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Female Genital Cutting and Long-term Adjustment of Marriage Markets: Evidence from West Africa[†]

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Abstract

The abandonment of female genital cutting (FGC) may reduce women's welfare if FGC improves their marriage prospects. This study explores whether and how the abandonment of FGC is associated with women's marriage in the long term. A game-theoretic model developed to formalize the well-known theory of marriage convention reveals that an increase in the cost of FGC induces a social change from an FGC to a no-FGC equilibrium, wherein all (no) females in a community are cut in the former (latter), while possibly reducing compensation previously paid by men to a married woman for the costly FGC and, thus, her welfare. To test this prediction, this study exploits a unique, potentially ubiquitous identification setting and first provides evidence consistent with the view that Burkina Faso's FGC-discouraging political efforts increased the cost of FGC as perceived by those who reside in the borderlands of its neighboring countries due to cross-border knowledge spillovers while reducing the cutting rate. However, this external policy shock only trivially affected a range of young women's marital outcomes in the borderlands. Thus, from the mating perspective, women's welfare may not markedly decline concomitantly along with the decline in FGC.

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1 Introduction

Female genital cutting (FGC) is a traditional practice that involves partial or total removal of external female genitalia or other injury to female genital organs for cultural or other non-medical reasons.[1] With more than three million infants and children being exposed to FGC every year, currently, more than 200 million women are believed to have undergone this procedure in 30 countries across Africa, the Middle East, and Asia (WHO, 2016). This practice is seen as a fundamental violation of human rights, subjecting girls to both the immediate (e.g., pain, hemorrhage, and urinary tract infections) and long-lasting traumatic health risks (e.g., infertility, sexual problems, and labor complications) (e.g., Berg and Underland, 2013; Obermeyer, 2005; Wagner, 2015; Whitehorn et al., 2002). As a consequence, significant and increasing political effort has been expended since the early 1990s, at international, national, and local levels, to eliminate FGC (e.g., UNFPA and UNICEF, 2014). The Sustainable Development Goals established in 2015 also include a specific target calling for the eradication of FGC by 2030 (Goal 5.3).

An implicit assumption underlying this global political effort is that the abandonment of FGC improves women's welfare, although political interest appears to have outpaced the understanding of the implications of this practice. On the one hand, eradicating FGC is likely to reduce unfavorable heath consequences for women and/or improve their human rights; indeed, the present policy discourse is largely built on this consideration (Shell-Duncan, 2008). On the other hand, it has anecdotally been mooted that FGC is required for a proper marriage in Africa (see Shell-Duncan and Hernlund, 2000 for an overview). If FGC signals qualities of brides that grooms value, such as aesthetics, cleanliness, faithfulness, and virginity as often referred to in anthropological and sociological studies and, thus, improves women's marriage prospects (e.g., Chesnokova and Vaithianathan, 2010), this assumption may not necessarily hold true.

While an emerging body of economic research has recently begun exploring FGC (e.g., Bellemare et al., 2015; Camilotti, 2015; Coyne and Coyne, 2014; Efferson et al., 2015; Vogt et al., 2016), there is still a lack of clarity on the welfare implications of this practice. To fill this knowledge gap, this study explores how the abandonment of FGC is associated with women's marriage in the long term.

To address this issue, first, a simple model is developed to formalize the widely known theory of marriage convention, as proposed outside economics by Mackie (1996). While recent studies both support and reject the marriage convention hypothesis (e.g., Hayford, 2005; Shell-Duncan et al., 2011) or even doubt the idea of social convention (e.g., Bellemare et al., 2015; Efferson et al., 2015), the decline in FGC in the well-known Senegalese Tostan Project is still seen as proof of this

[1] Historical debates exist about the terminology used to describe this practice (Shell-Duncan and Hernlund, 2000). While the term FGC is used in the present study due to its neutrality, other terms are also interchangeably applied.

hypothesis, and has attracted significant interest from relevant policymakers and practitioners (e.g., Diop and Askew, 2009; Mackie, 2000). Therefore, it is suggested that analyzing the relationship between FGC and women's marriage based on this influential theory is meaningful.

Mackie (1996) proposed a conceptual game-theoretic framework to explain the presence of FGC, wherein this practice persists as a social convention in Africa's typical intra-marrying communities when men believe that uncircumcised women are not faithful and women believe that men would not marry uncircumcised women.[2][3] This insight suggests that FGC corresponds to a within-economics concept of social norms as defined in Young (2008, 2015) (and adopted in the present study), namely a group-level behavior that is maintained as one of multiple self-enforcing equilibria in a suitably defined game,[4] and as particularly supported by men's and women's motive to coordinate the marital exchange.

To formalize this idea, the present study developed an extensive-form game with two agents, i.e., men and women (or their parents), who play in an intra-marrying community. In this game, two stable pure strategy subgame perfect equilibria, i.e., FGC and no-FGC equilibria, exist, wherein all (no) females in a community are circumcised in the former (latter). The FGC equilibrium is inferior to the no-FGC equilibrium because community members in the former incur the cost of FGC impairing women's health (i.e., coordination failure).

According to the model, the abandonment of FGC implies a social change from the FGC to the no-FGC equilibrium. For example, an increase (decrease) in the cost (benefit) of FGC perceived by community members induces the equilibrium shift. Since this equilibrium shift keeps couples randomly matched in marriage markets with respect to an FGC decision, the abandonment of FGC would exhibit no relationship with female marriage probability. However, this equilibrium shift may "reduce" married women's welfare. This is because men in the FGC equilibrium would have to provide married women with more livelihood support than men in the non-FGC equilibrium, in compensation for the health-impairment costs of FGC borne by circumcised women.[5] The possibility that the abandonment of FGC harms (benefits) married women (married men) is not noted in Mackie (1996) and thus makes women's marital outcomes more worthy of investigation, although it admittedly depends on the model assumptions.

[2] Mackie (1996) also proposes a hypothesis on the origin of FGC as well as the marriage convention hypothesis.

[3] In addition to Mackie (1996)'s convention theory, modernization theory and feminist theory are proposed outside economics to explain the persistence of FGC (see Yount, 2002, for example). In these theories, it is posited that an increase in the availability of women's options that do not rely on FGC (i.e., job opportunities and property rights) eradicates FGC.

[4] In contrast to Mackie and LeJeune (2009), the terms social convention and social norm are used interchangeably herein because these two concepts are equivalent according to this definition.

[5] While these findings emanate from a specific marriage-related practice, similar reasoning may also apply to some, if not all, elements of the theoretical mechanisms sustaining various modern health-related practices (e.g., orthodontic treatment for children, plastic surgery), which are common in some countries but not in others, if those practices are related to male or female marriageability or success in life.

The theoretical analysis yields two important implications for the subsequent empirical analysis. First, no causal relationship between FGC and women's marriage is likely to exist in the long term. Second, and relatedly, people's perceptions about the benefits and costs of FGC causally determine these two practices in a simultaneous manner. These two implications motivate the present study to identify a policy shock raising people's awareness about the costs of FGC (relative to its benefits) and to empirically analyze the impacts of this shock on both FGC and women's marriage (rather than examining the theoretically unlikely causal effects of FGC on women's marriage).

In the empirical analysis, a unique setting characterized by two factors is exploited. First, it is widely held that Burkina Faso is one of the pioneering African States engaging in the fight against FGC with strong political commitment thereof and success in reducing its prevalence (Colombo, 2013; Diop et al., 2008; UNFPA, 2010). Second, most of Africa's national boundaries were arbitrarily drawn during the late 1800s and often partition people belonging to one ethnic group, and thus the same culture is often shared in two or more countries (Herbst, 1989); consequently, cross-border social interactions such as marriage and market meetings commonly take place in this region. Taken together, it is hypothesized that Burkina Faso's political efforts increased the relative cost of FGC perceived by those who reside in communities (located close to Burkina Faso) of its neighboring countries because of cross-border social interactions and the resulting FGC-relevant knowledge spillovers while reducing the rate of FGC in the borderlands. The author's field observations in one of these borderlands also supported this possibility.

Accordingly, exploiting data from female respondents aged 15—49 drawn from multiple rounds of the Standard Demographic and Health Surveys (DHS) in four countries bordering Burkina Faso, i.e., Benin (2001, 2011—12), Côte d'Ivoire (1998—99, 2011—12), Mali (2001, 2006, 2012—13), and Togo (2013—14), this study compares the prevalence of FGC between communities located close to Burkina Faso and the inland communities before and after this country expended political efforts to eradicate FGC (after controlling for year-of-birth and community fixed effects). Since such efforts have been expended since 1990, the data permits analysis of policy consequences on FGC and women's marital outcomes more than 20 years later.

The findings yielded by this difference-in-differences (DID) approach are consistent with the view that the practice of FGC declined in borderlands due to spillover effects stemming from Burkina Faso's political efforts. This conclusion is robust to alternative controls (e.g., border conflict, household fixed effects), linear time trends specific to each community, analyses exploiting separate sub-samples (e.g., each country), assessment of bias attributable to unobservables (Oster, forthcoming), non-linear model specifications (i.e., logit, ordered logit), and multiple-hypothesis testing. Decline occurs fast; this century-old practice only started to exhibit a downward trend in the past 20 years in the borderlands. In contrast, as revealed from a similar DID approach,

this external policy effort did not influence the probability of young females forming a marital union while having limited impacts on the resulting marital outcomes, as measured by a husband's education and age, the number of co-wives, a spouse's ethnicity, family assets, the number of children, intra-household decision making (DM) power, likelihoods of intimate partner violence (IPV), and so on.

The studied setting offers two important advantages. First, in investigating the relationship between the abandonment of FGC and marriage, it is possible to explore the influence of Burkina Faso's political efforts on its own citizens. However, it is more difficult to define treated groups and control for relevant endogeneity in this approach. Since Burkina Faso's political efforts are external policy shocks to its neighboring countries, the cross-country nature of the proposed analyses arguably facilitates causal identification.[6] Second, and related to this point, one may challenge the accuracy of self-reported FGC status because people may not tell the truth for fear of legal and social sanctions (e.g., Cao and Lutz, 2014). Since FGC is not criminalized in Mali and laws against this are only weakly enforced by the remainder of Burkina Faso's neighbors, this measurement concern is less serious in the present study, compared to within-country analyses of the parties strictly outlawing this practice (e.g., Burkina Faso).[7]

Extant economic research aimed at understanding the role of FGC is scarce. Outside economics, the systematic literature review performed by Berg and Denison (2012) also revealed a scarcity of methodologically robust FGC-related empirical studies. Nevertheless, the present research is closely related to the following studies. First, while Chesnokova and Vaithianathan (2010) theoretically analyzed differences in marital outcomes between circumcised and uncircumcised women within a community achieving inefficiently high levels of cutting rates (i.e., FGC equilibrium according to their definition), the present study focuses on a shift from an FGC to a no-FGC equilibrium. Second, the present study also relates to several empirical studies investigating whether FGC is a normative equilibrium, within (e.g., Bellemare et al., 2015; Efferson et al., 2015) and outside economics (e.g., Hayford, 2005; Shell-Duncan et al., 2011). In contrast to Bellemare et al. (2015) analyzing people's willingness to continue FGC in West Africa, the present research examines the actual "behavior."[8] While Efferson et al. (2015) conducted a cross-sectional survey in Sudan cover-

[6] In this sense, this study could also be seen as indirectly addressing whether Burkina Faso's efforts effectively reduced the practice of FGC, which itself is also an interesting question.

[7] Moreover, the exploited data enables the present study to investigate the "long-term" adjustment of marriage markets in the "regional" context, which is indispensable not only for examining equilibrium dynamics but also for increasing the external validity of the findings. Furthermore, this study explores both extensive (e.g., likelihoods of FGC and marriage) and intensive (e.g., types of FGC and cutters, marital outcomes) margins regarding the adjustment of relevant practices, which renders its findings rich and comprehensive.

[8] The practice of FGC often continues among the offspring of mothers opposing this practice (e.g., Carr, 1997, p. 55—56) and according to UNICEF (2005a, p. 8), actual prevalence is the most important indicator for situation analysis of FGC.

ing 45 communities, the present study examines "social changes" in "more than 3000 communities" in "West Africa." Theoretical understanding of the mechanisms sustaining FGC has increasingly been important (Shell-Duncan et al., 2011) because relevant policy interventions to date have not always resulted in significantly reducing the prevalence of FGC (Berg and Denison, 2012, 2013). The findings of the present study are not inconsistent with the view that FGC is a normative equilibrium, although neither can other interpretations be entirely ruled out.

This research also exhibits similarities to previous studies harnessing Africa's national boundaries as a source of causal identification. However, unlike previous research (e.g., Michalopoulos and Papaioannou, 2014, 2016), this study exploits one policy originating from either side of the border as an exogenous shock to the other.[9] This approach could be applied in other settings and may be more effective when the outcomes of interest are politically sensitive; thus, the research findings are not entirely reliable if the data drawn from a country exactly implementing the policy are analyzed.

Similar to several studies focusing on the influence of political regimes (e.g., Lowes et al., 2017), wars (e.g., Voors et al., 2012), technology (e.g., Alesina et al., 2013), and economic shocks (e.g., Giuliano and Spilimbergo, 2014), the research reported herein also explores the evolution of "culture" including informal institutions according to the definition of Alesina and Giuliano (2015). In contrast to most empirical studies regarding culture as preferences/values internal to individuals (e.g., Guiso et al., 2006), this study refers to cultural change as an equilibrium shift (e.g., Greif and Kingston, 2011; Tabellini, 2008). In this context, what is presented may be viewed as a rare empirical example of testing the "swift" transition of normative equilibrium, which has been indicated in theory (e.g., Schelling, 2006) but suffers from a dearth of evidence in the real-world setting (e.g., Munshi and Myaux, 2006). As addressed in the context of other marriage-related social institutions (e.g., Anderson and Bidner, 2015; Jacoby and Mansuri, 2010; Kudo, 2017; Tertilt, 2005), investigating cultural institutions (which can be conceived as a form of social capital) itself is also valuable because the relevant economic research reveals great scarcity, particularly in the developing world (Greif and Iyigun, 2013, p. 534).

The remainder of the paper is organized as follows. To guide the empirical analyses, Section 2 develops a simple model that formalizes Mackie (1996)'s theory of marriage convention. Following the theoretical implications, Section 3 provides institutional background, referring to Burkina Faso's political efforts against FGC and its influence on neighboring countries. The empirical strategy and data overview are presented in Section 4 and Section 5, respectively. Section 6

[9] In previous studies, it is assumed that as borders have randomly allocated people to different-country treatments, differences in outcomes across the border can be interpreted as the local effects of treatments such as political institutions. The findings yielded herein may posit challenges for the tenability of this assumption, as already debated in Herbst (1989) and Mccauley and Posner (2015).

describes the empirical findings, with concluding remarks provided in Section 7.

2 Mackie (1996)'s theory of marriage convention

In Section S.1 in the supplemental appendix, a simple model is developed to formalize Mackie (1996)'s seminal theory of marriage convention. Its purpose is to clarify the long-term relationship between the abandonment of FGC and women's marriage while providing useful implications for the subsequent empirical analyses.

Mackie (1996) asserted that FGC persists in Africa's typical intra-marrying communities when men believe that uncircumcised women are unfaithful and women believe that men are unwilling to marry uncircumcised women. He regarded FGC as a social convention supported as a coordination failure and, thus, claimed that assembling a critical mass of people who publicly pledge to stop FGC (e.g., creation of an anti-FGC association) is important to eradicate this normative practice (i.e., tipping-point theory). However, he discussed these two issues separately by referring to a simple game matrix for the former and exploiting Schelling (2006)'s coordination diagram (Chapter 7) for the latter.

The present study endeavors to unify these two perspectives into a single framework and considers an extensive-form game with two agents, i.e., men and women (or their parents), who play in an intra-marrying community, whereby women compete with each other when seeking marital partners. It is assumed that two marriage-related customs, i.e., FGC or something else, exist and that (only) the practice of FGC is costly for women because it impairs their health. In the game, a man first announces whether and to whom (a circumcised or uncircumcised woman) he proposes and if he proposes, the amount of livelihood support provided for that woman during marital life. Whether FGC or not, men receive greater utility by marrying women conforming to a community's major marriage-related custom. In the face of the announcement, a woman (or her parents) decides whether to get circumcised as well as whether to accept a given proposal.

In this coordination game, two stable pure strategy subgame perfect equilibria, i.e., an FGC and a no-FGC equilibrium, exist, wherein all (no) females in a community are circumcised in the former (latter). Therefore, a community tends to converge on an FGC rate of one or zero, respectively. This discontinuity in the cutting rate across communities is confirmed to some extent in the data analysis, see subsection 5.2.

According to the model, an increase in the cost of FGC perceived by people (relative to its benefit) prompts a shift from the FGC to the no-FGC equilibrium (i.e., abandonment of FGC). In the subsequent empirical analysis, it is hypothesized that Burkina Faso's political efforts increased the utility cost of FGC as perceived by those residing in communities (located close to Burkina

Faso) of its neighboring countries due to cross-border social interactions and resulting spillovers of FGC-related health and political knowledge. In reality, only a fraction of community members in the borderlands might have obtained the new knowledge on FGC and updated their perceptions of its cost. Nevertheless, the model indicates that if a critical mass of people refuses FGC, a threshold is passed and the community tips over to the no-FGC equilibrium in a self-enforcing manner.

The transition to the no-FGC equilibrium would not affect women's marriage probability. However, this transition may "reduce" the realized utility of married women.[10] This decline is ascribed to the disappearance of compensation previously given by men to circumcised women (including both those who get married and those who fail to do so) for the health-impairment cost of FGC, which in turn raises married men's welfare. While unmarried women's welfare increases due to the avoidance of FGC and the total welfare enjoyed by all community members also improves,[11] the asymmetric consequence of the abandonment of FGC on married men and women's welfare is not highlighted in Mackie (1996) and may serve as an important caution for those who believe that the eradication of FGC improves "all" women's welfare. That said, the model also suggests that married women's utility loss may not be substantial when community members in the FGC equilibrium underestimate the cost of FGC or the marriage market is not particularly competitive for women. In some communities, for example, it is possible that people believe that FGC is a good tradition. Consequently, women's welfare consequences stemming from the equilibrium shift are an empirical question; its examination is the primary contribution of the present study.

Two theoretical implications deserve highlighting for the subsequent empirical analyses. First, no causal relationship between FGC and women's marriage exists in the long term. Second, underlying factors (e.g., cost of FGC) simultaneously determine these two practices. Therefore, this study separately estimates impacts of the external policy shock attributed to Burkina Faso's political efforts on the practices of FGC and marriage in the borderlands of its neighboring countries. This approach permits analysis of the long-term adjustment of marriage markets that takes place in step with the decline in FGC.

3 Burkina Faso: politics and spillover effects

As already described, this study separately explores the influence of political efforts by Burkina Faso to eradicate FGC on the practices of FGC and marriage performed by those residing in communities (located close to Burkina Faso) of its neighboring countries. The assumption underlying this empirical strategy is that Burkina Faso's efforts raised people's awareness about the relative cost

[10] Women's expected utility is the same between the FGC and no-FGC equilibrium.
[11] Thus, FGC equilibrium is a coordination failure.

of FGC (subsection 3.1), and its impacts permeated the borderlands of its neighboring countries due to cross-border social interactions (subsection 3.2). Referring to the relevant literature and the author's field survey, this section discusses this assumption.

3.1 Prohibition of FGC in Burkina Faso

Burkina Faso is a landlocked nation in West Africa bordered by six countries, namely, Benin, Côte d'Ivoire, Ghana, Mali, Niger, and Togo (see Figure S.1 in the supplemental appendix). According to 2010 DHS data, approximately 76% of women aged 15 to 49 were circumcised. While its prevalence is clearly high, the country has exhibited a strong desire to eradicate FGC for more than two decades (e.g., Chikhungu and Madise, 2015; Colombo, 2013; UNFPA, 2010; United States Department of State, 2001).

In 1990, a National Committee to Fight Against the Practice of Excision (CNLPE) was established by a presidential decree. Under the directorship of the Permanent Secretariat, this body has overseen all country-wide actions against FGC since its establishment while maintaining autonomy in its activities. These actions include the promotion of a national telephone hotline called the "Green Phone: SOS Excision." This hotline was instituted in 1990 to denounce cutters as well as parents and others that force girls to undergo FGC. This hotline was also utilized by those that detected instances of FGC being forcibly performed and, thus, sought advice in identifying and securing the relevant authoritative interventions. To increase its effectiveness, special patrols have also been deployed in 17 provinces characterized by high prevalence of FGC.

To raise public awareness about the harmful consequences of FGC, the CNLPE has also undertaken various activities (e.g., workshops) involving religious/traditional leaders, police, medical experts, and organizations for youth and women; it has also encouraged gendarmes and social workers to go into villages; and at other times exploited public media such as radio. The CNLPE has also succeeded in including a module on FGC, and the training of teachers on this practice, in the national school curriculum (28 TOO MANY, 2015). Moreover, Burkina Faso is one of the countries that provide medical services for women who have undergone FGC. Since 2009, all district and regional hospitals have developed the skills of health providers vis-à-vis treating the injuries caused by this practice (UNFPA, 2014). Finally, in 2008 the UNFPA and UNICEF implemented a joint program aimed at accelerating the abandonment of FGC in this country (UNFPA and UNICEF, 2014).

The passage of legislation prohibiting FGC in 1996 can be seen as a landmark of these political efforts. This law is considered one of the toughest in the entire African continent and has systematically been enforced since its enactment (UNFPA, 2014). The penal code, sentenced to

anyone that harms female genital organs by means of ablation, excision, infibulation, numbing, or any other means, includes six-months to three-years imprisonment and/or a fine ranging from CFA francs 150,000 to 900,000 (about 250 to 1480 USD based on the exchange rate at the end of March 2017) (Article 380). This is considerable in monetary terms given that Burkina Faso's GNI per capita was only 640 USD in 2015.[12] Further, prison terms can be extended to between 5—10 years if the procedure causes death. If the guilty party is a medical professional, the maximum punishment would be applied and the court can additionally prohibit them from practicing their profession for a maximum of five years (Article 381). A fine of CFA francs 50,000 to 100,000 (about 80 to 165 USD) would also be imposed on all people that have knowledge of the criminal behavior described in Article 380 and fail to notify the proper authorities of incidence (Article 382). A gradual increase in convictions from 94 in 1997—2005 to 646 individuals in 2005—2009 period is also reported (28 TOO MANY, 2015).

Due to these strenuous political efforts, Burkina Faso has been recognized as taking a leading position against FGC in Africa (Colombo, 2013; Diop et al., 2008). Indeed, the rate of decline in FGC in this country appears to be greater than in other African countries commonly practicing FGC such as Benin, Central African Republic, Côte d'Ivoire, Egypt, Ethiopia, Eritrea, Guinea, Kenya, Mali, Mauritania, Niger, Nigeria, and Sudan (Figure 18, UNICEF, 2005b). Of these countries, the proportion of women who have at least one circumcised daughter and believe that this practice should continue is also the smallest in Burkina Faso (Figure 19, UNICEF, 2005b). These findings indicate people's growing tendency to abandon FGC in this country.

3.2 External influence on border communities in neighboring countries

As Shell-Duncan and Hernlund (2000) (p. 7) note, "National boundaries (in Africa) are not all important, ⋯ as the distribution of genital cutting is better understood by ethnic groups, and groups practicing genital cutting often straddle national boundaries." As somewhat reflected in this remark, the practices of FGC and marriage in Africa are typically performed within the same ethnic group, and ethnic groups often spread across national borders, which were drawn in the late 1800s by Europeans having limited knowledge of or concern for social and linguistic groups (e.g., Michalopoulos and Papaioannou, 2014, 2016). This partition of ethnic groups because of arbitrarily drawn national boundaries makes cross-border social interactions reasonably common in Africa; therefore, this social interaction might have enabled a body of FGC-related health and political knowledge acquired by Burkinabé people to be introduced into the borderlands of neighboring countries, thus raising the cost of FGC (relative to its benefit) perceived by those border residents.

[12] See `http://data.worldbank.org/country/burkina-faso`.

Consequently, in the aforementioned six countries contiguous to Burkina Faso, the practice of FGC performed by those residing in communities located close to this country might have declined due to the political efforts in Burkina Faso.

To assess if such knowledge spillovers are possible, in February 2016, the author conducted a semi-structured questionnaire-based survey in 13 villages (including one sub-village) in Wa West, a district in northwest Ghana located very close to the Burkina Faso border (see the green polygon in Figure S.1 in the supplemental appendix for the location).[13] The decision to select Ghana for the field survey was informed by several concerns including security, research budget, and translation. The surveyed communities were primarily settled by the Dagaaba and Lobi, ethnic groups that spread over Burkina Faso and Ghana and used to practice FGC.

The interviews revealed that people in a community on one side of the two countries frequently had contact with those in a community on the other side through marriage and market meetings.[14] For example, one Burkinabé woman who had married into Ghana returned to her home at least three times per month to take care of her elderly mother. Burkinabé women may also visit markets and utilize health care services in Ghana. People simply crossed the border by boat (rainy season) or on foot (dry season) without formal immigration procedures.

Interviewees often noted how FGC had declined in the surveyed area because people had learned that this practice complicated childbirth (although they had previously believed that the opposite was true). While the nature of convenience sampling precludes generalizing findings from this field survey, this view is nevertheless consistent with that held by the Permanent Secretary of the CNLPE (UNFPA, 2010). According to the Secretary, informing people of the complications during childbirth attributable to FGC has thus far been seen as more effective in altering Burkinabé people's hearts and minds, rather than emphasizing the human rights perspective of the practice; this is because they cherish children and, thus, are particularly concerned about their reproductive health. Similarly, an elderly Burkinabé woman residing in Wa West informed the author that cross-border social interactions and the resultant knowledge spillovers might have succeeded in making FGC obsolete in the surveyed communities before penalties for FGC prescribed in Ghana's law became more serious in 2007.

Importantly, the strong law in Burkina Faso could have conceivably served to encourage Burk-

[13] In this survey, the author collected qualitative information on people's practices relevant to FGC, marriage, and sexual behavior. While neither villages nor respondents were randomly selected (i.e., convenience sampling), this approach nevertheless secured 26 effective interviews made with 11 male and 15 female adult respondents. Among the respondents were members of four ethnic groups (the Dagaaba, Lobi, Senu, and Wala); four respondents were ex-traditional cutters for girls and five respondents (including three ex-traditional cutters for girls) were either ex- or present cutters for boys. The duration of each interview was approximately 30—60 minutes. To ensure confidentiality and to maximize data reliability, the interviews were conducted in an environment where the respondent was alone with the author and two research assistants (for translation to and from local languages).

[14] Informal cross-border trade is quite common in Africa (e.g., Lesser and Moisé-Leeman, 2009; Meagher, 2003).

inabé parents to take their daughters to other countries for the purpose of FGC, wherein laws prohibiting FGC do not exist or the enforcement of such laws is not so strict.[15] In Sayagues (2009), for instance, it is reported that the following ethnic groups moved across national boundaries to get their daughters circumcised: the Dagaaba and Lobi spread between Burkina Faso and Ghana; the Mossi and Yagse moving across Burkina Faso and Mali; and the Fulani and Gourmantché distributed between Burkina Faso and Niger.[16] In the author's field survey in Ghana, one Dagaaba ex-cutter mentioned that she received an offer to perform FGC from Burkinabé parents (one year before the interview), although she refused this offer. On one hand, these findings suggest that FGC is so deeply entrenched in society that it is difficult to eradicate this practice. On the other hand, due to social interaction, people living outside Burkina Faso might be aware and concerned that FGC is a political issue involving criminalization and legal punishment, and decided to abandon this practice. In the author's field survey, one Ghanaian ex-cutter (for girls) heard of cases where the police had arrested Burkinabé cutters practicing FGC.[17]

4 Empirical strategy

To explore the impacts of Burkina Faso's policy efforts on the practices of FGC and marriage involving people residing in the borderlands of its neighboring countries, this study uses data drawn from multiple rounds of the Standard DHS conducted in Burkina Faso's neighboring countries, namely Benin (2001, 2011—12), Côte d'Ivoire (1998—99, 2011—12), Mali (2001, 2006, 2012—13), and Togo (2013—14). The DHS data includes information on population, health, and nutrition of females of reproductive age (15—49). Ghana and Niger were excluded from the analysis for the

[15] Similarly, legal sanctions against circumcizers might have encouraged local people to employ a traveling practitioner with relatively low skills and, thus, higher risks of complications (Shell-Duncan et al., 2013).

[16] Similar cases were also reported in the author's field survey conducted in Tarime, a district in the Mara region in northeast Tanzania, in January 2017. Tarime is located close to Kenya and primarily settled by the Kurya, an ethnic group that traditionally performs FGC. In this area, FGC is a community event occurring in December and most girls undergo FGC around age 15 and get married before reaching 20. According to the author's interviews with a regional police commander, parents forcing girls to undergo this procedure and a few traditional cutters were arrested and sent to prison in the circumcision season of 2016. As a result of the Tanzanian government's anti-FGC stance, it was locally believed that some Kurya parents in Tanzania took their daughters to the Kurya communities on the Kenyan side of the border for the purpose of FGC.

[17] The FGC-induced influx of Burkinabé people to the borderlands of Burkina Faso's neighboring countries might also have increased the cost of FGC for two reasons and thereby reduced its local prevalence. First, as people pay fees for cutting, local prices of FGC might have risen because of increasing demand for the service. Second, increasing demand for the services provided by cutters in neighboring countries may have increased the local cost of searching for available cutters. In the aforementioned survey, the author found one Ghanaian male cutter (for boys), who regularly stayed in Burkina Faso for a month, and practiced male circumcision in several communities, because Burkinbé people requested his skills. When he is away, Ghanaian people would have to identify alternative cutters. Despite these possibilities, however, in the survey, the author did not find any current (for boys) or ex-cutters (for girls) that had charged higher prices for cutting in response to increasing demand for their services. Rather, they sometimes gave a discount to poor parents. In addition, it would not be particularly bothersome for people to postpone cutting for a short period of time because of transient unavailability of cutters.

reasons described in Section 5. More precisely, for a female i living in a community j that was born in year t, this study estimates

$$y_{ijt} = \alpha_1 + \alpha_2 D_{ijt} \cdot B_j + \alpha_3 \mathbf{x_{ijt}} + v_j + \rho_t + \epsilon_{ijt}, \tag{1}$$

where y_{ijt} is outcomes of interest (e.g., FGC, marital outcomes); D_{ijt} is a dummy variable that equals one if the timing of FGC as determined by her society falls within the period of Burkina Faso's political efforts against FGC, else zero; B_j is another dummy that equals one for communities situated in the vicinity of the border to Burkina Faso, else zero; $\mathbf{x_{ijt}}$ contains other determinants of outcomes specific to her and her household (i.e., birth order, religion, and ethnicity categorized into 28 groups), including year-of-interview fixed effects;[18] v_j is a dummy for each community; ρ_t is year-of-birth fixed effects; and ϵ_{ijt} represents stochastic error.

Because age at FGC varies across and (to a lesser extent) within societies, there is no a priori age threshold for defining D_{ijt}. However, this study presumes that this variable equals one if the respondent was born in or after 1990 for two reasons. First, as described above, the CNLPE was established in 1990. Second, the mean age at FGC among the circumcised respondents residing close to Burkina Faso (e.g., within a 30-km distance to the national border) is 6.75 years. Therefore, it is possible that Burkina Faso's political efforts affected the practice of FGC performed by respondents born before 1990. However, political efforts seem to have been stronger since legislation against FGC was introduced in 1996 and went into effect in February 1997. Considering this timing and the mean age at FGC, exploiting 1990 as the threshold year seems reasonable.

Similarly, no a priori criteria exist to facilitate defining communities as being located "close" to Burkina Faso. In the benchmark specification, this study refers to communities situated within a 30-km distance from the national border to Burkina Faso as $B_j = 1$. The sensitivity of the empirical findings to alternative threshold years and distances to the national boundary will be explored below when reporting the estimation results.

Somewhat relatedly, as the DHS provides locational information on respondents' present communities only, this study needs to assume that respondents currently live in places located close to their residential areas (likely in childhood/puberty), where FGC might have taken place. Women's relocation to "nearby" villages at the time of marriage is quite common in patrilineal African societies, which does not critically invalidate this assumption. In addition, the identification strategy is still robust to this concern provided the relevant measurement error does not systematically differ

[18] For each country, ethnic groups were categorized for consistency across the survey rounds, which resulted in 10 groups for Benin, two groups for Côte d'Ivore, 10 group for Mali, and 6 groups for Togo. In addition, information on respondents' birth order was unavailable in all rounds of the Benin DHS and the 1998—99 DHS of Côto d'Ivore. For these rounds, the sample average (3.35) was applied.

between borderlands and inlands. Nevertheless, subsection 6.3 carefully discusses how violation of this assumption does not significantly undermine the main implications of this study.

This research exploits the ordinary least squares (OLS) regression framework for all estimations for three reasons. First, this technique enables statistical inference without having a strong distributional assumption about the error term. Second, it is possible to provide a straightforward interpretation for the interaction term coefficients (Ai and Norton, 2003). Third, it facilitates causal identification through controlling for numerous community-level fixed effects. Nevertheless, the robustness of the findings to other estimation techniques will be discussed in subsection 6.3. Standard errors are robust to heteroscedasticity and clustered at the community level (3021 communities; see Figure S.1 in the supplemental appendix for the locations); rare exceptions to this rule due to computational difficulties are specifically noted below.

The key identification assumption underlying the DID specification (1) is that in the absence of political efforts by Burkina Faso, the outcomes of interest in the border and inland communities would have followed parallel trends. After separating the respondent females into those living in communities within a 30-km distance from the national border to Burkina Faso and those in the remaining communities, Figure 1 plots the fraction of circumcised women by country and year of birth, with the vertical line indicating 1990. The post-1965 fraction was presented in the figure because the annual number of females born before 1965 was small, particularly in the borderlands; thus, the estimated cutting rate is likely to be non-representative in the pre-1965 periods. The mean circumcised proportion is approximately 14%, 44%, 90%, and 9% in Benin, Côte d'Ivore, Mali, and Togo, respectively.

Two remarks are made. First, it may be difficult to gain a good insight into the parallel trends from Benin and Togo, as the annual number of women born in the border communities therein in each year was minor due to small sample size and, thus, the circumcised proportions fluctuate dramatically year by year. However, in the remaining countries and especially Mali, a similar trend in terms of circumcised proportions was observed between the border and inland communities, up until around 1990. A more formal test described in Section S.3 in the supplemental appendix also provided no evidence undermining the parallel-trend assumption in the years preceding 1990. Second, it appears that the circumcised proportion in the borderlands has declined in Benin, Côte d'Ivore, and Mali since around 1990. This finding may indicate that the practice of FGC declined in those areas due to Burkina Faso's political efforts and the resultant knowledge spillovers; the DID approach attempts to identify this external influence.

[Here, Figure 1]

5 Data

Repeated cross-sectional data are utilized drawn from multiple rounds of the DHS in Benin (2001, 2011—12), Côte d'Ivoire (1998—99, 2011—12), Mali (2001, 2006, 2012—13), and Togo (2013—14). This survey was designed to provide nationally representative information in the fields of population, health, and nutrition.[19] In all survey rounds, a similar two-stage sampling protocol was exploited, including the first-stage selection of communities (clusters) from the population census followed by the second-stage selection of households from the respective communities. As all women aged between 15 and 49 years in each selected household are interviewed, this sample design enabled the present study to analyze 82,765 female respondents residing in 52,049 households located in 3,021 communities (see Table S.2 in the supplemental appendix for a country-round breakdown). While it was initially envisaged that the three most recent rounds of the Standard DHS would be exploited in all six countries surrounding Burkina Faso, this approach was abandoned because required data (i.e., the respondents' engagement in FGC, a community's GPS coordinates) is not always available.[20] While the rule differed somewhat by round and country, male household members aged 15 to 64 (for Benin) or 15 to 54 (for all remaining countries) belonging to approximately 40% of the selected households were also interviewed in the DHS (again, see Table S.2 in the supplemental appendix for the country-round breakdown). While the current research considers females to be the main analytical unit, this male sample is also exploited in several analyses. In the data set, the birth year of females (males) ranges from 1948 (1936) to 1999 (1999).

5.1 Summary statistics

For the sample females born before and after 1990, summary statistics for several variables are reported in Table 1, along with tests for equality of means between those residing within a 30-km distance to Burkina Faso (112 communities) and the remaining respondents (2909 communities).[21] As this study examines the influence of the abandonment of FGC on women's entry into their first marriage, the variables characterized as † and ‡ correspond to respondents aged 25 or younger and married females in that age cohort, respectively. In this young cohort, the likelihood of being widowed or divorced is minimal; therefore, the married/unmarried distinction is simplified to a

[19] Data and relevant documents are publicly available at `http://dhsprogram.com/data/available-datasets.cfm`.

[20] While the 2003 DHS in Ghana provided information on both the FGC and GPS coordinates, these data are excluded from the analysis. This is because the DHS respondents are aged 15—49 and thus this round did not include an effective post-treatment sample that could have conceivably been affected by Burkina Faso's political efforts.

[21] An attempt was also made to assess whether temporal changes in the mean values of several variables reported in Table 1 relevant to the respondents born before and after 1990 were statistically equal between the border and inland communities, and the resulting DID estimates are reported in Table S.3 in the supplemental appendix.

married/single dichotomy, which facilitates effective analysis of respondents' entry into their first marriage.[22] For this reason, the number of observations in Table 1 varies across the reported variables as well as because the collected information somewhat differs by round and country.

The circumcised proportion of respondents born before 1990 was significantly higher in the border communities at 71%, compared to 58% in the inland communities. However, this difference disappeared after 1990 due to a more pronounced reduction in the circumcised fraction in the borderlands, which resulted in about a 40% prevalence in both areas. The radical form of FGC, known as infibulation or pharaonic circumcision ("sewn closed"), is not particularly common in the surveyed areas and the practice of FGC is predominantly performed by traditional cutters, leaving limited space for health care professionals regarding this operation.[23] Before 1990, approximately 9% ($\approx \frac{0.04}{0.58}$) of the circumcised females were infibulated and approximately 89% ($\approx \frac{0.52}{0.58}$) of the practice was performed by traditional cutters. The mean age at FGC of the respondents born before 1990 is 6.83 years and approximately 83% of the circumcised females undergo the practice before reaching the age of 11 years. While the age at FGC does not significantly differ between the border and inland communities both before and after 1990, it has declined over time from 6.83 to 5.94 years on average. A similar tendency of declining age at FGC is reported in other countries such as Senegal (Shell-Duncan et al., 2011) and The Gambia (Hernlund, 2000), for example. As young children raise less suspicions on and speak out less against criminal activities, it is argued that the introduction of law criminalizing FGC, taken together with parents' resultant incentives to seek FGC in secrecy, has facilitated this downward-age tendency (Camilotti, 2015; Shell-Duncan et al., 2013).

Respondents in the borderlands are less educated, more pronouncedly engage in polygynous relationships, and (if born before 1990) exhibit higher likelihoods of entering into marriages and producing children at a young age, compared to the corresponding inland respondents. However, no statistically significant difference is observed between the border and inland communities with respect to the age at first sexual intercourse. The border respondents formed a marital union with younger and less educated husbands compared to inland respondents. A family's wealth index in the borderlands, which is a composite measure of a household's cumulative living standard and ranges from one to five, is smaller than that in the inland communities.[24] Together these findings

[22] In this age cohort, only 2% of respondents were identified as "formerly married," 41% were "never married," and 55% "currently married."

[23] The WHO has classified FGC into four types since 1996. Type I is "partial or total removal of the clitoris and/or the prepuce" (clitoridectomy). Type II is "partial or total removal of the clitoris and the labia minora, with or without excision of the labia majora" (excision). Type III is "narrowing of the vaginal orifice with creation of a covering seal by cutting and appositioning the labia minora and/or the labia majora, with or without excision of the clitoris" (infibulation). Type IV is "all other harmful procedures to the female genitalia for non-medical purposes" (e.g., pricking, piercing, incising, scraping, and cauterization).

[24] The DHS team calculated this wealth index using data on a household's ownership of selected assets, such as

suggest that the borderlands, which are also more rural, are economically less advanced than the inlands.

[Here, Table 1]

5.2 FGC as a marriage convention

While the present study hesitates to advocate a particular theoretical model, its empirical analyses are still largely motivated by Mackie (1996)'s theory of marriage convention. Mackie (1996) claims that (1) FGC is a social norm, namely one of the group-level multiple equilibria, and (2) particularly supported by men and women's motive to coordinate the marital exchange. This subsection aims to provide some empirical support for these two perspectives.

Four notable features of social norms are summarized in Young (2015). First, social norms show a tendency to "persist" for long periods. Second, norm shifts tend to be sudden when they take place, also called "tipping." Third, normative behaviors depend less on underlying fundamentals than would otherwise be expected and therefore, reveal less diversity, summarized by the term "compression." Fourth, as norms are one of the population-level multiple equilibria, they tend to exhibit both "local conformity" and "global diversity." As will be shown in Section 6, the centuries-long practice of FGC has swiftly declined in the borderlands of Burkina Faso's neighboring countries after this country initiated political efforts against the practice. This finding supports the first and second characteristics. To explore the remaining features, two additional exercises are performed here.

First, following Efferson et al. (2015), by residential areas, Figure 2 (left-hand panel) illustrates a histogram of the fraction of respondents circumcised in their (present) community. If FGC is a normative behavior supported under homogeneous values and preferences in a community, the surveyed communities should exhibit either very high or very low cutting rates, with the former (latter) seen as an FGC (no-FGC) equilibrium (also, recall the corresponding discussion provided in Section 2). As seen from this figure, the cutting rates are either one or zero in a significant proportion of the surveyed communities, although the communities revealing the interior cutting rates may suggest that some sort of heterogeneity in people's preferences for this practice exists within and across communities (see also Section S.4 in the supplemental appendix for a detailed interpretation of the interior cutting rates). This tendency is also more pronounced in rural areas, as seen in Figure S.5 in the supplemental appendix that shows the corresponding histogram after separating the DHS communities into rural and urban groups.

televisions and bicycles; materials used for housing construction; and types of water access and sanitation facilities. See `http://www.dhsprogram.com/topics/wealth-index/Wealth-Index-Construction.cfm` for more details.

Second, taking a conceptually similar approach to that adopted in Bellemare et al. (2015), this study regressed an indicator for FGC on community fixed effects, only. As the obtained value of R-squared is 0.734, a significant proportion of the variability in FGC is attributed to the community-level factor. Along with the swift decline of FGC in the borderlands, the (quasi-)discontinuity of the cutting rates shown in Figure 2 as well as the limited role of within-community factors in explaining the variation of FGC would support the view that FGC is a social norm.

On the other hand, women's natal communities may sustain FGC; these natal communities may be different from the DHS communities for some respondents, because women are typically circumcised in childhood or puberty and often marry out of their original village. In addition, according to Mackie (1996)'s theory, the relevant community is an intra-marrying community sharing a marriage market, which would include both the natal and destination villages of married women.[25] Therefore, in the right-hand panel of Figure 2, a histogram of the fraction of those circumcised in their administrative unit is also presented. In the data, the surveyed communities are grouped into 76 Communes in Benin, 142 Departments in Côte d'Ivore, 498 Communes in Mali, and 21 Prefectures in Togo, resulting in approximately four DHS communities included in each administrative unit on average.[26] The obtained implication is robust to the presumption that the relevant "community" of the present interest spreads over more extensive areas than those of the DHS communities. The corresponding exercise exploiting administrative-unit fixed effects, rather than community fixed effects again yielded a sizable value of R-squared, 0.680.

To gain insight into the question of whether FGC is a social norm particularly supported by the inter-dependent expectation operating in marriage markets, by country, Table 2 reports background information on FGC. Of particular interest are both women's [panel(A)] and men's [panel(B)] perceived benefits of this practice. The reported information, collected through a yes-no question for each item, is only based on answers provided by the circumcised women or men residing in a community that recorded at least one circumcised woman.[27] As seen from the table, across both men and women, the fraction of respondents who believed that FGC would improve women's marriage prospects is small, although it is slightly larger in Côte d'Ivore compared to

[25] However, these concerns do not necessarily invalidate the findings yielded by the above exercises. First, if these concerns are crucial, those exercises would not reveal any meaningful results. Second, the destination communities are often located close to the natal communities in rural areas. Moreover, parents may even show a greater respect for cultural practices in a community their daughter would marry into, compared to that practiced in her original community.

[26] An administrative unit corresponding to each community could not be identified from the DHS data alone. Therefore, this study matched a community's GPS latitude/longitude coordinates with a country's map sourced from DIVA-GIS (`http://www.diva-gis.org/datadown`). Communities for which the ArcGIS failed to uniquely identify the corresponding administrative unit are excluded from the analysis; the omitted communities correspond to less than 0.1% of the entire sample.

[27] The corresponding information for the overall sample is also available upon request, although the relevant information provided by those residing in communities not commonly practicing FGC may not be markedly reliable.

other countries.

On one hand, this finding may suggest that FGC has no contemporary relationship with women's marriage, although it is possible that FGC was a marriage convention in the past. On the other hand, the small fraction could still be conceived as being consistent with the view that FGC is a marriage convention. Since the marriage matching at FGC equilibrium is random with respect to this practice, both men and women may not identify a discernible marriage premium from this practice and therefore, may not answer that this practice improves women's marriageability.

[Here, Figure 2 and Table 2]

6 Empirical findings

6.1 FGC

Estimated impacts on FGC are reported in Table 3. By interacting a dummy for communities located close to Burkina Faso with different birth cohorts (the reference group is respondents born before 1965), the most flexible specification of equation (1) was estimated in column (a). A significant decline in cutting rates in the borderlands was found for respondents born in or after 1990. The estimation in column (b), which used a single dummy for respondents born during this period, confirms this finding. The purpose of the present study is not to evaluate the magnitude of spillover effects originating from Burkina Faso's political efforts but to explore the marriage-market adjustment taking place in step with the decline in FGC. Nevertheless, the estimated effect exhibited in column (b) implies that approximately 200 communities ($\approx$ 3021 communities $\times$ 0.068) out of about 1750 communities ($\approx$ 3021 communities $\times$ 0.58) that had practiced FGC before 1990 stopped this practice, assuming that FGC is a normative equilibrium as discussed in Section 2 and thus its prevalence in each community is either one (FGC equilibrium) or zero (no-FGC equilibrium).

By exploiting different birth year thresholds (1980, 1985, or 1990) and distances to the border (10 km to 200 km) in defining D_{ijt} and B_j, the top-left panel in Figure S.6 in the supplemental appendix reports the estimated α_2. Estimates corresponding to different birth year thresholds are also reported in the remaining panels along with 95% confidence intervals. First, given the fixed birth year threshold, external influences of Burkina Faso's political efforts are greater when the treated communities are defined as those located close to this country. Second, given the fixed threshold of distances to Burkina Faso, the relevant spillover effects are greater when the treated cohorts are defined as respondents born more recently, as observable in the top-left panel.

In column (c) in Table 3, a dummy for respondents circumcised before reaching age 10 is estimated. In Section 5, the tendency of girls to undergo FGC at younger ages was reported in both the borderlands and inlands. If this tendency is more pronounced in the borderlands, the likelihood of being circumcised at a younger age may increase in these areas (even if the overall cutting rate declines in such areas). No evidence supporting this view is revealed.[28]

This study also estimated the probability of genital parts being sewn closed with or without a control of an FGC dummy in columns (d) and (e) in Table 3, respectively. As indicated from the results in these and previous columns, not only the incidence of FGC but also the incidence of the most radical form of FGC is seen to be decreasing over time in the borderlands. This finding is also notable in terms of a concern pertaining to the accuracy of respondents' self-reported FGC status; while border respondents might have under-reported the incidence of FGC for fear of legal sanctions, there is no a priori reason why respondents would under-report the types of FGC as well.

Similar estimations were conducted for a dummy denoting whether respondents were circumcised by traditional cutters in columns (f) and (g). Controlling for FGC in column (g), both statistically and economically eliminates the significant spillover effect revealed in column (f); thus, there is no evidence suggesting that the type of cutters in the borderlands changed in association with the decline in FGC.

For all outcomes analyzed in Table 3, the robustness of findings was explored in Table 4. First, as Africa's national borders are often particularly vulnerable to armed conflicts and the effects thereof, an attempt was made herein to control for this influence. For this purpose, the UCDP Georeferenced Event Dataset (GED) Global version 5.0 (Croicu and Sundberg, 2015; Sundberg and Melander, 2013) was exploited which contains information regarding the timing and locations of organized violence from 1989 to 2015 (as of this research) that has occurred all over the world. In Africa, 32,834 cases of such violence are recorded during this period (see the locations in Figure S.1 in the supplemental appendix). Consequently, the number of conflict events that occurred within a 40-km radius of each community (interacted with D_{ijt}) was additionally included as a regressor and the estimation results are reported in the first column of Table 4.[29] The estimations in the second column controlled for household fixed effects (52,049 groups), whereas community-specific linear time trends, as measured by the years of birth (a continuous variable) multiplied by dummies

[28] Similarly, Figure S.7 in the supplemental appendix also presents the α_2 and the corresponding 95% confidence intervals arising from estimations of the likelihood of being cut before the age of X years. The large decline in estimates from the age of four to five years in this figure is due to the fact that the age at FGC is assumed to be five years when respondents referred to "during infancy" as the timing of circumcision. Overall, there is no evidence suggesting that girls undergo this procedure at younger ages in the borderlands compared to the inlands. Rather, the results confirm the overall decline in cutting rates in the border areas, as seen in columns (a) and(b) of Table 3.

[29] Although not reported herein, controlling for the number of people that died within a 40-km radius from each community also yielded similar implications.

for each community, were used as additional regressors in the analyses of the third column.[30] In the fourth column, the sample is defined only by the recent DHS rounds of the analyzed countries, i.e., Benin 2011—12, Côte d'Ivoire 2011—12, Mali 2012—13, and Togo 2013—14. Finally, because respondents might have resided in places far away from their present DHS community during their childhood, in the fifth column, data are utilized pertaining only to those who were identified as permanent residents of the surveyed community, although only limited rounds of the DHS, i.e., Benin (2001) and Mali (2001, 2006), included this information. The significant decline in the practice of FGC in the borderlands is again found and, overall, the previously stated implications remained unchanged.

In Table S.4 in the supplemental appendix, impacts on FGC were examined separately for each country. While the statistical significance is not always strong, the aforementioned negative effects on cutting rate and infibulation as well as zero impact on the type of cutters are observed in all countries. In particular, the estimation results in Mali are noteworthy, because this country has not legally prohibited the practice of FGC and thus information on FGC is more reliable (see also 28 TOO MANY, 2014 for the country profile on this practice).[31] Finally, note that as the R-squared values shown in Table 3 are relatively large, there is little variation of the outcomes left to bias the coefficients of interest. Nevertheless, following Oster (forthcoming), the relative importance of omitted variables that share covariance properties with observed controls and that are required to explain the identified effects, denoted as δ (i.e., a coefficient of proportionality on selection assumptions), was evaluated. By employing the value of R-squared obtained from a hypothetical regression of the outcome on the treatment, observed, and unobserved controls as $R_{max} = 1.3R$, which is heuristically suggested in Oster (forthcoming), the corresponding values of δ are reported at the bottom of Table 3.[32] The reported negative values indicate that the aforementioned FGC-discouraging effects may be attenuated if any bias exists.

[Here, Table 3 and Table 4]

[30] When controlling for household fixed effects, respondents' ethnicity and religion were excluded from the regressors, because such factors exhibit only limited intra-household variation. In the estimations in column (b), (g), (m), and (s) in Table 4, the standard errors are robust to heteroskedasticity but not clustered at the community level due to computational complexities.

[31] Nevertheless, it is still possible that Malian people would not honestly represent FGC status if they believed that Burkina Faso's legal penalty applied to them or that Mali also had a similar law. However, if this is the case, in the absence of arrests in Mali, these beliefs could be transient and therefore the decline of FGC should not be observed in the long term.

[32] It is assumed that year-of-birth fixed effects (ρ_t) and communities fixed effects (v_j) are proportional to unobservables.

6.2 Marriage

Table 5 reports estimation results for respondents aged 25 years or below regarding the formation of (most likely their first) marital union. As seen from columns (a)—(c), there is no evidence suggesting that the likelihoods of getting married, having sexual intercourse, and giving birth to children by the age of 25 years significantly changed in the borderlands in step with the decline in cutting rates. However, as column (d) shows, border residents delayed marriage by 0.7 years. While this result is not statistically significant, both the ages at first sexual intercourse and first birth also increased along with the increasing age at marriage, which might explain the significant reduction in the number of children delivered by this age, as revealed in column (g). The "no impact on marriage probability" could be the total effect of two conflicting forces, i.e., the abandonment of FGC decreasing women's marriage prospects and alternative premarital investment improving such prospects. Accordingly, the estimation in column (h) explored impacts on education, a likely substitute for FGC in rural settings. However, no educational improvement is found. As a result, together these findings may suggest that the external policy shock emanating from Burkina Faso had no influence on the probability of young females forming a marital union, although it temporally delayed their entry into marital relationships during the unavoidable adjustment periods in social transition.

Other marriage-related outcomes were estimated in Table 6 for currently married females aged 25 years or younger. Since the external policy shock had no influence on the probability of marriage for respondents in this age cohort, as found in column (a) in Table 5, the estimation results in Table 6 are free from potential selection concerns arising from only using data pertaining to the married sample. Because the relevant information is not collected in all the DHS rounds, the exploited sample is reported at the bottom of the table.

As the estimation results show, the external policy shock had no influence on the probability of young females engaging in polygynous relationships [columns (a)—(b)], their husband's education [column (c)] and age [column (d)], and family wealth [column (e)].[33] If women resisted, did not undergo FGC, and subsequently faced difficulty in getting married within their ethnic group, some may have attempted to find a marital partner belonging to other ethnic groups. To explore this possibility, a dummy which takes one if a couple shares the same ethnicity was estimated in column (f). Notably, the sample size in this estimation is smaller than that in the estimations reported in previous columns, because a husband's ethnicity is available only for the sub-sample of respondent

[33] While the results are not reported for brevity, additionally controlling for the number of household members did not affect the implication regarding the effect on family wealth. This study also estimated a variable, which takes n if a respondent is the nth wife of her husband, while applying the value of one to all females in monogamous marriage. The implications remained unchanged.

females.[34] The estimation result suggests no impact on the likelihood of inter-ethnic marriage.

In column (g), a dummy for women's intra-household DM power was estimated. This variable takes the value one for women who can make an independent decision on items pertaining to either own health care, large household purchases, or visiting their family or relatives. Similarly, a dummy referring to women who suffered from either emotional, physical, or sexual violence by their spouses was also estimated in column (h). If any, the likelihood of IPV declined in the borderlands, although the statistical significance is marginal. No strong support is provided for the view that women's welfare decreased in association with the decline in FGC. Estimation results for each item relevant to women's DM power as well as for each type of IPV are also reported in Table S.5 in the supplemental appendix but the aforementioned implications remain largely unchanged.[35]

The robustness of the findings reported in Table 5 and Table 6 to conflict proximate to a given community, household fixed effects, linear time trends, and separate sub-samples of the data (recent DHS, permanent residents) was explored in Table S.6 and Table S.7 in the supplemental appendix, respectively. Estimation results by country are also reported in Table S.8 in the supplemental appendix. Overall, the estimation results yielded no noticeable marriage impacts across specifications and countries.

Finally, exploiting different samples, the previous exercises are repeated, and the estimated α_2 and its 95% confidence intervals are reported in Figure 3. In this figure, the estimate corresponding to age M in the horizontal axis results from the regression using data pertaining to females aged 15 to M years.[36] Overall, the "negative FGC impacts" and "limited marriage effects" of the external policy shock are confirmed, along with "an increase in the age at marriage" (and possibly ages at first sexual intercourse and firth birth) and "the resulting reduction in fertility" that might have taken place during the transition period of marriage markets.

On the other hand, three findings are noteworthy. First, exploiting the elder cohort in the estimated sample resulted in identifying significantly positive impacts of the external shock on the probability of being married. However, this finding is not robust. The estimated marriage effects

[34] In the DHS, male household members were also interviewed in some of the selected households. Data on inter-ethnic marriage is only available when the interviewed man had wives within the interviewed household, who were the female sample of the DHS. On the other hand, the previously exploited information on husbands' education and age was discerned from the female interviewees. When constructing the relevant dummy, a couple both categorized as "other ethnic groups" was assumed to share the same ethnicity. However, this case corresponds to only approximately 1.7% of the total sample, and excluding this group from the estimation did not affect the obtained implication.

[35] Column (c) in Table S.5 shows that women's DM power on the issue of family/relative visiting significantly declined in the borderlands. While this finding was robust to controlling for community-specific linear time trends (coefficient -0.122 with std. 0.064), statistical significance vanishes when household fixed effects are controlled for (coefficient -0.172 with std. 0.170).

[36] Estimation results using data on females aged 18 or below are also available upon request, although they should be interpreted with caution due to the reduced sample size, as evidenced by the inflated standard errors.

exploiting the full sample (i.e., females aged 15 to 49 years) considerably decreased and statistical significance was lost once the estimations controlled for household fixed effects (coefficient 0.044 with std. 0.056)[37] or linear time trends specific to each community (coefficient 0.023 with std. 0.034), compared to the estimate (coefficient 0.087 with std. 0.030) reported in Figure 3.[38]

Second, Burkina Faso's political efforts significantly reduced the likelihood of IPV that hurt married women aged 15 to 49 years in the borderlands (coefficient -0.150 with std. 0.049). Again, the coefficient declined to -0.072 (standard error of 0.064) when the estimation controlled for community-specific linear time trends.[39] In any case, there is no indication that women's welfare decreased in the borderlands in terms of IPV.

Third, husbands' age significantly declined among the currently married women aged 15 to 49 years in the borderlands, as evidenced by the coefficient of -1.600 (standard error of 0.608). This finding seems tenable, because controlling for household fixed effects (coefficient -1.319 with std. 3.606) or community-specific linear time trends (coefficient -1.530 with std. 0.695) had little impact on the magnitude, although statistical significance disappears in the specification including household fixed effects. During the period that allowed society to shift from an old to a new equilibrium, senior men may not have desired to get married to women who abandoned FGC and therefore, young women that did not undergo FGC might have ended by marrying young men.

[Here, Table 5, Table 6, and Figure 3]

6.3 Threats to statistical inference

Several threats to statistical inference were considered before interpreting the empirical findings in subsection 6.4. First, as respondents might have resided in locations different from their present DHS communities at the time of FGC, the dummy for borderlands can be seen as a proxy for exposure to Burkina Faso's political influence measured with some noise which not only differs between the border and inland communities in a systematic manner but also correlates with the outcomes. Second, the possible reduction in child mortality (or more generally, health improvement) attributed to the abandonment of FGC enables women currently residing in the borderlands (more precisely, at the time of the most recent rounds of DHS including the post-treatment sample) to have particular characteristics valued in marriage markets, which systematically differ from

[37] The standard errors in the specification of household fixed effects are only robust to heteroskedasticity because of computational constraints to clustering residuals within a community.

[38] In addition, as the likelihoods of marital dissolution and/or widowhood increase with age, the full-sample estimates include impacts not only on forming but also on keeping a marital union. Providing a meaningful interpretation for the impacts on remaining in marital relationships somewhat goes beyond the scope of the present paper.

[39] Estimation results controlling for household fixed effects were not available due to computational difficulties.

those held by inland residents.[40] Third, OLS can yield predicted values outside the supposed interval (e.g., zero to one for the binary outcomes, one to five for the wealth index). Fourth, the significant decline in FGC in the borderlands might have been revealed by chance in the present study exploring numerous outcomes. Here the first issue is addressed while detailed arguments pertaining to the remainder are relegated to Section S.5 of the supplemental appendix.

Regarding the first issue, a particular concern in the present context is that respondents born in borderlands might have left their natal communities at marriage because they refused to undergo FGC and faced difficulty in finding a marital partner in their birthplaces. However, if this is the case, this study would overestimate cutting rates (i.e., underestimate the decline in FGC) and underestimate marriage probability in the border areas. Given the "no marriage effect" reported in column (a) of Table 5, there is no a priori reason why female marriage prospects improved in the border communities.

Nevertheless, it may still be possible that those who decided to leave or stay in their birthplaces may differ in terms of several attributes, which may make the marriage probability indifferent between the border and inland communities even in the presence of women's relocation for marriage. If any, those who stopped FGC and relocated inland might have been more educated. If the educational attainment of these migrants was facilitated by education-related polices of neighboring countries, this is a serious concern.

For example, assume that such policies encouraged educational attainment of border residents while reducing the prevalence of FGC among them as well as decreasing the probability of early marriage simultaneously. Then, if those who were more educated and less likely to marry early relocated inland (for any reasons) and married, the previous DID approach results in underestimation of educational improvement and the decline of both FGC and marriage probability in the border communities. Consequently, this possibility could simultaneously explain the "negative FGC effect" and "no marriage and education effects" identified previously.[41]

To consider this possibility, first, this study exploited the male DHS sample and estimated a range of marriage-related outcomes and education in Table S.9 in the supplemental appendix, because (if any) such education policies may affect both males and females, and males typically marry in their natal community. As the required information was not available in some rounds, the exploited data are reported at the bottom of Table S.9. The results provided some evidence suggesting that, compared to inland male respondents, border men born in or after 1990 attained more

[40] The abandonment of FGC may also influence the fertility of the post-treatment sample, which is actually demonstrated herein, and in turn affect marital outcomes of children born to this sample. However, this selected fertility is not an empirical concern in this study because the exploited data does not include children born to the post-treatment sample.

[41] If this is the case, true effects on marriage (education) in borderlands would be negative (positive) while rendering the corresponding true effects on FGC more negative.

education and delayed their marriage while reducing their engagement in early sexual intercourse and polygynous relationships and so, the number of children.

While the statistical significance of these findings is not necessarily strong, they increase the likelihood of the above concern to some extent. Therefore, second, this study exploited insights pertaining to bounds on treatment effects (Lee, 2009) and conducted all the previous estimations for females after excluding from the sample those who not only resided further than 30-km away from Burkina Faso but also had "any positive" education. The relevant DID estimates are reported in panel (A) of Table S.10 in the supplemental appendix. In panel (B), inland respondents who had no education were excluded from the estimated sample. While the results provide some evidence suggesting that women born in or after 1990 and residing in borderlands might have improved education, overall, the previously obtained implications remained unchanged; namely, while women's delay of first marriage (and possibly, first sexual intercourse and birth) and the resulting reduction in fertility might have been observed in borderlands during the periods in social transition, the external policy shock attributed to Burkina Faso's political efforts had limited influence on their marriage prospects while discouraging the practice of FGC. Also, recall that the main findings of the present study were robust to exploitation of sub-samples pertaining to permanent residents of the DHS communities.

Related to this concern, the FGC-discouraging effects for border respondents born in or after 1990 may be attributed to particular internal polices implemented by the neighboring countries themselves, rather than external policy shocks originating from Burkina Faso. However, the robustness of the aforementioned findings to the inclusion of community-specific time trends may alleviate this concern to some extent, if the trends appropriately control for such policy efforts. In addition, this concern does not necessarily invalidate the aim of this research, which is to assess the marriage-market adjustment occurring in step with the decline in FGC. This purpose can be achieved whether the sources of policy shocks are internal or external, although the latter shocks facilitate causal identification more easily than the former.

6.4 Why is the influence on women's marriage limited?

Thus far, this study has shown that the external policy shock originating from Burkina Faso's political efforts significantly reduced the practice of FGC in communities of its neighboring countries while having no (for marriage probability) or limited (for other outcomes) impacts on young women's marital outcomes. Thus, these findings may pose a puzzle: why has it traditionally been considered that FGC is required for a proper marriage?

As the simple model in Section 2 demonstrated, these findings are theoretically plausible if

and "because" FGC is a marriage convention as asserted by Mackie (1996), and the unfavorable health consequences of FGC are not well acknowledged by community members. On the other hand, Chesnokova and Vaithianathan (2010) also modeled FGC as a premarital investment and apparently predicts that an equilibrium shift from an FGC to a no-FGC equilibrium would decrease women's age at marriage in the long term (see Section S.6 in the supplemental appendix for a summary of their model). While their theory is salient for considering differences in age at marriage and a husband's wealth between circumcised and uncircumcised women "within" a community having inefficiently high (but not 100%) levels of cutting rates (i.e., FGC equilibrium according to their definition), this prediction is not supported in the empirical analysis conducted herein.

Another explanation for the puzzle is that FGC is no longer relevant to women's marriage although it was a marriage convention in the past. Nevertheless, note that the findings yielded by the present study may still be consistent with the view that FGC is a normative equilibrium.[42] While they may not be mutually exclusive, Young (2008, 2015) enumerate several mechanisms that sustain social norms, such as a motive to "coordinate" with others in a particular type of transaction (e.g., marriage as claimed in Mackie, 1996), "peer pressure" involving social punishment inflicted on deviants and possible screening of conformists (e.g., Iannaccone, 1992), and "symbolic signaling" of the holding of particular values or particular group membership.

In this context, Shell-Duncan et al. (2011)'s study conducted in Senegal and The Gambia provided some evidence suggesting that FGC was not a marriage convention. According to their conjecture, FGC signals a respect for a hierarchic social system among women, which provides circumcised women with access to the network-based social capital in a community. This social capital may also be maximized by excluding uncircumcised women through peer pressure such as harassment and ostracism.[43] In Meru, Kenya, Thomas (2000) also links FGC to the maintenance of power wielded by elders among women of different age groups. Similarly, it is also reported that elderly women in Mali advocate FGC to maintain control over the gendered sphere of power (e.g., Gosselin, 2001). Consistent with these findings, in Table 2, a relatively large fraction of the respondents considered that FGC is needed for social acceptance and this fraction is greater for women than for men. While the religious requirement is the most agreed benefit among the sample respondents, this finding may also suggest the significance of religion-based social networks. For example, in Mali, it is reported that uncircumcised Muslim women are not clean and therefore, would not be able to pray and fast (Gosselin, 2000a).

[42] The possibility that FGC is not a normative equilibrium cannot be entirely excluded, although it is less likely due to the characteristics of FGC, as discussed in subsection 5.2.

[43] In a social group that provides club goods, screening out free-riders by imposing unproductive costs such as FGC on its heterogeneous members may improve social welfare (e.g., Iannaccone, 1992).

7 Conclusion

Despite concerted global efforts to eradicate FGC, the abandonment of this practice may not necessarily increase women's welfare because FGC has been considered to be a prerequisite for women's marriage in Africa and may improve their marriage prospects. Therefore, this study examined whether the abandonment of FGC is associated with women's marital outcomes in the long term, specifically focusing on the adjustment of marriage markets.

To address this issue, first, this study formalized Mackie (1996)'s theory of marriage convention that has received much publicity in the fields of anthropology and sociology. As a developed game-theoretic model demonstrated, the abandonment of FGC implies a social change from an FGC to a no-FGC equilibrium, wherein all (no) women in a community are cut in the former (latter). This equilibrium shift could be induced by changes in the benefits and costs of FGC perceived by community members, and these factors determine women's (or their parents') FGC decisions and marital outcomes in a simultaneous manner; therefore, a causal relationship from FGC to women's marriage is less likely to exist in the long term. This equilibrium shift is expected to have no influence on the likelihood of women's marriage while possibly reducing married women's welfare and increasing married men and unmarried women's welfare. However, this welfare loss (gain) of married women (married men) may not be significant when community members do not greatly appreciate the utility cost involving this practice in the FGC equilibrium.

According to this theoretical framework, the empirical analyses herein exploited a novel setting, whereby the health and political knowledge, whose acquisition was facilitated by Burkina Faso's political efforts, might have spread to the communities of its neighboring countries located while increasing the cost of FGC perceived by border residents. This conjecture was made as Africa's arbitrarily drawn national boundaries make cross-border social interactions reasonably common. Then, it was hypothesized that such knowledge spillovers reduced the practice of FGC in the borderlands.

The DID approach, comparing border and inland communities of the neighboring four countries (i.e., Benin, Côte d'Ivore, Mali, and Togo) before and after Burkina Faso expended anti-FGC political efforts, provided evidence consistent with the hypothesis; the practice of FGC swiftly declined in the borderlands, including the sewn-closed form of FGC. In contrast, this external policy shock had no influence on the probability of young females forming a marital union and the resulting marital outcomes, as measured by a husband's education and age, the number of co-wives, family wealth, intra-household DM power, likelihoods of IPV, and so on; although it temporarily delayed their entry into first marriage and, thus, reduced their number of children during the unavoidable periods of social transition. It is acknowledged that the marital outcomes

examined may not necessarily be optimal measures of married women's welfare, although it is difficult to estimate such intra-household welfare in general. Nevertheless, women's welfare is less likely to decline significantly concomitant with the decline in FGC in the long term, at least from the mating perspective in the studied setting.

While the primary aim of the present research is to empirically explore the long-term adjustment of marriage markets occurring in parallel with the abandonment of FGC, it is noteworthy that the above findings are not inconsistent with the view that FGC is a marriage convention. Relatedly, this study also showed a relatively sharp discontinuity in cutting rates across more than 3000 communities while also revealing that approximately 73% of the variation of FGC is attributed to community-level heterogeneity. Taken together, at the very least, FGC appears to be a normative equilibrium. Identifying the norm-supporting mechanisms (e.g., coordination, peer pressure, and symbolic signaling) and the corresponding key players (e.g., males, females, elders, and peers) would improve the effectiveness of the relevant policy interventions because different theoretical mechanisms recommend different strategies to eliminate FGC (Shell-Duncan et al., 2011). This issue would be a fruitful avenue for future research possibly involving "community-wide" randomized controlled trials that have particular target groups (see also Section S.7 in the supplemental appendix for further policy-oriented discussion).

Finally, the areas and time periods studied in the present research are larger and longer than those utilized in prior case studies and, thus, the reported findings may attain a certain level of external validity. The high prevalence of FGC in West Africa also increases the economic significance of research focusing on this area (e.g., Sipsma et al., 2012). However, the findings yielded by this study cannot necessarily be generalized to wider spatial and temporal contexts. The practice of FGC varies across societies and ethnic groups in terms of age of circumcision and the manner of performance (e.g., in private/public or in person/group). Unlike the context of the present study wherein FGC takes place in infancy or even a few weeks after birth (e.g., Gosselin, 2000b), in other areas, girls are cut around puberty immediately prior to entering a marital relationship.[44] Such cases may be seen in coastal West Africa whereby entrance into women's secret society often involves FGC (e.g., Ahmadu, 2000) or elsewhere. In addition, the mechanisms sustaining FGC may also change over time. As found for some Malian Mande groups, for instance, the recent declining age at FGC may indicate a loss of the meaning of puberty rituals previously surrounding this practice (Gosselin, 2000a). To design relevant and optimal welfare-enhancing policies, it is required to improve the theoretical understanding of FGC in further rigorous empirical research.

[44] In the aforementioned field survey in Ghana conducted by the author, the Dagaaba used to practice FGC a few weeks after birth, for example. See also footnote 16 related to a further field survey conducted by the author in Tanzania.

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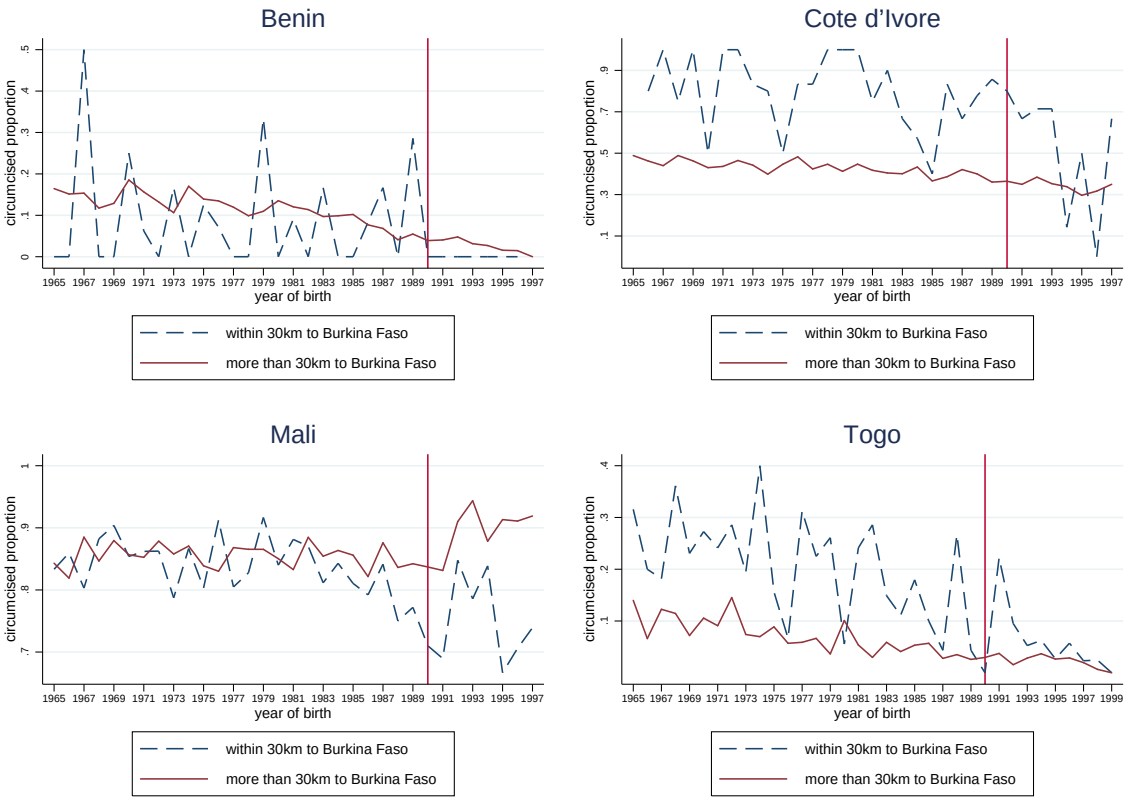

Figure 1: Proportion of circumcised population by the year of birth

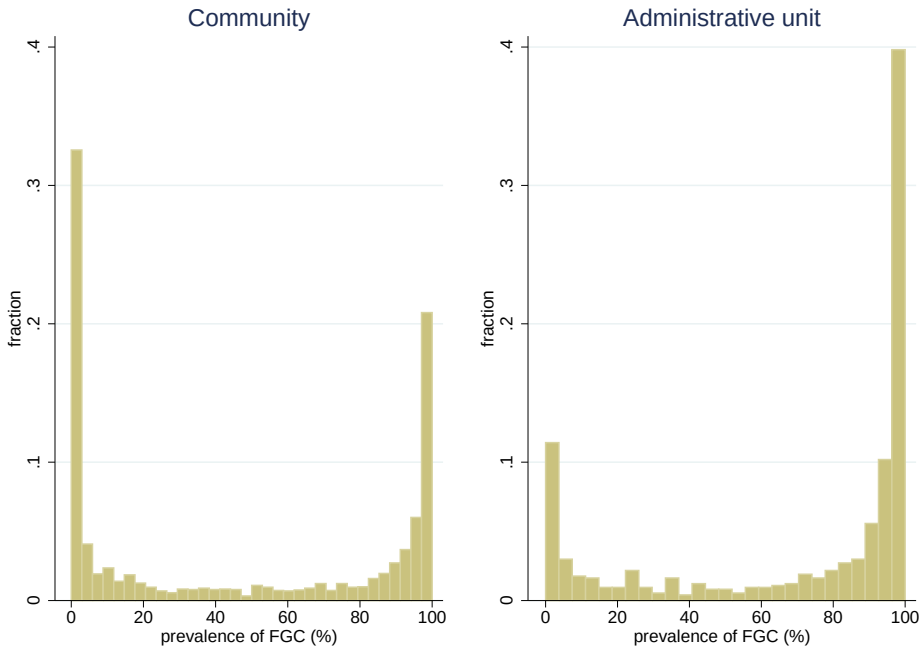

Figure 2: Distribution of cutting rates across spaces

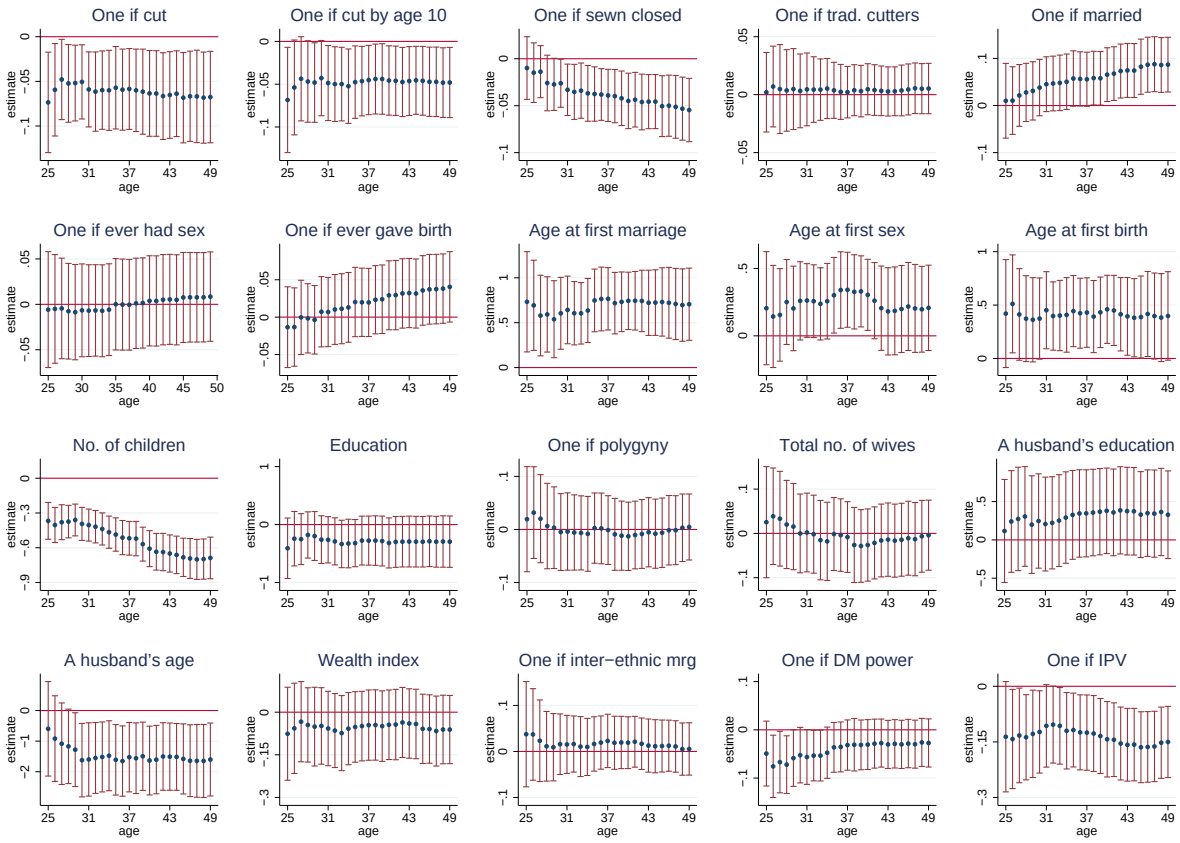

Figure 3: Impacts on females aged M or below (OLS)

Notes: (1) This figure reports the estimated α_2 in equation (1) with 95% confidence intervals by changing the exploited sample by the respondents' age. (2) Age M in the horizontal axis means that the estimation uses data pertaining to female respondents aged 15 to M years. (3) The estimations of the likelihoods of being sewn closed and by traditional cutters control for an indicator for FGC.

Table 1: Summary statistics

	Distance to BF ≤ 30 km			Distance to BF > 30 km			All		
	Mean	Std.	No. of obs.	Mean	Std.	No. of obs.	Mean	Std.	No. of obs.
(A) Born before 1990									
One if cut	0.71***	0.45	2818	0.58	0.49	57776	0.58	0.49	60594
One if sewn closed (zero if not cut)	0.06***	0.25	2400	0.04	0.20	51550	0.04	0.21	53950
One if cut by traditional cutters (zero if not cut)	0.66***	0.47	2802	0.51	0.49	57532	0.52	0.49	60334
Age at FGC if cut	6.85	3.91	966	6.83	4.47	15112	6.83	4.44	16078
One if married†	0.81***	0.38	847	0.69	0.46	20310	0.69	0.45	21157
One if ever had sex†	0.87	0.32	844	0.86	0.34	20128	0.86	0.34	20972
One if gave birth†	0.75***	0.43	847	0.64	0.47	20310	0.65	0.47	21157
Age at first marriage†	16.05***	2.53	707	16.49	2.84	14648	16.47	2.83	15355
Age at first sex†	15.80	2.24	741	15.90	2.38	17412	15.89	2.37	18153
Age at first birth†	17.16***	2.52	636	17.64	2.67	13179	17.62	2.66	13815
No. of children†	1.82***	1.53	847	1.40	1.40	20310	1.41	1.41	21157
Education (years)†	1.05***	2.59	845	2.45	3.97	20288	2.39	3.93	21133
One if polygyny‡	0.36***	0.48	693	0.26	0.44	14041	0.26	0.44	14734
No. of a husband's wives‡	1.43***	0.64	686	1.32	0.60	13886	1.32	0.61	14572
A husband's education (years)‡	1.20***	2.97	668	2.37	4.23	12831	2.31	4.18	13499
A husband's age‡	31.96***	7.99	680	32.86	7.94	13299	32.82	7.95	13979
Family wealth index (1 to 5)‡	2.31***	1.20	442	3.08	1.39	8388	3.04	1.39	8830
One if inter-ethnic marriage‡	0.26	0.44	208	0.24	0.43	3518	0.24	0.43	3726
One if have DM power‡	0.21	0.41	685	0.21	0.41	13465	0.21	0.41	14150
One if had any IPV‡	0.28	0.45	287	0.27	0.44	4564	0.27	0.44	4851
Birth order	3.34	2.10	3006	3.33	1.81	65125	3.33	1.82	68131
One if Muslim	0.55***	0.59	3004	0.59	0.49	65030	0.59	0.49	68034
One if Christian	0.19***	0.39	3004	0.27	0.44	65030	0.27	0.44	68034
Urban (dummy)	0.11***	0.32	3006	0.38	0.48	65125	0.36	0.48	68131
No. of battles (÷ 10)	0.09***	0.284	3006	0.83	2.33	65125	0.80	2.28	68131
Distance to BF (km)	16.05***	8.22	3006	325.37	178.38	65125	311.72	185.62	68131
(B) Born in or after 1990									
One if cut	0.40	0.49	554	0.43	0.49	11118	0.43	0.49	11672
One if sewn closed (zero if not cut)	0.04	0.19	494	0.04	0.21	10048	0.04	0.21	10542
One if cut by traditional cutters (zero if not cut)	0.36	0.48	554	0.38	0.48	11083	0.38	0.48	11637
Age at FGC if cut	5.62	3.47	85	5.96	4.14	1726	5.94	4.11	1811
One if married†	0.45***	0.49	644	0.35	0.47	13990	0.35	0.47	14634
One if ever had sex†	0.61	0.48	642	0.64	0.47	13864	0.64	0.47	14506
One if gave birth†	0.37**	0.48	644	0.33	0.47	13990	0.33	0.47	14634
Age at first marriage†	16.22	2.30	299	16.00	2.40	5156	16.01	2.39	5455
Age at first sex†	15.81	1.99	395	15.68	2.05	8883	15.69	2.04	9278
Age at first birth†	17.11	2.32	242	16.95	2.21	4677	16.95	2.21	4919
No. of children†	0.56*	0.87	644	0.50	0.83	13990	0.50	0.83	14634
Education (years)†	2.84***	3.61	642	4.51	4.39	13980	4.44	4.38	14622
One if polygyny‡	0.28***	0.45	295	0.20	0.40	4958	0.21	0.40	5253
No. of a husband's wives‡	1.32**	0.55	294	1.24	0.52	4903	1.25	0.52	5197
A husband's education (years)‡	2.48***	3.93	293	3.21	4.60	4836	3.17	4.57	5129
A husband's age†‡	28.77***	6.80	295	29.89	8.56	4897	29.82	8.48	5192
Family wealth index (1 to 5)‡	2.20***	1.27	295	2.83	1.38	4958	2.79	1.38	5253
One if inter-ethnic marriage‡	0.11***	0.32	109	0.24	0.42	1499	0.23	0.42	1608
One if have DM power‡	0.14*	0.35	295	0.18	0.38	4952	0.17	0.38	5247
One if had any IPV‡	0.33	0.47	142	0.33	0.47	2161	0.33	0.47	2303
Birth order	3.54	2.06	644	3.46	1.96	13990	3.46	1.96	14634
One if Muslim	0.44	0.49	644	0.47	0.49	13978	0.47	0.49	14622
One if Christian	0.35**	0.47	644	0.39	0.48	13978	0.39	0.48	14622
Urban (dummy)	0.16***	0.36	644	0.45	0.49	13990	0.43	0.49	14634
No. of battles (÷ 10)	0.21***	0.43	644	1.02	2.42	13990	0.98	2.38	14634
Distance to BF (km)	16.30***	7.96	644	341.54	174.98	13990	327.23	183.64	14634

Notes: (1) The equality of means between the respondents residing within a 30-km distance to Burkina Faso and the remaining respondents are examined by T-tests. *** denotes significance at 1%, ** at 5%, and * at 10%. (2) The information is relevant only to the respondents aged 25 or below for †, married respondents aged 25 or below for ‡, and all the respondents aged 49 or below for the remaining.

Table 2: Background information on FGC

Country:	Benin			Côte d'Ivoire		
	Mean	Std	No. of obs	Mean	Std	No. of obs
(A) Female sample						
One if cut	0.13	0.34	17388	0.44	0.49	12080
Age at FGC†‡	8.95	3.38	1580	7.48	5.54	3324
One if any flesh removed at FGC†	0.88	0.31	2268	0.93	0.23	3420
One if sewn closed	0.09	0.29	2183	0.06	0.24	4714
One if cut by traditional cutters	0.91	0.27	2415	0.82	0.37	5226
Support FGC if cut (dummy)†	0.09	0.28	2346	0.37	0.48	5119
Benefits of FGC if cut (dummy)						
Better hygiene/cleanliness	0.01	0.13	1052	0.08	0.28	707
Social acceptance	0.29	0.45	1052	NA	NA	NA
Better marriage	0.03	0.17	1052	0.16	0.36	707
Keep virginity/morality	0.02	0.15	1052	0.07	0.25	707
For male pleasure	0.00	0.07	1052	0.01	0.13	707
Religious requirement†	0.19	0.39	2275	0.35	0.47	3664
(B) Male sample						
Support FGC if FGC prevalence $>$ 0 (dummy)†	0.04	0.21	2422	0.16	0.37	4733
Benefits of FGC if FGC prevalence $>$ 0 (dummy)						
Better hygiene/cleanliness	0.00	0.09	1040	0.07	0.26	153
Social acceptance	0.08	0.27	1040	NA	NA	NA
Better marriage	0.01	0.11	1040	0.11	0.31	153
Keep virginity/morality	0.01	0.13	1040	0.14	0.35	153
For male pleasure	0.00	0.09	1040	0.05	0.22	153
Religious requirement†	0.11	0.31	2273	0.41	0.86	3988
Country:	Mali			Togo		
	Mean	Std	No. of obs	Mean	Std	No. of obs
(A) Female sample						
One if cut	0.90	0.29	35779	0.08	0.28	7019
Age at FGC†‡	6.15	4.02	12566	10.25	3.86	419
One if any flesh removed at FGC†	0.88	0.31	27604	0.81	0.38	545
One if sewn closed	0.09	0.29	25509	0.19	0.39	521
One if cut by traditional cutters	0.89	0.30	32171	0.96	0.19	594
Support FGC if cut (dummy)†	0.83	0.37	31362	0.08	0.28	592
Benefits of FGC if cut (dummy)						
Better hygiene/cleanliness	0.22	0.41	22854	NA	NA	NA
Social acceptance	0.41	0.49	22854	NA	NA	NA
Better marriage	0.08	0.28	22854	NA	NA	NA
Keep virginity/morality	0.09	0.29	22854	NA	NA	NA
For male pleasure	0.05	0.21	22854	NA	NA	NA
Religious requirement†	0.80	0.39	28870	0.38	0.48	576
(B) Male sample						
Support FGC if FGC prevalence $>$ 0 (dummy)†	0.75	0.42	10816	0.02	0.14	1700
Benefits of FGC if FGC prevalence $>$ 0 (dummy)						
Better hygiene/cleanliness	0.15	0.36	6802	NA	NA	NA
Social acceptance	0.24	0.43	6802	NA	NA	NA
Better marriage	0.05	0.22	6802	NA	NA	NA
Keep virginity/morality	0.16	0.37	6802	NA	NA	NA
For male pleasure	0.04	0.21	6802	NA	NA	NA
Religious requirement†	0.70	0.45	8909	0.08	0.27	1680

Note: (1) Those who answered "don't know" were excluded when estimating the statistics characterized as †. (2) Those who answered "during infancy/neonatal periods" were excluded when estimating the statistics characterized as ‡.

Table 3: Impacts on FGC (OLS)

Dependent variables:	One if cut	One if cut	One if cut by age 10	One if sewn closed (zero if not cut)	One if sewn closed (zero if not cut)	One if traditional cutters (zero if not cut)	One if traditional cutters (zero if not cut)
	(a)	(b)	(c)	(d)	(e)	(f)	(g)
Located within a 30-km distance to BF							
× Born in or after 1995	-0.125***	-	-	-	-	-	-
	(0.041)						
× Born b/w 1990 and 1994	-0.069**	-	-	-	-	-	-
	(0.032)						
× Born b/w 1985 and 1989	-0.033	-	-	-	-	-	-
	(0.026)						
× Born b/w 1980 and 1984	-0.015	-	-	-	-	-	-
	(0.022)						
× Born b/w 1975 and 1979	-0.018	-	-	-	-	-	-
	(0.024)						
× Born b/w 1970 and 1974	-0.019	-	-	-	-	-	-
	(0.024)						
× Born b/w 1965 and 1969	-0.018	-	-	-	-	-	-
	(0.021)						
× Born in or after 1990	-	-0.068***	-0.048**	-0.062***	-0.055***	-0.052*	0.005
		(0.026)	(0.021)	(0.019)	(0.017)	(0.027)	(0.011)
Birth order	0.003***	0.003***	0.002***	0.000	-0.000	0.002***	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Muslim	0.121***	0.121***	0.115***	0.019***	0.006	0.101***	-0.002
	(0.009)	(0.009)	(0.009)	(0.004)	(0.004)	(0.009)	(0.005)
Christian	-0.049***	-0.049***	-0.046***	-0.002	0.002	-0.037***	0.004
	(0.006)	(0.006)	(0.005)	(0.002)	(0.002)	(0.005)	(0.003)
One if cut	-	-	-	-	0.109***	-	0.857***
					(0.007)		(0.007)
Oster (forthcoming)'s δ	-	-3.638	-0.617	-4.262	-4.640	-17.203	-0.155
Predicted values within the unit interval (proportion)	0.999	0.999	1.000	0.967	0.616	0.999	0.814
R-squared	0.761	0.761	0.699	0.291	0.307	0.648	0.819
No. of obs.	71921	71921	71921	64188	64188	71627	71627
Country-ethnicity FE	YES	YES	YES	YES	YES	YES	YES
Year-of-birth FE	YES	YES	YES	YES	YES	YES	YES
Community FE	YES	YES	YES	YES	YES	YES	YES
Year-of-interview FE	YES	YES	YES	YES	YES	YES	YES

Notes: (1) Figures ( ) are standard errors. *** denotes significance at 1%, ** at 5%, and * at 10%. (2) Standard errors are robust to heteroskedasticity and clustered residuals within each community.

Table 4: Robustness checks on impacts on FGC (OLS)

	Battle	Household FE	Time trend	Recent DHS	Permanent residents
Dependent variable:	One if cut				
	(a)	(b)	(c)	(d)	(e)
Born in or after 1990					
× Located within a 30-km	-0.070***	-0.074**	-0.053**	-0.059**	-0.159***
distance to BF	(0.026)	(0.031)	(0.023)	(0.029)	(0.056)
× No. of battles (÷ 10)	-0.003*	-	-	-	-
within 40 km	(0.002)				
R-squared	0.761	0.931	0.781	0.702	0.819
No. of obs.	71921	72266	71921	37576	15613
Dependent variable:	One if cut by age 10				
	(f)	(g)	(h)	(j)	(k)
Born in or after 1990					
× Located within a 30-km	-0.051**	-0.057*	-0.042*	-0.038*	-0.137*
distance to BF	(0.021)	(0.031)	(0.025)	(0.022)	(0.071)
× No. of battles (÷ 10)	-0.003*	-	-	-	-
within 40 km	(0.002)				
R-squared	0.699	0.892	0.718	0.668	0.708
No. of obs.	71921	72266	71921	37576	15613
Dependent variable:	One if sewn closed (zero if not cut)				
	(l)	(m)	(o)	(p)	(q)
Born in or after 1990					
× Located within a 30-km	-0.055***	-0.069***	-0.014	-0.057***	-0.013
distance to BF	(0.017)	(0.023)	(0.015)	(0.019)	(0.023)
× No. of battles (÷ 10)	-0.000	-	-	-	-
within 40 km	(0.001)				
One if cut	0.109***	0.078***	0.108***	0.138***	0.095***
	(0.007)	(0.008)	(0.007)	(0.009)	(0.013)
R-squared	0.307	0.853	0.344	0.314	0.382
No. of obs.	64188	64492	64188	34669	13001
Dependent variable:	One if cut by traditional cutters (zero if not cut)				
	(r)	(s)	(t)	(u)	(v)
Born in or after 1990					
× Located within a 30-km	0.005	0.016	0.006	0.012	-0.022
distance to BF	(0.011)	(0.016)	(0.017)	(0.011)	(0.033)
× No. of battles (÷ 10)	0.000	-	-	-	-
within 40 km	(0.001)				
One if cut	0.857***	0.847***	0.858***	0.914***	0.859***
	(0.007)	(0.010)	(0.007)	(0.006)	(0.013)
R-squared	0.819	0.933	0.827	0.872	0.756
No. of obs.	71627	71971	71627	37463	15533
Birth order	YES	YES	YES	YES	YES
Religion	YES	NO	YES	YES	YES
Country-ethnicity FE	YES	NO	YES	YES	YES
Year-of-birth FE	YES	YES	YES	YES	YES
Community FE	YES	NO	YES	YES	YES
Year-of-interview FE	YES	YES	YES	YES	YES

Notes: (1) Figures ( ) are standard errors. *** denotes significance at 1%, ** at 5%, and * at 10%. (2) Standard errors are robust to heteroskedasticity in columns (b), (g), (m), and (s), whereas they are robust to heteroskedasticity and clustered residuals within each community in the remaining columns.

Table 5: Marriage effects on females aged 25 or below (OLS)

Dependent variables:	One if married	One if ever had sex	One if ever gave birth	Age at first marriage	Age at first sex	Age at first birth	No. of children	Education (years)
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
Located within a 30-km distance to BF								
× Born in or after 1990	0.010	-0.006	-0.013	0.733**	0.205	0.420	-0.368***	-0.409
	(0.040)	(0.033)	(0.028)	(0.285)	(0.214)	(0.258)	(0.081)	(0.266)
Birth order	-0.001	0.001	0.002*	-0.024**	-0.013*	-0.022**	0.005*	-0.018*
	(0.001)	(0.001)	(0.001)	(0.010)	(0.007)	(0.010)	(0.003)	(0.011)
Muslim	0.028**	-0.003	-0.004	0.131	0.144**	0.109	-0.036	0.145
	(0.011)	(0.010)	(0.011)	(0.094)	(0.065)	(0.091)	(0.025)	(0.094)
Christian	-0.058***	-0.014*	-0.058***	0.472***	0.242***	0.326***	-0.179***	1.600***
	(0.010)	(0.008)	(0.009)	(0.094)	(0.058)	(0.087)	(0.023)	(0.084)
Predicted values within the unit interval (proportion)	0.690	0.698	0.584	-	-	-	-	-
R-squared	0.492	0.412	0.467	0.351	0.293	0.334	0.528	0.448
No. of obs.	35645	35332	35645	20706	27305	18651	35645	35609
Country-ethnicity FE	YES	YES	YES	YES	YES	YES	YES	YES
Year-of-birth FE	YES	YES	YES	YES	YES	YES	YES	YES
Community FE	YES	YES	YES	YES	YES	YES	YES	YES
Year-of-interview FE	YES	YES	YES	YES	YES	YES	YES	YES

Notes: (1) Figures ( ) are standard errors. *** denotes significance at 1%, ** at 5%, and * at 10%. (2) Standard errors are robust to heteroskedasticity and clustered residuals within each community.

Table 6: Marriage effects on married females aged 25 or below (OLS)

Dependent variables:	One if polygyny	Total no. of a husband's wives	A husband's education (years)	A husband's age (years)	Wealth index (1 to 5)	One if inter-ethnic marriage	One if have DM power	One if had any IPV
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
Located within a 30-km distance to BF								
× Born in or after 1990	0.019	0.025	0.116	-0.598	-0.076	0.037	-0.049	-0.136*
	(0.051)	(0.064)	(0.343)	(0.787)	(0.083)	(0.058)	(0.034)	(0.076)
Birth order	0.004**	0.007***	-0.004	0.062*	0.004	0.002	-0.002	-0.002
	(0.002)	(0.002)	(0.016)	(0.033)	(0.004)	(0.005)	(0.002)	(0.003)
Muslim	-0.001	-0.022	-0.089	-0.142	0.196***	0.040	-0.019	-0.092***
	(0.018)	(0.026)	(0.138)	(0.350)	(0.044)	(0.039)	(0.017)	(0.030)
Christian	-0.087***	-0.141***	1.391***	-1.371***	0.178***	0.043	0.025*	-0.065**
	(0.017)	(0.030)	(0.150)	(0.312)	(0.036)	(0.032)	(0.014)	(0.031)
Predicted values within the unit/index interval (proportion)	0.950	-	-	-	1.000	0.845	0.955	0.743
R-squared	0.242	0.256	0.468	0.298	0.734	0.602	0.274	0.343
No. of obs.	19886	19669	18530	19072	14038	5304	19297	7117
Country-ethnicity FE	YES	YES	YES	YES	YES	YES	YES	YES
Year-of-birth FE	YES	YES	YES	YES	YES	YES	YES	YES
Community FE	YES	YES	YES	YES	YES	YES	YES	YES
Year-of-interview FE	YES	YES	YES	YES	YES	YES	YES	YES
Sample DHS								
Benin 2001	YES	YES	YES	YES	NO	YES	YES	NO
Benin 2011-12	YES	YES	YES	YES	YES	YES	YES	NO
Côte d'Ivoire 1998-99	YES	YES	NO	NO	NO	NO	NO	NO
Côte d'Ivoire 2011-12	YES	YES	YES	YES	YES	YES	YES	YES
Mali 2001	YES	YES	YES	YES	NO	YES	YES	NO
Mali 2006	YES	YES	YES	YES	YES	YES	YES	YES
Mali 2012-13	YES	YES	YES	YES	YES	YES	YES	YES
Togo 2013-14	YES	YES	YES	YES	YES	YES	YES	YES

Notes: (1) Figures ( ) are standard errors. *** denotes significance at 1%, ** at 5%, and * at 10%. (2) Standard errors are robust to heteroskedasticity and clustered residuals within each community.

Supplemental appendix

S.1 Mackie (1996)'s theory of marriage convention

In this section, a simple model is developed to formalize Mackie (1996)'s well-established theory of marriage convention. The purpose is to clarify the long-term relationship between the abandonment of FGC and women's marriage while providing useful implications for this study's empirical analyses. The relevant propositions are proved in Section S.2 in this supplemental appendix.

Mackie (1996) asserted that FGC persists in Africa's typical intra-marrying communities when men believe that uncircumcised women are not faithful and women believe that men would not marry uncircumcised women. He regarded FGC as a social convention supported as a coordination failure and, thus, claimed that assembling a critical mass of people who publicly pledge to stop FGC (e.g., creation of an anti-FGC association) is important to eradicate this normative practice (i.e., tipping-point theory). However, he separately discussed these two issues by referring to a simple game matrix for the former and exploiting Schelling (2006)'s coordination diagram (Chapter 7) for the latter. However, the coordination diagram does not clearly explain how women coordinate FGC in marriage markets. Relatedly, the relevant studies provided outside economics referring to Mackie (1996) often describe the role of social pressure by community members on those who refuse FGC as a mechanism sustaining FGC. However, if pure coordination, as proposed in Mackie (1996), maintains FGC, no punishment of such deviants is required.

The following model attempts to unify these two perspectives into a single framework as simply as possible. On the other hand, multiple equilibria regarding the practice of FGC, which will be shown below, could be demonstrated by utilizing a signaling model (e.g., Spence, 1973), for example; women of heterogeneous types (e.g., faithfulness), which are private information, signal own types by FGC and all the different types of women choose the same level of FGC in a pooling equilibrium. However, this complication is avoided here, as one goal of this section is to replicate Mackie (1996)'s original idea in a more formal manner, which does not assume any heterogeneity and the associated imperfect information, and to generate theoretical implications useful for this study's empirical analyses;[45] a simple model would be sufficient for these purposes.

Consider an intra-marrying community, whereby women compete with each other when seeking their marital partners with no search friction, as implicitly presumed by Mackie (1996). To explicitly take this competition into account, the ratio of men to women is $p \in (0, 1)$ and the size of the male population is normalized as one. Men (agent m) and women (agent w) are assumed to have homogeneous preferences. In addition, two marriage-related customs, i.e., FGC or something else, exist in this community.

The sequence of actions taken by both agents is as follows (see also Figure S.2 in this supple-

[45] The signaling model may also not necessarily be convenient for analyses of tipping.

mental appendix). First, a man announces whether and to whom, he proposes, and if he proposes, the amount of livelihood support $g \geq 0$ that will be provided to a woman during marital life. If he decides to propose to a circumcised (uncircumcised) woman, he chooses endogenously determined g_c (g_0). When a man does not make a proposal, he chooses exogenously determined g_s ($= 0$) and the game ends, which makes him (and so, women) remain single. Following a man's announcement, a woman (or her parents) decides whether to undergo circumcision (action k), whereby $k = k_c$ if she is circumcised and $k = k_0$ otherwise, and then selects her response z to the proposal; this response includes either "accept and marry (m)" or "reject and stay single (s)." Consequently, the strategy profile taken by both men and women can be characterized as (g, k, z).

The corresponding payoffs $v_i(\cdot, \cdot, \cdot)$ of an agent i (either m or w) are demonstrated as follows:

$$
\begin{aligned}
v_m(g_s) &= 0, && \text{(S.1.1)}\\
v_w(g_s) &= 0, && \text{(S.1.2)}\\
v_m(g_c, k_c, m) &= \gamma b - g_c, && \text{(S.1.3)}\\
v_w(g_c, k_c, m) &= g_c - c, && \text{(S.1.4)}\\
v_m(g_c, k_c, s) &= 0, && \text{(S.1.5)}\\
v_w(g_c, k_c, s) &= -c, && \text{(S.1.6)}\\
v_m(g_0, k_0, m) &= (1-\gamma)b - g_0, && \text{(S.1.7)}\\
v_w(g_0, k_0, m) &= g_0, && \text{(S.1.8)}\\
v_m(g_0, k_0, s) &= 0, && \text{(S.1.9)}\\
v_w(g_0, k_0, s) &= 0. && \text{(S.1.10)}
\end{aligned}
$$

Whether FGC or not, men are assumed to believe that women conforming to a community's major marriage-related custom are faithful and obtain γb ($(1-\gamma)b$) by marrying circumcised (uncircumcised) women, whereby $b > 0$ is exogenous and $\gamma \in [0, 1]$ is the fraction of circumcised women in a community. This fraction is endogenously determined by women's choice of k. When $\gamma = 0.8$, for example, men marrying circumcised women obtain higher utility than those marrying uncircumcised women by $0.6b$ ($= 0.8b - 0.2b$). This utility premium is zero if there is no majority custom (i.e., $\gamma = 0.5$). It is assumed that married men receive no utility other than this premium, which simplifies the analysis. Both men and women obtain reservation utility normalized at the level of zero when they remain single. This case arises when women reject a proposal (i.e., $z = s$) or men make no proposal (i.e., $g = g_s$). The practice of FGC and the resulting health impairment make women less productive and, thus, reduce their utility by the exogenous amount of $c > 0$

during both married and single life.[46]

Defining $\tilde{c} \equiv \frac{c}{p}$, then, it can be shown that

Proposition S.1 *When the cost of FGC is not particularly large (i.e., $b > \tilde{c}$), the strategy profiles $(g_c = \tilde{c}, k_c, m)$ and $(g_0 = 0, k_0, m)$ are subgame perfect and stable, along with the equilibrium levels of utility $v_m = b - \tilde{c}$, $v_w = \tilde{c} - c$ for married women, and $v_w = -c$ for unmarried women in the former, whereas $v_m = b$ and $v_w = 0$ for both married and unmarried women in the latter.*

There are two pure strategy subgame perfect equilibria that are both stable, whereby all women are circumcised in the profile $(g_c = \tilde{c}, k_c, m)$ (FGC equilibrium achieving the circumcised fraction of $\gamma = 1$) and uncircumcised in the $(g_0 = 0, k_0, m)$ (no-FGC equilibrium achieving the circumcised fraction of $\gamma = 0$).

Once the FGC equilibrium arises as a social norm due to historical accident (see Mackie, 1996, for example), it becomes a uniquely salient or focal solution to the relevant game. In the FGC equilibrium, a man has no incentive to marry uncircumcised women because he believes that they are unfaithful and thus such a marriage provides him with lower utility than the current one. A woman also has no incentive to refuse FGC because (she believes that) no man proposes to uncircumcised women. The FGC equilibrium is inferior to the no-FGC equilibrium because shifting from the former to the latter improves the total welfare enjoyed by all community members from $b - \tilde{c}$ to b.[47] Therefore, the existence of both the FGC and no-FGC equilibrium reflects a coordination problem. The proposition S.1 also implies that a community tends to reveal the cutting rate of either one or zero. This discontinuity of the cutting rate across communities is confirmed in the analyzed data, as examined in subsection 5.2.

In addition, when γ is just below (above) $\frac{b+\tilde{c}}{2b}$, as indicated from the proof of proposition S.1, a community converges to the no-FGC equilibrium (FGC equilibrium) (see also Figure S.3 in the supplemental appendix). Thus, if more than $\frac{b-\tilde{c}}{2b}$ $(= 1 - \frac{b+\tilde{c}}{2b})$ fraction of people do not undergo FGC, a shift from the FGC to the no-FGC equilibrium is achieved in a self-enforcing manner. Following Schelling (2006)'s idea of "viable coalition," therefore, Mackie (1996) claims that organizing a group including a critical minimum number of people that refuse FGC and making it visible to the public is necessary for the eradication of this practice. Since $\frac{b-\tilde{c}}{2b} < \frac{1}{2}$, this group does not necessarily have to include most of the female community members.

In this study's empirical analysis, it is hypothesized that Burkina Faso's political efforts increased the utility cost of FGC perceived by those residing in communities of its neighboring

[46] This reduced productivity may also decrease men's utility in marital life when they marry circumcised women. Explicitly considering this cost in the model does not affect the key theoretical implications.

[47] The total welfare in the FGC equilibrium is $(b - \tilde{c}) + \frac{1}{p}\left(p(\tilde{c} - c) + (1 - p)(-c)\right) = b - \tilde{c}$. The total welfare in the no-FGC equilibrium would easily be checked in a similar manner.

countries located close to Burkina Faso due to cross-border social interactions and the resulting spillovers of FGC-related health and political knowledge. Accordingly,

Proposition S.2 *When $b < \tilde{c}$, the strategy profile $(g_c = 0, k_0, m)$ is subgame perfect and stable, along with the equilibrium levels of utility $v_m = b$ and $v_w = 0$ for both married and unmarried women.*

In response to the increase in perceived utility cost, all women refrain from FGC. In reality, however, only a fraction of community members might have obtained the new knowledge on FGC and updated their perception of its cost. Nevertheless, if a great mass of people, exceeding the critical threshold (i.e., $\frac{b-\tilde{c}}{2b}$ in the present model) refuse FGC, a community tips over to the no-FGC equilibrium in a self-enforcing manner.[48]

The transition to new equilibrium would not affect women's expected utility.[49] As the number of men available in the market is constant, the likelihood of women's marriage would also remain unchanged (at the level of p) before and after this social change takes place. On the other hand, this transition could reduce married women's "realized" utility from $\tilde{c}-c = \frac{(1-p)c}{p}$ to zero. This decline is ascribed to the disappearance of compensation previously given by men to circumcised women (including both those who get married and those who fail to do so) for the health-impairment cost of FGC, which in turn raises married men's welfare from $b - \tilde{c}$ to b. While unmarried women's welfare increases from $-c$ to zero due to the avoidance of FGC and the total welfare enjoyed by all community members also improves from $b - \tilde{c}$ to b, the asymmetric consequence of the abandonment of FGC on married men and women's welfare is not highlighted in Mackie (1996) and may serve as an important caution for those who believe that the eradication of FGC improves "all" women's welfare. That said, the model also suggests that married women's utility loss may not be particularly large when community members previously underestimated the cost of FGC (i.e., $c \approx 0$) or the marriage market is not seriously competitive for women (i.e., $p \approx 1$).

Admittedly, the assumption that a man's decision is made before a woman makes the cutting decision is crucial in ensuring the multiplicity of equilibria in the aforementioned model. If the order of these two decisions is switched (see Figure S.4 in this supplemental appendix for this alternative game), an FGC equilibrium never arises because any compensation proposed by men to circumcised women is not credible.[50] As this itself is another finding provided by this section's

[48] Following a standard approach in the relevant social norm literature, perturbing women's best response by assuming that they choose k_0 with an exogenous probability may also prompt the equilibrium shift if the initial perturbation, as caused by Burkina Faso's political efforts, is sufficiently large. In contrast to this approach based on strategic uncertainty, a change in social fundamentals (i.e., an increase in c relative to b) induces the equilibrium shift in proposition S.2, as in Munshi and Myaux (2006). Note that this difference is not crucial in the present study because the key predictions provided for the empirical analysis are the same between these approaches.

[49] Note that women's expected utility is zero in both the FGC and no-FGC equilibrium.

[50] More precisely, in this alternative game, a woman (or her parents) first decides whether to make her circumcised

attempt to formalize Mackie (1996), it may cast doubt on his insights. In this alternative game, however, multiplicity is still possible, provided a man commits himself to the amount of livelihood support (e.g., $g_c = \tilde{c}$ and $g_0 = 0$) women expect when making the cutting decision. This may be possible if men's behavior is regulated by their societies. In fact, the amount of marital support in such a society may be more or less exogenous to an individual man. For example, if the socially accepted amount is given at the level of $b > g\ (= g_c = g_0) = \tilde{g} > c$, both the FGC and no-FGC equilibrium again arise in this alternative setup. In this particular example, an increase in the cost of FGC and the resulting transition from the FGC to no-FGC equilibrium raise all women's welfare (from $\tilde{g} - c$ to $\tilde{g}$ for those married and from $-c$ to zero for those unmarried) while keeping men's welfare at the level of $b - \tilde{g}$. Taken together with the prediction provided by the original model, this possibility suggests that the long-term relationship between the abandonment of FGC and changes in married women's welfare is a priori ambiguous, which makes this study's empirical endeavors worthwhile.

Summarizing, it should be acknowledged that both the original game (with the amount of g endogenously determined) and the alternative game (with g exogenously determined at a certain level) can replicate Mackie (1996)'s ideas. Most importantly for the empirical exercises conducted herein, both (and possibly further alternative) setups still provide two similar theoretical implications. First, no causal relationship between FGC and women's marriage exists in the long term. Second, the underlying factors (e.g., b, c, p) simultaneously determine these two practices. Therefore, this study separately estimates impacts of the external policy shock attributed to Burkina Faso's political efforts on the practices of FGC and marriage in the borderlands of its neighboring countries. This approach enables the present study to analyze the long-term adjustment of marriage markets that takes place in step with the decline in FGC.

S.2 Proof

Proof of proposition S.1:
Note that men choose $g_0 = 0$ to encourage uncircumcised women to accept a marital offer, resulting in $v_m(g_0, k_0, m) = (1-\gamma)b$ and $v_w(g_0, k_0, m) = 0$. Since $(1-\gamma)b \geq 0$, men always have an (weak) incentive to make a marital offer to uncircumcised women rather than staying single. To consider an equilibrium where women choose FGC while accepting a marital offer, it must be the case that

before entering into a marriage market. Then, in the marriage market, a man decides whether and to whom he proposes and if he proposes, the amount of g. Thus, if he makes no proposal, women in this game incur the cost of FGC, as seen from $v_w(k_c, g_s) = -c$ in Figure S.4. In this game, a man can reduce women's marital utility to the level of their reservation utility (zero for those uncircumcised and $-c$ for those circumcised) due to their competition in the marriage market, resulting in $g_c = g_0 = 0$. Thus, no woman chooses the costly FGC. Consequently, the strategy profile $(k_0, g_0 = 0, m)$ becomes subgame perfect (i.e., no-FGC equilibrium).

$g_c - c \geq 0$ as well as $p(g_c - c) + (1-p)(-c) \geq pg_0 + (1-p) \cdot 0 = 0$, resulting in $g_c \geq \frac{c}{p} \equiv \tilde{c}$. So, men choose $g_c = \tilde{c}$, resulting $v_m(g_c, k_c, m) = \gamma b - \tilde{c}$ and $v_w(g_c, k_c, m) = \tilde{c} - c > 0$.

Now, consider the following three cases. First, assume the equilibrium fraction of the circumcised girls in a community $\gamma^* = \underline{\gamma} \leq \frac{\tilde{c}}{b}$. Since $\underline{\gamma} b - \tilde{c} \leq 0$ and $(1-\underline{\gamma})b > 0$ in this case, men prefer to marry uncircumcised women and uncircumcised women accept the proposal. For this outcome to be realized at equilibrium, women have to choose $k = k_0$, which leads to $\underline{\gamma} = 0 < \frac{\tilde{c}}{b}$ (no-FGC equilibrium). Second, assume $\gamma^* = \overline{\gamma} > \frac{b+\tilde{c}}{2b}$. Since $\overline{\gamma} > \frac{b+\tilde{c}}{2b} > \frac{\tilde{c}}{b}$, it becomes that $\overline{\gamma} b - \tilde{c} > 0$ and $\overline{\gamma} b - \tilde{c} > (1-\overline{\gamma})b$. Therefore, men prefer to marry circumcised women and circumcised women accept the proposal. For this outcome to be realized at equilibrium, women have to choose $k = k_c$, which leads to $\overline{\gamma} = 1 > \frac{b+\tilde{c}}{2b}$ (FGC equilibrium). Third, assume $\frac{\tilde{c}}{b} < \gamma^* = \hat{\gamma} \leq \frac{b+\tilde{c}}{2b}$. In this case, it becomes that $(1-\hat{\gamma})b \geq \hat{\gamma} b - \tilde{c} > 0$. When $(1-\hat{\gamma})b > \hat{\gamma} b - \tilde{c}$, men prefer to marry uncircumcised women and uncircumcised women accept the proposal. For this outcome to be realized at equilibrium, women have to choose $k = k_0$, which leads to $\hat{\gamma} = 0 \leq \frac{\tilde{c}}{b}$. This is a contradiction to the definition of $\hat{\gamma}$. When $(1-\hat{\gamma})b = \hat{\gamma} b - \tilde{c}$ (i.e., $\hat{\gamma} = \frac{b+\tilde{c}}{2b}$), men are indifferent to the practice of FGC. In this case, it is possible that women randomize the cutting decision at equilibrium and choose $k = k_c$ with the probability $\frac{b+\tilde{c}}{2b}$ and $k = k_0$ with the remaining probability.[51] However, this equilibrium is not stable because just a small deviation from this fraction leads to either the FGC or no-FGC equilibrium.

Proof of proposition S.2:
As before, men choose $g_c = \tilde{c}$ (or $g_0 = 0$) to encourage circumcised (or uncircumcised) women to accept a marital offer. Assume the equilibrium fraction $\gamma^* = \tilde{\gamma} \leq 1 < \frac{b+\tilde{c}}{2b} < \frac{\tilde{c}}{b}$. Since $\tilde{\gamma} b - \tilde{c} < 0$ and $\tilde{\gamma} b - \tilde{c} < (1-\tilde{\gamma})b$, men prefer to marry uncircumcised women and uncircumcised women accept the proposal. For this outcome to be realized at equilibrium, women have to choose $k = k_0$, which leads to $\tilde{\gamma} = 0 \leq 1$.

S.3 Parallel-trend assumption

This section statistically tests whether trends in cutting rates before 1990 are parallel between the border and inland communities. Data pertaining to respondents born in or before 1989 are used

[51] Put differently, for women to randomize the cutting decision, it must be the case that $p(g_c - c) + (1-p)(-c) = pg_0 + (1-p) \cdot 0$, so $g_c - g_0 = \tilde{c}$. For men to be indifferent to the practice of FGC, which allows women to randomize the cutting decision, it must be the case that $\gamma b - g_c = (1-\gamma)b - g_0$, so $\gamma = \frac{b+g_c-g_0}{2b}$. Therefore, it must be the case that $\gamma = \frac{b+\tilde{c}}{2b}$ at the interior equilibrium. To encourage women to accept a marital offer in this equilibrium, men have to choose g_c (when proposing to circumcised women) and g_0 (when proposing to uncircumcised women), such that $g_c - g_0 = \tilde{c}$, $g_c - c \geq 0$, and $g_0 \geq 0$. Consequently, men choose $g_c = \tilde{c}$ and $g_0 = 0$.

to estimate the following equation

$$y_{ijt} = \beta_1 + \sum_h \beta_2^h \cdot W_{ij}^h + \sum_h \beta_3^h \cdot W_{ij}^h \cdot B_j + v_j + u_{ijt}, \tag{S.3.1}$$

where W_{ij}^h is a dummy equal to one if the person was born in year h and zero otherwise (the reference group included those born in or before 1979) and u_{ijt} is a stochastic error term. The parallel trend is consistent with the estimated β_3^h, which is insignificantly different from zero. With [column (b)] or without [column (a)] several individual-level controls, estimation results for cutting rates are reported in Table S.1. This exercise provided no evidence undermining the parallel-trend assumption of cutting rates before 1990.

S.4 Interior cutting rates

Several communities with cutting rates between zero and one, as found in Figure 2, are worth explaining. At least three reasons could account for the interior cutting rates. First, the interior cutting rates might pertain to communities that are shifting from an FGC to a no-FGC equilibrium and thus not in steady state. Second, such communities may be cohabited by two ethnic groups, one that traditionally practices FGC and one that does not, and it may be the case that the stable equilibrium is achieved in a marriage market of the respective ethnic groups that does not overlap between them.

Third, within-community heterogeneity may also point toward the interior cutting rates, as analyzed by Efferson et al. (2015). For example, assume that a community includes two (publicly known) types of men, i.e., those who place a high intrinsic value on a community's marriage-related custom (i.e., conformists) and those who do not (i.e., reformists), whereby the former type is characterized as having $b = b_h$, along with the latter type of $b = b_l$ ($< b_h$). In this case, it would be possible that the equilibrium fraction of circumcised women lies between $\frac{b_h+\tilde{c}}{2b_h}$ and $\frac{b_l+\tilde{c}}{2b_l}$ (i.e., interior equilibria).[52]

The presence of the interior equilibria provides two related implications. First, cutting rates existing (and varying) between zero and one, as seen in Figure 2, may suggest that a plausible amount of heterogeneity exists in terms of the within-community distribution of the types across

[52] Whatever the fraction of the respective types, both types of men can choose $g_c = \tilde{c}$ and $g_0 = 0$ at equilibrium, which encourages women to accept a proposal while making them indifferent to the practice of FGC. Assume the equilibrium fraction of circumcised girls in a community $\gamma^* = \gamma_H \in [\frac{b_h+\tilde{c}}{2b_h}, \frac{b_l+\tilde{c}}{2b_l}]$. Since $\gamma_H b_h - \tilde{c} \geq (1-\gamma_H)b_h$ and $\gamma_H b_l - \tilde{c} \leq (1-\gamma_H)b_l$, the conformists (reformists) prefer to marry circumcised (uncircumcised) women. In response to this choice, some women may choose $k = k_c$ and others may choose $k = k_0$. It is possible that γ_H is achieved at equilibrium.

communities. Second, refinements considering heterogeneous preferences within and across communities are needed when organizing an anti-FGC association proposed by Mackie (1996). For example, both the FGC and no-FGC equilibrium (in addition to the interior equilibria) can still arise even when allowing for heterogeneous preferences within a community.[53] Then, consider a shift from the FGC equilibrium. In Section 2, it was noted that the no-FGC equilibrium is achieved in a self-enforcing manner when the fraction of circumcised girls in a community is just below $\frac{b+\tilde{c}}{2b}$. In the aforementioned example, this threshold value is $\frac{b_l+\tilde{c}}{2b_l}$ for the reformists. However, inducing $\frac{b_l-\tilde{c}}{2b_l}$ $(= 1 - \frac{b_l+\tilde{c}}{2b_l})$ fraction of women to refrain from FGC may not completely eliminate this practice. This is because the conformists still prefer to marry circumcised women provided more than $\frac{b_h+\tilde{c}}{2b_h}$ fraction of women practice FGC. While these discussions were based on the marriage coordination model, the logic is quite general and applies to any mechanisms supporting the normative equilibrium.

S.5 Further threats to statistical inference

In addition to the relocation issue discussed in subsection 6.3, three more empirical issues are discussed here. First, the possible reduction of child mortality (or more generally, health improvement) attributed to the abandonment of FGC enables women currently residing in the borderlands (more precisely, at the time of the most recent rounds of DHS including the post-treatment sample) to have certain characteristics valued in marriage markets which systematically differ from those held by inland residents.[54] Similarly, in the borderlands the possible decrease of deaths in childhood may also increase the intensity of competition in marriage markets among women who survive until the present and, thus, reduce their current marriage prospects (although this possibility provides further support for the "no marriage-discouraging effect of the abandonment of FGC").

Second, OLS can yield predicted values outside the supposed interval (e.g., zero to one for the binary outcomes, one to five for the wealth index). However, a proportion of the predicted values within the supposed interval, reported at the bottom of Table 3, Table 5, Table 6, is not necessarily small. In the estimated impacts of the incidence of FGC, for example, the proportion is almost one.

[53] When the circumcised fraction is above $\frac{b_l+\tilde{c}}{2b_l}$ (below $\frac{b_h+\tilde{c}}{2b_h}$), the FGC equilibrium (no-FGC equilibrium) arises in a self-enforcing manner.

[54] The abandonment of FGC may also influence the fertility of the post-treatment sample, which indeed is demonstrated in this study, and in turn affect the marital outcomes of children born to this sample. However, this selected fertility is not an empirical concern in this study because the exploited data does not include children born to the post-treatment sample.

Nevertheless, it is still possible to estimate non-linear models such as a conditional logit model (Chamberlain, 1980) or a fixed-effects ordered logit model (Baetschmann et al., 2015) while avoiding the potential incidental parameter problem arising from exploiting numerous community-level indicators in the non-linear models (e.g., Greene, 2004; Lancaster, 2000). However, estimating a large battery of fixed effects in these models is very demanding in general and may not be appropriate when the fixed-effects tend to explain the outcomes perfectly.[55]

Therefore, after replacing community and year-of-birth fixed effects with dummies for respondents residing within a 30-km distance to Burkina Faso and for those born in or after 1990 (while keeping the remaining regressors exploited previously), logit and ordered logit models were estimated in Table S.11 in this supplemental appendix. This table reports the (proportional) odds ratio of interest, i.e., how much the impacts of Burkina Faso's policy shock on the expected odds, as normalized by the baseline odds of their own categories (i.e., border or inland residents), differ between the border and inland communities in a proportional sense (see also Buis, 2010 for the interpretation). A ratio less than one indicates that the negative (positive) impacts of the policy shock for the border residents are greater (smaller) than for the inland residents in a multiplicative sense. Note that the reported estimates may be biased because these estimations do not control for all time-invariant characteristics specific to each community. Nevertheless, overall, the resultant implications remained unchanged.

Finally, another empirical concern is that the significant decline in FGC in the borderlands might have been revealed by chance in the present study exploring numerous outcomes. To address this concern, Table S.12 in this supplemental appendix explores whether the finding is robust to the consideration of multiple-hypothesis testing. After selecting the 14 key outcomes to avoid the relevant tests being too conservative (e.g., Schochet, 2008), Table S.12 replicates estimates from Table 3, Table 5, and Table 6 and the original p-values, along with the adjusted p-values using Bonferroni's, Holm (1979)'s step-down, and Hochberg (1988)'s step-up adjustment procedures.[56] These tests tend to suffer from low statistical power because they do not account for dependency across tests when controlling familywise error rate. Nevertheless, the negative FGC effect (with statistical significance around 5 to 10% levels), the increase in the age at first marriage (at around 10%), and fertility reduction (at 1%) were still detected.

[55] For example, if all respondents in a community practice or do not practice FGC, all respondents in this community are computationally excluded from the estimated sample of the FGC equation when controlling for community fixed effects. Thus, a (quasi-)discontinuity in cutting rates across the surveyed communities, as shown in Figure 2, renders the conditional logit model less suitable for the analysis of FGC.

[56] As early marriage, early sexual intercourse, and early childbirth are highly correlated, the exercises in Table S.12 focused on the impacts on marriage, which is one of the two most important outcomes in the present study (i.e., FGC and marriage).

S.6 Literature review: FGC as a premarital investment

Chesnokova and Vaithianathan (2010) modeled FGC as a premarital investment and showed that inefficiently high (but not 100%) cutting rates in a community (i.e., FGC equilibrium according to their definition) arise as a mixed strategy equilibrium, along with males and females matched assortatively on the basis of FGC and grooms' wealth "within" a community achieving the FGC equilibrium.[57]

Their model differs from Mackie (1996) by assuming that two (publicly known) types of men in a marriage market (i.e., rich and poor), both of whom "innately" prefer to marry circumcised women rather than to marry uncircumcised women, and that women also prefer to marry rich men relative to poor men. The marriage market, having the same number of men and women, includes two rounds, with the first round characterized as random matching and the second round of "assumed" positive assortative matching based on FGC and men's wealth.

Due to these assumptions, all men in the FGC equilibrium decline to marry uncircumcised women in the first round because they have a positive probability of being matched with circumcised women in the second round. On the other hand, men have no such incentive in a community having zero cutting rate (i.e., no-FGC equilibrium). Since this implies that all rich men (as well as poor men) in the no-FGC equilibrium marry in the first round, women in this equilibrium have no chance to meet rich men in the second round. Therefore, (whether matched with rich men or poor men) women in the no-FGC equilibrium would not decline their marriage in the first round. Consequently, an equilibrium shift from an FGC to a no-FGC equilibrium would decrease women's age at marriage in the long term.[58] On the other hand, according to their model, women's marriage probability and marital outcomes as measured by a husband's wealth would not be affected by the equilibrium shift, on average.

[57] In general, assortative matching based on a premarital investment can arise in marriage markets characterized by heterogeneous men and women, which potentially improves economic efficiency (e.g., Bidner, 2010; Hoppe et al., 2009; Rege, 2008). However, premarital investments are inherently public goods in the sense that the return may not be fully enjoyed by parents. Therefore, parents may underinvest in children (i.e., holdup problem). Alternatively, as a small advantage over others may result in a match with a partner of a considerably high quality, this rat-race nature of marriage markets may stimulate parents to overinvest in their children. These factors may reduce social welfare arising from assortative and efficient matching (e.g., Bhaskar and Hopkins, 2016; Peters, 2007; Peters and Siow, 2002). In Chesnokova and Vaithianathan (2010), women enjoy high returns by marrying rich men and the rat-race nature of marriage markets induces inefficiently high levels of FGC, whereas the value of marriage-related customs (e.g., FGC) to men plays a role in driving market inefficiency in the model presented in Section 2.

[58] However, note that since men prefer to marry circumcised rather than uncircumcised women, FGC is correlated with younger age at marriage "within" a community achieving the FGC equilibrium.

S.7 Policy considerations

Several analyses conducted herein provided some support for the view that FGC is a normative equilibrium. If so, community-based interventions would be effective for the eradication of FGC rather than strategies providing each of the community members with an individual (e.g., monetary) incentive. According to Young (2015), coordination, social pressure, or symbolic signaling of group membership often support normative behaviors. Thus, future research identifying which of these mechanisms maintains FGC and who supports this normative institution would be helpful to optimize policy interventions.

Related to this point, two major demand-side policy interventions currently in use include creating an anti-FGC association that facilitates a public declaration to abandon FGC, as put forth by Mackie (1996), and organizing alternative initiation rituals.[59] The latter strategy is proposed, as FGC often takes places as a rite of passage into adulthood (see Mackie, 2000, for example).

Both approaches may potentially eliminate FGC if a sufficient number of people crossing a crucial group-threshold agree to its abandonment as a result of these interventions. Importantly, if FGC is a social norm coordinating women's marriage, forming a public association including a great number of potential grooms and brides (and their parents) that pledge not to practice FGC may be required. Similarly, if social pressure from circumcised women of the same generation facilitates FGC, the relevant association would have to include such peers as critical members. If FGC is sustained by signaling the subordination of young girls to female elders, alternative initiation rites may halt FGC only when elders interpret young girls' participation in those rituals as a sign of respect to the elders. Relevant future research possibly involving randomized controlled trials should carefully be designed to disentangle underlying factors of this kind.

On the other hand, as the underlying mechanisms may not be mutually exclusive, it would be practical to implement experimental interventions (e.g., community-based education programs) that have particular target groups (e.g., males, females, elders, peers). Targeted groups may also have to include those who place a high intrinsic value on FGC when substantial heterogeneity in preferences for this practice is likely to exist within and across communities.

[59] Supply-side interventions include monetary compensation for cutters that stop FGC and/or legal punishment for parents that made daughters get circumcised and those that performed the cutting.

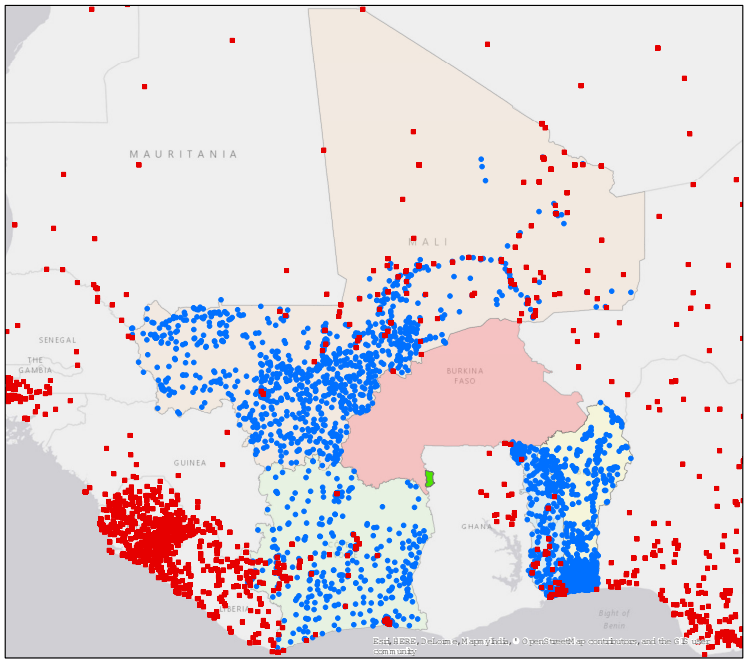

Figure S.1: Position of DHS communities (blue circle), violence incidence (red square), and the author's surveyed area (green polygon)

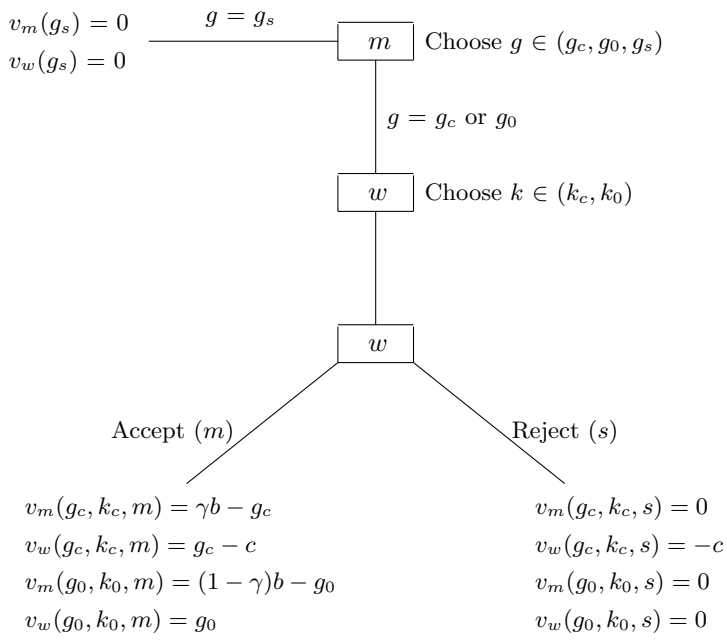

Figure S.2: Marriage coordination game

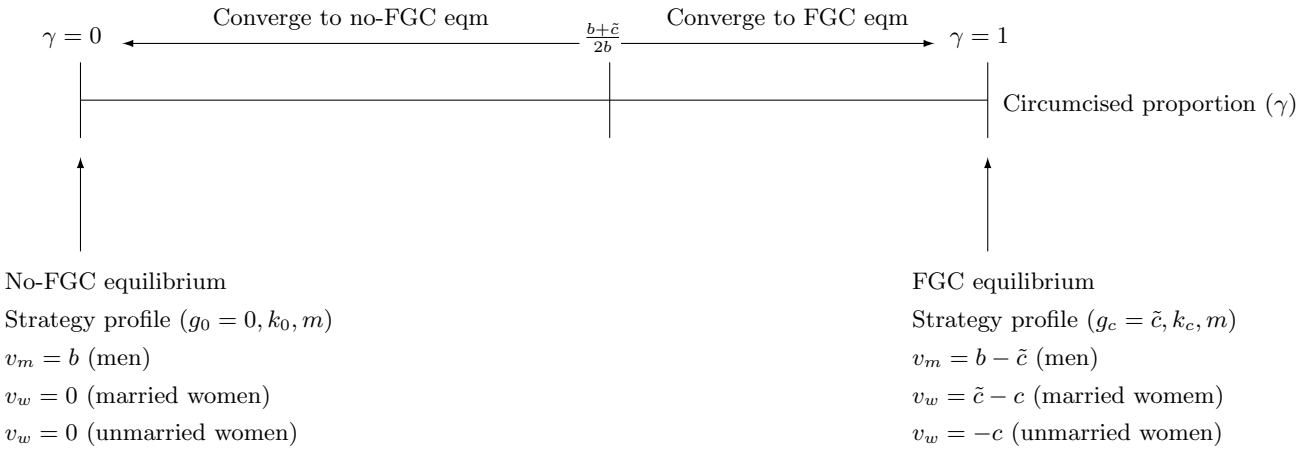

Figure S.3: Graphical description of equilibria

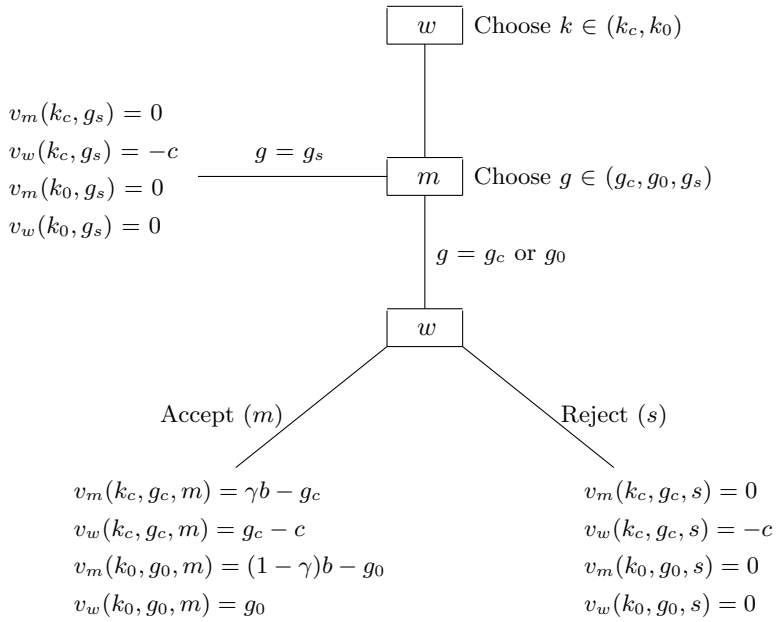

Figure S.4: Alternative marriage coordination game

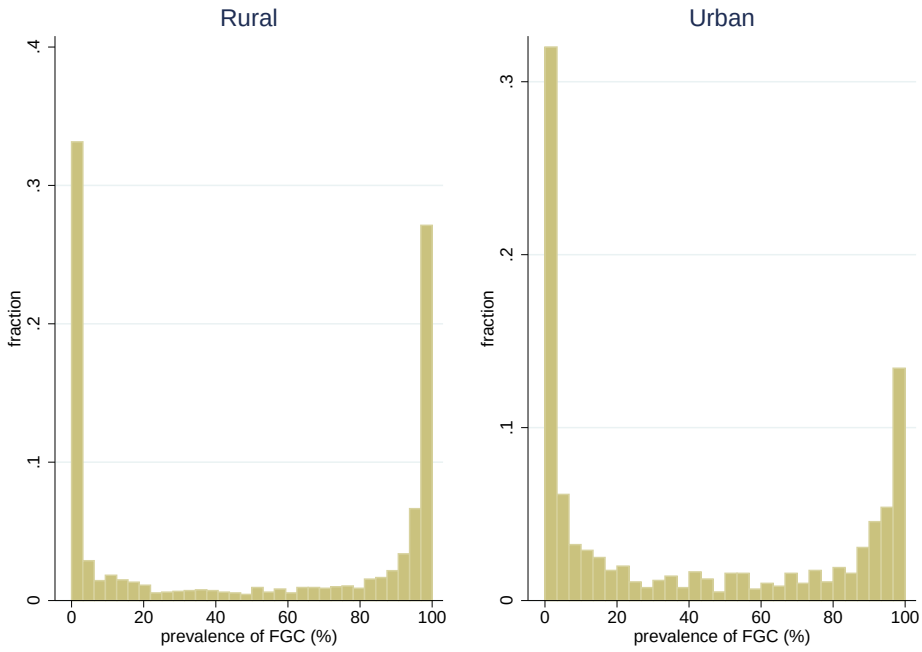

Figure S.5: Distribution of cutting rates across communities

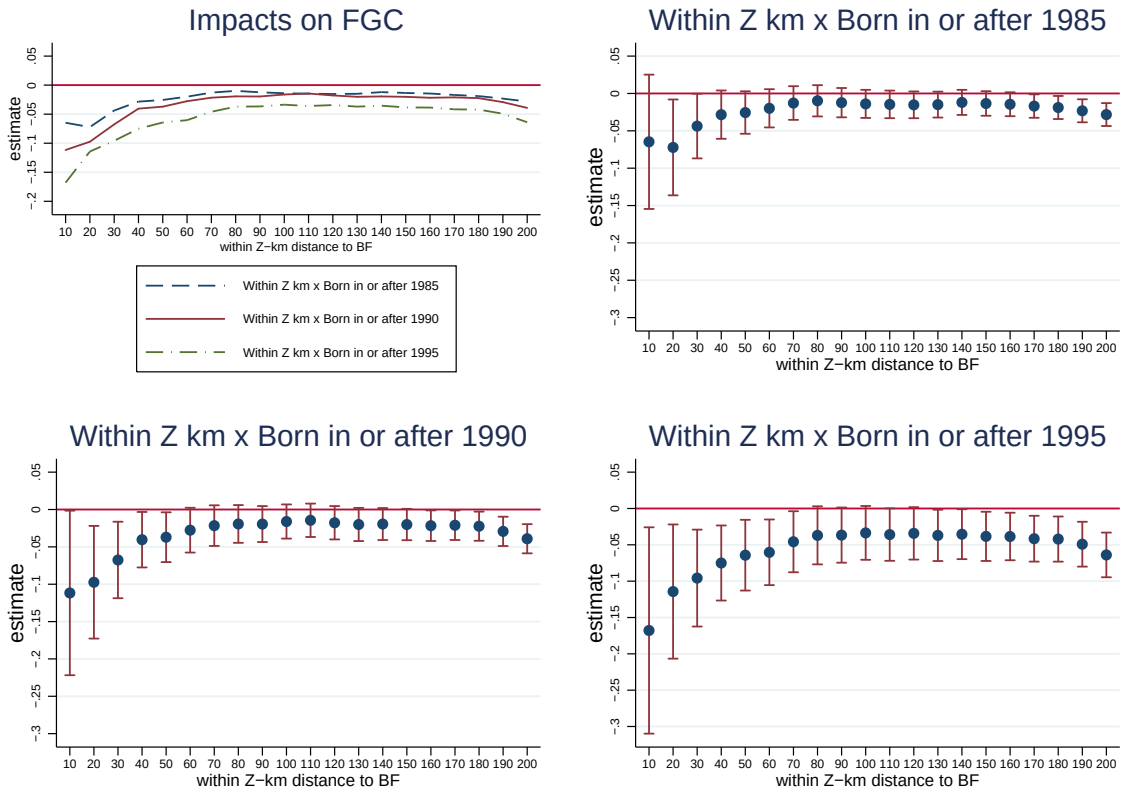

Figure S.6: Impacts on FGC by distances to the border to Burkina Faso

Note: This figure reports the estimated α_2 in equation (1) with 95% confidence intervals by changing the definition of D_{ijt} and B_j.

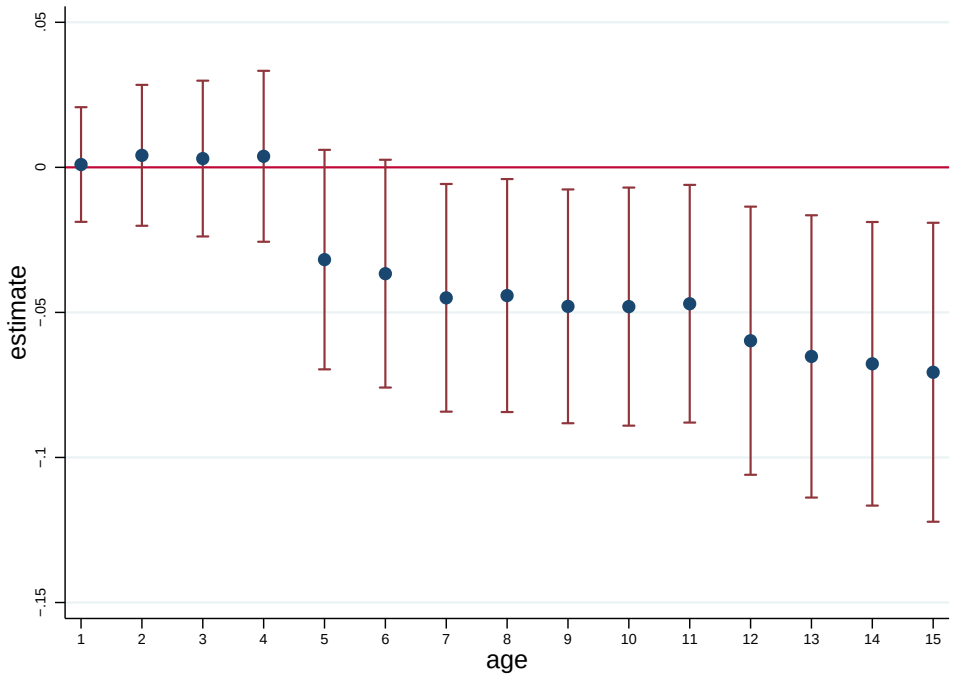

Figure S.7: Impacts on FGC by age X

Note: This figure reports the estimated effects (α_2) on the likelihood of being cut before reaching the ages of X years with 95% confidence intervals.

Table S.1: Checking on the parallel trends of cutting rates before 1990

Dependent variable:	One if cut	
	(a)	(b)
Born in 1989	-0.048***	-0.049***
	(0.008)	(0.008)
Born in 1988	-0.038***	-0.041***
	(0.007)	(0.007)
Born in 1987	-0.028***	-0.029***
	(0.007)	(0.007)
Born in 1986	-0.040***	-0.044***
	(0.006)	(0.006)
Born in 1985	-0.036***	-0.036***
	(0.006)	(0.006)
Born in 1984	-0.029***	-0.030***
	(0.006)	(0.005)
Born in 1983	-0.021***	-0.027***
	(0.006)	(0.006)
Born in 1982	-0.021***	-0.023***
	(0.005)	(0.005)
Born in 1981	-0.011**	-0.013**
	(0.006)	(0.005)
Born in 1980	-0.011*	-0.012**
	(0.006)	(0.006)
Located within a 30-km distance to BF		
× Born in 1989	-0.016	0.001
	(0.042)	(0.042)
× Born in 1988	-0.039	-0.034
	(0.035)	(0.034)
× Born in 1987	-0.040	-0.034
	(0.036)	(0.035)
× Born in 1986	0.010	0.012
	(0.034)	(0.033)
× Born in 1985	-0.023	-0.015
	(0.034)	(0.035)
× Born in 1984	-0.014	-0.010
	(0.035)	(0.034)
× Born in 1983	-0.031	-0.026
	(0.033)	(0.034)
× Born in 1982	0.036	0.043
	(0.028)	(0.028)
× Born in 1981	0.023	0.016
	(0.035)	(0.036)
× Born in 1980	-0.009	-0.014
	(0.028)	(0.025)
Individual controls	NO	YES
Country-ethnicity FE	NO	YES
Community FE	YES	YES
Year-of-interview FE	NO	YES
All interactions = 0 (p-values)	0.823	0.837
R-squared	0.745	0.770
No. of obs.	60594	60270

Notes: (1) Figures ( ) are standard errors. *** denotes significance at 1%, ** at 5%, and * at 10%. (2) Standard errors are robust to heteroskedasticity and clustered residuals within each community. (3) The individual controls include birth order and religion dummies (Islam and Christianity).

Table S.2: Sample composition

	DHS round	No. of respondents	No. of households	No. of communities
(A) Female sample				
Benin	2001	6219	4256	247
	2011–12	16522	12365	746
Côte d'Ivoire	1998–99	3040	1598	140
	2011–12	9800	6468	341
Mali	2001	12774	2105	399
	2006	14506	10447	405
	2012–13	10424	7973	413
Togo	2013–14	9480	6837	330
Total		82765	52049	3021
(B) Male sample				
Benin	2001	2709	2059	247
	2011–12	5153	3983	746
Côte d'Ivoire	1998–99	886	531	140
	2011–12	4999	3380	341
Mali	2001	3394	1221	398
	2006	4183	3089	405
	2012–13	4399	3514	413
Togo	2013–14	4476	3327	330
Total		30199	21104	3020

Table S.3: Summary statistics (DID)

Dependent variables:	Coefficient	Standard errors	R-sqd	No. of obs
One if cut	-0.165***	(0.044)	0.015	72266
One if sewn closed (zero if not cut)	-0.031**	(0.015)	0.000	64492
One if cut by traditional cutters (zero if not cut)	-0.166***	(0.041)	0.014	71971
Age at FGC if cut	-0.363	(0.591)	0.004	17889
One if married†	-0.023	(0.036)	0.114	35791
One if ever had sex†	-0.038	(0.028)	0.070	35478
One if gave birth†	-0.061*	(0.032)	0.098	35791
Age at first marriage†	0.658***	(0.194)	0.006	20810
Age at first sex†	0.230	(0.164)	0.002	27431
Age at first birth†	0.643***	(0.218)	0.014	18734
No. of children†	-0.358***	(0.087)	0.123	35791
Education (years)†	-0.268	(0.315)	0.061	35755
One if polygyny‡	-0.020	(0.040)	0.006	19987
No. of a husband's wives‡	-0.032	(0.052)	0.005	19769
A husband's education (years)‡	0.440	(0.404)	0.011	18628
A husband's age‡	-0.216	(0.691)	0.027	19171
Family wealth index (1 to 5)‡	0.130	(0.157)	0.020	14083
One if inter-ethnic marriage‡	-0.148***	(0.055)	0.002	5334
One if have DM power‡	-0.042	(0.029)	0.002	19397
One if had any IPV‡	-0.010	(0.057)	0.004	7154
Birth order	0.071	(0.107)	0.001	82765
One if Muslim	0.016	(0.043)	0.009	82656
One if Christian	0.036	(0.039)	0.011	82656
Urban (dummy)	-0.026	(0.035)	0.016	82765
No. of battles (÷ 10)	-0.065	(0.067)	0.005	82765
Distance to BF (km)	-15.920***	(3.726)	0.121	82765

Notes: (1) Figures ( ) are standard errors. *** denotes significance at 1%, ** at 5%, and * at 10%. (2) Standard errors are robust to heteroskedasticity and clustered residuals within each community. (3) The information is relevant only to the respondents aged 25 or below for †, married respondents aged 25 or below for ‡, and all the respondents aged 49 or below for the remaining.

Table S.4: Impacts on FGC by country (OLS)

Dependent variable:	One if cut	One if cut by age 10	One if sewn closed (zero if not cut)	One if traditional cutters (zero if not cut)	One if cut	One if cut by age 10	One if sewn closed (zero if not cut)	One if traditional cutters (zero if not cut)
Country:	Benin				Côte d'Ivoire			
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
Located within a 30-km distance to BF								
× Born in or after 1990	-0.016	-0.020	-0.071	-0.012	-0.051	-0.075	-0.001	0.023
	(0.101)	(0.086)	(0.070)	(0.011)	(0.128)	(0.142)	(0.037)	(0.021)
Birth order	-	-	-	-	0.003*	0.004**	0.001	-0.001
					(0.002)	(0.002)	(0.001)	(0.001)
Muslim	0.034***	0.035***	-0.008	-0.003	0.228***	0.230***	0.007	0.007
	(0.012)	(0.012)	(0.006)	(0.004)	(0.024)	(0.024)	(0.005)	(0.012)
Christian	0.000	-0.001	-0.003	0.001	-0.103***	-0.089***	-0.001	0.009
	(0.007)	(0.005)	(0.002)	(0.002)	(0.015)	(0.015)	(0.004)	(0.007)
One if cut	-	-	0.125***	0.890***	-	-	0.080***	0.826***
			(0.016)	(0.012)			(0.010)	(0.015)
R-squared	0.564	0.541	0.245	0.918	0.510	0.419	0.257	0.811
No. of obs.	17387	17387	17148	17380	12054	12054	11432	11940
Country:	Mali				Togo			
	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)
Located within a 30-km distance to BF								
× Born in or after 1990	-0.070***	-0.071**	-0.004	0.020	-0.118**	-0.059*	-0.093***	0.002
	(0.024)	(0.028)	(0.016)	(0.024)	(0.048)	(0.030)	(0.023)	(0.003)
Birth order	0.002***	0.000	-0.001	0.000	0.000	0.001	0.000	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
Muslim	0.035***	0.038***	0.030***	-0.012	0.192***	0.141***	-0.019**	-0.003
	(0.008)	(0.012)	(0.010)	(0.010)	(0.019)	(0.016)	(0.008)	(0.002)
Christian	-0.098***	-0.101***	0.018	-0.001	0.018**	0.014*	-0.001	0.001
	(0.020)	(0.022)	(0.013)	(0.014)	(0.009)	(0.007)	(0.004)	(0.001)
One if cut	-	-	0.109***	0.850***	-	-	0.198***	0.956***
			(0.009)	(0.009)			(0.033)	(0.010)
R-squared	0.535	0.388	0.299	0.537	0.393	0.312	0.332	0.960
No. of obs.	35488	35488	28697	35323	6992	6992	6911	6984
Country-ethnicity FE	YES	YES	YES	YES	YES	YES	YES	YES
Year-of-birth FE	YES	YES	YES	YES	YES	YES	YES	YES
Community FE	YES	YES	YES	YES	YES	YES	YES	YES
Year-of-interview FE	YES	YES	YES	YES	YES	YES	YES	YES

Notes: (1) Figures ( ) are standard errors. *** denotes significance at 1%, ** at 5%, and * at 10%. (2) Standard errors are robust to heteroskedasticity and clustered residuals within each community.

Table S.5: Impacts on married females aged 25 or below: Decision making power and intimate partner violence

Dependent variables:	One if have DM power			One if had IPV		
	Health care	Large household purchases	Visit family or relatives	Any emotional	Any physical	Any sexual
	(a)	(b)	(c)	(d)	(e)	(f)
Located within a 30-km distance to BF						
× Born in or after 1990	-0.000	-0.001	-0.076***	-0.124	-0.051	-0.060
	(0.025)	(0.028)	(0.029)	(0.078)	(0.059)	(0.044)
Birth order	-0.002**	-0.001	-0.001	-0.000	-0.000	0.001
	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)	(0.002)
Muslim	0.001	-0.007	-0.012	-0.083***	-0.058**	-0.019
	(0.010)	(0.010)	(0.014)	(0.024)	(0.029)	(0.018)
Christian	0.013	0.010	0.014	-0.061**	-0.057*	0.000
	(0.011)	(0.010)	(0.011)	(0.026)	(0.029)	(0.016)
R-squared	0.238	0.240	0.282	0.364	0.302	0.314
No. of obs.	19307	19302	19304	7119	7119	7120
Country-ethnicity FE	YES	YES	YES	YES	YES	YES
Year-of-birth FE	YES	YES	YES	YES	YES	YES
Community FE	YES	YES	YES	YES	YES	YES
Year-of-interview FE	YES	YES	YES	YES	YES	YES
Sample DHS						
Benin 2001	YES	YES	YES	NO	NO	NO
Benin 2011-12	YES	YES	YES	NO	NO	NO
Côte d'Ivoire 1998-99	NO	NO	NO	NO	NO	NO
Côte d'Ivoire 2011-12	YES	YES	YES	YES	YES	YES
Mali 2001	YES	YES	YES	NO	NO	NO
Mali 2006	YES	YES	YES	YES	YES	YES
Mali 2012-13	YES	YES	YES	YES	YES	YES
Togo 2013-14	YES	YES	YES	YES	YES	YES

Notes: (1) Figures ( ) are standard errors. *** denotes significance at 1%, ** at 5%, and * at 10%. (2) Standard errors are robust to heteroskedasticity and clustered residuals within each community.

Table S.6: Robustness checks on marriage effects on females aged 25 or below (OLS)

	Battle	Household FE	Time trend	Recent DHS	Permanent residents	Battle	Household FE	Time trend	Recent DHS	Permanent residents
Dependent variables:	One if married					Age at first marriage				
	(1a)	(1b)	(1c)	(1d)	(1e)	(1f)	(1g)	(1h)	(1i)	(1j)
Born in and after 1990										
× Located within a 30-km	0.016	0.078	0.091*	0.074*	-0.092	0.678**	0.358	0.663	0.720**	1.195
distance to BF	(0.041)	(0.118)	(0.056)	(0.042)	(0.063)	(0.284)	(1.468)	(0.448)	(0.321)	(0.736)
× No. of battles (÷ 10)	0.008***	-	-	-	-	-0.110***	-	-	-	-
within 40 km	(0.003)					(0.030)				
R-squared	0.492	0.878	0.560	0.495	0.508	0.351	0.883	0.464	0.360	0.350
No. of obs.	35645	35791	35645	19264	7947	20706	20810	20706	9766	5040
Dependent variables:	One if ever had sex					Age at first sex				
	(2a)	(2b)	(2c)	(2d)	(2e)	(2f)	(2g)	(2h)	(2i)	(2j)
Born in and after 1990										
× Located within a 30-km	-0.006	0.016	-0.024	0.049**	-0.095*	0.160	-0.364	-0.238	0.197	0.463
distance to BF	(0.033)	(0.104)	(0.040)	(0.024)	(0.057)	(0.214)	(1.363)	(0.323)	(0.241)	(0.427)
× No. of battles (÷ 10)	-0.000	-	-	-	-	-0.053***	-	-	-	-
within 40 km	(0.002)					(0.017)				
R-squared	0.412	0.830	0.509	0.443	0.479	0.294	0.857	0.393	0.306	0.327
No. of obs.	35332	35478	35332	18984	7931	27305	27431	27305	14416	5743
Dependent variables:	One if ever gave birth					Age at first birth				
	(3a)	(3b)	(3c)	(3d)	(3e)	(3f)	(3g)	(3h)	(3i)	(3j)
Born in or after 1990										
× Located within a 30-km	-0.006	-0.058	0.117**	0.028	-0.050	0.370	-0.498	0.292	0.437	-2.128***
distance to BF	(0.028)	(0.143)	(0.047)	(0.027)	(0.055)	(0.257)	(1.681)	(0.515)	(0.274)	(0.379)
× No. of battles (÷ 10)	0.009***	-	-	-	-	-0.090***	-	-	-	-
within 40 km	(0.003)					(0.028)				
R-squared	0.467	0.860	0.524	0.477	0.510	0.334	0.886	0.455	0.358	0.364
No. of obs.	35645	35791	35645	19264	7947	18651	18734	18651	9480	4152
Dependent variables:	No. of children					Education (years)				
	(4a)	(4b)	(4c)	(4d)	(4e)	(4f)	(4g)	(4h)	(4i)	(4j)
Born in or after 1990										
× Located within a 30-km	-0.320***	-0.286	0.038	-0.356***	-0.320*	-0.520*	0.228	-0.833**	-0.732**	0.315
distance to BF	(0.081)	(0.306)	(0.129)	(0.104)	(0.171)	(0.266)	(0.935)	(0.388)	(0.302)	(0.555)
× No. of battles (÷ 10)	0.058***	-	-	-	-	-0.135***	-	-	-	-
within 40 km	(0.007)					(0.032)				
R-squared	0.530	0.882	0.603	0.518	0.578	0.449	0.858	0.511	0.426	0.535
No. of obs.	35645	35791	35645	19264	7947	35609	35755	35609	19259	7928
Birth order	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Religion	YES	NO	YES	YES	YES	YES	NO	YES	YES	YES
Country-ethnicity FE	YES	NO	YES	YES	YES	YES	NO	YES	YES	YES
Year-of-birth FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Community FE	YES	NO	YES	YES	YES	YES	NO	YES	YES	YES
Year-of-interview FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: (1) Figures ( ) are standard errors. *** denotes significance at 1%, ** at 5%, and * at 10%. (2) Standard errors are robust to heteroskedasticity and clustered residuals within each community in all columns but (due to computational difficulty) columns (1h), (2h), and (3h).

Table S.7: Robustness checks on marriage effects on married females aged 25 or below (OLS)

	Battle	Household FE	Time trend	Recent DHS	Permanent residents	Battle	Household FE	Time trend	Recent DHS	Permanent residents
Dependent variables:	One if polygyny					Total no. of a husband's wives				
	(1a)	(1b)	(1c)	(1d)	(1e)	(1f)	(1g)	(1h)	(1i)	(1j)
Born in or after 1990										
× Located within a 30-km	0.027	0.031	0.063	0.031	-0.037	0.034	0.023	0.014	0.056	-0.109
distance to BF	(0.050)	(0.116)	(0.080)	(0.056)	(0.267)	(0.064)	(0.180)	(0.110)	(0.069)	(0.218)
× No. of battles (÷ 10)	0.016***	-	-	-	-	0.018***	-	-	-	-
within 40 km	(0.005)					(0.006)				
R-squared	0.243	0.865	0.357	0.276	0.294	0.257	0.860	0.363	0.303	0.302
No. of obs.	19886	19987	19886	9393	4835	19669	19769	19669	9301	4762
Dependent variables:	A husband's education (years)					A husband's age (years)				
	(2a)	(2b)	(2c)	(2d)	(2e)	(2f)	(2g)	(2h)	(2i)	(2j)
Born in or after 1990										
× Located within a 30-km	0.058	-1.009	-0.988	0.205	-0.989	-0.515	2.215	-1.495	-0.157	-4.141
distance to BF	(0.345)	(1.093)	(0.656)	(0.386)	(0.811)	(0.791)	(2.744)	(1.439)	(0.871)	(3.192)
× No. of battles (÷ 10)	-0.126*	-	-	-	-	0.179**	-	-	-	-
within 40 km	(0.067)					(0.089)				
R-squared	0.468	0.928	0.572	0.498	0.523	0.298	0.882	0.421	0.301	0.385
No. of obs.	18530	18628	18530	9107	4608	19072	19171	19072	9282	4779
Dependent variables:	Wealth index (1 to 5)					One if inter-ethnic marriage				
	(3a)	(3b)	(3c)	(3d)	(3e)	(3f)	(3g)	(3h)	(3i)	(3j)
Born in or after 1990										
× Located within a 30-km	-0.076	-	-0.074	-0.064	0.040	0.044	0.034	0.094	0.066	0.061
distance to BF	(0.084)		(0.181)	(0.091)	(0.274)	(0.059)	(0.181)	(0.161)	(0.064)	(0.210)
× No. of battles (÷ 10)	-0.001	-	-	-	-	0.014	-	-	-	-
within 40 km	(0.008)					(0.019)				
R-squared	0.734	-	0.775	0.765	0.678	0.602	0.953	0.775	0.636	0.728
No. of obs.	14038	-	14038	9393	2610	5304	5334	5304	2962	1029
Dependent variables:	One if have DM power					One if had any IPV				
	(4a)	(4b)	(4c)	(4d)	(4e)	(4f)	(4g)	(4h)	(4i)	(4j)
Born in or after 1990										
× Located within a 30-km	-0.050	-0.142	-0.086	-0.058	0.064	-0.140*	-	-0.129	-0.141	-0.039
distance to BF	(0.034)	(0.222)	(0.082)	(0.036)	(0.141)	(0.076)	-	(0.139)	(0.092)	(0.319)
× No. of battles (÷ 10)	-0.001	-	-	-	-	-0.005	-	-	-	-
within 40 km	(0.005)					(0.007)				
R-squared	0.274	0.864	0.393	0.296	0.371	0.343	-	0.496	0.390	0.358
No. of obs.	19297	19397	19297	9382	4834	7117	-	7117	3645	1957
Birth order	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Religion	YES	NO	YES	YES	YES	YES	NO	YES	YES	YES
Country-ethnicity FE	YES	NO	YES	YES	YES	YES	NO	YES	YES	YES
Year-of-birth FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Community FE	YES	NO	YES	YES	YES	YES	NO	YES	YES	YES
Year-of-interview FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: (1) Figures ( ) are standard errors. *** denotes significance at 1%, ** at 5%, and * at 10%. (2) Standard errors are robust to heteroskedasticity and clustered residuals within each community in all columns but (due to computational difficulty) columns (1c), (1h), (2c), and (2h). (3) The estimation result in column (3b) is not reported because family wealth is measured at the household level. (4) The estimation result in column (4g) is not reported due to computational difficulty.

Table S.8: Marriage effects by country (OLS)

Country:	Benin				Côte d'Ivore			
Dependent variables:	Coefficient	Standard errors	R-sqd	No. of obs.	Coefficient	Standard errors	R-sqd	No. of obs.
(A) Females aged 25 or below								
One if married	0.142	(0.173)	0.533	9580	0.108	(0.153)	0.429	5892
One if ever had sex	0.099	(0.085)	0.461	9316	-0.011	(0.025)	0.415	5882
One if ever gave birth	-0.024	(0.069)	0.505	9580	0.120*	(0.062)	0.445	5892
Age at first marriage	0.615	(0.898)	0.336	4835	0.724	(0.599)	0.338	2547
Age at first sex	0.629	(0.602)	0.312	6958	-0.364	(0.336)	0.264	4766
Age at first birth	-0.057	(1.067)	0.363	4456	1.094***	(0.369)	0.316	2827
No. of children	-0.359	(0.313)	0.532	9580	-0.081	(0.207)	0.480	5892
Education (years)	-0.497	(0.612)	0.438	9579	-1.486**	(0.688)	0.373	5888
(B) Married females aged 25 or below								
One if polygyny	-0.110	(0.182)	0.304	4643	0.124	(0.097)	0.261	2389
Total no. of a husband's wives	-0.076	(0.186)	0.315	4582	0.198	(0.147)	0.253	2378
A husband's education (years)	2.090**	(1.016)	0.503	4312	0.347	(0.939)	0.445	1714
A husband's age (years)	-1.751	(2.748)	0.323	4629	-0.824	(2.267)	0.302	1711
Wealth index (1 to 5)	-0.163	(0.189)	0.723	3115	-0.105	(0.273)	0.802	1818
One if inter-ethnic marriage	-0.039	(0.064)	0.720	1329	0.478***	(0.167)	0.597	611
One if have DM power	-0.081	(0.102)	0.283	4642	-0.165*	(0.085)	0.278	1808
One if had any IPV	-	-	-	-	0.073	(0.133)	0.314	1349
Country:	Mali				Togo			
Dependent variables:	Coefficient	Standard errors	R-sqd	No. of obs.	Coefficient	Standard errors	R-sqd	No. of obs.
(A) Females aged 25 or below								
One if married	-0.017	(0.043)	0.438	16387	-0.044	(0.060)	0.451	3786
One if ever had sex	0.003	(0.042)	0.405	16350	-0.050	(0.037)	0.457	3784
One if ever gave birth	0.004	(0.035)	0.444	16387	-0.097**	(0.044)	0.450	3786
Age at first marriage	0.808**	(0.403)	0.246	11740	0.493	(0.563)	0.368	1584
Age at first sex	0.175	(0.324)	0.239	12877	0.127	(0.388)	0.326	2704
Age at first birth	0.412	(0.359)	0.260	9829	0.203	(0.499)	0.369	1539
No. of children	-0.306***	(0.094)	0.532	16387	-0.484***	(0.185)	0.479	3786
Education (years)	-0.047	(0.320)	0.384	16357	-0.485	(0.674)	0.436	3785
(B) Married females aged 25 or below								
One if polygyny	0.007	(0.063)	0.208	11346	0.054	(0.116)	0.280	1508
Total no. of a husband's wives	-0.014	(0.087)	0.208	11209	0.072	(0.117)	0.286	1500
A husband's education (years)	-0.581	(0.361)	0.376	11026	0.397	(0.910)	0.505	1478
A husband's age (years)	-0.078	(1.090)	0.267	11228	-0.902	(1.407)	0.323	1504
Wealth index (1 to 5)	-0.083	(0.110)	0.693	7597	-0.021	(0.172)	0.843	1508
One if inter-ethnic marriage	-0.017	(0.061)	0.555	2801	-0.057	(0.090)	0.662	563
One if have DM power	-0.068	(0.044)	0.267	11340	0.058	(0.074)	0.323	1507
One if had any IPV	-0.190*	(0.113)	0.351	4556	-0.164	(0.127)	0.359	1212

Notes: (1) Figures ( ) are standard errors. *** denotes significance at 1%, ** at 5%, and * at 10%. (2) Standard errors are robust to heteroskedasticity and clustered residuals within each community. (3) The explored sample and controls correspond to those used in Table 5 and Table 6.

Table S.9: Impacts on male respondents (OLS)

Dependent variables:	One if married	One if ever had sex	One if ever had children	Age at first marriage	Age at first sex	Age at first children born	No. of children	One if polygyny	No. of wives	Education (years)
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Located within a 30-km distance to BF										
× Born in or after 1990	-0.020	-0.093***	-0.019	1.011	0.101	1.961***	-1.356***	-0.027	-0.015	0.363
	(0.024)	(0.031)	(0.022)	(0.721)	(0.323)	(0.627)	(0.209)	(0.065)	(0.076)	(0.313)
Muslim	0.028***	0.011	0.012	0.800***	0.706***	0.535**	-0.175**	0.018	0.012	-0.227*
	(0.010)	(0.008)	(0.009)	(0.206)	(0.130)	(0.221)	(0.085)	(0.016)	(0.022)	(0.132)
Christian	0.013	0.010*	-0.009	0.665***	0.377***	0.533***	-0.453***	-0.076***	-0.101***	1.891***
	(0.008)	(0.006)	(0.008)	(0.163)	(0.103)	(0.179)	(0.074)	(0.014)	(0.020)	(0.096)
R-squared	0.629	0.507	0.662	0.371	0.425	0.382	0.638	0.284	0.289	0.509
No. of obs.	29205	29206	29205	18505	24218	13659	29205	17631	17628	29156
Country-ethnicity FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year-of-birth FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Community FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year-of-interview FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Sample DHS										
Benin 2001	YES	YES	YES	YES	YES	NO	YES	YES	YES	YES
Benin 2011-12	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Côte d'Ivoire 1998-99	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Côte d'Ivoire 2011-12	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Mali 2001	YES	YES	YES	YES	YES	NO	YES	YES	YES	YES
Mali 2006	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Mali 2012-13	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Togo 2013-14	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: (1) Figures ( ) are standard errors. *** denotes significance at 1%, ** at 5%, and * at 10%. (2) Standard errors are robust to heteroskedasticity and clustered residuals within each community.

Table S.10: Checking on influences of educated or uneducated women's relocation (OLS)

Dependent variables:	Coefficient	Standard errors	R-sqd	No. of obs.
(A) Trim inland residents that have positive education				
(a) Impacts on FGC				
One if cut	-0.079***	(0.026)	0.754	47757
One if cut by age 10	-0.065***	(0.022)	0.665	47757
One if sewn closed (zero if not cut)†	-0.055***	(0.017)	0.325	41888
One if traditional cutters (zero if not cut)†	0.007	(0.012)	0.813	47531
(b) Marriage effects on females aged 25 or below				
One if married	-0.019	(0.043)	0.489	20219
One if ever had sex	-0.036	(0.034)	0.445	20026
One if ever gave birth	-0.012	(0.029)	0.486	20219
Age at first marriage	0.612**	(0.292)	0.348	15026
Age at first sex	0.041	(0.223)	0.307	16706
Age at first birth	0.400	(0.270)	0.344	13223
No. of children	-0.156*	(0.086)	0.548	20219
Education (years)	0.452*	(0.266)	0.561	20215
(c) Marriage effects on married females aged 25 or below				
One if polygyny	0.043	(0.052)	0.265	14570
Total no. of a husband's wives	0.054	(0.066)	0.278	14471
A husband's education (years)	0.335	(0.350)	0.416	13750
A husband's age (years)	-0.456	(0.834)	0.328	14056
Wealth index (1 to 5)	-0.099	(0.087)	0.692	9823
One if inter-ethnic marriage	0.021	(0.067)	0.627	4002
One if have DM power	-0.054	(0.035)	0.308	14234
One if had any IPV	-0.147*	(0.079)	0.394	4995
(B) Trim inland residents that have no education				
(a) Impacts on FGC				
One if cut	-0.077***	(0.027)	0.765	27509
One if cut by age 10	-0.050**	(0.022)	0.744	27509
One if sewn closed (zero if not cut)†	-0.057***	(0.017)	0.334	25170
One if traditional cutters (zero if not cut)†	0.000	(0.012)	0.823	27425
(b) Marriage effects on females aged 25 or below				
One if married	0.002	(0.043)	0.488	16907
One if ever had sex	0.014	(0.034)	0.459	16782
One if ever gave birth	-0.050*	(0.030)	0.474	16907
Age at first marriage	1.109***	(0.349)	0.529	6676
Age at first sex	0.498**	(0.237)	0.418	11725
Age at first birth	0.580*	(0.316)	0.524	6299
No. of children	-0.702***	(0.087)	0.530	16907
Education (years)	0.588**	(0.283)	0.485	16871
(c) Marriage effects on married females aged 25 or below				
One if polygyny	-0.029	(0.061)	0.436	6294
Total no. of a husband's wives	-0.036	(0.078)	0.473	6168
A husband's education (years)	0.433	(0.480)	0.577	5731
A husband's age (years)	-0.950	(0.940)	0.513	5981
Wealth index (1 to 5)	0.009	(0.101)	0.843	4951
One if inter-ethnic marriage	-0.000	(0.114)	0.816	1619
One if have DM power	-0.061	(0.044)	0.449	6033
One if had any IPV	-0.114	(0.095)	0.482	2550

Notes: (1) Figures ( ) are standard errors. *** denotes significance at 1%, ** at 5%, and * at 10%. (2) Standard errors are robust to heteroskedasticity and clustered residuals within each community. (3) An indicator for circumcised women is included in regressors for †.

Table S.11: Robustness checks on non-linear models

Dependent variables:	Estimation	Odds ratio $\exp(\alpha_2)$	Standard errors	R-sqd.	No. of obs.
(A) Impacts on FGC					
One if cut	Logit	0.674*	(0.150)	0.607	71921
One if cut by age 10	Logit	0.850	(0.171)	0.543	71921
One if sewn closed (zero if not cut)†	Logit	0.798	(0.262)	0.064	32674
One if traditional cutters (zero if not cut)†	Logit	0.866	(0.278)	0.085	40141
(B) Marriage effects on females aged 25 or below					
One if married	Logit	0.910	(0.155)	0.163	35645
One if ever had sex	Logit	0.900	(0.142)	0.121	35332
One if ever gave birth	Logit	0.759*	(0.113)	0.135	35645
Age at first marriage	Ordered logit	1.312**	(0.163)	0.029	20706
Age at first sex	Ordered logit	1.081	(0.139)	0.020	27305
Age at first birth	Ordered logit	1.363**	(0.182)	0.022	18651
No. of children	Ordered logit	0.705***	(0.094)	0.084	35645
Education (years)	Ordered logit	1.065	(0.186)	0.058	35609
(C) Marriage effects on married females aged 25 or below					
One if polygyny	Logit	0.961	(0.186)	0.030	19886
Total no. of a husband's wives	Ordered logit	0.973	(0.186)	0.025	19669
A husband's education (years)	Ordered logit	1.417	(0.309)	0.051	18530
A husband's age (years)	Ordered logit	0.937	(0.157)	0.017	19072
Wealth index (1 to 5)	Ordered logit	1.219	(0.262)	0.054	14038
One if inter-ethnic marriage	Ordered logit	0.486*	(0.199)	0.102	5304
One if have DM power	Logit	0.695*	(0.147)	0.018	19297
One if had any IPV	Logit	0.821	(0.222)	0.054	7117

Notes: (1) Figures ( ) are standard errors. *** denotes significance at 1%, ** at 5%, and * at 10%. (2) Standard errors are robust to heteroskedasticity and clustered residuals within each community. (3) Due to computational reasons, all circumcised women are excluded from the estimations for †.

Table S.12: Checking on multiple-hypothesis testing

	Coefficient	Original p-values	Adjusted p-values			R-sqd	No. of obs.
			Bonferroni	Holm (1979)	Hochberg (1988)		
Dependent variables:	(a)	(b)	(c)	(d)	(e)	(f)	(g)
(A) Impacts on FGC							
One if cut	-0.068***	(0.010)	(0.135)	(0.116)	(0.111)	0.761	71921
One if sewn closed (zero if not cut)†	-0.055***	(0.002)	(0.021)	(0.019)	(0.019)	0.307	64188
One if traditional cutters (zero if not cut)†	0.005	(0.634)	(1.000)	(1.000)	(0.803)	0.819	71627
(B) Marriage effects on females aged 25 or below							
One if married	0.010	(0.804)	(1.000)	(1.000)	(0.803)	0.492	35645
Age at first marriage	0.733**	(0.010)	(0.141)	(0.116)	(0.111)	0.351	20706
No. of children	-0.368***	(0.000)	(0.000)	(0.000)	(0.000)	0.528	35645
Education (years)	-0.409	(0.125)	(1.000)	(1.000)	(0.803)	0.448	35609
(C) Marriage effects on married females aged 25 or below							
One if polygyny	0.019	(0.702)	(1.000)	(1.000)	(0.803)	0.242	19886
A husband's education (years)	0.116	(0.735)	(1.000)	(1.000)	(0.803)	0.468	18530
A husband's age (years)	-0.598	(0.448)	(1.000)	(1.000)	(0.803)	0.298	19072
Wealth index (1 to 5)	-0.076	(0.363)	(1.000)	(1.000)	(0.803)	0.734	14038
One if inter-ethnic marriage	0.037	(0.520)	(1.000)	(1.000)	(0.803)	0.602	5304
One if have DM power	-0.049	(0.151)	(1.000)	(1.000)	(0.803)	0.274	19297
One if had any IPV	-0.136*	(0.073)	(1.000)	(0.730)	(0.730)	0.343	7117

Notes: (1) *** denotes significance at 1%, ** at 5%, and * at 10%, corresponding to the original p-values based on the estimation results reported in Table 3 [for panel (A)], Table 5 [for panel (B)], and Table 6 [for panel (C)]. (2) An indicator for circumcised women is included in regressors for †.