in section 6. The possibility of anticipation effects of the law and of an eventual impact of the ban on the misreporting of women's FGC status as potential limitations of the results are discussed and dismissed in sections 5 and 6.

[6]The introduction of the law was accompanied by a media campaign aiming to raise awareness of the law and of the negative consequences of FGC. Although it is beyond the objective of the study understanding whether the effect was driven by the legal change or by the campaign itself, the existing evidence suggests that mass campaigns promoting behavioral change in developing countries in issues such as sexual practices, fertility, child rearing or gender violence have little or no effect (Banerjee et al., 2017; Krishnaratne et al., 2016; García-Moreno et al., 2014).

[7]The findings of the study suggest that most individuals do not know key aspects of the law such as the penalty for ordering or committing FGC.

4 Data

The main analysis of the paper is conducted using the 2016, 2015, 2014, 2012 and 2010 cross-sectional rounds of the Senegalese Demographic and Health Survey (DHS). DHS are nationally representative surveys that include individual and household level modules that collect rich information on health and demographic characteristics. They have been implemented in more than 100 low- and middle-income countries across the world for more than three decades and the high quality of these databases is claimed in Pullum (2008). DHS questionnaires include information on basic demographic and educational outcomes for every member of the household. Furthermore, information on different health outcomes is provided for a subsample of the household members, which vary in every survey. The 2010-2016 rounds of the DHS include a module on FGC. This module is designed to collect information on the FGC status for every girl aged 0-49 years old[8]. The information on whether a girl underwent FGC is self-reported for those girls aged 15 or older and is reported by the mother of the girl for those girls younger than 15 years old at the time of the survey. When applying the survey, enumerators are instructed to search for privacy and avoid the presence of other members of the family in the same room, although this might not always be possible (ICF, 2018).

While the information available on FGC in the 2012-2016 DHS surveys is comprehensive, these datasets only collected anthropometric and key health information such as the incidence of anemia for children younger than 5 years old. On the other hand, information on marital status and other marital outcomes is only available for individuals aged 15 or older.

In total, the 2016, 2015, 2014, 2012 and 2010 Senegalese DHS databases include information from 25,256 households. The analysis is however focused in the 28,425 girls from these households born from January 1990 that by the time of the survey were at least 7 years old. We restrict the analysis to girls born from 1990 because the accuracy of the information on date of birth is likely to be larger among younger cohorts. However, the selection of the exact birth date used as a threshold for being excluded from the sample is arbitrary and in the analysis, we examine the robustness of the results to the inclusion of older cohorts of girls. The restriction of the analysis to those girls aged at least 7 years old has a twofold objective. Firstly, this is the legal age at which children should start school in Senegal. Secondly, since the vast majority of cuttings occur during girl's infancy

[8]Not in every round of the DHS survey the information on FGS status was collected for the full sample of girls aged 0-49 years old. While this information was collected for all girls aged 0-49 years old in the 2014, 2015 and 2016 rounds of the survey, the 2010 round does not gather FGC information for girls aged 11-14 years old and the 2012 from girls aged 15 or older. Although the 2005 Senegalese DHS also includes a FGC module, this information is only collected for women equal or older than 15. Since the main analytical sample is restricted to girls born from 1990, we do not use the 2005 round in the main analysis.

or early childhood[9], setting the threshold at the age of 7 years avoids the possibility that the reduction in the prevalence of FGC is simply capturing the fact that girls are yet to be cut by the time of the survey. In section 7, we also provide evidence that the results do not change relevantly when alternative ages are used as thresholds for being included in the analytical sample.

Table 2: Summary statistics:

	Full sample					FGC women (N= 9,360)	Non-FGC women (N= 19,209)	
	N	Mean	Standard deviation	Min	Max	Mean	Mean	Diff (FGC - Non-FGC)
Age	28,425	14.49	5.23	7	26	15.31	14.09	1.24***
Year of birth	28,425	1,998.70	5.28	1,990	2,009	1,997.93	1,999.07	-1.14***
Never in school (0/1)	28,425	0.36	0.48	0	1	0.37	0.36	0.02***
Years of education	28,425	3.16	3.61	0	17	3.17	3.15	0.02
Years of educ≥1	25,817	0.62	0.48	0	1	0.61	0.63	-0.02***
Years of educ≥2	23,346	0.60	0.49	0	1	0.59	0.61	-0.02***
Years of educ≥3	21,382	0.57	0.50	0	1	0.55	0.57	-0.02***
Years of educ≥4	19,283	0.54	0.50	0	1	0.51	0.55	-0.04***
Wealth index	28,424	2.61	1.32	1	5	2.13	2.84	-0.71***
Rural	28,425	0.63	0.48	0	1	0.71	0.60	0.12***
Wolof	28,425	0.32	0.47	0	1	0.01	0.47	-0.46***
Poular	28,425	0.34	0.47	0	1	0.59	0.22	0.37***
Serer	28,425	0.12	0.33	0	1	0.01	0.18	-0.17***
Mandingue	28,425	0.09	0.28	0	1	0.19	0.04	0.16***
Diola	28,425	0.04	0.20	0	1	0.06	0.03	0.03***
Soninke	28,425	0.02	0.13	0	1	0.03	0.01	0.02***
Not a Senegalese	28,425	0.02	0.14	0	1	0.04	0.01	0.03***
Other	28,425	0.05	0.22	0	1	0.06	0.04	0.01***

Summary statistics for the sample of girls included in the analysis are reported in table 2. The age of the girls in the main analytical sample ranges between 7 and 26 years old and despite all these girls have an age over the legal age for starting school, 36% of them have never attended it. The average number of years of schooling for these girls is 3 years, although at the time of the survey some of them were still enrolled in school.

Furthermore, the descriptive statistics show that cut girls, which represent the 32% of the sample, are not a random draw of the Senegalese female population. They are overall poorer and older than uncut girls and more likely to live in rural areas. Cut girls are also significantly more likely to report never attended school, although differences between

[9]DHS data show that less than 3% of the girls in Senegal aged 15-49 were cut after the age of 6. This corresponds to less than 10% of the girls that underwent FGC in the DHS data.

them in terms of years of education are not statistically significant at conventional confidence levels. The lack of significant differences in terms of years of schooling achieved by cut and uncut girls contrasts with the strong negative association between FGC and education that we observed in section 2 when controlling for ethnicity, age and village of residence, suggesting that both education and prevalence of FGC vary substantially across space and ethnic groups.

Table 3: Pre-law prevalence of FGC across ethnic groups in Senegal:

Ethnic group	FGC prevalence	Share ethnic. in sample
Wolof	0.017	0.322
Poular	0.642	0.341
Serer	0.020	0.119
Mandingue	0.812	0.086
Diola	0.553	0.039
Soninke	0.679	0.019
Not a Senegalese	0.744	0.023
Other	0.450	0.051

Note: The pre-law prevalence of FGC among each ethnic group and the share of each ethnic group in the sample are calculated using the sample of women born between 1990 and 1998 that were interviewed in the Senegalese DHS rounds 2016, 2015, 2014, 2012 and 2010.

Table 3 reports the prevalence of FGC across the different ethnic groups, calculated from girls born before the introduction of the anti-FGC legislation in Senegal[10]. In a country where inter-ethnic marriages are not frequent[11], the data confirm the wide variation in terms of the prevalence of FGC across ethnic groups, which ranges between 81% among Mandingue girls and 1.7% among girls that belong to the Wolof ethnic group.

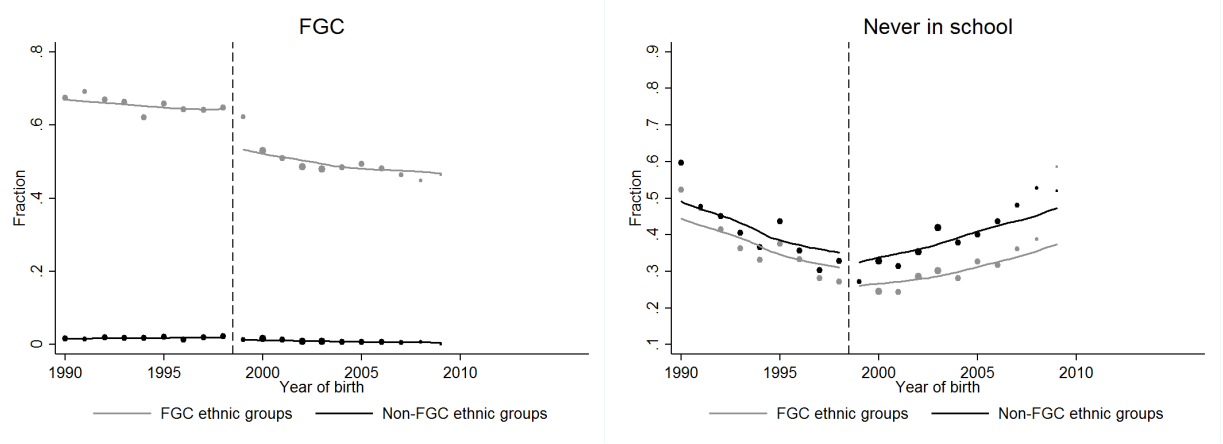
Figure 1 illustrates how the prevalence of FGC and school outcomes change over time. The graphs show that while the prevalence of FGC hardly changed across cohorts of girls from ethnic groups where the incidence of FGC is small (Wolof and Serer), the prevalence of FGC dropped sharply for girls born after the introduction of the law in January 1999 that belong to an ethnic group where the practice of FGC was widespread. Furthermore, the graph reveals that, although within ethnic groups cut girls receive lower levels of

[10] We use the information available in DHS rounds 2010-2016 for those girls born between 1990 and 1998.

[11] According to the DHS couple recode, only in 24% of the marriages spouses are from a different ethnic group. In rural areas the percentage of inter-ethnic marriages is 17%.

educational investments, the percentage of girls that never attended school was lower among ethnic groups where the practice of FGC is traditional. Another pattern in the figure that draws the attention is the higher probability of never attended school among younger cohorts of girls from both FGC and non-FGC ethnic groups. At this point, it is worth to highlight that the upward trend in the probability of never attended school among cohorts of girls born after the introduction of the law disappears when the figure is constructed using only girls aged 10 or older[12] (see figure A2 in the appendix), suggesting that this trend is the result of many girls starting school after the age of 7. In section 7, we examine the robustness of the results to the exclusion of the youngest cohorts of girls from the analytical sample.

Figure 1: FGC and never in school across year of birth cohorts (All ethnic groups):



5 Empirical strategy

The first step of the analysis is examining whether the introduction of the law, which is interpreted as an increase in the cost of cutting, reduced the prevalence of female genital cutting. We assess the impact of the law through exploring whether girls born after the introduction of the law that belong to ethnic groups for which the pre-law prevalence of FGC was higher experienced larger reductions in their probability of undergoing FGC. For this, we estimate the following regression:

[12]In the DHS data, school initiation after the age of 10 is extremely rare among every ethnic group. For example, less than 1.5% and 0.8% of children aged of 11 or 12 at the time of the survey initiated school that year.

$$FGC_{ikrt} = \alpha_0 + \alpha_1(POST_t \times LawIntensity_k) + \alpha_2 YearBirth_t + \alpha_3 EthnicGroup_k + \alpha_4 Village_r + \alpha_5 X_i + \mu_{ikrt} \tag{5.1}$$

where FGC_{ikrt} indicates whether girl i from the ethnic group k, living in village r, and born during year t, underwent FGC. $YearBirth_t$, $EthnicGroup_k$ and $Village_r$ are vectors of dummy variables that indicate the year of birth, ethnic group and village of residence of the girl. X_i is a vector of control variables indicating the age of the girl at the time of the survey and a dummy variable equal to 1 if the FGC status of the girl is reported by her mother and 0 if the status is reported by herself[13]. The term $POST_t \times LawIntensity_k$ is the interaction between the variable $POST_t$, that is equal to 1 if the girl is born after the introduction of the anti-FGC law (January 1999), and the variable $LawIntensity_k$, which measures the pre-law average incidence of FGC among the ethnicity k[14]. The parameter α_1 measures the differential change in the prevalence of FGC after the introduction of the law for ethnic groups with higher and lower pre-law levels of FGC. Ultimately, the parameter α_1 measures the effect of the degree of exposure of the law (larger among girls from ethnic groups with a higher pre-law prevalence of FGC) on the probability of experiencing FGC. μ_{ikrt} is the error term. Since the number of ethnic groups in the data is small, we follow Cameron et al. (2008) and calculate wild bootstrapped standard errors clustered at the ethnic group level.

Next, we follow Duflo (2001) and use the interaction term $POST_t \times LawIntensity_k$ in equation 5.1 as an instrumental variable to investigate whether the reduction in FGC caused by the law increased educational investments. Using a 2SLS procedure, we estimate:

$$Education_{ikrt} = \beta_0 + \beta_1 \widehat{FGC}_{ikrt} + \beta_2 YearBirth_t + \beta_3 EthGroup_k + \beta_4 Village_r + \beta_5 X_i + u_{ikrt} \tag{5.2}$$

where $Education_{ikrt}$ measures educational investments received by girl i from the ethnic group k living in village r and born during year t and $\widehat{FGC}$ is the predicted probability of FGC estimated from equation 5.1. The parameter of first interest is β_1, that yields the causal effect of FGC on educational investments for those girls that were not cut because they were exposed to the law. If the first stage is sufficiently strong, the parameter β_1 also indicates whether exposure to the law had any effect on the educational investments

[13]The information on FGC status is self-reported if the girl is aged 15 or older or is reported by the mother of the girl if the girl is younger than 15 years old.

[14]This is calculated using the cohorts of girls within each ethnic group born between 1990 and 1998.

received by girls. In order to account for differential trends in FGC or education over time across Senegal, equations 5.1 and 5.2 are also estimated using a vector of regional dummies and region-specific time trends.

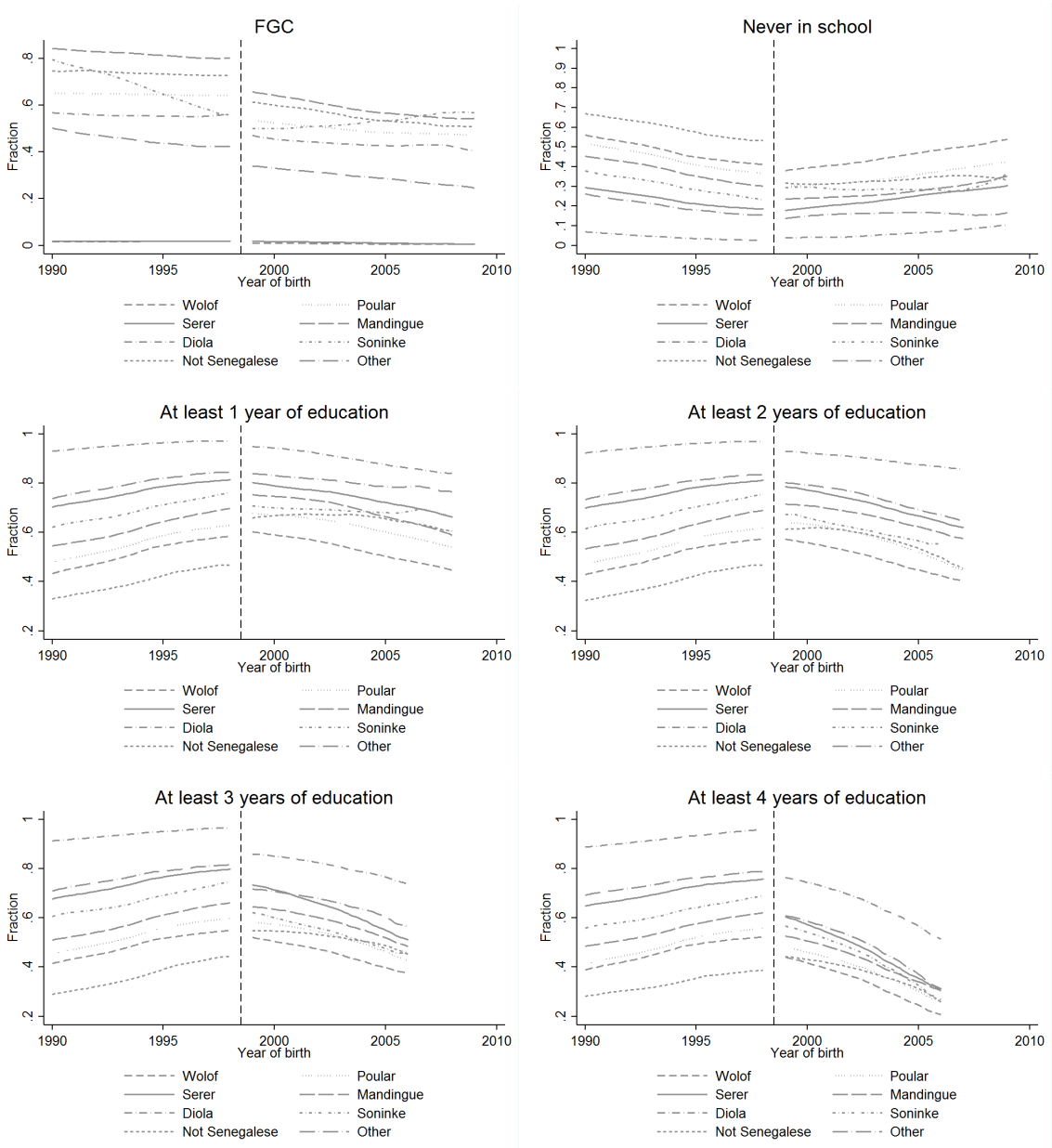
The main advantage of the empirical approach presented above is that it allows us to overcome the potential endogeneity in the link between FGC and educational investments. The main condition for the causal interpretation of the parameters of interest α_1 and β_1 is that, in absence of the introduction of the law, the evolution of the prevalence of FGC and educational investments should have been the same across ethnic groups. We can test the feasibility of this parallel trends condition through examining whether the evolution of the prevalence of FGC and educational outcomes across cohorts of girls born before the introduction of the law is similar across the different ethnic groups. The latter assumption would be violated if the prevalence of FGC among FGC ethnic groups already started dropping among cohorts of girls born before the introduction of the law. Figure 1 suggests that the evolution of both the prevalence of FGC and the probability of never attended school for cohorts of girls born before the introduction of the law was not very different in ethnic groups where FGC is traditional and in ethnic groups where it is not[15]. However, the validity of our identification strategy would require parallel trends across every ethnic group used in the analysis. Figure 2 displays the evolution of these variables over cohorts of birth by ethnic group. The graphs show that the evolution of educational outcomes for girls born before the introduction of the law was remarkably similar across every ethnic group. On the other hand, the figure reveals that although the prevalence of FGC remains constant across cohorts of girls born before the introduction of the law in 6 out of the 8 ethnic categories in the sample, the prevalence of FGC was already dropping among girls born before the introduction of the law from the ethnic group Soninke and the ethnic category *Other*.

In the main analysis conducted in the study, we use two different samples. Firstly, we estimate the equations above restricting the sample to the 6 ethnic groups for which the prevalence of FGC does not decrease among cohorts born before the introduction of the law. The two ethnic groups removed from this analysis account for the 7% of the girls in the sample and as it can be appreciated in figures A5 and A4 in the appendix, excluding them from the analysis ensures the pre-law parallel trends in terms of educational variables and FGC. Secondly, we also conduct the main analysis using all the 8 ethnic groups in the data.

We test further whether the results could be driven by differential pre-trends in section 7 through estimating the effects of placebo bans introduced in 1993, 1995 and 1997 and limiting the analysis to girls born before the introduction of the true law in January 1999. Consistent with the lack of pre-trends in FGC or education before the introduction of the

[15]Figure A3 in the appendix displays the graphs for the rest of educational outcomes used in the study for these two groups, showing similar patterns.

Figure 2: FGC and outcomes All ethnic groups: Continuous treatment



law, these analyses show no effects of the false laws on educational outcomes or on the prevalence of FGC.

The second identifying condition for the estimation of β_1 in equation 5.2, which yields the causal effect of FGC on education, requires that those ethnic groups with a larger pre-law prevalence of FGC experienced larger reductions in the prevalence of FGC following the introduction of the law. This condition would be satisfied if the parameter α_1 in equation 5.1 is large and statistically significant. The seminal works by Bound et al. (1995) and Angrist and Pischke (2008) propose that, in order to avoid a problem of *weak* instrument, the F-statistics of the instrumental variables in the first stage regression should be equal or larger than 10. Section 6.1 examines the *relevance* of our instrumental variable, showing that the statistical significance of α_1 largely satisfy this threshold in most specifications.

One potential concern with the identification of the effect of FGC on education is the accuracy of the FGC information, which in the DHS is either self-reported by the girl or reported by her mother depending on the age of the girl. The reporting of FGC status in settings where this cultural practice has been contested could be problematic (De Cao and Lutz, 2018). In principle, imperfect reporting could challenge our results in two different ways. On the one hand, inaccuracy in the reporting of FGC status may lead to a problem of measurement error eventually biasing the estimation of the effect of FGC on education towards 0. However, this measurement error should be less problematic if the instrumental variable used, measuring pre-law prevalence of FGC, reflects the relative intensity of this practice across the different ethnic groups. Additionally, and in order to fully overcome the problem, we also conduct the analysis using as instrumental variable a dichotomous measure of exposure to the law based on whether FGC was embedded in the culture of each ethnic group. This dichotomous measure of exposure to the law is unlikely measured with error and would provide an straightforward solution for the measurement error problem described in this paragraph.

One the other hand, it is also possible that the reporting of FGC status could be different among girls born before and after the introduction of the law. If the degree of underreporting increases dramatically among those cohorts of girls born after the introduction of the law, one could argue that the effects of the law on the reported prevalence of FGC could be also capturing an increase in the degree of underreporting of the practice and not only a reduction in the *true* prevalence of FGC. The latter may occur if the introduction of the law contributes to the stigmatization of FGC. However, although the law might have contributed to this stigmatization, the latter is unlikely to have affected differently the report of FGC among those girls born 1 or 2 years before and after the introduction of the law because all the surveys were collected at least 11 years after the ban.

Higher levels of underreporting among girls born after the ban on FGC was passed would also arise if the fear to confess a crime led these girls and their mothers to un-

derreport FGC more frequently than pre-ban cohorts. At this point, it is important to highlight that the prevalence of FGC was relevantly lower among girls born in 1999 and 2000 (after the introduction of the law) than among girls born in 1998 or 1997 (before the anti-FGC legislation was passed). We believe this drop is unlikely driven by differential reporting for three reasons. Firstly, enumerators are instructed to explain the confidential nature of the information provided and to conduct the interview without the presence of other household members (ICF, 2018). Secondly, the superficial knowledge of key aspects of the law documented by Shell-Duncan et al. (2013), eventually indicating that parents were unsure about the date in which the law was introduced, suggests that the differences in the reported prevalence of FGC among girls born 16 and 17 years ago and those born 18 or 19 years ago are unlikely driven by strategic misreporting in order to avoid the reporting of a crime. Finally, although most respondents might not know, the Senegalese law established a ten-years statutory term for criminal offenses and therefore, parents that cut girls born in 1999 or 2000 while infants were not legally accountable for this crime at the time of the surveys.

We investigate further the feasibility of fear-to-the-law underreporting of FGC in the following test. We examine whether the person reporting the FGC status of a girl in the survey -mother of the girl vs the girl- affects the magnitude of the drop in the probability of reporting FGC among those girls born after the introduction of the law. The hypothesis is as follows. If the drop in FGC for cohorts born after the introduction of the law is simply capturing fear to confess a crime, the reporting of FGC for girls born after the introduction of the law is arguably more likely by a person who is not accountable for the crime, particularly if the interview occurred when the parents are not present. Thus, we should observe that the drop in the prevalence of FGC among girls born after the introduction of the law is larger when the FGC status is reported by the mother. To test this hypothesis, we estimate the following regression:

$$\begin{aligned} FGC_{irt} = \delta_0 + \delta_1 Mother_i + \delta_2 (POST_t \times Mother_i) + \delta_3 YearBirth_t \\ + \delta_4 EthnicGroup_k + \delta_5 Village_r + \delta_5 Age_i + \mu_{ikrt} \end{aligned} \tag{5.3}$$

where $POST_t \times Mother_i$ is an interaction term between a dummy variable, *Mother*, that is equal to 1 if the FGC status is reported by the mother of the girl and 0 by the girl and a dummy variable, *POST*, that is equal to 1 if the girl is born after the introduction of the law. The results of this analysis are reported in table A2 in the appendix. The coefficient of the interaction term is negative, but small in magnitude and statistically insignificant at conventional confidence levels. This result suggests that the reporting of FGC does not change differently after the introduction of the law by whether this is self-reported or is reported by the mother of the girl. The lack of significance of δ_2 is consistent with

the hypothesis that the drop in the prevalence of FGC among those girls born after the introduction of the law is not simply capturing an stronger reluctance of these girls to report FGC.

6 Results

6.1 Effect of the law on the prevalence of FGC

We start by estimating the effect of exposure to the law on the prevalence of FGC using the sample that includes girls from all ethnic groups. The estimates of interest are reported in columns 3, 5 and 7 of Panel A of table 4, which report the results of the first stage regression (equation 5.1) using region fixed effects, then adding region-specific time trends and finally using village fixed effects. The coefficient of the variable $Intensity \times PostLaw$ in these regressions shows that girls from ethnic groups with higher pre-law incidence of FGC that were born after the introduction of the law experienced larger reductions in the probability of undergoing FGC than girls from ethnic groups where FGC was less prevalent. The estimates indicate that girls born after the introduction of the law that belong to an ethnic group that cut the 100% of the girls born before the law would experience a reduction in the probability of experiencing FGC of 16-25 percentage points, depending on the specification. The coefficient measuring the effect of the law is statistically significant at the 5% significance level in every specification and satisfy the relevance condition (F>10) when the regression is estimated using region-specific time trends.

We then re-estimate the regressions excluding from the analysis the girls from the two ethnic groups for which the prevalence of FGC started decreasing for cohorts born before the introduction of the law: Soninke and the category *Other ethnic group*. These two groups account for the 7% of the girls and excluding them from the sample ensures parallel pre-law trends in the prevalence of FGC and educational outcomes across ethnic groups. The results of this analysis are reported in Panel B of table 4 and they confirm the large effect of exposure to the law on the prevalence of FGC. As expected, the magnitude of the impact of the law on FGC is slightly larger than in Panel A and the statistical significance of this effect largely meets the relevance threshold in the three specifications. These results suggest that the increase in the cost of cutting caused by the introduction of the law led to a reduction in the prevalence of this practice.

In order to assess the timing of the effect of the law on the prevalence of FGC, we also estimate a leads and lags model interacting the variable measuring the pre-law prevalence

Table 4: Extensive margin: Impact of Female Genital Cutting on ever in school.

PANEL A: All ethnic groups

	OLS		IV		IV		IV	
	(1) Never in School	(2) Never in School	(3) Prevalence FGC (0/1)	(4) Never in School	(5) Prevalence FGC (0/1)	(6) Never in School	(7) Prevalence FGC (0/1)	(8) Never in School
Intensity × PostLaw	-0.059*		-0.238***		-0.157***		-0.247**	
	(0.031)		(0.090)		(0.036)		(0.102)	
FGC		0.083***		0.392**		0.281***		0.240*
		(0.011)		(0.178)		(0.098)		(0.123)
Mean Dep. var	0.364	0.364	0.327	0.364	0.327	0.364	0.327	0.364
Regional Dummies	No	No	Yes	Yes	Yes	Yes	No	No
Regional time trends	No	No	No	No	Yes	Yes	No	No
DHS Cluster dummies	Yes	Yes	No	No	No	No	Yes	Yes
N	28,425	28,425	28,425	28,425	28,425	28,425	28,425	28,425

PANEL B: Restricted sample ethnic groups

	OLS		IV		IV		IV	
	(1) Never in School	(2) Never in School	(3) Prevalence FGC (0/1)	(4) Never in School	(5) Prevalence FGC (0/1)	(6) Never in School	(7) Prevalence FGC (0/1)	(8) Never in School
Intensity × PostLaw	-0.064***		-0.236***		-0.164***		-0.245***	
	(0.015)		(0.053)		(0.037)		(0.055)	
FGC		0.079***		0.418**		0.315***		0.262**
		(0.011)		(0.173)		(0.071)		(0.108)
Mean Dep. var	0.374	0.374	0.318	0.374	0.318	0.374	0.318	0.374
Regional Dummies	No	No	Yes	Yes	Yes	Yes	No	No
Regional time trends	No	No	No	No	Yes	Yes	No	No
DHS Cluster dummies	Yes	Yes	No	No	No	No	Yes	Yes
N	26,517	26,517	26,517	26,517	26,517	26,517	26,517	26,517

Note: All the regressions include as control variables a vector of year of birth dummies, a variable for age at survey, a vector of ethnic group dummies, a dummy indicating whether the FGC condition is reported by the girl and a vector of dummies for survey rounds. Standard errors clustered at the ethnic group level using wild bootstrapping are reported in parentheses.***p<0.01;**p<0.05;*p<0.1

of FGC with the set of dummy variables that indicate the year of birth of the girl[16]. The

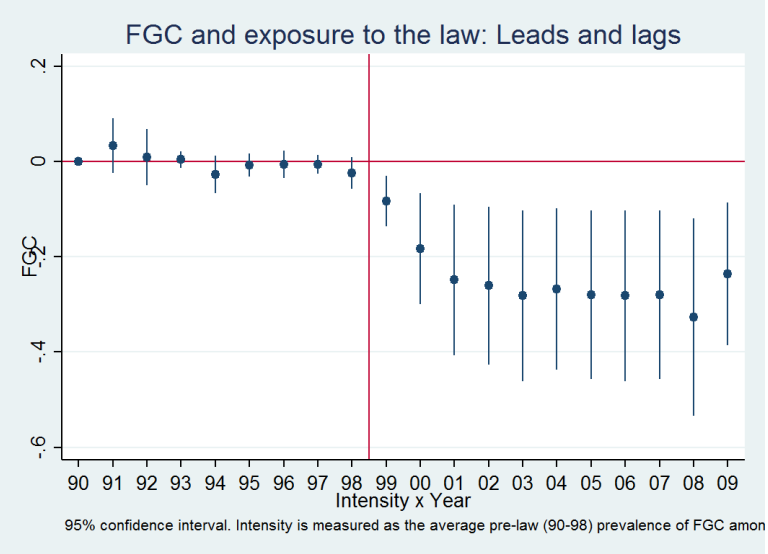
[16]The leads and lags model estimated is:

$$FGC_{ikrt} = \alpha_0 + \sum_{\tau=1991}^{1998} \alpha_{1\tau}(YearBirth_t \times LawIntensity_k) + \sum_{\tau=1999}^{2009} \alpha_{1\tau}(YearBirth_t \times LawIntensity_k) + \alpha_2 YearBirth_t + \alpha_3 EthnicGroup_k + \alpha_4 Region_r + \alpha_5 X_i + \mu_{ikrt} \quad (6.1)$$

where $(YearBirth_t \times LawIntensity_k)$ is a vector of variables constructed as the interaction of the pre-law average prevalence of FGC among ethnic group k with each year of birth dummy. These interaction variables are known in the literature as the lead and lag variables. In our specification, the lead variables are the interaction between average pre-law FGC prevalence among the ethnic group of the girl and the

model yields the differential variation in the prevalence of FGC across ethnic groups for each year of birth cohort relative to the 1990 cohort. Figure 3 displays the results of this analysis. The figure shows that exposure to the law reduced significantly the prevalence of FGC for those girls born the year where the law was introduced, doubled the following year, increased further the third year and then remained relatively stable. On the other hand, the evolution of FGC across cohorts of girls was not significantly different across ethnic groups for girls born before the introduction of the law. These results on the timing of the effect provide reassurance that the drop in the prevalence of FGC is caused by the law and dismiss the potential existence of anticipatory effects.

Figure 3: Leads and lags: Exposure to the law and FGC



6.2 Causal effect of FGC on educational investments

In this subsection, we examine the causal link between FGC and educational investments received by girls.

Column 2 of table 4 reports the *naive* statistical association between experiencing FGC and the probability of never attended school. The estimates show that conditional on ethnic group, age, year of birth and village of residence, girls that experienced FGC are

year of birth for those girls from cohorts born before the introduction of the law in January 1999. The lag variables are the interactions terms for those girls from cohorts born after the introduction of the law. The coefficients of the lead and lag variables yield the differential variation in the prevalence of FGC between girls from different ethnic groups across year of birth cohorts relative to those girls born in 1990, omitted category in the regression specification. The estimated coefficients of the lead variables provide an empirical test for the parallel trends condition. If these coefficients are small and statistically indistinguishable from 0, the prevalence of FGC across ethnic groups was arguably following the same trend before the introduction of the law, validating our empirical approach. Furthermore, the coefficients of the lag variables provide useful information on the timing of the effect of the law.

also 8 percentage points more likely to never attended school. However, these estimates should not be interpreted as the causal effect of FGC because the statistical association could be driven by unobservable factors such as attitudes towards tradition. In order to overcome the endogeneity in the link between FGC and educational investments and estimate the causal effect of FGC on education, we exploit the exogenous variation in the prevalence of FGC caused by across-ethnic group variation in exposure to the law.

The results of the reduced form equation of the effects of exposure to the law on educational outcomes are reported in column 1 of table 4 using all the ethnic groups (Panel A) and the restricted sample of ethnic groups with parallel pre-law trends (Panel B). The estimates are relatively similar and suggest that a higher degree of exposure to the law decreases the probability of never attended school. The coefficients measuring the causal effect of FGC on the probability of never attended school, corresponding to equation 5.2 estimated using the full and the restricted sample of ethnic groups are reported in columns 4, 6 and 8 of table 4. The coefficient of the variable FGC in these regressions indicates that FGC has a large and negative effect on the extensive margin of educational investments. An increase of 10 percentage points in the prevalence of FGC increases the probability of never attended school by 2.40-4.18 percentage points, depending on the regression specification and sample used. In percentage changes, a decrease by 30% in the prevalence of FGC would reduce the probability of never attended school by approximately 6-11%. The coefficient measuring the effect of FGC on the probability of never attended school is statistically significant at conventional confidence levels in all specifications. The estimates on the extensive margin of education suggest that many parents reacted to the rise in the cost of cutting caused by the law abandoning this practice and investing in daughters' education.

On the other hand, the results of the analysis suggest limited effects of FGC on the intensive margin of educational investments. Table 5 reports the estimates of the second stage regression using the village fixed effects specification and whether the girl has at least 1, 2, 3 and 4 years of education as dependent variables. The use of these outcome variables imposes constraints in the minimum age of girls that are included in the analysis. For example, for the estimation of the effect of FGC on having three or more years of education, we only include in the analytical sample girls equal or older than 10 years old (rather than 7), because this is the age at which girls that started school on time should have three years of education. The results of these regressions suggest that FGC reduces the probability of receiving one or two years of education. On the other hand, the effect of FGC on the probability of receiving 3 or more years of education is much smaller and statistically indistinguishable from 0. We re-estimate the intensive margin analysis using region fixed effects and region specific time trends for both samples in tables A5 and A6 in the appendix. The results of these analyses are consistent with those reported in table 5, with statistically significant results only for one or two years of education; and small and

insignificant coefficients for the effect of FGC on the probability of receiving 3 or more years of education.

Table 5: Intensive margin: Impact of Female Genital Cutting on Education.

PANEL A: All ethnic groups

	(1) Years of education≥1	(2) Years of education≥2	(3) Years of education≥3	(4) Years of education≥4
FGC	-0.222*	-0.161	-0.090	-0.039
	(0.118)	(0.122)	(0.187)	(0.188)
Mean dep. var	0.623	0.599	0.567	0.537
DHS Cluster dummies	Yes	Yes	Yes	Yes
N	25,817	23,346	21,382	19,283
First stage regression				
POST × Intensity	-0.228**	-0.202**	-0.182**	-0.151**
	(0.094)	(0.094)	(0.092)	(0.070)

PANEL B: Restricted sample ethnic groups

	(1) Years of education≥1	(2) Years of education≥2	(3) Years of education≥3	(4) Years of education≥4
FGC	-0.244**	-0.199**	-0.144	-0.074
	(0.101)	(0.082)	(0.192)	(0.207)
Mean dep. var	0.612	0.589	0.556	0.526
DHS Cluster dummies	Yes	Yes	Yes	Yes
N	24,060	21,726	19,900	17,945
First stage regression				
POST × Intensity	-0.226***	-0.199***	-0.181**	-0.149**
	(0.051)	(0.045)	(0.084)	(0.069)

Note: All the regressions include as control variables a vector of year of birth dummies, a variable for age at survey, a vector of ethnic group dummies, a dummy indicating whether the FGC condition is reported by the girl and village of residence fixed effects. Standard errors, reported in parentheses, are clustered at the ethnic group level using wild bootstrapping.***p<0.01;**p<0.05;*p<0.1

Jointly, these results suggest that the reduction in the prevalence of FGC caused by the law increased educational investments in the extensive margin but has little effect on the intensive margin. In other words, reducing the prevalence of FGC seems to increase educational investments among those girls that receive little or no education but not among those that attend school for some years. Finally, regarding the external validity of the

2SLS estimation, it is important to remark that the coefficients of the second stage regressions should be interpreted as the effect of FGC on educational investments for those girls that were uncut because they were exposed to the ban. These girls would arguably belong to law abiding households or live in areas where the capacity of formal institutions to enforce the law is strong.

7 Robustness checks

The previous section shows that undergoing FGC increases the probability of never attended school, although the effect on the intensive margin of educational investments is very limited. In this section, we check the robustness of these results to different falsification tests and to alternative explanations.

First, we re-examine the main results of the study setting falsely the introduction of the law in January 1995 (rather than 1999) and limiting the analysis to those girls born before the introduction of the *true* law in 1999. This placebo test is an additional robustness check for the parallel trends condition and the lack of anticipation effects. The main results of the study would be compromised if the estimates of equations 5.1 and 5.2 using exposure to the placebo law as instrumental variable show significant effects on the prevalence of FGC or on educational investments. The results of this falsification test are reported in columns 1 and 2 of table 6 and they support the argument that the effect of FGC on the extensive margin of educational investments identified above is not driven by pre-law differential trends across ethnic groups in terms of the prevalence of FGC or educational outcomes. These results are indeed consistent with the patterns observed in figure A4 and with those obtained in the leads and lags analysis presented in section 6.1. We also repeat the analysis setting artificially the introduction of the law in January 1993 and 1997. The coefficients of the first and the second stage equations estimated using these placebo laws as instruments, reported in table A3 in the appendix, are statistically indistinguishable from 0.

Second, we estimate the effect of the law on educational outcomes for boys. Because the law may affect educational investments received by boys with sisters exposed to the law, we restrict the analysis to boys aged 7 or older, born from 1990 and without any sister born after the introduction of the law that banned FGC. Although in principle we cannot dismiss the possibility that the introduction of the law could have had some spillovers effects operating via the job market or the marriage market on the education received by these boys, the estimates reported in column 3 of table 6 suggest that the law did not have any effect on the probability of never attended school or on the probability of completing at least four years of education for boys without any sister born after the introduction of the law.

Third, since restricting the analytical sample to those girls born from 1990 was to some degree arbitrary, we re-estimate the main regressions including in the analytical sample those girls born from 1980. The results of this exercise are reported in columns 4 and 5 of table 6 and show that the magnitudes of the effects of FGC on the probability of never attended school and on the intensive margin of educational investments are larger than the those found when the pre-law period is limited to those girls born from 1990. However, the statistical significance of these coefficients remain unchanged, broadly confirming the robustness of the results to the inclusion of older cohorts of girls.

Table 6: Robustness checks: Female Genital Cutting and Education.

	Placebo: law in 1995		Placebo: Sample of men	Pre-law period from 1980	
Panel A: Never in school (0/1)					
	(1) Prevalence FGC (0/1)	(2) Never in School	(3) Never in School	(4) Prevalence FGC (0/1)	(5) Never in School
Intensity × PostLaw	-0.005		0.006	-0.272***	
	(0.004)		(0.021)	(0.062)	
FGC		2.913			0.355**
		(3.752)			(0.147)
Mean dep var	0.365	0.407	0.338	0.338	0.462
DHS-cluster FE	Yes	Yes	Yes	Yes	Yes
N	12,560	12,560	4,924	38,358	38,358
Panel B: Years of education≥4 (0/1)					
	(1) Prevalence FGC (0/1)	(2) Years of education≥4 (0/1)	(3) Years of education≥4 (0/1)	(4) Prevalence FGC (0/1)	(5) Years of education≥4 (0/1)
Intensity × PostLaw	-0.005		0.004	-0.172**	
	(0.004)		(0.028)	(0.080)	
FGC		-3.167			-0.187
		(5.695)			(0.142)
Mean dep var	0.365	0.531	0.586	0.362	0.432
DHS-cluster FE	Yes	Yes	Yes	Yes	Yes
N	12,560	12,560	3,398	29,786	29,786

Note: Analytical sample restricted to the ethnic groups with parallel trends in terms of FGC among women born before the introduction of the law. All the regressions include as control variables a vector of year of birth dummies, a variable for age at survey, a vector of ethnic group dummies, a dummy indicating whether the FGC condition is reported by the girl and village of residence fixed effects. Standard errors, reported in parentheses, are clustered at the ethnic group level using wild bootstrapping.***p<0.01;**p<0.05;*p<0.1

Fourth, we also believe that the educational reforms and programs implemented in Senegal over the last decades are unlikely to confound the results of the study. The main aspects of the Senegalese educational system were established in the law number 91-22,

approved on February 1991, which sets free and compulsory education until the age of 16. Although the expansion of free education might have affected educational outcomes, even the oldest cohort of girls in the analytical sample started school a few years after the free primary education policy was established by the law. On the other hand, the Senegalese government and different NGOs implemented in the last couple of decades other educational programs aiming to improve the quality of education and expanding vocational education such as the Ten-Year Education and Training Program in 2000. Although these programs could have affected the educational investments received by girls, they would only confound the estimates reported in this study if conditional on village and year of birth, these programs affect differently the education of girls from different ethnic groups only for cohorts born after the introduction of the anti-FGC law. Furthermore, and given that those girls from ethnic groups that traditionally practice FGC are on average more educated, the effect is also unlikely driven by over-time convergence in school attendance among girls from ethnic groups that were less likely to attend school.

Table 7: Impact of Female Genital Cutting on Education (Excluding rural areas in Kolda, Thies and Fatick):

	Never in School (0/1)		Years of education≥4 (0/1)	
	(1) Prevalence FGC (0/1)	(2) Never in school	(3) Prevalence FGC (0/1)	(4) Years of education≥4
Intensity × PostLaw	-0.240***		-0.133**	
	(0.054)		(0.062)	
FGC		0.286**		-0.201
		(0.118)		(0.212)
Mean dep var	0.326	0.378	0.360	0.526
DHS cluster dummies	Yes	Yes	Yes	Yes
N	22,233	22,233	15,193	15,193

Note: Analytical sample restricted to the ethnic groups with parallel trends in terms of FGC among women born before the introduction of the law. All the regressions include as control variables a vector of year of birth dummies, a variable for age at survey, a vector of ethnic group dummies, a dummy indicating whether the FGC condition is reported by the girl and village of residence fixed effects. Standard errors, reported in parentheses, are clustered at the ethnic group level using wild bootstrapping.***p<0.01;**p<0.05;*p<0.1.

Fifth, in the last three decades different NGOs and activists have developed programs aiming to tackle FGC. The largest anti-FGC intervention in Senegal was conducted by

Tostan. Since early 90's, this NGO conducted a community-based program aiming to inform local communities about the health risks of FGC and promote community level anti-FGC declarations. Although the geographical scope of the intervention was limited, one may argue that the estimated effect of the law on the prevalence of FGC could be confounded by the impact of Tostan's program. Although the timing of the effect showed in figure 3 highlights the relevance of the law, we do not have household or village level information on participation in anti-FGC programs to fully rule out this possibility. Instead, we re-estimate the main results of the study excluding from the sample those girls living in rural areas of Kolda, Thies and Fatick regions, where the NGO conducted the vast majority of their Community Empowerment Programs (Yoder, 2008). The results of these analyses are reported in table 7. The estimates, very similar to those reported in the main estimations of the study, suggest that the effect of FGC on the extensive margin of educational investments identified in the main analysis is not confounded by the anti-FGC work that this NGO has been conducting in Senegal in the last decades.

Sixth, we estimate the main regressions using a dichotomous measure of exposure to the law. Instead of defining exposure as the mean prevalence of FGC within an ethnic group calculated from the sample of girls from this ethnic group born before the introduction of the law, we use a dummy variable that is equal to 1 if the ethnic group has traditionally practiced FGC. In this analysis, the girls from the Wolof and Serer ethnic groups, where the practice of FGC is rare, would constitute the control group (unexposed to the law) while girls from the rest of the ethnic groups in Senegal would constitute the treatment group (exposed to the law). Although using a dichotomous variable to define exposure to the law drops variation in the instrumental variable, the main advantage of this approach is that it provides an straightforward solution for an eventual measurement error problem caused by reporting error in the FGC status. Table 8 reports the results of the estimations on both the extensive and the intensive margin of educational investments when exposure to the law is defined using FGC vs non-FGC ethnic groups. The estimates and statistical significance of the coefficients measuring the effect of FGC on educational outcomes are remarkably similar to those obtained using the continuous measure of exposure to the ban.

Seventh, we examine the robustness of the results to the exclusion of non-Senegalese girls from the sample. Foreign girls are the 2.5 percent of the sample. Since the Senegalese law only granted the citizenship to the children of Senegalese citizens, many of the younger non-Senegalese girls were likely born in Senegal and therefore, subject to the anti-FGC legislation. Ideally, we would exclude from the main analytical sample those girls that were non-Senegalese and were not born in Senegal. However, since we lack information on birthplace, we include non-Senegalese girls in the main analytical sample. Nonetheless, we also test the robustness of the results to the exclusion of non-Senegalese girls. The results of this analysis, reported in table A4 in the appendix, show that limiting

Table 8: Impact of Female Genital Cutting on Education using dichotomous exposure to the law.

Panel A: Never in school (0/1)

	OLS		IV		IV		IV	
	(1) Never in School	(2) Never in School	(3) Prevalence FGC (0/1)	(4) Never in School	(5) Prevalence FGC (0/1)	(6) Never in School	(7) Prevalence FGC (0/1)	(8) Never in School
Exposed × PostLaw	-0.038**		-0.153***		-0.105**		-0.160***	
	(0.018)		(0.035)		(0.049)		(0.036)	
FGC		0.079***		0.395**		0.278**		0.239**
		(0.011)		(0.164)		(0.115)		(0.099)
Mean Dep. var	0.374	0.374	0.318	0.374	0.318	0.374	0.318	0.374
Regional Dummies	No	No	Yes	Yes	Yes	Yes	No	No
Regional time trends	No	No	No	No	Yes	Yes	No	No
DHS Cluster dummies	Yes	Yes	No	No	No	No	Yes	Yes
N	26,517	26,517	26,517	26,517	26,517	26,517	26,517	26,517

Panel B: Years of education≥4 (0/1)

	(1) Years of education≥4	(2) Years of education≥4	(3) Prevalence FGC (0/1)	(4) Years of education≥4	(5) Prevalence FGC (0/1)	(6) Years of education≥4	(7) Prevalence FGC (0/1)	(8) Years of education≥4
Exposed × PostLaw	0.007		-0.095**		-0.068**		-0.097***	
	(0.018)		(0.044)		(0.032)		(0.022)	
FGC		-0.087***		-0.149		0.104		-0.074
		(0.013)		(0.257)		(0.258)		(0.184)
Mean Dep. var	0.526	0.526	0.350	0.526	0.350	0.526	0.350	0.526
Regional Dummies	No	No	Yes	Yes	Yes	Yes	No	No
Regional time trends	No	No	No	No	Yes	Yes	No	No
DHS Cluster dummies	Yes	Yes	No	No	No	No	Yes	Yes
N	17,945	17,945	17,945	17,945	17,945	17,945	17,945	17,945

Note: Analytical sample restricted to the ethnic groups with parallel trends in terms of FGC among women born before the introduction of the law. All the regressions include as control variables a vector of year of birth dummies, a variable for age at survey, a vector of ethnic group dummies, a dummy indicating whether the FGC condition is reported by the girl and village of residence fixed effects. Exposed is a dummy variable equal to 1 if the girl belongs to an ethnic group where the practice of FGC is traditional (Mandingue, Diola, Poular or Non-Senegalese) and 0 if the girs belongs to an ethnic group where the practice of FGC is not traditional (Wolof and Serer). Standard errors, reported in parentheses, are clustered at the ethnic group level using wild bootstrapping.***p<0.01;**p<0.05;*p<0.1

the analysis to those girls with the Senegalese citizenship hardly changes the magnitudes and the statistical significance of the estimates.

Another potential concern with the estimation of the effect of FGC on the extensive margin of educational investments is that, since the cohorts of girls born before the introduction of the law were at least 11 years old at the time of the survey, the effects of FGC on the variable measuring whether a girl never attended school could be at least partially explained by school initiation at a later age among ethnic groups that did not practice FGC. In other words, girls aged 7-10 in the sample were all born after the introduction of the law and therefore, the estimates could be capturing a larger prevalence of late school initiation among non-FGC ethnic groups rather than a true effect of FGC on the probability of never attended school. With the objective of testing this hypothesis, we conduct

the following analyses. Firstly, we re-estimate the main regressions restricting the sample to girls equal or older than 8, 9 and 10 years old. In the data used in the analysis, school initiation after the age of 10 is extremely rare among every ethnic group[17]. The results of this analysis, reported in table 9, show that removing girls aged 7 to 9 from the analysis does not change relevantly the magnitude of the estimates. Secondly, we re-estimate the main analysis on the probability of never attended school including also the 2005, 2006 and 2008 DHS rounds. Through adding these datasets, the sample used in the analysis includes also girls aged 7-10 years old at the time of the survey that were born before the introduction of the law, improving the age-at-survey control variable in the regression. On the other hand, the lack of information on FGC status for girls born from 1990 in the DHS rounds 2005, 2006 and 2008 only allows for a reduced form estimation of the effect of exposure to the law on the probability of never attended school. The results of this robustness check are reported in table 10. The estimates of the effect of the law have the correct sign and are all statistically significant at conventional confidence levels. The results of these two analyses dismiss the hypothesis that the effect of FGC on the probability of never attended school is simply capturing a larger prevalence of late school initiation among girls from non-FGC ethnic groups.

Table 9: Impact of Female Genital Cutting on Education: Sample limited to older girls.

	(1) Never in school (0/1)	(2) Never in school (0/1)	(3) Never in school (0/1)	(4) Never in school (0/1)
FGC	0.262**	0.261**	0.243**	0.239**
	(0.108)	(0.108)	(0.100)	(0.111)
Mean dep. var	0.374	0.365	0.364	0.366
DHS Cluster dummies	Yes	Yes	Yes	Yes
N	26,517	24,060	21,726	19,900
Sample of girls	$\geq$ 7 years old	$\geq$ 8 years old	$\geq$ 9 years old	$\geq$ 10 years old
First stage regression				
POST $\times$ Intensity	-0.245***	-0.226***	-0.199***	-0.181**
	(0.055)	(0.051)	(0.045)	(0.084)

Note: Analytical sample restricted to the ethnic groups with parallel trends in terms of FGC among women born before the introduction of the law. All the regressions include as control variables a vector of year of birth dummies, a variable for age at survey, a vector of ethnic group dummies, a dummy indicating whether the FGC condition is reported by the girl and village of residence fixed effects. Standard errors, reported in parentheses, are clustered at the ethnic group level using wild bootstrapping.***p<0.01;**p<0.05;*p<0.1

[17]In our sample, less than 1.5% and 0.8% of children aged of 11 or 12 at the time of the survey initiated school that year. This pattern is not different across ethnic groups or across surveys.

Table 10: Impact of Female Genital Cutting on Education: Sample limited to older girls using all surveys available.

	(1) Never in school (0/1)	(2) Never in school (0/1)	(3) Never in school (0/1)	(4) Never in school (0/1)
POST × Intensity	-0.057**	-0.056***	-0.043***	-0.036***
	(0.026)	(0.013)	(0.010)	(0.008)
Mean dep. var	0.396	0.388	0.388	0.391
DHS Cluster dummies	Yes	Yes	Yes	Yes
N	41,869	38,548	35,421	32,980
Sample of girls	$\geq$ 7 years old	$\geq$ 8 years old	$\geq$ 9 years old	$\geq$ 10 years old

Note: Analytical sample restricted to the ethnic groups with parallel trends in terms of FGC among women born before the introduction of the law. All the regressions include as control variables a vector of year of birth dummies, a variable for age at survey, a vector of ethnic group dummies, a dummy indicating whether the FGC condition is reported by the girl and village of residence fixed effects. Standard errors, reported in parentheses, are clustered at the ethnic group level using wild bootstrapping.***p<0.01;**p<0.05;*p<0.1

8 Mechanisms

Section 6 showed that the reduction in the prevalence of FGC led to an increase in the extensive margin of educational investments, which is consistent with the substitution hypothesis. However, this drop may have occurred for other reasons. In order to test further the substitution hypothesis, one would ideally need to find a subsample of girls for which FGC do not improve marriage market outcomes. If parents increase educational investments to compensate for worse marriage market outcomes (e.g. lower probability of marriage, lower bride price, etc) among uncut girls, we would not observe any effect of FGC on education for this subsample of girls. Unfortunately, the 2010-2016 rounds of the Senegalese DHS lack information on perceived benefits of FGC practice. Thus, we investigate this mechanism through exploring the heterogenenous effects of FGC on education for different samples that differ in terms of the value of FGC in the marriage market. More specifically, we explore whether the effect of FGC on education is different in rural and urban areas. Because the value of FGC in the marriage market is higher in rural areas (Mackie, 2000; Kandala and Komba, 2015)[18], a larger effect of FGC on educational

[18]Mackie (2000) argues that urbanization enlarges marriage opportunities, reducing the negative consequences in the marriage market of not being cut. The paper also mentions the chapter written by I. O. Orubuloye, Pat Caldwell and John Caldwell in the same book that argues that the higher value of FGC in marriage markets in rural Yoruba (Nigeria) relative to urban Yoruba is explained by the fact that social

outcomes in rural settings would be consistent with the substitution mechanism.

We also examine whether the effect of FGC on education differs among wealthier and poorer households. A smaller effect of FGC on education in wealthier households, where investments in education would be less constrained and households might send girls to school regardless of whether they are cut, would be aligned with the conceptual framework described in the paper.

Table 11 shows the results of these analyses. The coefficients reported in columns 5 to 8 indicate that while the effect of FGC on the probability of never attended school is strong in rural areas, the magnitude of the impact is smaller and statistically indistinguishable from 0 at conventional confidence levels in urban areas. In line with these results, the coefficients reported in columns 1 to 4 show that while the magnitude of the effect of FGC on educational outcomes among the two wealthiest quintiles is small and statistically insignificant, the effect is remarkably large and significant for girls in the poorest three quintiles. On the other hand, we do not observe any effect of FGC on the probability of receiving 4 or more years of education among poor households. Taken together, the results of the analyses by wealth and location are consistent with the hypothesis that the effect of FGC on educational investments is driven by constrained parents abandoning FGC and investing in the education of uncut girls to protect them against potential welfare losses in the marriage market.

There are two other mechanisms through which FGC may reduce educational investments received by girls. Firstly, FGC may also work indirectly on education through affecting the age at marriage. In the context of a competitive marriage market where parents prefer to marry their daughters as soon as possible after menarche (Wahhaj, 2015; Moghadam, 2004), cut girls could be in a better position to marry at a younger age. Although the estimates are not causal and should be taken with caution, the analysis reported in table 1 documents the negative correlation between FGC and age at cohabitation for girls in the Senegalese DHS data. Since early marriage could lead to early school dropout (Field and Ambrus, 2008; Hicks and Hicks, 2015), one may argue that FGC could also reduce educational investments through lowering women's age at marriage.

However, although FGC may decrease the age at marriage, we believe this mechanism is unlikely to drive the observed educational impacts of FGC. The results presented in section 6 suggest that FGC has a limited effect on the intensive margin of educational investments. Specifically, the estimates reveal no effect of FGC on the probability of receiving 3 or more years of education, which should in principle be completed by the age of 10. Given the small impact on the intensive margin of education and that only 5% of girls older than 18 were cohabiting with their partner by the age of 14, it seems unlikely that the increase in educational investments caused by the law is driven by uncut girls

conventions are less enforceable in urban areas. In this line, Kandala and Komba (2015) argues that the practice of FGC in Senegal is a cultural and social norm embedded predominantly in rural settings.

Table 11: Impact of Female Genital Cutting on Education: Heterogenous effects

	Poorest three quintiles		Richest two quintiles		Urban sample		Rural sample	
Panel A: Never in school (0/1)								
	(1) Prevalence FGC (0/1)	(2) Never in School	(3) Prevalence FGC (0/1)	(4) Never in School	(5) Prevalence FGC (0/1)	(6) Never in School	(7) Prevalence FGC (0/1)	(8) Never in School
Intensity × PostLaw	-0.225***		-0.336***		-0.314***		-0.211***	
	(0.051)		(0.076)		(0.071)		(0.048)	
FGC		0.346**		0.033		-0.012		0.493**
		(0.143)		(0.058)		(0.069)		(0.248)
Mean dep. var	0.383	0.431	0.141	0.221	0.244	0.193	0.349	0.474
N	19,388	19,388	7,129	7,129	9,434	9,434	17,083	17,083
Panel B: Years of education≥4 (0/1)								
	(1) Prevalence FGC (0/1)	(2) Years of education≥4	(3) Prevalence FGC (0/1)	(4) Years of education≥4	(5) Prevalence FGC (0/1)	(6) Years of education≥4	(7) Prevalence FGC (0/1)	(8) Years of education≥4
Intensity × PostLaw	-0.122*		-0.245***		-0.201***		-0.124**	
	(0.066)		(0.055)		(0.046)		(0.058)	
FGC		-0.154		-0.156		0.050		-0.219
		(0.363)		(0.136)		(0.125)		(0.239)
Mean dep. var	0.426	0.459	0.163	0.690	0.274	0.711	0.396	0.412
N	12,762	12,762	5,183	5,183	6,827	6,827	11,118	11,118

Note: Analytical sample restricted to the ethnic groups with parallel trends in terms of FGC among women born before the introduction of the law. All the regressions include as control variables a vector of year of birth dummies, a variable for age at survey, a vector of ethnic group dummies, a dummy indicating whether the FGC condition is reported by the girl and village of residence fixed effects. Standard errors, reported in parentheses, are clustered at the ethnic group level using wild bootstrapping procedures.***p<0.01;**p<0.05;*p<0.1

marrying older.

A second alternative mechanism through which FGC may curb educational investments is its potential perverse impact on health. If health during childhood is a strong determinant of educational achievements and eventually reduce returns to education [19], FGC could also affect educational investments and school drop out through lastingly affecting the health of the girls. Although the literature is not homogeneous, some studies suggest that FGC is associated with negative physical health outcomes such as genital tissue swelling, menstrual problems, painful intercourse and difficulties during labor (Berg et al., 2014; Berg and Underland, 2013), while others found no or little effect on most of the outcomes analyzed, including sexual reproduction health (see for example Wagner (2015)). Although the existing evidence on the health consequences of FGC is inconclusive, severe complications during the cut are not rare and most of the evidence suggest an effect of FGC on the prevalence of sexually transmitted diseases. Thus, we cannot dismiss the possibility that the effect of FGC on education may also be driven by lasting effects of FGC on health, eventually leading to lower educational achievements.

The most straightforward way to test the health mechanism would be re-estimating equations 5.1 and 5.2 using health outcomes as dependent variables in the second stage equation. However, the databases used in the main analysis do not provide health information on anthropometric measurements, incidence of anemia and diarrhea for girls older than 5 years old implying that we do not observe key health outcomes for children born before the introduction of the anti-FGC law. To cope with this limitation, we add to the sample rounds 2005 and 1997 of the Senegalese DHS and rounds 2008 and 2006 of the Senegalese Malaria Indicator Survey (MIS). These databases include information on health outcomes for girls born before and after the introduction of the law that banned FGC. On the other hand, these rounds of the DHS and the MIS do not include information on FGC for young girls, limiting the analysis to reduced form estimations. In order to test the health mechanism, we estimate the effect of the law on health outcomes:

$$\begin{aligned} Health_{ikrt} =& \alpha_0 + \alpha_1 POST_t \times LawIntensity_k + \alpha_2 YearBirth_t + \alpha_3 EthnicGroup_k \\ &+ \alpha_4 Village_r + \alpha_5 X_i + \mu_{ikrt} \end{aligned} \tag{8.1}$$

where $Health_{ikrt}$ indicates the health status of girl i from the ethnic group k, living in village r and born during year t. We use different health variables including weight, height, anemia, diarrhea and whether the girl has a health card, aiming to measure health status and investments. The health variables analyzed correspond to the health-related questions that are available for girls below 5 in all survey rounds included. In equation 8.1, α_1 yields the effect of the degree of exposure to the law that banned FGC on health

[19] See for example Grantham-McGregor et al. (2007).

outcomes. If the parameter α_1 is consistently small and statistically insignificant across the different specifications, the effect of FGC on education is arguably not driven by any effect of FGC on health.

The results of this analysis are reported in table 12. The coefficients that measure the effect of the law on weight, height, anemia or the probability of having a health card are all statistically indistinguishable from 0 at conventional confidence levels. Only the probability of having diarrhea during the last 24 hours is statistically significant at the 10%. Overall, the results suggest that FGC may have limited effects on the health outcomes analyzed. On the other hand, the young age of most girls born after the introduction of the ban hampers the assessment of the effect of the law on sexual and reproductive health outcomes. Indeed, one may argue that the effect of FGC on education could be caused by cut teenage girls dropping from school due to poor sexual and reproductive health outcomes, which might not be reflected in the health variables analyzed. However, most of the effects of FGC on sexual and reproductive health (e.g. irregular menstruation, painful intercourse, etc) are unlikely to impact girls' education before teenage. Hence, the fact that FGC has a large impact on the probability of never attended school but little on the probability of finishing 3 or more years of education suggests that the beneficial effect of reducing FGC on educational investments observed does not seem to be driven by poor sexual and reproductive health among girls that undergo FGC.

Table 12: Impact of Female Genital Cutting Ban on Health Outcomes and Investments:

	(1) Ln Weight (kg 1 dec)	(2) Ln Height (cm 1 dec)	(3) Anemia (0/1)	(4) Diarrhea last 24 h(0/1)	(5) Health card (0/1)
Intensity × PostLaw	-0.006	0.014	-0.043	-0.054*	-0.001
	(0.036)	(0.017)	(0.039)	(0.032)	(0.009)
Mean dep variable	176.828	964.768	0.328	0.175	0.905
DHS Cluster FE	Yes	Yes	Yes	Yes	Yes
N	13,965	13,763	15,158	19,656	18,413

Note: Analytical sample restricted to the ethnic groups with parallel trends in terms of FGC among women born before the introduction of the law. All the regressions include as control variables a vector of year of birth dummies, a quadratic polynomial for age at survey, a vector of ethnic group dummies, village of residence fixed effects, a dummy indicating whether a women is born after the introduction of the law and a variable indicating 1980-1998 average pre-law incidence of FGC for the ethnicity of the woman. Standard errors, reported in parentheses, are clustered at the ethnic group level using wild bootstrapping.***p<0.01;**p<0.05;*p<0.1

9 Conclusions

Through showing that the introduction of a law in Senegal that banned the practice of FGC reduced significantly the prevalence of FGC, the study contributes to the thin literature that investigates the effectiveness of legal reforms as policy instruments to tackle harmful traditional practices in developing countries. The study provides evidence consistent with previous studies that find that the introduction of laws reduced the prevalence of child marriage in Ethiopia (Garcia-Hombrados, 2017) and FGC in Burkina Faso (Crisman et al., 2016). More specifically, the results support the introduction of anti-FGC legislation in the many countries where the practice is widespread but still not regulated (Allen et al., 2015), highlighting also that these laws could also have some beneficial consequences in terms of human capital accumulation among women.

Secondly, the study provides the first causal estimates on the effect of FGC on education, documenting the negative effects of this practice on the extensive margin of educational investments, particularly among poor people. Finally, we believe the main contribution of the paper is widening our understanding of this practice by showing how parents perceived FGC and educational investments as substitutes in the marriage market and the extent to which their investment decisions are sensitive to increases in the relative costs of FGC and education. The results open the debate on whether interventions aiming to lower the value of FGC in the marriage market or to bring down the cost of education could be effective strategies to reduce the prevalence of FGC.

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A Appendix: Additional tables and figures

Table A1: Descriptive statistics for variables used in correlations between marriage, fgc and education (girls aged 15-49):

Variable	N	Mean	SD	Min	Max
No education	38527	0.57	0.495	0	1
Primary education	38527	0.204	0.403	0	1
Secondary educ or higher	38527	0.226	0.418	0	1
Years of education	38527	3.02	4.07	0	21
FGC	38527	0.39	0.488	0	1
Age	38527	27.8	9.31	15	49
Age at first cohabitation	27749	18.1	4.44	8	48
Married	38485	0.681	0.466	0	1
Partner years of education	25189	1.86	4.06	0	21

Table A2: The law and the reporting FGC:

	(1) Prevalence FGC (0/1)
Mother reports	-0.050***
	(0.011)
Post × Mother reports	-0.022
	(0.032)
Ethnic group dummies	Yes
Year of birth dummies	Yes
DHS Cluster dummies	Yes
N	28,425

Note: Regression includes as control variables a vector of year of birth dummies, a variable for age at survey, a vector of ethnic group dummies and village-level dummies. Standard errors, reported in parentheses, are clustered at the ethnic group level using wild bootstrapping.***p<0.01;**p<0.05;*p<0.1

Table A3: Introduction of placebo laws: Female Genital Cutting and Education.

	Placebo: law in 1993		Placebo: law in 1995		Placebo: law in 1997	
Panel A: Never in school (0/1)						
	(1) Prevalence FGC (0/1)	(2) Never in School	(3) Prevalence FGC (0/1)	(4) Never in School	(5) Prevalence FGC (0/1)	(6) Never in School
Intensity × PostLaw	-0.019		-0.005		-0.017	
	(0.016)		(0.004)		(0.012)	
FGC		-0.913		2.913		0.605
		(1.176)		(3.752)		(1.586)
Mean dep var	0.365	0.407	0.365	0.407	0.365	0.407
DHS-cluster FE	Yes	Yes	Yes	Yes	Yes	Yes
N	12,560	12,560	12,560	12,560	12,560	12,560
Panel B: Years of education≥4 (0/1)						
	(1) Prevalence FGC (0/1)	(2) Years of education≥4 (0/1)	(3) Prevalence FGC (0/1)	(4) Years of education≥4 (0/1)	(5) Prevalence FGC (0/1)	(6) Years of education≥4 (0/1)
Intensity × PostLaw	-0.019		-0.005		-0.017	
	(0.016)		(0.004)		(0.012)	
FGC		0.496		-3.167		-1.044
		(1.062)		(5.695)		(1.068)
Mean dep var	0.365	0.531	0.365	0.531	0.365	0.531
DHS-cluster FE	Yes	Yes	Yes	Yes	Yes	Yes
N	12,560	12,560	12,560	12,560	12,560	12,560

Note: Analytical sample restricted to the ethnic groups with parallel trends in terms of FGC among women born before the introduction of the law. All the regressions include as control variables a vector of year of birth dummies, a variable for age at survey, a vector of ethnic group dummies, a dummy indicating whether the FGC condition is reported by the girl and village of residence fixed effects. Standard errors, reported in parentheses, are clustered at the ethnic group level using wild bootstrapping.***p<0.01;**p<0.05;*p<0.1

Figure A1: Marriage over life course in Senegal

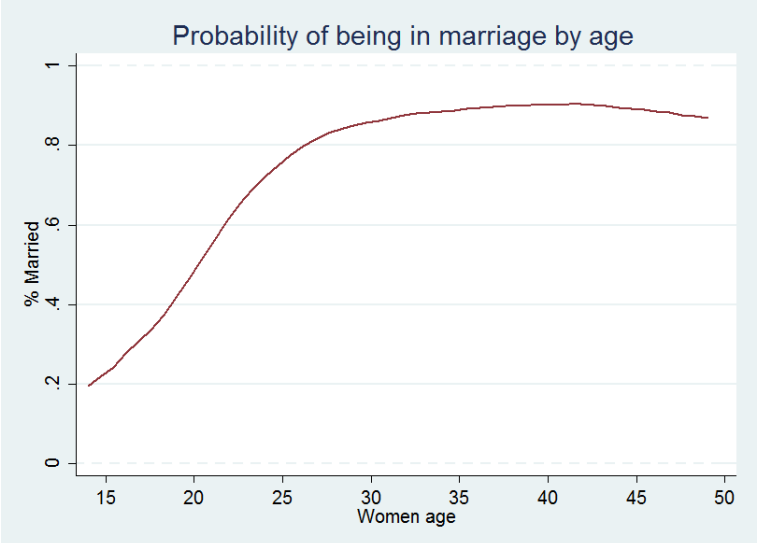

Table A4: Impact of Female Genital Cutting on Education (Excluding from the sample ethnic categories: Other, not a Senegaleses and Soninke):

	Never in School (0/1)		Complete Primary Education (0/1)	
	(1) Prevalence FGC (0/1)	(2) Never in school	(3) Prevalence FGC (0/1)	(4) Complete Primary Education
Intensity × PostLaw	-0.248***		-0.152*	
	(0.056)		(0.082)	
FGC		0.223**		-0.004
		(0.104)		(0.049)
Mean dep. var	0.310	0.372	0.341	0.529
DHS cluster dummies	Yes	Yes	Yes	Yes
N	25,911	25,911	17,518	17,518

Note: All the regressions include as control variables a vector of year of birth dummies, a variable for age at survey, a vector of ethnic group dummies, a dummy indicating whether the FGC condition is reported by the girl and village of residence fixed effects. Standard errors, reported in parentheses, are clustered at the ethnic group level using wild bootstrapping procedures.***p<0.01;**p<0.05;*p<0.1

Figure A2: Probability of never in school across cohorts (only girls≥10):

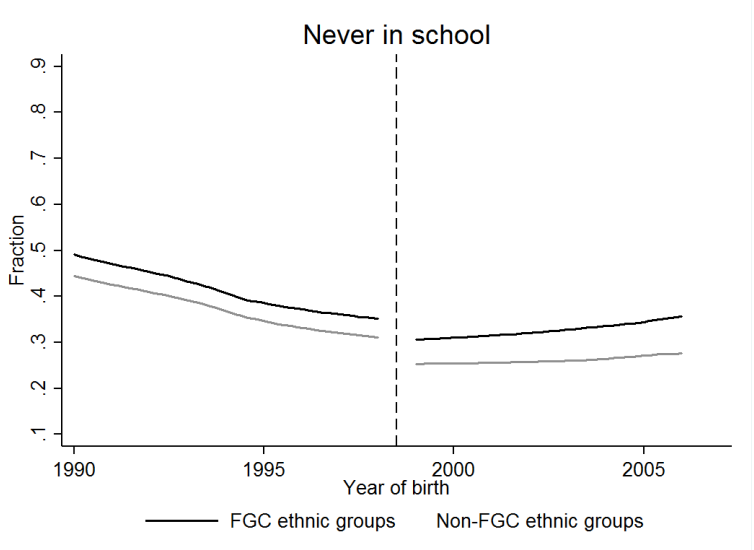

Figure A3: FGC and the intensive margin of educational investments. All ethnic groups: Dichotomous treatment

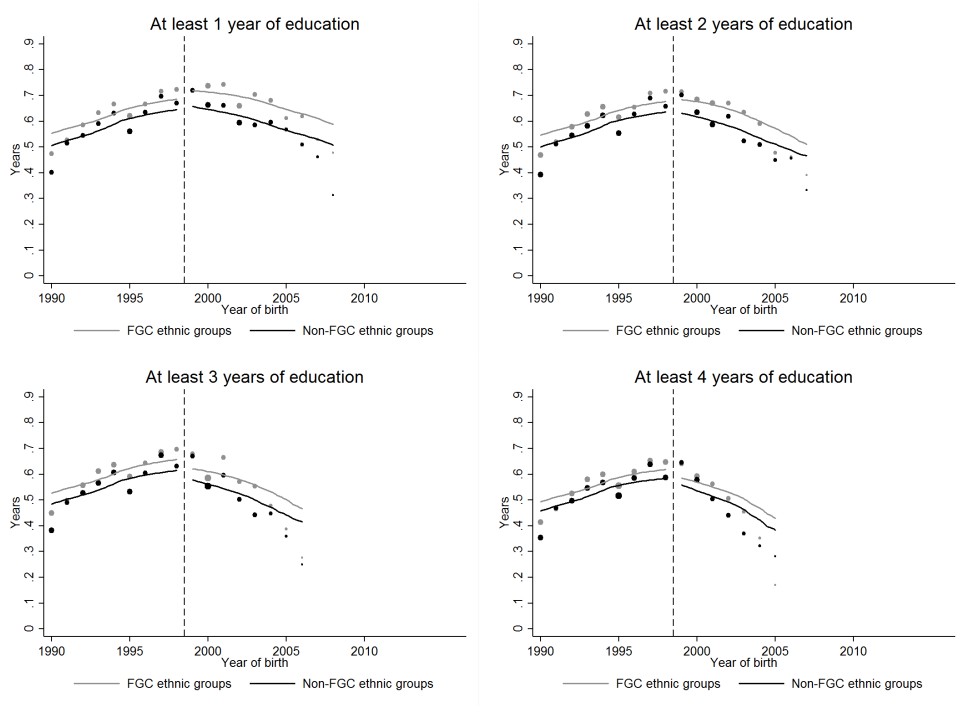

Figure A4: FGC and educational outcomes. Restricted sample of ethnic groups: Continuous treatment

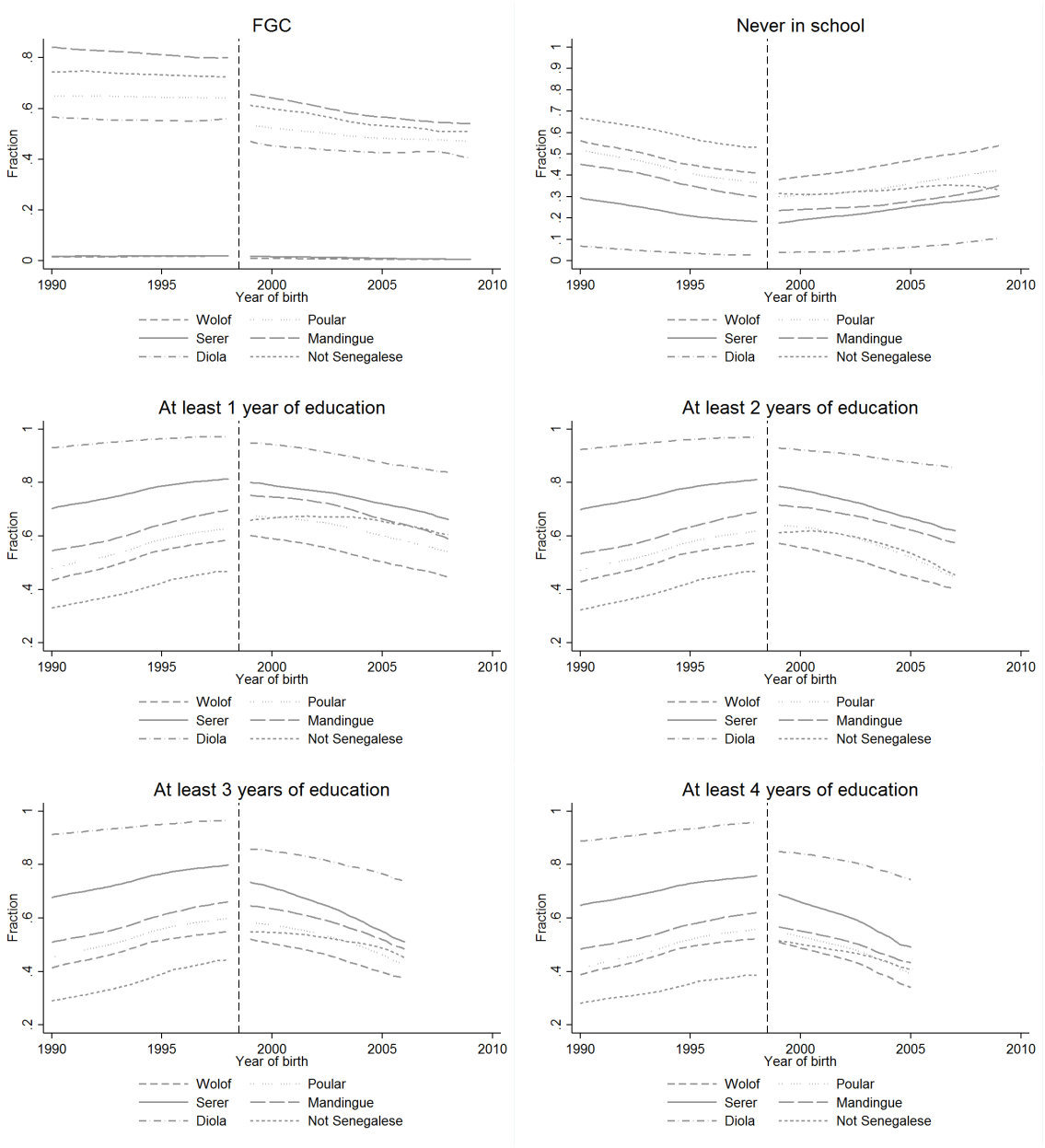

Figure A5: FGC and educational outcomes. Restricted sample of ethnic groups: Dichotomous treatment

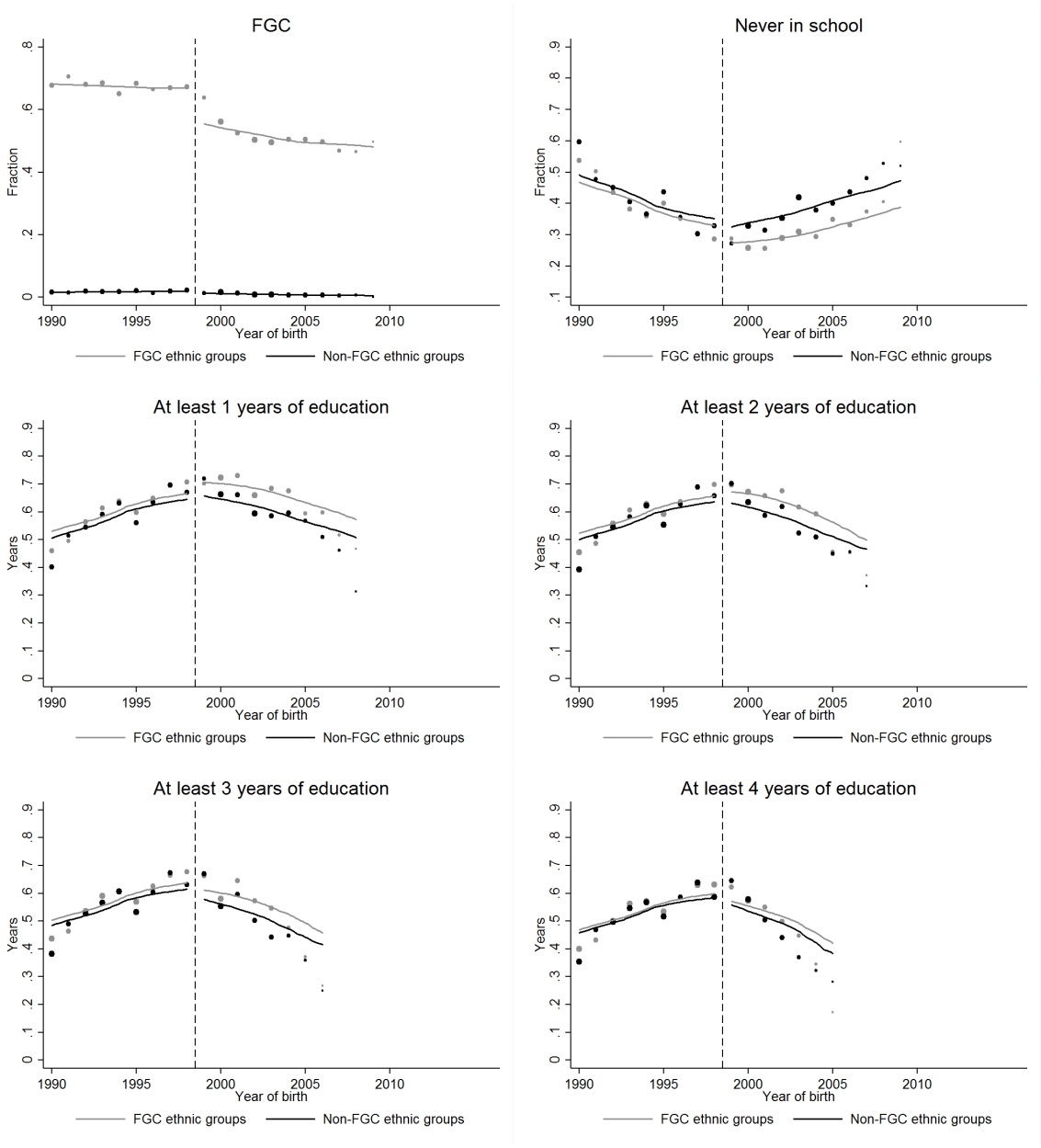

Table A5: Intensive margin: Impact of Female Genital Cutting on Education (with and without regional time trends). Restricted sample of ethnic groups.

	(1) Years of education≥1	(2) Years of education≥2	(3) Years of education≥3	(4) Years of education≥4
FGC	-0.391**	-0.322**	-0.249*	-0.158
	(0.162)	(0.133)	(0.141)	(0.244)
Mean dep. var	0.612	0.589	0.556	0.526
Regional dummies	Yes	Yes	Yes	Yes
Regional time trends	No	No	No	No
N	24,060	21,726	19,900	17,945
First stage regression				
POST × Intensity	-0.220***	-0.198***	-0.181***	-0.146***
	(0.050)	(0.045)	(0.041)	(0.033)

	(1) Years of education≥1	(2) Years of education≥2	(3) Years of education≥3	(4) Years of education≥4
FGC	-0.249**	-0.142	0.000	0.089
	(0.116)	(0.166)	(0.004)	(0.566)
Mean dep. var	0.612	0.589	0.556	0.526
Regional dummies	Yes	Yes	Yes	Yes
Regional time trends	Yes	Yes	Yes	Yes
N	24,060	21,726	19,900	17,945
First stage regression				
POST × Intensity	-0.157***	-0.144***	-0.134***	-0.106***
	(0.036)	(0.033)	(0.030)	(0.024)

Note: All the regressions include as control variables a vector of year of birth dummies, a variable for age at survey, a vector of ethnic group dummies, a dummy indicating whether the FGC condition is reported by the girl and a vector of dummies for survey rounds. Standard errors, reported in parentheses, are clustered at the ethnic group level using wild bootstrapping.***p<0.01;**p<0.05;*p<0.1

Table A6: Intensive margin: Impact of Female Genital Cutting on Education (with and without regional time trends). All ethnic groups.

	(1) Years of education≥1	(2) Years of education≥2	(3) Years of education≥3	(4) Years of education≥4
FGC	-0.361**	-0.282**	-0.201	-0.139
	(0.182)	(0.131)	(0.166)	(0.230)
Mean dep. var	0.623	0.599	0.567	0.537
Regional dummies	Yes	Yes	Yes	Yes
Regional time trends	No	No	No	No
N	25,817	23,346	21,382	19,283
First stage regression				
POST × Intensity	-0.222***	-0.201**	-0.184**	-0.151**
	(0.083)	(0.089)	(0.085)	(0.073)
	(1) Years of education≥1	(2) Years of education≥2	(3) Years of education≥3	(4) Years of education≥4
FGC	-0.216**	-0.093	0.104	0.151
	(0.107)	(0.172)	(0.231)	(0.305)
Mean dep. var	0.623	0.599	0.567	0.537
Regional dummies	Yes	Yes	Yes	Yes
Regional time trends	Yes	Yes	Yes	Yes
N	25,817	23,346	21,382	19,283
First stage regression				
POST × Intensity	-0.151***	-0.139***	-0.127***	-0.100***
	(0.034)	(0.031)	(0.029)	(0.023)

Note: All the regressions include as control variables a vector of year of birth dummies, a variable for age at survey, a vector of ethnic group dummies, a dummy indicating whether the FGC condition is reported by the girl and a vector of dummies for survey rounds. P-values based on Wild Cluster bootstrapping at the ethnic group level in parentheses.***p<0.01;**p<0.05;*p<0.1

B Appendix: Theoretical model

In this appendix we develop a model that formalizes the role of FGC and education as pre-marital investments described in section 2. Our goal is to determine the response of the educational choice when the cost of FGC increases.

We understand the problem as the daughter's utility maximization, but the amount of education and FGC choice are parental decisions. A key assumption of the model is perfect altruism: parents take investment decisions considering only their daughter's utility. In a context where marriage payments from groom's family to bride's family are frequent, this assumption might not hold. Following Ashraf et al. (2016), we are currently working on expanding the model to relax this assumption. On the other hand, incorporating bride price and the utility of the parents in the maximization problem will not change the main predictions of the model if marriage payments received by the family of the bride positively depend on bride's education and FGC status.

In the current version of the model, girls live two periods, premarital investments take place in the first period and the payoff of schooling and FGC are realized in the second period. The utility function takes the following form:

$$u(c_1, c_2) = u(c_1) + \frac{E[u(c_2)]}{1+r} \tag{B.1}$$

In the second period girls face two possible outcomes, marrying or staying single. For simplicity, we assume an exponential utility function $u(c_t) = -e^{-c_t}$, which is increasing in consumption ($u_c > 0$) at a decreasing rate ($u_{cc} < 0$). Consistent with the existing evidence for Senegal (Yoder and Wang, 2013), we assume that pre-marital investments are parental decisions that occur in early childhood and parents decide to cut the girl or not, depending on the incurred cost.

In the first period households are endowed with w and two investments for girls are possible: education and cutting. Let's denote γ a variable that indicates whether a girl is cut, and σ its relative cost to the cost of education.

Accordingly, consumption in the first period is:

$$c_1 = w - i - \sigma\gamma \tag{B.2}$$

The payoffs of cutting and education investments are realized in the second period differently. Firstly, the model assumes that educational investments i lead to higher consumption in the second period. This reflects both the positive returns to education on consumption and the assortative mating hypothesis. On the other hand, in line with evidence from Wagner (2015) and Chicoine (2018), the probability of marriage π in the model is not directly affected by the educational investments. Secondly, the model assumes that in the marriage market, cut girls have a higher probability of marrying. We denote the

probability of marriage by $\pi(\gamma)$, which is increasing with the cutting decision $\pi_\gamma > 0$. The girls that marry enjoy *ceteris paribus* a higher level of consumption. The positive returns to marriage are formalized as a surplus attached to the educational investment, ϕi, where $\phi > 1$ is the surplus relative to education returns. Model assumptions about the channels through which education and FGC would affect the consumption of women in the second period are backed by the evidence discussed in section 2.

Formally, expected consumption for single and married women in period two are:

$$c_S = i \tag{B.3}$$

$$c_M = \phi i \tag{B.4}$$

The maximization problem is:

$$U = u(w - \sigma\gamma) + \frac{\pi(\gamma)u(\phi i) + [1 - \pi(\gamma)]\, u(i)}{1 + r} \tag{B.5}$$

The first order conditions for γ and i are:

$$\sigma e^{\gamma\sigma + i - w} = \frac{1}{r+1}\left[e^{-i}\frac{d\pi}{d\gamma} - e^{-i\phi}\frac{d\pi}{d\gamma}\right] \tag{B.6}$$

and

$$e^{\gamma\sigma + i - w} = \frac{1}{r+1}\left[\phi\pi e^{-i\phi} + (1-\pi)\, e^{-i}\right] \tag{B.7}$$

Using these two equations we can derive the elasticity of σ on the education decision, i:

$$\frac{\partial i}{\partial \sigma} = \frac{\frac{\partial \pi}{\partial \gamma}}{(\phi - 1)\left[\sigma^2\pi(1-\pi) + \sigma(2\pi - 1)\frac{\partial \pi}{\partial \gamma} - \left[\frac{\partial \pi}{\partial \gamma}\right]^2\right]} \tag{B.8}$$

Which is positive for large costs associated with FGC and when the overall probability of marriage is more than $1/2$[20]. In this context we can formulate our first prediction.

Prediction 1: *Increasing the relative cost of cutting leads to a decrease in the prevalence of FGC and to an increase in schooling investment as substitution*

From equation B.8, our model also yields a prediction based on the relation between FGC and the probability of marrying.

[20] In our data set, 68% of women are married.

Prediction 2: *If cutting has no effect on the probability of marrying (i.e.* $\frac{\partial \pi}{\partial \gamma} = 0$*), changes in the relative cost of FGC have no effect on the education investment decision*

The second prediction also implies that in contexts where cutting is a key feature in the marriage market, thus increasing particularly the probability of mating, an increase in the cost of cutting leads to a stronger response of the schooling decision.

These two predictions are tested in sections 6 and 8. The effects of the law reducing the prevalence of FGC and raising the extensive margin of educational investments, and the stronger substitution effect in areas where the value of FGC in the marriage market is larger yield widespread support for the predictions of the model.