Female genital cutting and long-term adjustment of marriage markets: Evidence from West Africa

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Yuya KUDO*

December 2018

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Keywords: Coordination failure, female circumcision, female empowerment, mating, social institution, social norm

JEL classification: I12, J12, J16, J18, Z13

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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. 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 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). Consequently, significant and increasing political effort has been made since the early 1990s at the international, national, and local levels to eliminate FGC (e.g., UNFPA and UNICEF, 2014). The Sustainable Development Goals set by the United Nations General Assembly 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. 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), their welfare may not necessarily increase owning to the abandonment of FGC.

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; Poyker, 2018; Vogt et al., 2016), there is still a lack of clarity on the welfare implications of this practice. To fill this knowledge gap, the present study explores whether and how the abandonment of FGC is associated with women's marriage in the long term.

To address this question, first, a simple model is developed to formalize the widely known theory of marriage convention, as proposed outside the field of economics by Mackie (1996). While recent studies both support and reject the marriage convention hypothesis (e.g., Efferson et al., 2015; Hayford, 2005; Shell-Duncan et al., 2011), or even doubt the idea of social convention (e.g., Bellemare et al., 2015), the decline in FGC in the well-known Senegalese Tostan Project is still seen as proof of this hypothesis, and has attracted significant interest from relevant policymakers and practitioners (e.g., Diop and Askew, 2009; Mackie, 2000). Therefore, it is suggested that it can be meaningful to analyze the relationship between FGC and women's marriage based on this influential theory.

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 will not marry uncircumcised women. 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, and as particularly supported by women's motive to coordinate marital transaction.

To formalize this idea, the present study develops a normal-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 their marital partners. In this game, when the health-impairment costs of FGC are not particularly large, two stable pure strategy Nash equilibria, i.e., FGC and no-FGC equilibria, arise, 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, which reduces a community's total welfare.

Circumcised women solely suffer from the costly FGC if they fail to get married. Thus, a woman normally hesitates to undergo FGC. However, she may decide to do so if men compensate her by providing more livelihood support when she marries. This compensation facilitates "all" women to undergo FGC in the FGC equilibrium. Consequently, married (unmarried) women's welfare is larger (smaller) in the FGC equilibrium than that in the no-FGC equilibrium.

According to the model, the abandonment of FGC implies a social change from the FGC to the no-FGC equilibrium. For example, an increase in the cost of FGC as perceived by community members induces the equilibrium shift. Because this 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, its consequence for married women's welfare is ambiguous. First, this equilibrium shift may reduce their welfare by eliminating the aforementioned compensation given to them in the FGC equilibrium. That said, if the health-impairment costs of FGC (and, thus, the corresponding compensation) were previously negligible, married women's welfare would not change in a significant manner. Furthermore, if people previously undervalued the costs of FGC due to cognitive limitations, it is also possible that married women's welfare would improve.

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, people's perceptions about the benefits and costs of FGC causally determine these two practices in a simultaneous manner. These two implications provide the motivation behind the present study to identify a policy shock that raises 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 its empirical analysis, this study exploits a unique setting characterized by two factors. First, Burkina Faso is one of the pioneering African states engaging in the fight against FGC with a 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 colonial times and often partition people belonging to one ethnic group, and, thus, the same culture is often shared in two or more countries (e.g., Herbst, 1989; see also Zartman, 1965 for West Africa). 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 as perceived by those who reside in communities (located close to Burkina Faso) of its neighboring countries due to cross-border social interactions and the resulting FGC-relevant knowledge spillovers, while reducing the rate of FGC in the borderlands. My field observations in one of these borderlands also supported this possibility.

Accordingly, exploiting data pertaining to 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 engaged in political efforts to eradicate FGC. Because such efforts have been expended since 1990, the data permit 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, similar sub-groups), assessment of bias attributable to unobservables (Oster, forthcoming), an alternative treatment indicator based on ethnic homelands by Murdock (1959)'s classification, nonlinear model specifications (i.e., logit, ordered logit), multiple-hypothesis testing, selection concerns (i.e., health, relocation), and so on. 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 no distinct adverse 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, intrahousehold decision-making (DM) power, likelihood of intimate partner violence (IPV), and so on. This study also shows no noticeable changes in a range of health outcomes (e.g., genital problems) of young women residing in those borderlands.

The setting under study offers two striking 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. Because 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. Second, one may challenge the accuracy of self-reported FGC status because people may not tell the truth for fear of legal sanctions (e.g., De Cao and Lutz, 2018). FGC is not criminalized in Mali and laws against FGC are only weakly enforced by the remainder of Burkina Faso's neighbors; therefore, 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).[1][2]

Extant economic research aimed at understanding the role of FGC is scarce. Outside the field of 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 that investigate whether FGC is a normative equilibrium, within (e.g., Bellemare et al., 2015; Efferson et al., 2015) and outside the area of economics (e.g., Hayford, 2005; Shell-Duncan et al., 2011). In contrast to Bellemare et al. (2015), who analyzes people's willingness to continue FGC in West Africa, the current research examines the actual behavior.[3] While Efferson et al. (2015) conducted a cross-sectional survey in Sudan covering 45 communities, the present study examines social changes in more than 3,000 communities in West Africa. This research complements the focus and findings of these prior studies. While other interpretations cannot be entirely ruled out, the findings of the present study are not inconsistent with the view that FGC is a normative equilibrium. Notably, the theoretical reasoning for this specific marriage-related practice may also apply to some, if not all, elements of the theoretical mechanisms that maintain various normative modern health-related practices (e.g., orthodontic treatment for children, plastic surgery), which are common in some countries

[1]Similar to prior studies (e.g., Michalopoulos and Papaioannou, 2014), in the present study, it is presumed that law enforcement is restricted "within" a country.

[2]Moreover, the exploited data enable 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.

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

but not in others, if those practices are related to male or female marriageability or success in life.

This study also exhibits similarities to previous studies that harness Africa's national boundaries as a source of causal identification. However, unlike past research (e.g., Michalopoulos and Papaioannou, 2014), it exploits one policy originating from either side of the border as an exogenous shock to the other.[4] This approach could be applied in other settings, and may be more effective when the outcomes of interest are politically sensitive, and, thus, the research findings are not entirely reliable if the data drawn from a country that exactly implements 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), and technology (e.g., Alesina et al., 2013), 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 that regard culture as preferences/values internal to individuals (e.g., Guiso et al., 2006), this study more explicitly refers to cultural change as an equilibrium shift. In this context, what is presented may be viewed as a rare empirical example of testing the "swift" transition of a 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; Tertilt, 2005), investigating cultural institutions, conceivably a form of social capital, 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 the 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 describes the empirical findings, with concluding remarks provided in Section 7.

2 Mackie (1996)'s theory of marriage convention

In this section, a simple model is developed to formalize Mackie (1996)'s seminal 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.1 in the supplemental appendix.

[4]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; see also Mccauley and Posner (2015) for the tenability of this assumption.

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 will 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 (see Figure 1 of Mackie, 1996) for the former and by exploiting Schelling (2006)'s (Chapter 7) coordination diagram (see Figure 2 of Mackie, 1996) for the latter. However, the coordination diagram does not necessarily clearly explain how circumcised women coordinate their marriage. The following model attempts to unify these two perspectives into a single framework as simply as possible.[5]

Consider a normal-form game describing an intra-marrying community, whereby women compete with each other, with no search friction, when seeking their marital partners, as implicitly presumed by Mackie (1996). To take this competition into account in the simplest manner, 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.

In this game, a man decides whether and to whom he proposes, and if he proposes, the amount of livelihood support $g \geq 0$ that he will provide 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 ($= 0$), which makes him (and so, women) remain single. In contrast, 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:

$$v_m(g_s, k_c, m) = v_m(g_s, k_c, s) = v_m(g_c, k_c, s) = v_m(g_0, k_c, m) = v_m(g_0, k_c, s) = 0, \quad (1)$$

$$v_m(g_s, k_0, m) = v_m(g_s, k_0, s) = v_m(g_0, k_0, s) = v_m(g_c, k_0, m) = v_m(g_c, k_0, s) = 0, \quad (2)$$

$$v_m(g_c, k_c, m) = \gamma b - g_c, \quad (3)$$

$$v_m(g_0, k_0, m) = (1 - \gamma)b - g_0, \quad (4)$$

[5] It would also be possible to show multiple equilibria regarding the practice of FGC, which will be shown below, by utilizing a signaling model (e.g., Spence, 1973). 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. Relatedly, if pure coordination, as proposed in Mackie (1996), maintains FGC, social pressure exerted by community members on those who reject FGC is not required to sustain this practice.

$$v_w(g_s, k_c, m) = v_w(g_s, k_c, s) = v_w(g_c, k_c, s) = v_w(g_0, k_c, m) = v_w(g_0, k_c, s) = -c, \quad (5)$$

$$v_w(g_s, k_0, m) = v_w(g_s, k_0, s) = v_w(g_0, k_0, s) = v_w(g_c, k_0, m) = v_w(g_c, k_0, s) = 0, \quad (6)$$

$$v_w(g_c, k_c, m) = g_c - c, \quad (7)$$

$$v_w(g_0, k_0, m) = g_0, \quad (8)$$

Whether the marriage-related custom is FGC or not, men are assumed to believe that women conforming to a community's major 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.[6] This fraction is endogenously determined by women's choice of k. When $\gamma = 0.8$, for example, men who marry circumcised women obtain higher utility than those who marry 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. 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.[7]

Assuming $c = c_0$ and defining $\tilde{c}_0 \equiv \frac{c_0}{p}$, it can be shown that

Proposition 1 *When the cost of FGC is not particularly large (i.e., $b > \tilde{c}_0$), the strategy profiles $(g_c = \tilde{c}_0, k_c, m)$ and $(g_0 = 0, k_0, m)$ are stable Nash equilibria, along with the equilibrium levels of utility $v_m = b - \tilde{c}_0$, $v_w = \tilde{c}_0 - c_0$ for married women, and $v_w = -c_0$ 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 stable pure strategy Nash equilibria, whereby all women are circumcised in the profile $(g_c = \tilde{c}_0, k_c, m)$ (FGC equilibrium achieving the circumcised fraction of $\gamma = 1$) and uncircumcised in the profile $(g_0 = 0, k_0, m)$ (no-FGC equilibrium achieving the circumcised fraction of $\gamma = 0$); see also Figure 1.

Once the FGC equilibrium arises as a social norm due to historical accident (see Mackie, 1996), 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 will propose to uncircumcised women. The FGC equilibrium is inferior to the no-FGC equilibrium because shifting from

[6]More generally, a benefit arising from a social custom is felt more strongly as the number of people adhering to the custom increases, as presupposed in prior studies (e.g. Lindbeck, 1997; Lindbeck et al., 1999). See also Rege (2004) for the validity of this type of assumption.

[7]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.

the former to the latter improves the total welfare enjoyed by all community members from $b - \tilde{c}_0$ to b.[8] Therefore, the existence of both the FGC and the no-FGC equilibrium reflects a coordination problem. The proposition 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 DHS data; see subsection S.6.1 in the supplemental appendix.

In addition, when γ is just below (above) $\frac{b+\tilde{c}_0}{2b}$, as indicated from the proof of proposition 1, a community converges to the no-FGC equilibrium (FGC equilibrium). Thus, if more than $\frac{b-\tilde{c}_0}{2b}$ $(= 1 - \frac{b+\tilde{c}_0}{2b})$ fraction of women do not undergo FGC, a shift from the FGC to the no-FGC equilibrium is achieved in a self-enforcing manner. Following Schelling (2006), therefore, Mackie (1996) claims that organizing a group that includes a critical minimum number of people who refuse FGC and make it visible to the public are necessary for the eradication of this practice. Because $\frac{b-\tilde{c}_0}{2b} < \frac{1}{2}$, 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 countries located close to Burkina Faso, from c_0 to $c_1 > c_0$, due to cross-border social interactions and the resulting spillovers of FGC-related health and political knowledge. Accordingly,

Proposition 2 *When $b < \tilde{c}_1 \equiv \frac{c_1}{p}$, the strategy profile $(g_c = 0, k_0, m)$ is a stable Nash equilibrium, 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 new knowledge on FGC and updated their perception of its cost. Nevertheless, if a great mass of people exceeding the critical threshold refuse FGC, a community tips over to the no-FGC equilibrium in a self-enforcing manner.

On the one hand, the transition to a new equilibrium would keep the likelihood of women's marriage at the level of p before and after this social change takes place, because the number of men available in the market is constant. On the other hand, this transition could reduce married women's utility from $\tilde{c}_0 - c_0 = \frac{(1-p)c_0}{p}$ to zero. The reasoning goes as follows. In competitive marriage markets in which women fail to get married with a positive probability, they solely suffer from the costly FGC unless they successfully find marital partners. Then, to encourage "all" women to undergo FGC, men in the FGC equilibrium would have to provide married women with more livelihood support than men in the no-FGC equilibrium, in compensation for the health-impairment costs of FGC. Thus, the aforementioned prediction that married women's utility may decline as a result of the equilibrium shift is ascribed to the disappearance

[8]The total welfare in the FGC equilibrium is $(b - \tilde{c}_0) + \frac{1}{p}\left(p(\tilde{c}_0 - c_0) + (1-p)(-c_0)\right) = b - \tilde{c}_0$. The total welfare in the no-FGC equilibrium would easily be checked in a similar manner.

of this compensation, which in turn raises married men's welfare from $b - \tilde{c}_0$ to b. While unmarried women's welfare increases from $-c_0$ to zero due to the avoidance of FGC, and the total welfare enjoyed by all community members also improves from $b - \tilde{c}_0$ to b, the asymmetric consequence of the abandonment of FGC on married men's 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.

However, the model also suggests that married women's welfare loss may not be particularly large when the cost of FGC was previously negligible (i.e., $c_0 \approx 0$). Moreover, the perceived and actual costs of FGC may be different due to cognitive limitations. In fact, people often believe that FGC encourages fertility and, thus, is a good tradition (UNFPA, 2010). If the perceived cost is c_0 despite the true cost of c_1, for example, married women's welfare may increase in step with the abandonment of FGC from $\tilde{c}_0 - c_1$ to 0 (when $c_0 > pc_1$). These arguments suggest that the long-term relationship between the abandonment of FGC and changes in married women's welfare is a priori ambiguous,[9] which makes this study's empirical endeavors worthwhile.

Most importantly, Mackie (1996)'s insights provide two important implications for the empirical exercises conducted herein. 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.

[Here, Figure 1]

3 Burkina Faso: politics and spillover effects

The underlying assumption to estimate the aforementioned impacts is that Burkina Faso's political efforts raised people's awareness about the relative cost of FGC (subsection 3.1), and that its impacts permeated the borderlands of its neighboring countries due to cross-border social interactions (subsection 3.2). Referring to the relevant literature and my 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). While the prevalence of FGC is clearly high

[9] If men's behavior, including the amount of marital support, is regulated by their societies, it is also possible to show that all women's welfare increases as a result of this equilibrium shift while keeping men's welfare constant, depending upon the parameter values.

according to 2010 DHS data (approximately 76% among women aged 15 to 49), this country has exhibited a strong desire to eradicate this practice for more than two decades, as follows (e.g., Chikhungu and Madise, 2015; Colombo, 2013; UNFPA, 2010; United States Department of State, 2001).

In 1990, the National Committee to Fight against the Practice of Excision (CNLPE) was established through 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. To raise public awareness about the harmful health consequences of FGC, the CNLPE has undertaken various activities (e.g., workshops) involving religious/traditional leaders, police, medical experts, and organizations for youth and women. It has also exploited public media such as radio as well as succeeded in including a module on FGC in the national school curriculum and training teachers on this practice (28 TOO MANY, 2015).

The passage of legislation prohibiting FGC in 1996 may be seen as a landmark of these political efforts. This law is considered one of the toughest on the entire African continent and has systematically been enforced since its enactment (UNFPA, 2014).[10] Relatedly, the CNLPE's 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 who force girls to undergo FGC. This hotline was also utilized by those who 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 a high prevalence of FGC. As a result, a gradual increase in convictions from 94 in 1997—2005 to 646 in 2005—2009 is 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).[11] 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 (see Figure 18 of UNICEF, 2005b). Of these countries, the proportion of women who have at least one circumcised daughter and believe that

[10] The penal code, which sentences anyone who 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 255 to 1530 USD based on the exchange rate at the end of October 2018) (Article 380). This fine is considerable in monetary terms given that Burkina Faso's gross national income per capita (by the World Bank Atlas method) was only 610 USD in 2017 (see `http://databank.worldbank.org/data/download/GNIPC.pdf`.) Further, prison terms can be extended to between five and ten years if the procedure causes death. If the guilty party is a medical professional, the maximum punishment will 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 85 to 170 USD) will also be imposed on all people who have knowledge of the criminal behavior described in Article 380 and fail to notify the proper authorities of incidents (Article 382).

[11] Burkina Faso is also 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). In 2008, the UNFPA and UNICEF also implemented a joint program aimed at accelerating the abandonment of FGC in this country (UNFPA and UNICEF, 2014).

this practice should continue is also the smallest in Burkina Faso (see Figure 19 of UNICEF, 2005b). These findings indicate people's growing tendency to abandon FGC in this country. Burkina Faso's "nationwide" political effort might have successfully prompted a sufficient number of people crossing a crucial group-threshold to stop FGC.

3.2 External influence on border communities in neighboring countries

As Shell-Duncan and Hernlund (2000) (p. 7) notes, "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 (rural) Africa are typically performed within the same ethnic group, and ethnic groups often spread across national borders.

Ethnic groups stretching over multiple countries exists because Africa's national borders were drawn during colonial periods by Europeans with limited knowledge of or concern for social and linguistic groups (e.g., Herbst, 1989). While parts of national boundaries in West Africa consist of segments on rivers (e.g., Black Volta between Burkina Faso and Côte d'Ivoire), most of them are still based on the colonial administrative divisions of French West Africa, which were determined with no precise knowledge of human or physical geography (e.g., Zartman, 1965; see also Brownie, 1979 for details of the respective national boundaries). The partitioned measure of "artificial states," which highlights ethnic features of state artificiality, is also quite high in the aforementioned six countries bordering Burkina Faso (see Table 7 of Alesina et al., 2011).

This partition of ethnic groups makes cross-border social interactions reasonably common in Africa (e.g., Lesser and Moisé-Leeman, 2009; Meagher, 2003); 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) as perceived by those border residents.

To assess whether such knowledge spillovers are possible, in February 2016, I 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).[12] 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.

[12]The decision to select Ghana for the field survey was informed by several concerns including security, research budget, and translation. In this survey, I 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 conducted 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 two research assistants (for translation to and from local languages) and me.

While the nature of convenience sampling precludes generalizing findings from this field survey, three points are still noted. First, 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.[13] Second, 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). This view is 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.[14]

Third, one Dagaaba ex-cutter mentioned that she received an offer to perform FGC from Burkinabé parents (one year before the interview), although she rejected this offer. This finding indicates that the strong law in Burkina Faso could have conceivably served to encourage Burkinabé parents to take their daughters to other countries for the purpose of FGC, in which laws prohibiting FGC do not exist or the enforcement of such laws is not so strict. Consistently, it is reported that the following ethnic groups moved across national boundaries to get their daughters circumcised while avoiding Burkina Faso's law enforcement (Sayagues, 2009): the Dagaaba and Lobi spread between Burkina Faso and Ghana; the Mossi and Yagse moved across Burkina Faso and Mali; and the Fulani and Gourmantché distributed between Burkina Faso and Niger. On the 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 costly practice involving criminalization and legal punishment.[15][16]

4 Empirical strategy

This study examines the impacts of Burkina Faso's policy effort on the practices of FGC and marriage involving people residing in the borderlands of its neighboring countries, rather than on these outcomes for Burkinabé citizens.

[13]For example, one Burkinabé woman who had married into Ghana returned to her natal 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.

[14]Similarly, an elderly Burkinabé woman residing in Wa West informed me 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.

[15]In my interview, one ex-cutter (for girls) heard of cases where the police had arrested Burkinabé cutters practicing FGC.

[16]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 other reasons and thereby reduced its local prevalence. First, as people pay fees for cutting, local prices of FGC might have risen due to increasing demand for the service. Second, increasing demand for the services provided by cutters in neighboring countries may have raised the local cost of searching for available cutters. In my field survey, I 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, I did not find any current (for boys) or ex-cutters (for girls) who 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 the transient unavailability of cutters.

Burkina Faso is not analyzed here for two reasons. First, because FGC in Burkina Faso is prevalent across almost all regions and ethnic groups, and its policy effort likely affected most of its citizens, it is difficult to define an appropriate treatment group within this country as well as to address the relevant endogeneity. Second, Burkina Faso strictly criminalizes FGC, and as a result, its citizens may not report their FGC status truthfully. While a few studies support the reliability of self-reported FGC data (e.g., Morison et al., 2001), most prior studies found inconsistency between self-reported and clinically determined FGC, while casting doubt on the self-reported information regarding FGC status (e.g., Klouman et al., 2005; Snow et al., 2002), FGC types (e.g., Elmusharaf et al., 2006), and attitudes toward FGC (e.g., De Cao and Lutz, 2018). According to Jackson et al. (2003)'s study of Ghana, which is closely related to the present context, 13% of women who reported in 1995 that they had been circumcised stated that they had not been circumcised when they were re-interviewed in 2000 after the government banned FGC, for example. Thus, this measurement concern has often facilitated researchers to acknowledge the limitation of their studies (e.g., Bellemare et al., 2015) or to innovate a new means to measure FGC status (e.g., Efferson et al., 2015).[17] By analyzing Burkina Faso's policy impacts that spill over to its neighboring countries, whereby FGC is not criminalized or laws against FGC are weakly enforced compared to Burkina Faso, the present study attempts to overcome these issues effectively.

To estimate the impacts of interest, 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). Ghana and Niger were excluded from the analysis for the 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 the following equation by the ordinary least squares (OLS):[18]

$$y_{ijt} = \alpha_1 + \alpha_2 D_{ijt} \cdot B_j + \alpha_3 \mathbf{x_{ijt}} + v_j + \rho_t + \epsilon_{ijt}, \tag{9}$$

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

[17] Efferson et al. (2015)'s study of Sudan relied on henna applied to circumcised girls' feet for assessing the respondents' FGC status.

[18] This research exploits the OLS 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.

country-ethnicity indicators categorized into 28 groups), including year-of-interview fixed effects;[19][20] 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. On the other hand, 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, which constitute the second reason, exploiting 1990 as the threshold year seems reasonable.

Similarly, no a priori criteria exist to facilitate the defining of 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 in Section S.3 in the supplemental appendix.

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 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 between borderlands and inlands. Nevertheless, these issues will be more carefully analyzed in subsection 6.4.

In the present study, it may be plausible to cluster standard errors at the level of marriage markets, likely characterized by both the respondents' ethnicity and residential areas, which facilitates two-way clustering (e.g., Cameron et al., 2011). However, ethnic groups in the DHS are not necessarily categorized in a consistent manner across countries and even across the survey rounds within the same country (see also footnote 19). Consequently, after controlling for the community fixed effects and the country-ethnicity fixed effects, the main empirical model exploits standard errors 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

[19]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'Ivoire, 10 groups for Mali, and six groups for Togo. Also, note that the DHS does not necessarily categorize ethnic groups in a consistent manner across countries. Thus, this study exploits the relevant fixed effects at the country-ethnicity level. However, the community fixed effects still control for attributes specific to areas settled by particular ethnic groups.

[20]Information on respondents' birth order was unavailable in all rounds of the Benin DHS and the 1998—99 DHS of Côto d'Ivoire. For these rounds, the sample average (3.35) was applied.

noted below. While this approach is identical to that of Bellemare et al. (2015)'s study of FGC in West Africa, this study will also check the robustness of the findings to different levels of clustering in Section S.3.

The key identification assumption underlying the DID specification (9) is that in the absence of political efforts by Burkina Faso, the outcomes of interest in the borderland and inlands 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 2 plots the fraction of circumcised women by country and year of birth (three-year cohort), with the vertical line indicating the 1990—92 cohort. This figure presents the post-1966 fraction because the annual number of females born before 1966 was small, particularly in the borderlands.[21]

Two points are noted. First, it may be difficult to gain a good insight into the parallel trends from Benin, 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 year by year (even if three years of birth are treated as one group in this figure). However, in the remaining countries, 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.2 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 all countries 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 jointly tests this spillover assumption and its consequences.

[Here, Figure 2]

5 Data

Repeated cross-sectional data are utilized that are 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.[22] 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

[21] The mean circumcised proportion is approximately 14%, 44%, 90%, and 9% in Benin, Côte d'Ivoire, Mali, and Togo, respectively.

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

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) are not always available.[23] In the data set, the birth year of females ranges from 1948 to 1999.

For the sample females born before [panel (A)] and after 1990 [panel (B)], 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 (2,909 communities). 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 married/single dichotomy, which facilitates effective analysis of respondents' entry into their first marriage.[24] For this reason as well as because the collected information somewhat differs by round and country, the number of observations in Table 1 varies across the reported variables.

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.[25] Before 1990, approximately 8% ($\approx \frac{0.04}{0.58}$) of circumcised females were infibulated and approximately 89% ($\approx \frac{0.52}{0.58}$) of this 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 the 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 suspicion about and speak out less against criminal activities, it is argued that the introduction of a law criminalizing

[23]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.

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

[25]The World Health Organization has classified FGC into four types since 1996. Type I is the "partial or total removal of the clitoris and/or the prepuce" (clitoridectomy). Type II is the "partial or total removal of the clitoris and the labia minora, with or without excision of the labia majora" (excision). Type III is the "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).

FGC, taken together with the resulting incentives for parents to seek FGC in secrecy, has facilitated this tendency toward a lower age (Camilotti, 2015; Shell-Duncan et al., 2013).

Respondents in the borderlands are less educated, engage more pronouncedly 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 the 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 the inland respondents. A family's wealth index in the borderlands, which is a composite measure of a household's cumulative living standard, and which ranges from one to five, is smaller than that in the inland communities.[26] Together these findings suggest that the borderlands, which are also more rural, are economically less advanced than the inlands.

[Here, Table 1]

6 Empirical findings

6.1 FGC

Estimated impacts on FGC are reported in Table 2. 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 (9) 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 1,750 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).

In column (c), 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 the inlands. If this tendency is more pronounced in the borderlands, the likelihood of being circumcised at a younger age may increase in these areas

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

(even if the overall cutting rate declines in such areas). No evidence supporting this view is shown.

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), 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 as 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 underreported the incidence of FGC for fear of legal sanctions, there is no a priori reason why respondents would underreport 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.

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 2.[27] The reported negative values indicate that the aforementioned FGC-discouraging effects may be attenuated if any bias exists.

In column (h), this research appended the data drawn from three rounds (1998—99, 2003, 2010) of the Standard DHS conducted in Burkina Faso to its main study sample and estimated a version of the FGC equation (9), which additionally includes in regressors the interaction terms between an indicator for the respondents born in or after 1990 and indicators for communities located in Burkina Faso.[28] The Burkinabé communities are divided into those situated within a 30-km distance from its national border and the remaining ones. Two findings are noted. First, a significant decline in FGC is observed in Burkina Faso after this country started to engage in strenuous political efforts to eradicate FGC (see also Figure S.2 in the supplemental appendix for the trend of the fraction of circumcised women by three-year cohort of birth). Second, the FGC-discouraging effects are the largest in the inland communities in Burkina Faso (i.e., −0.157), followed by those on the borderlands in Burkina Faso (i.e., −0.137) and, then, those on the borderlands of its neighboring countries (i.e., −0.068).

The latter finding is plausible, considering the capital of Burkina Faso, Ouagadougou, is located in the heart of this country. Namely, this finding may indicate that political efforts are likely to be more influential in the vicinity of the

[27] It is assumed that year-of-birth fixed effects (ρ_t) and communities fixed effects (v_j) are proportional to unobservables.
[28] In Burkinabé DHS data, the mean age of FGC is 6.58 years.

capital than in the hinterlands (e.g., Michalopoulos and Papaioannou, 2014), and that the policy impacts gradually decline toward the latter as well as its neighboring countries. On the other hand, the greater impacts on Burkinabé citizens may also arise from people's incentive to lie about their FGC status for fear of legal punishment. In addition, the estimated impacts on Burkina Faso capture the influence of all the economic and political factors generating the difference in the trend of FGC between Burkina Faso and (the inlands of) its neighboring countries. The nature of this country-level difference in the relevant trends may make the interpretation of the estimates more difficult, particularly for other outcomes (e.g., marriage, health, education), compared to the analysis of the main study sample, whereby the borderlands are compared with the inlands within the same country and, thus, under the same economic and political conditions except for the external policy shock originating from Burkina Faso. These concerns motivate the present study to focus on Burkina Faso's neighboring countries in all but the exercise performed in this column (h).

For all outcomes analyzed in Table 2, the robustness of findings was explored in Table 3. 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 Uppsala Conflict Data Program (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 (see Figure S.1 in the supplemental appendix for the locations of such violence). In the first column of Table 3, 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.[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 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.

One may insist that the FGC-discouraging effects on border respondents are attributed to particular internal polices

[29] Alternatively, controlling for the number of people who died within a 40-km radius of each community also yielded similar implications.

[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 columns (b), (g), (l), and (q) in Table 3, the standard errors are robust to heteroskedasticity but not clustered at the community level due to computational complexities.

"simultaneously" implemented by the neighboring countries themselves, rather than external policy shocks originating from Burkina Faso. However, the robustness of the findings to the inclusion of community-specific time trends may alleviate this (unlikely) concern if the trends appropriately control for such policy efforts. In any case, 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 shock facilitates causal identification more easily than the former.

[Here, Table 2 and Table 3]

6.2 Marriage

Table 4 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 along with the decline in cutting rates. However, as column (d) shows, border residents delayed marriage by 0.7 years.[31] While these results are 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. 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 delayed their entry into marital relationships.

It is not straightforward to interpret the approximately nine-month delay in the first marriage as possibly causing the decline in the number of children delivered by the age of 25 years. For example, because an investment in childbearing may be an important strategy for women to protect them in their old age in rural societies (e.g., Hoddinott, 1992), the reduced fertility may imply their welfare loss. However, the potential trade-off between the quantity and the quality of children may make the relevant welfare implications ambiguous (e.g., Becker and Lewis, 1973; Millimet and Wang, 2011). In addition, social scientific and public health research (e.g., Field and Ambrus, 2008; Marphatia et al., 2017) relates delay in young women's marriage to improvement in numerous welfare outcomes, such as schooling, maternal health, mortality and morbidity of children born to them, and access to contraception and

[31] The ages at first marriage, first sexual intercourse, and first birth are estimated only for those who experienced these events.

health-care services. However, it is not so obvious whether a "significant" welfare improvement can be achieved when the mean age at first marriage solely increases from about 16 years (recall Table 1) to 16.7 years, although the welfare improvement itself cannot be rejected.[32] Moreover, the identified delay in marriage and the reduced fertility might also have happened just during the unavoidable adjustment periods in social transition.

In Table 5, other marriage-related outcomes were estimated for currently married females aged 25 years or younger. Because the relevant information pertaining to the analyzed outcomes 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 that 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 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 own health care, large household purchases, or visiting their family or relatives. Similarly, a dummy referring to women who suffered from 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.4 in the supplemental appendix, but the aforementioned implications remain largely unchanged.[35]

The robustness of the findings reported in Table 4 and Table 5 to conflict proximate to a given community,

[32]To differentiate child marriage, the committee on the United Nations Convention on the Rights of the Child regards 18 years as the legal threshold of marriageable age.

[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.

[34]In the DHS, male household members were also interviewed in some of the selected households. Data on inter-ethnic marriage are 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, in which both members were categorized as "other ethnic group," 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.4 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 -0.173 with std. 0.171).

household fixed effects, community-specific linear time trends, and separate sub-samples of the data (recent DHS, permanent residents) is explored in Table S.5 and Table S.6 in the supplemental appendix. The previous findings of an increase in the age at first marriage (and possibly ages at first sexual intercourse and first birth) and the resulting reduction in fertility are less robust in some specifications. Overall, no systematical marriage impacts are observed.

[Here, Table 4 and Table 5]

6.3 Further robustness checks

While the detailed explanation of the estimation results is relegated to Section S.3 in the supplemental appendix, further robustness checks were performed. First, this study exploited different birth year thresholds (1985, 1990, or 1995) and distances to the border (10 km to 200 km) in defining D_{ijt} and B_j (Figure S.3). Second, it estimated the likelihood of being cut before the age of X (Figure S.4). Third, impacts on FGC and marriage are estimated separately for each country (Table S.7 and Table S.8). Relying on Murdock (1959)'s classification, fourth, this study alternatively exploited as B_j an indicator for communities situated in ethnic homelands stretching over Burkina Faso and its neighboring countries (Table S.9; see also Figure S.5 for such ethnic homelands). Fifth, Table S.10 reports the estimation results using a sub-sample limited only to the respondents residing within a 60-km distance to Burkina Faso. Within this sub-sample, the characteristics of the border residents born before 1990 reveal great similarity to those of the corresponding inland residents due to the geographical proximity, as seen from the summary statistics of this sub-sample (Table S.11). Sixth, in Table S.12, logit and ordered logit models were also estimated for several outcomes having the supposed interval (e.g., zero to one for the binary outcomes, one to five for the wealth index). Seventh, using data pertaining to females aged 15 to M years, whereby $M \leq 49$, equation (9) is repeatedly estimated, and the estimated α_2 and its 95% confidence intervals are reported in Figure S.6.

Two issues pertaining to statistical inference are also addressed. First, the significant decline in FGC in the borderlands might have been revealed by chance in the present study, which explores numerous outcomes. This study explored whether the finding is robust to the consideration of multiple-hypothesis testing using Bonferroni's, Holm (1979)'s step-down, and Hochberg (1988)'s step-up adjustment procedures (Table S.13). Second, in Table S.14, it also exploited standard errors clustered at the levels of administrative units (737 units having approximately four DHS communities in each unit) and of ethnic homelands based on Murdock (1959)'s classification (78 ethnic homelands).

Overall, the "negative FGC impacts" and "no distinct adverse marriage impacts" of the external policy shock on young women are confirmed.

6.4 Selected relocation and health

Despite the highly robust findings, two important selection issues should still be addressed. 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 that systematically differ from those possessed by inland residents.[36] Particularly in the present context, in the borderlands, the possible decrease of deaths in childhood may 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, 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 the inland communities in a systematic manner but also correlates with the outcomes.

On the one hand, such unfavorable health consequences of FGC are not well established in prior studies (see Wagner, 2015 for the literature review, for example). In fact, it is puzzling why this practice has persisted so long if it crucially undermines human health, in which case the FGC equilibrium is less likely to arise in the first instance (recall the proposition 2 in Section 2).

Regarding the relocation 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 4, there is no a priori reason why female marriage prospects improved in the border communities. Moreover, if the relocation-induced measurement noise does not systematically differ between the borderlands and the inlands, this issue simply attenuates the estimates. Consistently, the values of Oster (forthcoming)'s δ, as reported in Table 2, indicate that the estimated FGC-discouraging effects may be attenuated if any bias exists. Moreover, the FGC-discouraging effects on those who were identified as permanent residents of the surveyed community (and the corresponding values of R-squared) were also greater than those on the full sample (recall Table 3), although only the limited data, i.e., Benin (2001) and Mali (2001, 2006), severed the relevant analyses.

Nevertheless, an indicator equal to one if the respondents migrated into the present DHS communities (i.e., if they

[36] The abandonment of FGC may influence the fertility of the post-treatment sample, as demonstrated in Table 4, and in turn affect the marital outcomes of children born to this sample. However, the exploited data does not include children born to the post-treatment sample, thus making the present study free from this concern.

were not permanent residents), as well as a range of health-related outcomes, such as height, weight, height for age, body mass index (BMI), hemoglobin levels, indicators for genital problems, and terminated pregnancies, are estimated for the female respondents aged 25 or below. The results, as reported in Table 6, provide no strong evidence suggesting the above concerns.[37] Notably, the no health impacts exist despite the possibility that women's (apparently marginal) delay in marriage per se, as found in Table 4, might have improved their health conditions (e.g., anemia, BMI), as often indicated in public health research (e.g., Marphatia et al., 2017).[38]

Another similar attempt was also made exploiting the census data drawn from Benin's Population and Habitation Census (PHC) 1979, 1992, 2002, and 2013 as well as Mali's General Census of Population and Housing (GCPH) 1987, 1998, and 2009. As detailed in Section S.4 in the supplemental appendix, the estimation results show no significant impacts on the border residents regarding relocation and morality-related outcomes (Table S.15).

[Here, Table 6]

6.5 FGC as a social norm

Thus far, this study has shown that the external policy shock originating from Burkina Faso's political efforts reduced the practice of FGC in the borderlands of its neighboring countries while having no distinct negative impacts on young women's marital outcomes. In this subsection, it discusses how these findings can be interpreted from a theoretical standpoint although it hesitates to conclusively advocate a particular interpretation.

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 costs of FGC (e.g., unfavorable health consequences) were previously negligible. The no health-undermining impacts of FGC, as explored in subsection 6.4, are also consistent with this interpretation. In addition, recall that the radical form of FGC is not common in the studied areas.[39] Moreover, as shown in subsection S.6.1 in the supplemental appendix, in the exploited DHS data, the fraction of respondents who believed that FGC would improve women's marriage prospects is small. Since the marriage matching

[37]In the 2011—12 DHS in Benin, the 2011—12 DHS in Côte d'Ivoire, and the 2012—13 DHS in Mali, anthropometric information is available for a 50% sub-sample of the surveyed households. Similarly, the information regarding hemoglobin levels is collected only from a sub-sample (i.e., 50% or one-third) of the surveyed households, depending upon country and round.

[38]The no impacts on general health outcomes (e.g., height, weight, BMI, hemoglobin) are consistent with the findings yielded by Wagner (2015), which analyzes the DHS data drawn from 13 African countries (including Benin and Mali). On the other hand, she also found that circumcised women were more likely to suffer from vaginal discharge, genital sore/ulcer, and terminated pregnancies than uncircumcised women. However, she made the relevant comparison of circumcised and uncircumcised women after controlling for the community fixed effects. This implies that the relatively large fraction of communities showing the cutting rate of one or zero, as indeed observed in the analyzed DHS data (see Figure S.8, as explained in subsection S.6.1 in the supplemental appendix), is not exploited for her identification of the relevant estimates, which makes the scope of the analyzed population markedly different between her and the present studies. She also found that circumcised women were more likely to marry early and have many children. Because the estimation of the terminated pregnancies does not control for this increased fertility, the relevant likelihood may artificially increase, all the other factors being constant. Also, it is possible that circumcised and uncircumcised women systematically differ "within" a community, revealing the interior cutting rate between zero and one.

[39]Chesnokova and Vaithianathan (2010) also modeled FGC as a premarital investment. However, the yielded model prediction is not supported in the empirical analysis conducted herein, as explained in Section S.5 in the supplemental appendix.

at FGC equilibrium is random with respect to this practice, they might not have identified a discernible marriage premium from this practice and therefore, might not have answered that FGC improves women's marriageability.

Another interpretation is that FGC is a normative equilibrium but no longer relevant to women's marriage. Young (2008, 2015) enumerate several mechanisms that, while they may not be mutually exclusive, 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 may provide some support for this interpretation. According to their conjecture, FGC signals respect for a hierarchical social system among women, which provides circumcised women with access to 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. 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).[40]

The third possibility is that FGC is neither a normative equilibrium nor related to women's marriage. According to Young (2015), however, social norms have four notable features. First, they show a tendency to "persist" for long periods. Second, norm shifts tend to be sudden when they take place, which is called "tipping." Third, as norms are one of the population-level multiple equilibria, they tend to exhibit both "local conformity" and "global diversity." Fourth, normative behaviors depend less on underlying fundamentals than would otherwise be expected and, therefore, reveal less diversity, summarized by the term "compression." As already analyzed, the centuries-long practice of FGC has swiftly declined in the borderlands of Burkina Faso's neighboring countries. This finding supports the first and second characteristics. Moreover, taking conceptually similar approaches to those adopted in Bellemare et al. (2015) and Efferson et al. (2015), in subsection S.6.1 in the supplemental appendix, this study also shows a relatively sharp discontinuity in cutting rates across communities, while also revealing that approximately 73% of the variation of FGC is attributed to community-level heterogeneity, which supports the remaining features of social norms. Therefore, this possibility seems less likely than the first two interpretations.

[40]Consistent with these findings, in Table S.16 as explained in subsection S.6.1 in the supplemental appendix, 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 apparently the most agreed-upon 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).

7 Conclusion

This study examined whether and how the abandonment of FGC is associated with women's marital outcomes in the long term. Two major contributions are noted. First, it clarified the long-term relationship between FGC and women's marriage in a theoretical manner and analyzed this practice's welfare consequences from the mating perspective. For this purpose, it formalized Mackie (1996)'s theory of marriage convention that has received much publicity in the fields of anthropology and sociology. Second, it proposed a unique, externally applicable identification strategy and empirically explored what happens to women's marriage in the long term if they abandon FGC. 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 (located close to this country) of its neighboring countries while increasing the cost of FGC as perceived by the border residents. 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'Ivoire, Mali, and Togo) before and after Burkina Faso undertook anti-FGC political efforts, provided evidence consistent with the hypothesis; the practice of FGC swiftly declined in the borderlands. In contrast, this external policy shock had no influence on the probability of young females forming a marital union, while having no distinct adverse impacts on 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. It is acknowledged that the marital outcomes examined herein 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, concomitantly with the decline in FGC in the long term, at least from the mating perspective in the studied setting.

Despite the careful empirical analysis, however, the implications that are yielded still have to be interpreted with the following qualification in mind. Namely women's possible health improvement and relocation induced by the abandonment of FGC might have affected the relevant estimates. However, this concern may not significantly undermine the main implications of the present study according to the performed analyses, which show no noticeable impacts on the health and relocation outcomes in the borderlands. This finding can also be seen as another contribution of the present paper, because there is little rigorous empirical evidence on the health consequences of FGC. While future research, particularly the collection and utilization of the long-term panel data tracing the same individuals, should aim to validate its findings, to the best of my knowledge, the present study still exploits the most promising settings (e.g., external policy shock, cross-border knowledge spillover), data (e.g., less noisy FGC measurement), and empirical approach (e.g., DID) available to date for the posed question, while shedding light on the issue of FGC, an area showing a marked paucity of rigorous empirical studies.

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., Ahmadu, 2000; Gosselin, 2000b). The mechanisms sustaining FGC may also change over time.[41] Nevertheless, the areas and time periods studied in the present research are still 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).

Finally, the above findings are not inconsistent with the view that FGC is a marriage convention or at the very least, a normative equilibrium. Relying on the marriage convention interpretation, it may appear that the present study opposes (too) costly political effort (only) to eliminate FGC because the welfare improvement arising from the abandonment of FGC is apparently insignificant. However, infibulation, which may most seriously undermine women's health, is not common in the studied areas. There are also other welfare outcomes that have not been addressed in this study (e.g., mental health, mortality and morbidity of children born to mothers refusing FGC, self-esteem, social capital), particularly if FGC is not a marriage convention. Moreover, this study found a delay in young women's marriage and their reduced fertility in the borderlands in some specifications, although its interpretation is not necessarily straightforward. Thus, it is still important to improve the understanding of the theoretical mechanisms sustaining FGC while exploring the relevant welfare consequences. This importance holds true because policy interventions pertaining to FGC have not always resulted in significantly reducing its prevalence (Berg and Denison, 2012, 2013) and different theoretical mechanisms recommend different strategies to put an end to it (Shell-Duncan et al., 2011). Presuming that FGC is a social norm, 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) may be a fruitful avenue for future research. When the elimination of FGC is a policy goal, this future work, possibly involving "community-wide" randomized controlled trials that have particular target groups and aspects to educate (e.g., health consequences, human rights), would also improve the effectiveness of the relevant policy interventions.[42]

[41] 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).

[42] See also Section S.7 in the supplemental appendix for further policy-oriented discussion.

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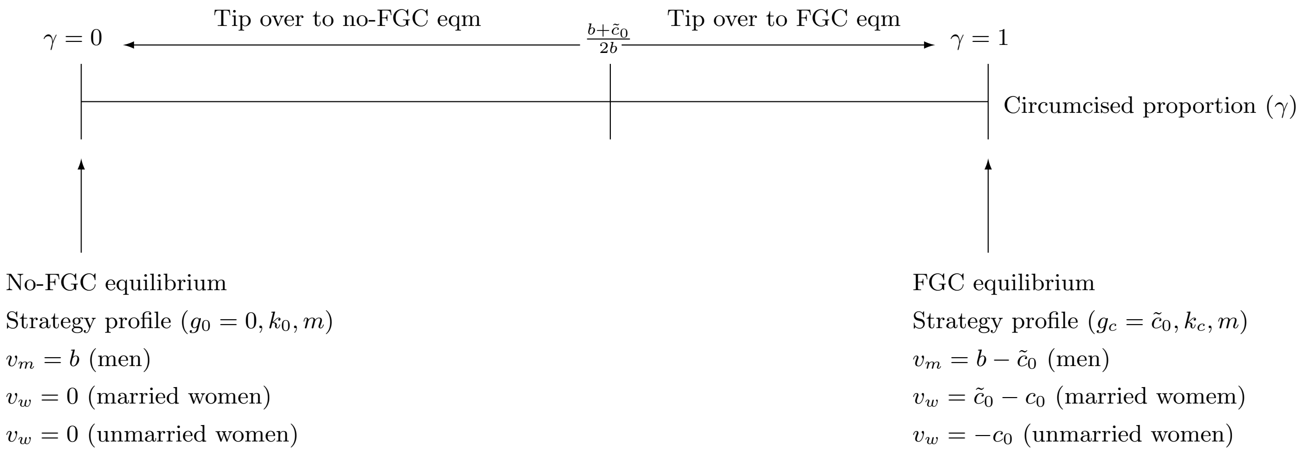

Figure 1: Graphical description of equilibria

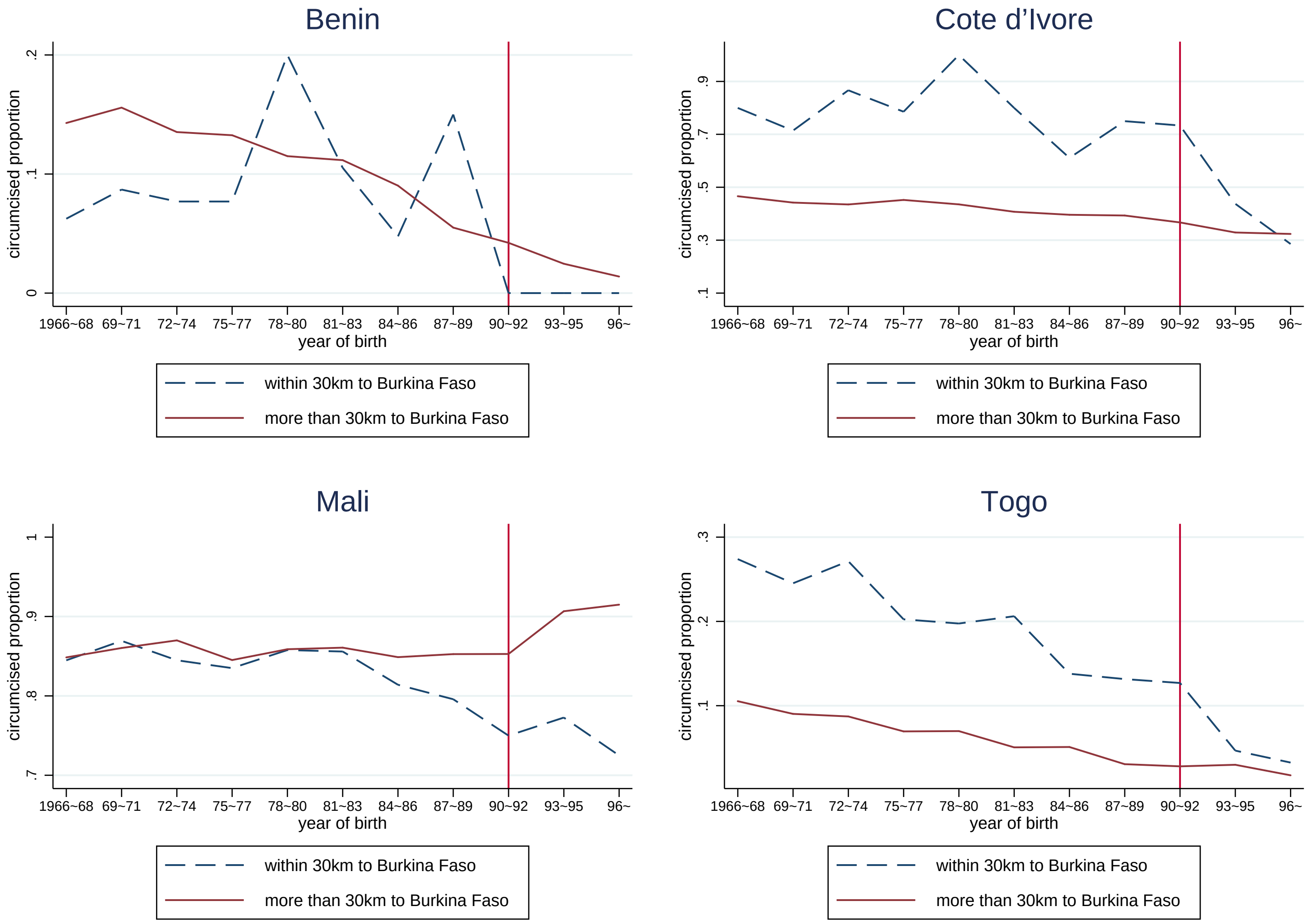

Figure 2: Proportion of circumcised population by the year of birth

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
One if migrant†	0.50	0.50	627	0.48	0.49	13054	0.48	0.49	13681
Weight (kg)†	54.25***	7.32	756	55.84	9.65	18029	55.77	9.57	18965
Height (cm)†	159.74	6.74	753	159.70	7.04	18263	159.70	7.02	19016
Height for age (z-scores)†	-0.60	1.01	751	-0.61	1.06	18134	-0.61	1.06	18885
BMI × 10†	212.52***	27.51	753	218.47	33.70	18156	218.23	33.49	18909
Hemoglobin (g/dl)†	11.46	1.68	304	11.34	1.84	6934	11.35	1.83	7238
One if had genital sore/ulcer†	0.07	0.25	814	0.07	0.25	16972	0.07	0.25	17786
One if had genital discharge†	0.13**	0.34	817	0.16	0.36	16983	0.15	0.36	17800
One if had terminated pregnancy†	0.09	0.28	834	0.08	0.28	18753	0.08	0.28	19587
Birth order	3.34	2.10	3006	3.33	1.81	65125	3.33	1.82	68131
One if Muslim	0.55***	0.49	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***	0.28	3006	0.83	2.33	65125	0.80	2.28	68131

Continued

Table 1: Continued

	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.
(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
One if migrant†	0.18	0.39	64	0.24	0.42	1163	0.23	0.42	1227
Weight (kg)†	51.90***	8.14	402	54.14	9.88	9572	54.05	9.83	9974
Height (cm)†	158.07	7.38	402	158.06	7.95	9536	158.06	7.93	9938
Height for age (z-scores)†	-0.76	0.90	400	-0.77	1.08	9461	-0.77	1.07	9861
BMI × 10†	206.45***	28.25	401	215.92	34.29	9504	215.54	34.11	9905
Hemoglobin (g/dl)†	11.76	1.74	318	11.75	1.66	5894	11.75	1.66	6212
One if had genital sore/ulcer†	0.03*	0.18	638	0.04	0.21	13913	0.04	0.21	14551
One if had genital discharge†	0.10	0.30	638	0.11	0.31	13907	0.11	0.31	14545
One if had terminated pregnancy†	0.03	0.17	644	0.03	0.19	13981	0.03	0.19	14625
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

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: 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)	One if cut (Append BF's DHS)
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
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	-0.068***
		(0.026)	(0.021)	(0.019)	(0.017)	(0.027)	(0.011)	(0.026)
Located in BF's borderlands ($\leq$ 30 km)								
× Born in or after 1990	-	-	-	-	-	-	-	-0.137***
								(0.022)
Located in BF's inlands ($>$ 30 km)								
× Born in or after 1990	-	-	-	-	-	-	-	-0.157***
								(0.011)
Birth order	0.003***	0.003***	0.002***	0.000	-0.000	0.002***	-0.000	0.002***
	(0.001)	(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	0.083***
	(0.009)	(0.009)	(0.009)	(0.004)	(0.004)	(0.009)	(0.005)	(0.007)
Christian	-0.049***	-0.049***	-0.046***	-0.002	0.002	-0.037***	0.004	-0.049***
	(0.006)	(0.006)	(0.005)	(0.002)	(0.002)	(0.005)	(0.003)	(0.005)
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)	0.997	0.008	1.000	0.725	0.752	0.997	0.813	0.983
R-squared	0.761	0.761	0.699	0.291	0.307	0.648	0.819	0.663
No. of obs.	71921	71921	71921	64188	64188	71627	71627	105366
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 3: 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)	(i)	(j)
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)				
	(k)	(l)	(m)	(n)	(o)
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)				
	(p)	(q)	(r)	(s)	(t)
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), (l), and (q), whereas they are robust to heteroskedasticity and clustered residuals within each community in the remaining columns.

Table 4: 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)	0.783	0.697	0.666	-	-	-	-	-
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 5: 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)	0.960	-	-	-	1.000	0.894	0.977	0.996
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.

Table 6: Selected relocation and health: Females aged 25 or below (OLS)

Dependent variables:	One if migrant	Weight (kg)	Height (cm)	Height for age (z-scores)	BMI (× 10)	Hemoglobin (g/dl)	One if had genital sore/ulcer in the last 12 months	One if had genital discharge in the last 12 months	One if had ever terminated pregnancy
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
Located within a 30-km distance to BF									
× Born in or after 1990	-0.103	1.053	0.688	0.046	0.387	0.093	0.005	0.013	0.034*
	(0.073)	(0.855)	(0.763)	(0.095)	(3.872)	(0.219)	(0.018)	(0.022)	(0.019)
Birth order	-0.001	0.058*	0.029	0.007*	0.162	0.007	0.001	0.000	0.002*
	(0.002)	(0.033)	(0.026)	(0.004)	(0.115)	(0.009)	(0.001)	(0.001)	(0.001)
Muslim	0.034	1.330***	0.941***	0.124***	2.861***	-0.109	-0.015*	-0.003	-0.017**
	(0.023)	(0.270)	(0.235)	(0.031)	(0.936)	(0.083)	(0.008)	(0.010)	(0.007)
Christian	0.012	0.796***	0.628***	0.082***	1.243	-0.041	-0.008	-0.004	-0.006
	(0.023)	(0.249)	(0.212)	(0.028)	(0.898)	(0.072)	(0.006)	(0.008)	(0.007)
R-squared	0.229	0.233	0.243	0.220	0.236	0.331	0.146	0.181	0.130
No. of obs.	14787	28812	28826	28620	28688	13397	32194	32203	34066
Country-ethnicity FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year-of-birth FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Community FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year-of-interview FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Sample DHS									
Benin 2001	YES	YES	YES	YES	YES	YES	YES	YES	YES
Benin 2011-12	NO	YES	YES	YES	YES	YES	YES	YES	YES
Côte d'Ivoire 1998-99	NO	YES	YES	YES	YES	NO	NO	NO	NO
Côte d'Ivoire 2011-12	NO	YES	YES	YES	YES	YES	YES	YES	YES
Mali 2001	YES	YES	YES	YES	YES	YES	YES	YES	YES
Mali 2006	YES	YES	YES	YES	YES	YES	YES	YES	YES
Mali 2012-13	NO	YES	YES	YES	YES	YES	YES	YES	YES
Togo 2013-14	NO	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 Proof

Proof of proposition 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 $g_c - c_0 \geq 0$ as well as $p(g_c - c_0) + (1-p)(-c_0) \geq pg_0 + (1-p)\cdot 0 =$ 0, resulting in $g_c \geq \frac{c_0}{p} \equiv \tilde{c}_0$. So, men choose $g_c = \tilde{c}_0$, resulting $v_m(g_c, k_c, m) = \gamma b - \tilde{c}_0$ and $v_w(g_c, k_c, m) = \tilde{c}_0 - c_0 > 0$.

Now, consider the following three cases. First, assume the equilibrium fraction of the circumcised girls in a community $\gamma^* = \underline{\gamma} \leq \frac{\tilde{c}_0}{b}$. Since $\underline{\gamma}b - \tilde{c}_0 \leq 0$ 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 $\underline{\gamma} = 0 < \frac{\tilde{c}_0}{b}$ (no-FGC equilibrium). Second, assume $\gamma^* = \overline{\gamma} > \frac{b+\tilde{c}_0}{2b}$. Since $\overline{\gamma} > \frac{b+\tilde{c}_0}{2b} > \frac{\tilde{c}_0}{b}$, it becomes that $\overline{\gamma}b - \tilde{c}_0 > 0$ and $\overline{\gamma}b - \tilde{c}_0 > (1-\overline{\gamma})b$. 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 $\overline{\gamma} = 1 > \frac{b+\tilde{c}_0}{2b}$ (FGC equilibrium). Third, assume $\frac{\tilde{c}_0}{b} < \gamma^* = \hat{\gamma} \leq \frac{b+\tilde{c}_0}{2b}$. In this case, it becomes that $(1-\hat{\gamma})b \geq \hat{\gamma}b - \tilde{c}_0 > 0$. When $(1-\hat{\gamma})b > \hat{\gamma}b - \tilde{c}_0$, 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 $\hat{\gamma} = 0 \leq \frac{\tilde{c}_0}{b}$. This is a contradiction to the definition of $\hat{\gamma}$. When $(1-\hat{\gamma})b = \hat{\gamma}b - \tilde{c}_0$ (i.e., $\hat{\gamma} = \frac{b+\tilde{c}_0}{2b}$), 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 $\frac{b+\tilde{c}_0}{2b}$ and $k = k_0$ with the remaining probability.[43] 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 2:

As before, men choose $g_c = \tilde{c}_1$ (or $g_0 = 0$) to encourage circumcised (or uncircumcised) women to accept a marital offer. Assume the equilibrium fraction $\gamma^* = \tilde{\gamma} \leq 1 < \frac{b+\tilde{c}_1}{2b} < \frac{\tilde{c}_1}{b}$. Since $\tilde{\gamma}b - \tilde{c}_1 < 0$ and $\tilde{\gamma}b - \tilde{c}_1 < (1-\tilde{\gamma})b$, 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 $\tilde{\gamma} = 0 \leq 1$.

[43] Put differently, for women to randomize the cutting decision, it must be the case that $p(g_c - c_0) + (1-p)(-c_0) = pg_0 + (1-p)\cdot 0$, so $g_c - g_0 = \tilde{c}_0$. 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 $\gamma = \frac{b+\tilde{c}_0}{2b}$ 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 $g_c - g_0 = \tilde{c}_0$, $g_c - c_0 \geq 0$, and $g_0 \geq 0$. Consequently, men choose $g_c = \tilde{c}_0$ and $g_0 = 0$.

S.2 Parallel-trend assumption

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

$$y_{ijt} = \beta_1 + \sum_h \beta_2^h \cdot W_{ij}^h + \sum_h \beta_3^h \cdot W_{ij}^h \cdot B_j + v_j + u_{ijt}, \tag{S.2.1}$$

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. With [column (b)] or without [column (a)] several individual-level controls, estimation results for cutting rates are reported in Table S.1. The estimated β_3^h are insignificantly different from zero, both individually and jointly (see p-values at the bottom of the table). This exercise provided no evidence undermining the parallel-trend assumption of cutting rates before 1990.

S.3 Further robustness checks

S.3.1 Alternative threshold years and distances to Burkina Faso

By exploiting different birth year thresholds (1985, 1990, or 1995) and distances to the border (10 km to 200 km) in defining D_{ijt} and B_j, the top-left panel in Figure S.3 reports the estimated impacts on an indicator for FGC. 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 closer 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.

S.3.2 Girls' tendency to undergo FGC at younger ages

Similar to the estimation result shown in column (c) in Table 2, Figure S.4 indicates 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 age at FGC being 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 shown in columns (a) and (b) of Table 2.

S.3.3 Country-by-country regressions

In Table S.7, impacts on FGC are shown separately for each country. While the statistical significance is not always strong, as seen from panel (A), the aforementioned negative effects on cutting rate and infibulation are observed in all countries. The relevant statistical significance was more pronounced when exploiting different thresholds of birth years (i.e., 1995) and of distances to the border (i.e., 40 km) in defining D_{ijt} and B_j [panel (B)]. In addition, 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).[44] See also Table S.8 for the corresponding estimation results of marital outcomes.

S.3.4 An alternative treatment indicator by Murdock (1959)'s ethnic homelands

Relying on Murdock (1959)'s classification, this study alternatively exploited as B_j an indicator for communities situated in ethnic homelands stretching over Burkina Faso and its neighboring countries and estimated equation (9) with the same controls exploited before.[45][46] Out of 78 ethnic homelands mapped on the analyzed four countries, 18 ethnic homelands (one located over Benin and Togo, one over Côte d'Ivoire and Mali, one in Benin, six in Côte d'Ivoire, six in Mali, and three in Togo), were identified as crossing the national border to Burkina Faso (see also Figure S.5). With coefficients on controls suppressed, the estimated treatment effects are reported in Table S.9. A significant decline in cutting rates was found in those 18 ethnic homelands, although the impact on the sewn-closed form of FGC is not robust in this specification.

S.3.5 Balance: A sub-sample of geographical proximity

Table S.10 reports the estimation results using a sub-sample limited only to the respondents residing within a 60-km distance to Burkina Faso. Within this sub-sample, the characteristics of the border residents born before 1990 reveal great similarity to those of the corresponding inland residents due to the geographical proximity, as seen from the summary statistics of this sub-sample (see Table S.11). While only a few variables indicate statistically significant differences between the inlands and the borderlands, some of them (e.g., religion, community-level characteristics) are controlled in regressions. As Table S.10 shows, the results again reveal a significant decline in FGC in the borderlands.

[44]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.

[45]A map of Murdock (1959)'s ethnic homelands is available from `https://scholar.harvard.edu/nunn/pages/data-0` due to a contribution made by Nunn (2008).

[46]Fixed effects corresponding to the ethnic homelands were not controlled because the exploited regressors include the community fixed effects.

S.3.6 Non-linear models

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 2, Table 4, and Table 5, is not necessarily small. In the estimated impacts of the incidence of FGC, for example, the proportion is almost one.

Nevertheless, it is still possible to estimate nonlinear 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 that arises from exploiting numerous community-level indicators in the nonlinear 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.[47]

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.12. 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 the 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. 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.

S.3.7 Data pertaining to females aged 15 to M years ($M \leq 49$)

Exploiting different samples, equation (9) is repeatedly estimated, and the estimated α_2 and its 95% confidence intervals are reported in Figure S.6. 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.[48] The "negative FGC impacts" and "no distinct adverse marriage impacts" of the external policy shock are confirmed.

However, three new findings are noteworthy. First, exploiting the elder cohort in the estimated sample resulted

[47] 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 S.8 (see subsection S.6.1 for its explanation), renders the conditional logit model less suitable for the analysis of FGC.

[48] 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.

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 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)[49] 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 S.6.[50]

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.[51] 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. 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 who did not undergo FGC might have ended by marrying young men. That said, statistical significance is absent in the specification including the household fixed effects.

S.3.8 Inference: Multiple-hypothesis testing and alternative levels of clustering

Two issues pertaining to statistical inference are addressed. First, the significant decline in FGC in the borderlands might have been revealed by chance in the present study, which explores numerous outcomes. To address this concern, this study 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), the present study replicates estimates from Table 2, Table 4, and Table 5 and reports 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, as shown in Table S.13.[52] These tests tend to suffer from low statistical power because they do not account for dependency across tests when controlling the familywise error rate. Nevertheless, the negative FGC effect (with statistical significance around

[49]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.

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

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

[52]As early marriage, early sexual intercourse, and early childbirth are highly correlated, the exercises in Table S.13 focused on the impacts on marriage, which is one of the two most important outcomes in the present study (i.e., FGC and marriage).

5% to 10% levels), the increase in the age at first marriage (at around 10%), and fertility reduction (at 1%) were still detected.

Second, in the present study, it may be plausible to cluster standard errors at the level of marriage markets. While it is difficult to discern the relevant market boundaries, the aforementioned 14 outcomes are re-estimated in Table S.14, along with the standard errors clustered at the levels of administrative units [columns (d)—(f)], as described in subsection S.6.1, and of ethnic homelands based on Murdock (1959)'s classification [columns (g)—(i)], as described in subsection S.3.4. The obtained implications remain unchanged.

S.4 Selected relocation and health: Census data

Similar analyses to those performed in Table 6 were also made exploiting the census data. The data drawn from Benin's Population and Habitation Census (PHC) 1979, 1992, 2002, and 2013 as well as Mali's General Census of Population and Housing (GCPH) 1987, 1998, and 2009 made this attempt possible. These data, which refer to 10% of the total population, are available from the "Integrated Public Use Microdata Series (IPUMS), International: Version 7.0" (Minnesota Population Center, 2018).[53] After 16 second-level administrative units (out of all the analyzed 124 units) whose centroids are located within a 30-km distance to the national border to Burkina Faso, for females aged 15 to 25 years old, migration and mortality-related outcomes are examined in columns (a)—(c) in Table S.15. A map of the administrative units is also sourced from the IPUMS project (see Figure S.7).[54] Because the performed analyses did not control several covariates (e.g., ethnicity, religion), which are not available in all the census rounds, these factors might also have affected the estimates. Nevertheless, the results show no significant impacts on the border residents regarding the relocation and health-related outcomes.[55][56]

Women's marriage-related outcomes are also estimated in the remaining columns. The estimation results in columns (d)—(e) show a significant decline in the likelihoods of getting married and giving birth to children by the age of 25 years. Apparently, these results may not support the main findings relying on the DHS data. However, these results may also indicate an increase in ages at first marriage and first birth. Together with a significant decline in fertility and no impacts on education, as found in column (f) and columns (g)—(h), respectively, all these results are still not

[53] See https://international.ipums.org/international-action/sample_details/country/bj#bj1979a, https://international.ipums.org/international-action/sample_details/country/bj#bj1992a, https://international.ipums.org/international-action/sample_details/country/bj#bj2002a, and https://international.ipums.org/international-action/sample_details/country/bj#bj2013a for the details of the PHC 1979, 1992, 2002, and 2013, respectively. See also https://international.ipums.org/international-action/sample_details/country/ml#ml1987a, https://international.ipums.org/international-action/sample_details/country/ml#ml1998a, and ttps://international.ipums.org/international-action/sample_details/country/ml#ml2009a for details of the GCPH 1987, 1998, and 2009, respectively.

[54] See https://international.ipums.org/international/gis.shtml.

[55] The respondents were defined as migrants if their previous residence is a different major administrative unit or abroad.

[56] The IPUMS project provided no census data for Côte d'Ivoire and Togo at the time of the present study (see https://international.ipums.org/international-action/samples).

inconsistent with the main findings of the present study.

S.5 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 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 that has a zero cutting rate (i.e., no-FGC equilibrium). Because 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] 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 achieving the FGC equilibrium according to their definition, this prediction is not supported in the empirical analysis conducted in the present study. 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 because 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.6 Further data overview: FGC as a marriage convention

Mackie (1996) claims that (1) FGC is a social norm, namely one of the group-level multiple equilibria, and (2) FCG is particularly supported by women's motive to coordinate a marital transaction. This section presents several data characteristics from these perspectives.

S.6.1 Is it a social norm?

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, which is called "tipping." Third, as norms are one of the population-level multiple equilibria, they tend to exhibit both "local conformity" and "global diversity." Fourth, normative behaviors depend less on underlying fundamentals than would otherwise be expected and, therefore, reveal less diversity, summarized by the term "compression." As shown in Section 6, the centuries-long practice of FGC has swiftly declined in the borderlands of Burkina Faso's neighboring countries since 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 S.8 (top-left 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 panel, 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 subsection S.6.3 for more detailed interpretation of the interior cutting rates). This tendency is also more pronounced in rural areas, as seen in the two panels demonstrated at the bottom of Figure S.8 that show the corresponding histogram after the DHS communities are separated into rural and urban groups.

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 S.8, as well as the limited role of within-community factors in explaining the variation of FGC, seemingly supports the view that FGC is a social norm.

On the other hand, women's natal communities may play a role in sustaining 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 one that shares a marriage market, which would include both the natal and the destination villages of married women.[59] Therefore, in the top-right panel of Figure S.8, 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'Ivoire, 498 Communes in Mali, and 21 Prefectures in Togo, resulting in approximately four DHS communities included in each administrative unit on average.[60] 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.

S.6.2 Is it a marriage convention?

To gain insight into the question of whether FGC is a social norm particularly supported by men's and women's inter-dependent expectations operating in marriage markets, by country, Table S.16 reports background information on FGC. Of particular interest are both women's [panel(A)] and men's [panel(B)] perceived benefits of this practice. 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 (see Table S.2 for the country-round breakdown).

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.[61] 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'Ivoire compared to other countries.

On the one hand, this finding may suggest that FGC has no contemporary relationship with women's marriage although it might have been a marriage convention in the past. On the other hand, the small fraction could still be

[59] 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.

[60] 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.

[61] 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.

conceived as being consistent with the view that FGC is a marriage convention. Because the marriage matching at the 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.

S.6.3 Interior cutting rates

Several communities with cutting rates between zero and one, as shown in Figure S.8, are worth explaining. At least three reasons could account for the interior cutting rates. First, these cutting rates might pertain to communities that are shifting from an FGC to a no-FGC equilibrium and thus are 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 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 $\frac{b_h+\tilde{c}_0}{2b_h}$ and $\frac{b_l+\tilde{c}_0}{2b_l}$ (i.e., interior equilibria).[62]

The presence of the interior equilibria provides two related implications. First, cutting rates existing (and varying) between zero and one, as shown in Figure S.8, may suggest that a plausible amount of heterogeneity exists in terms of the within-community distribution of the types across communities. Second, refinements that consider heterogeneous preferences within and across communities are needed when organizing an anti-FGC association, as proposed by Mackie (1996). For example, both the FGC and the no-FGC equilibrium (in addition to the interior equilibria) can still arise even when allowing for heterogeneous preferences within a community.[63] 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 $\frac{b+\tilde{c}_0}{2b}$. In the aforementioned example, this threshold value is $\frac{b_l+\tilde{c}_0}{2b_l}$ for the reformists. However, inducing $\frac{b_l-\tilde{c}_0}{2b_l}$ ($= 1 - \frac{b_l+\tilde{c}_0}{2b_l}$) fraction of women to refrain from FGC may not

[62]Whatever the fraction of the respective types, both types of men can choose $g_c = \tilde{c}_0$ 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 $\gamma^* = \gamma_H \in [\frac{b_h+\tilde{c}_0}{2b_h}, \frac{b_l+\tilde{c}_0}{2b_l}]$. Because $\gamma_H b_h - \tilde{c}_0 \geq (1-\gamma_H)b_h$ and $\gamma_H b_l - \tilde{c}_0 \leq (1-\gamma_H)b_l$, 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.

[63]When the circumcised fraction is above $\frac{b_l+\tilde{c}_0}{2b_l}$ (below $\frac{b_h+\tilde{c}_0}{2b_h}$), the FGC equilibrium (no-FGC equilibrium) arises in a self-enforcing manner.

completely eliminate this practice. This is because the conformists still prefer to marry circumcised women provided more than $\frac{b_h+\tilde{c}_0}{2b_h}$ 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.7 Policy considerations

Several analyses conducted in this study 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 the symbolic signaling of group membership often supports normative behaviors. Thus, future research identifying which of these mechanisms maintains FGC and who supports this normative institution would be helpful in optimizing 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.[64] 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 and forming a public association that includes a great number of potential grooms and brides (and their parents) who 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 be carefully 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.

[64]Supply-side interventions include monetary compensation for cutters who stop FGC and/or legal punishment for parents who compelled daughters to get circumcised as well as cutters.

(For the supplemental appendix)

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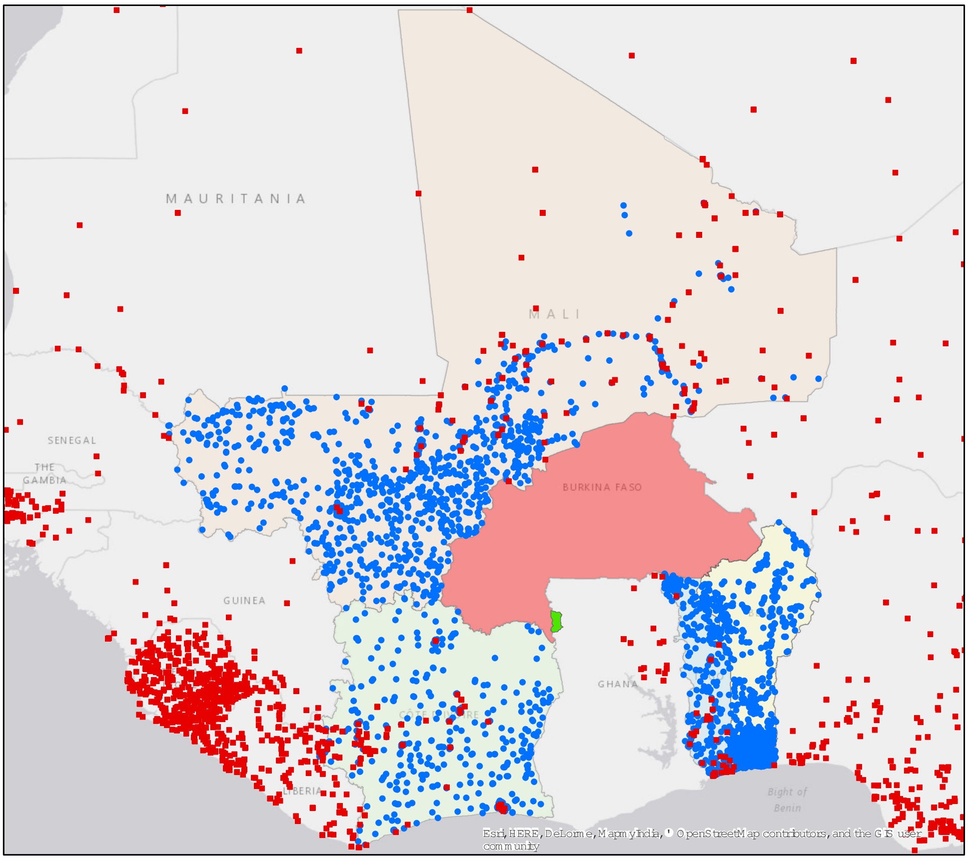

Figure S.1: Position of DHS communities (blue circle), violence incidence (red square), an area of my survey (green polygon), and Burkina Faso (red polygon)

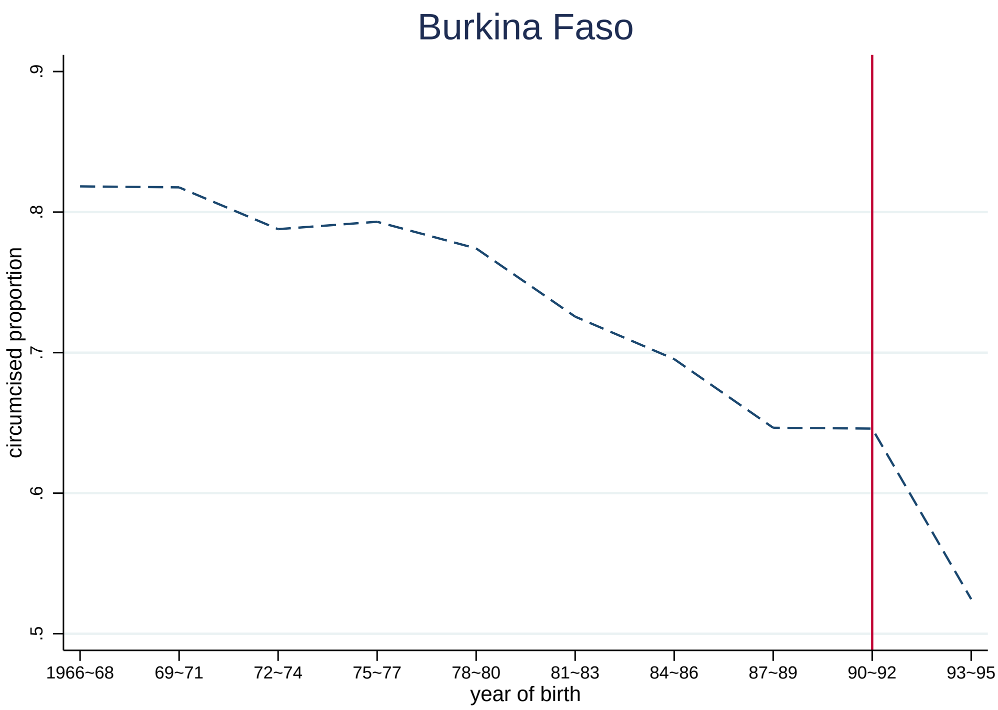

Figure S.2: Proportion of circumcised population by the year of birth: Burkina Faso

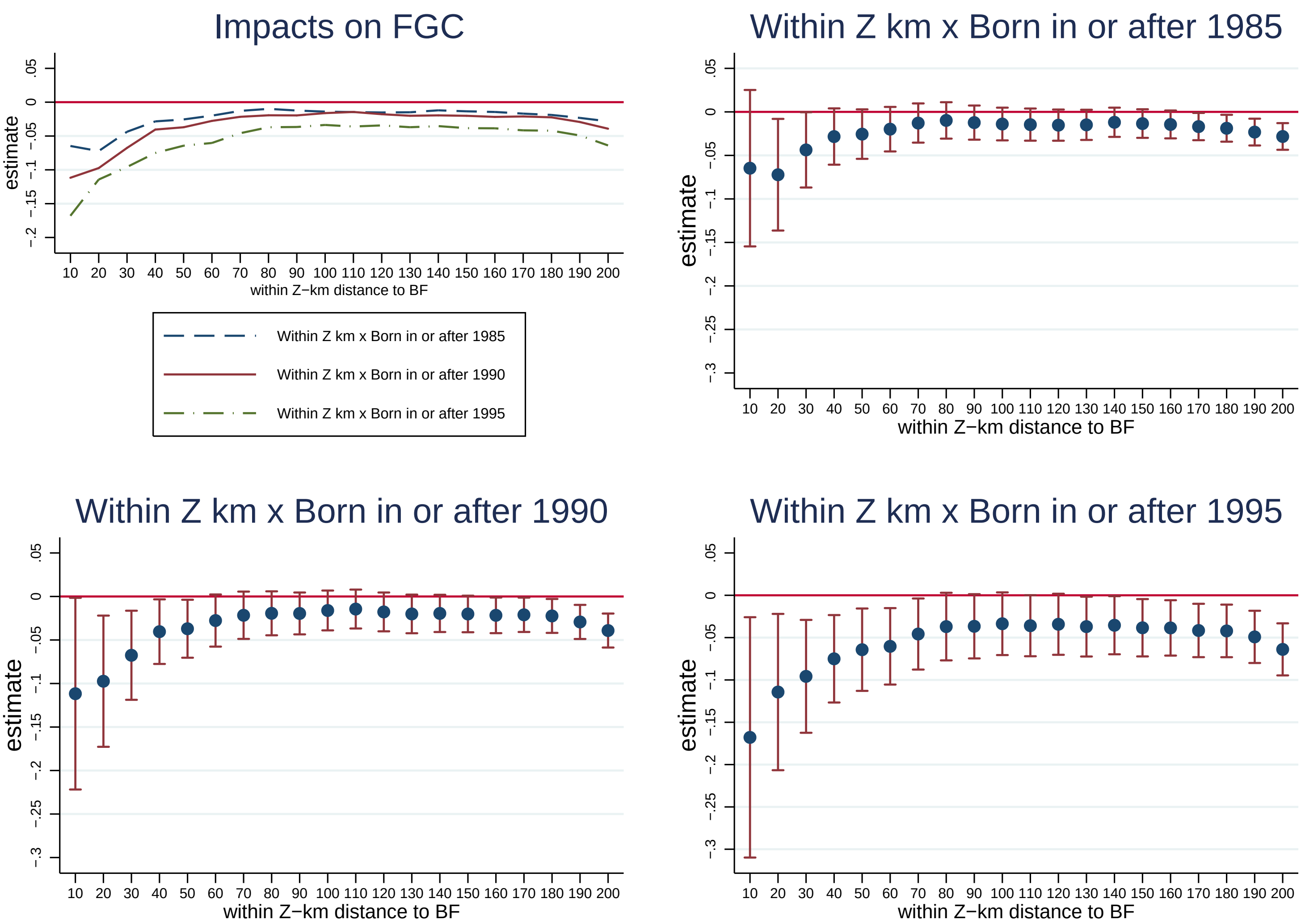

Figure S.3: Impacts on FGC by different threshold years of birth and distances to the border to Burkina Faso

Note: This figure reports the estimated α_2 in equation (9) with 95% confidence intervals by changing the definition of D_{ijt} and B_j.

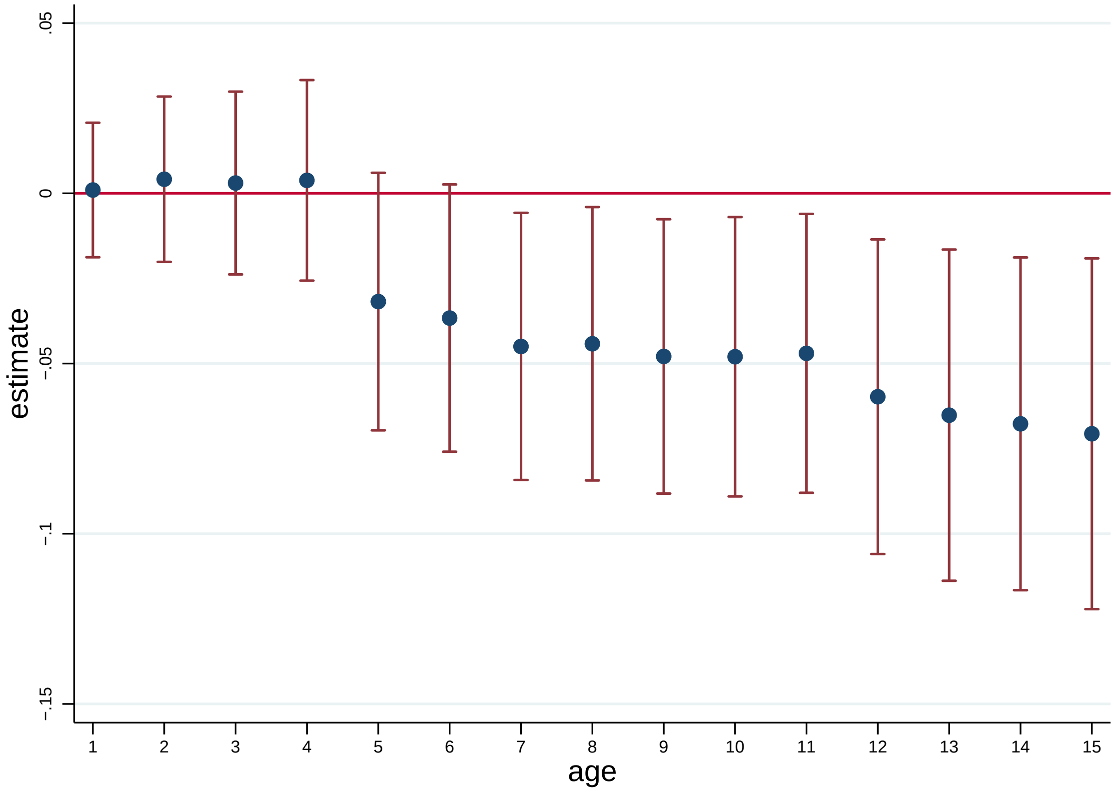

Figure S.4: Impacts on FGC by age X

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.

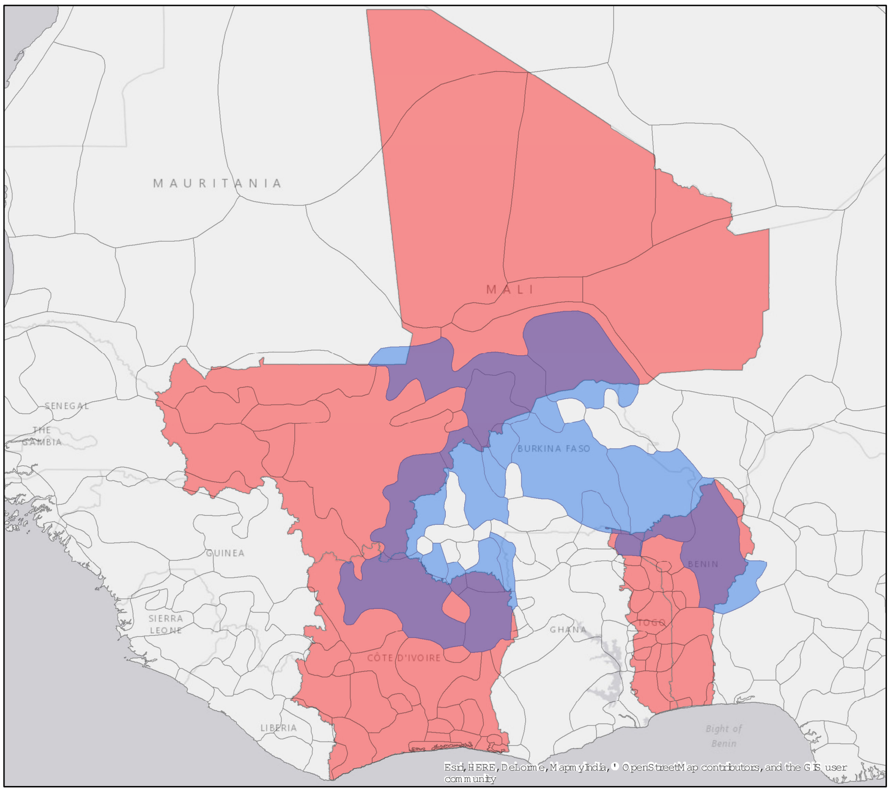

Figure S.5: Ethnic homelands by Murdock (1959)'s classification, analyzed countries (red), and ethnic homelands stretching over Burkina Faso and the analyzed countries (blue)

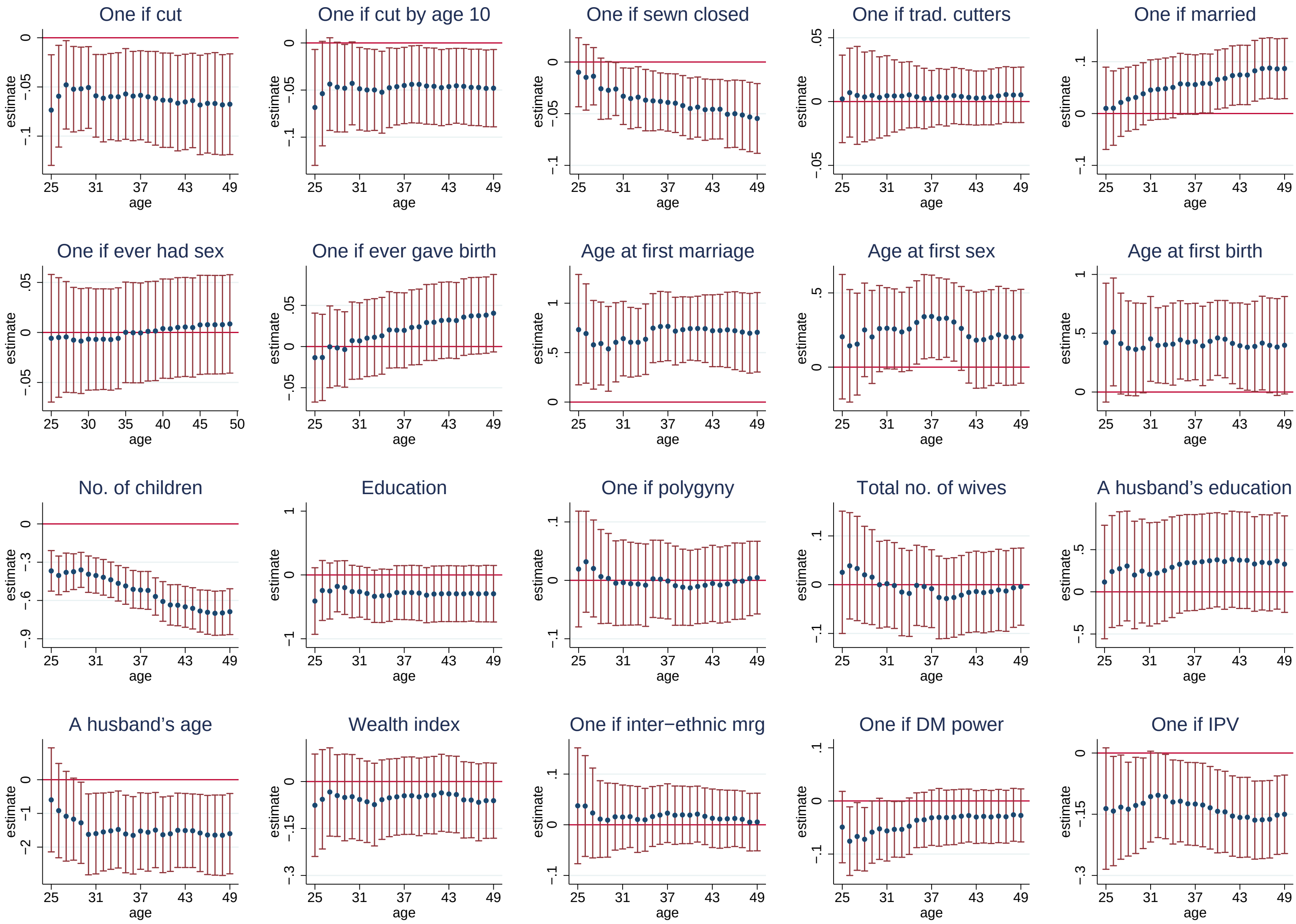

Figure S.6: Impacts on females aged M or below (OLS)

Notes: (1) This figure reports the estimated α_2 in equation (9) 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.

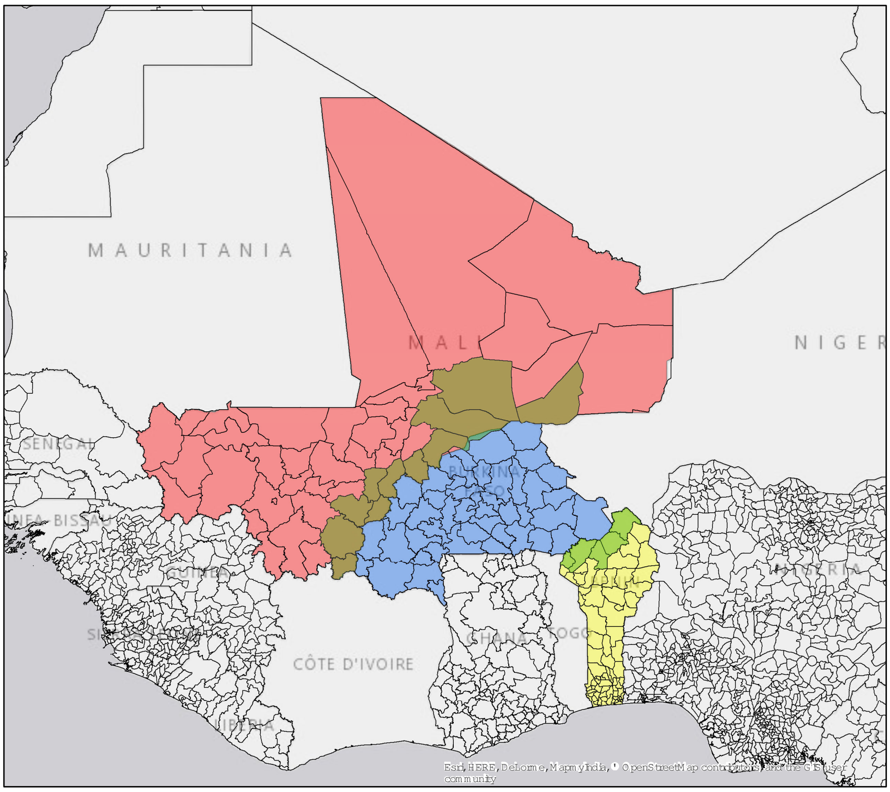

Figure S.7: Districts by the IPUMS's classification, Benin (yellow), Burkina Faso (blue), Mali (red), and Benin's and Mali's districts whose centroids are located within 30 km distance to Burkina Faso (green)

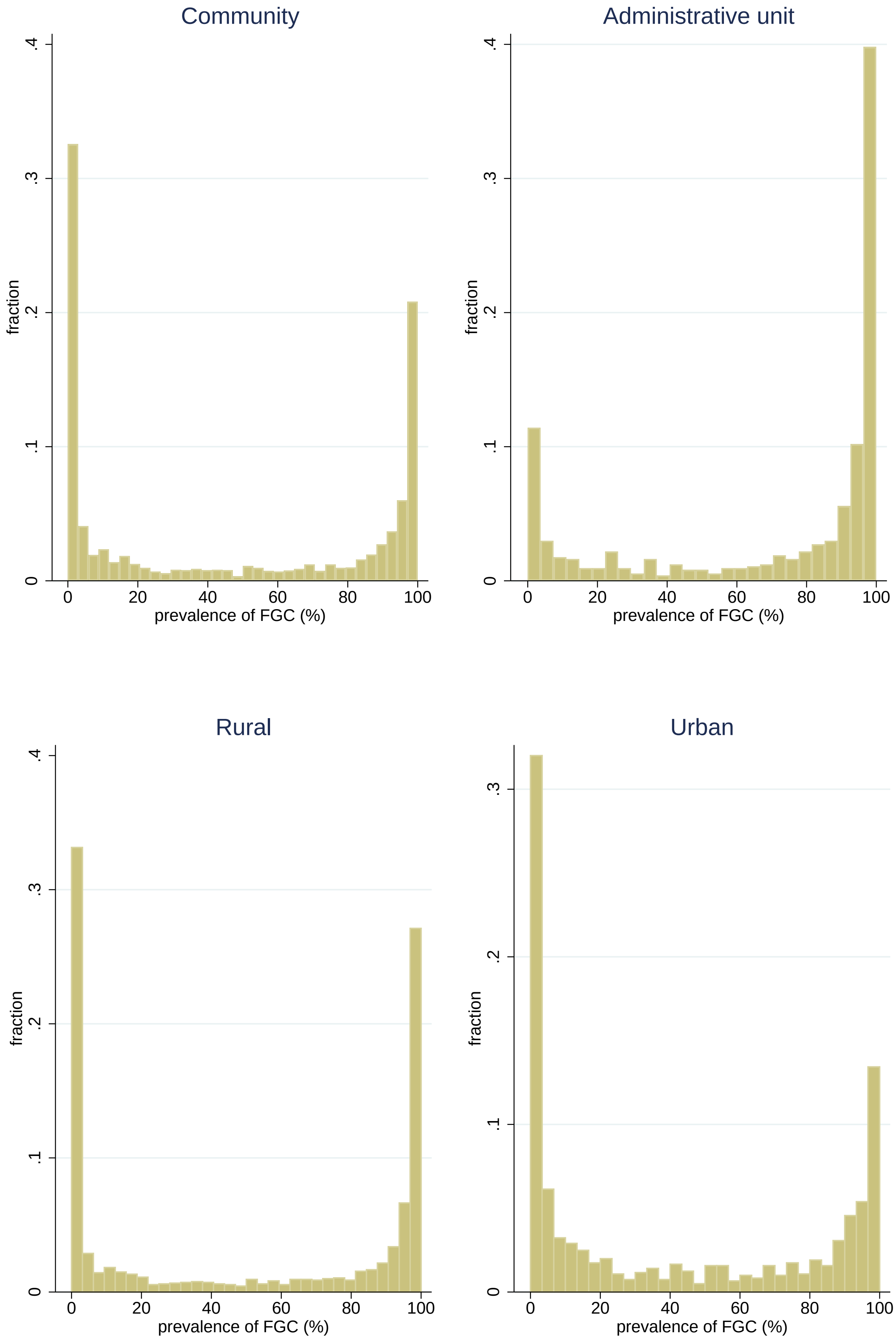

Figure S.8: Distribution of cutting rates across spaces

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

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
One if migrant†	-0.074	(0.057)	0.018	14908
Weight (kg)†	-0.648	(0.652)	0.009	28939
Height (cm)†	-0.031	(0.476)	0.011	28954
Height for age (z-scores)†	0.002	(0.069)	0.005	28746
BMI × 10†	-3.518	(2.314)	0.003	28814
Hemoglobin (g/dl)†	-0.117	(0.152)	0.013	13450
One if had genital sore/ulcer†	-0.012	(0.013)	0.002	32337
One if had genital discharge†	0.021	(0.017)	0.005	32345
One if had terminated pregnancy†	-0.008	(0.014)	0.011	34212
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

Notes: (1) In this table, it was assessed whether temporal changes in the mean values of several variables reported in Table 1 that are relevant to the respondents born before and after 1990 were statistically equal between the border and the inland communities, and the resulting DID estimates are reported. (2) Figures ( ) are standard errors. *** denotes significance at 1%, ** at 5%, and * at 10%. (3) Standard errors are robust to heteroskedasticity and clustered residuals within each community. (4) 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 married females aged 25 or below: Decision making power and intimate partner violence (OLS)

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						
$\times$ 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.5: 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)	(0.467)	(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)	(0.339)	(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)	(0.578)	(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 in columns (1h), (2h), and (3h) (due to computational difficulty), whereas they are robust to heteroskedasticity and clustered residuals within each community in the remaining columns.

Table S.6: 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.7: 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)
(A) 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
(B) Located within a 40-km distance to BF								
× Born in or after 1995	-0.123	-0.108*	-0.136***	-0.027***	-0.248**	-0.300***	0.009	-0.040**
	(0.077)	(0.064)	(0.046)	(0.010)	(0.105)	(0.114)	(0.016)	(0.019)
One if cut	-	-	0.125***	0.890***	-	-	0.080***	0.826***
			(0.016)	(0.012)			(0.010)	(0.015)
R-squared	0.565	0.541	0.246	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)
(A) 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
(B) Located within a 40-km distance to BF								
× Born in or after 1995	-0.068**	-0.070**	-0.019	0.040	-0.080*	-0.053*	-0.074***	0.001
	(0.034)	(0.034)	(0.034)	(0.040)	(0.041)	(0.030)	(0.018)	(0.003)
One if cut	-	-	0.109***	0.850***	-	-	0.200***	0.956***
			(0.009)	(0.009)			(0.035)	(0.010)
R-squared	0.535	0.388	0.299	0.537	0.391	0.311	0.326	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.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 exploited sample and controls correspond to those used in Table 4 and Table 5.

Table S.9: Treatment effects of "Border ethnic homelands by Murdock (1959) × Born in or after 1990" (OLS)

Dependent variables:	Coefficient	Standard errors	R-sqd.	No. of obs.
(A) Impacts on FGC				
One if cut	-0.071***	(0.013)	0.762	71921
One if cut by age 10	-0.064***	(0.012)	0.699	71921
One if sewn closed (zero if not cut)†	0.000	(0.007)	0.307	64188
One if traditional cutters (zero if not cut)†	0.002	(0.008)	0.819	71627
(B) Marriage effects on females aged 25 or below				
One if married	-0.021	(0.019)	0.492	35645
One if ever had sex	-0.010	(0.017)	0.412	35332
One if ever gave birth	-0.024	(0.016)	0.467	35645
Age at first marriage	0.418***	(0.157)	0.351	20706
Age at first sex	0.166	(0.117)	0.294	27305
Age at first birth	0.418***	(0.152)	0.334	18651
No. of children	-0.259***	(0.048)	0.528	35645
Education (years)	-0.023	(0.160)	0.448	35609
(C) Marriage effects on married females aged 25 or below				
One if polygyny	-0.006	(0.029)	0.242	19886
Total no. of a husband's wives	0.004	(0.036)	0.256	19669
A husband's education (years)	-0.088	(0.195)	0.468	18530
A husband's age (years)	-0.462	(0.483)	0.298	19072
Wealth index (1 to 5)	0.027	(0.049)	0.734	14038
One if inter-ethnic marriage	0.082*	(0.048)	0.603	5304
One if have DM power	0.010	(0.022)	0.274	19297
One if had any IPV	-0.063	(0.042)	0.343	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) An indicator for circumcised women is included in regressors for †. (4) The regressors include all controls exploited in Table 2 [panel (A)], Table 4 [panel (B)], and Table 5 [panel (C)].

Table S.10: Treatment effects: A sub-sample of the respondents residing within a 60-km distance to Burkina Faso (OLS)

Dependent variables:	Coefficient	Standard errors	R-sqd.	No. of obs.
(A) Impacts on FGC				
One if cut	-0.070**	(0.029)	0.678	7242
One if cut by age 10	-0.042*	(0.025)	0.597	7242
One if sewn closed (zero if not cut)†	-0.029	(0.019)	0.331	6268
One if traditional cutters (zero if not cut)†	0.014	(0.016)	0.834	7204
(B) Marriage effects on females aged 25 or below				
One if married	0.038	(0.050)	0.523	3287
One if ever had sex	0.022	(0.040)	0.453	3263
One if ever gave birth	0.006	(0.038)	0.533	3287
Age at first marriage	0.653*	(0.361)	0.254	2210
Age at first sex	0.029	(0.283)	0.253	2512
Age at first birth	0.147	(0.354)	0.314	1938
No. of children	-0.131	(0.115)	0.580	3287
Education (years)	-0.581*	(0.345)	0.449	3279
(C) Marriage effects on married females aged 25 or below				
One if polygyny	0.074	(0.068)	0.237	2157
Total no. of a husband's wives	0.086	(0.082)	0.261	2132
A husband's education (years)	0.081	(0.395)	0.434	2100
A husband's age (years)	-0.739	(1.150)	0.289	2127
Wealth index (1 to 5)	-0.158	(0.113)	0.653	1592
One if inter-ethnic marriage	-0.080	(0.078)	0.728	659
One if have DM power	-0.071*	(0.042)	0.248	2141
One if had any IPV	-0.143	(0.111)	0.401	860

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 †. (4) The regressors include all controls exploited in Table 2 [panel (A)], Table 4 [panel (B)], and Table 5 [panel (C)].

Table S.11: Summary statistics: Respondents born before 1990 and residing within a 60-km distance to Burkina Faso

	Distance to BF					
	≤ 30 km			> 30 km & ≤ 60 km		
	Mean	Std.	No. of obs.	Mean	Std.	No. of obs.
One if cut	0.71	0.45	2818	0.70	0.45	3265
One if sewn closed (zero if not cut)	0.06	0.25	2400	0.06	0.24	2858
One if cut by traditional cutters (zero if not cut)	0.66	0.47	2802	0.65	0.47	3244
Age at FGC if cut	6.85**	3.91	966	7.27	3.95	1075
One if married†	0.81	0.38	847	0.80	0.39	1063
One if ever had sex†	0.87	0.32	844	0.88	0.31	1050
One if gave birth†	0.75	0.43	847	0.73	0.43	1063
Age at first marriage†	16.05	2.53	707	16.24	2.81	881
Age at first sex†	15.80	2.24	741	15.76	2.37	931
Age at first birth†	17.16*	2.52	636	17.40	2.66	786
No. of children†	1.82	1.53	847	1.74	1.50	1063
Education (years)†	1.05***	2.59	845	1.46	3.05	1061
One if polygyny‡	0.36	0.48	693	0.34	0.47	861
No. of a husband's wives‡	1.43	0.64	686	1.42	0.65	852
A husband's education (years)‡	1.20	2.97	668	1.44	3.46	835
A husband's age‡	31.96	7.99	680	32.19	7.82	846
Family wealth index (1 to 5)‡	2.31**	1.20	442	2.51	1.38	536
One if inter-ethnic marriage‡	0.26	0.44	208	0.20	0.40	245
One if have DM power‡	0.21*	0.41	685	0.17	0.38	854
One if had any IPV‡	0.28	0.45	287	0.23	0.42	311
One if migrant†	0.50	0.50	627	0.49	0.50	814
Weight (kg)†	54.25	7.32	756	53.99	7.89	962
Height (cm)†	159.74	6.74	753	159.28	6.63	961
Height for age (z-scores)†	-0.60	1.01	751	-0.68	1.01	958
BMI × 10†	212.52	27.51	753	212.67	27.92	961
Hemoglobin (g/dl)†	11.46	1.68	304	11.45	1.68	395
One if had genital sore/ulcer†	0.07	0.25	814	0.08	0.27	980
One if had genital discharge†	0.13	0.34	817	0.12	0.33	983
One if had terminated pregnancy†	0.09	0.28	834	0.07	0.26	1044
Birth order	3.34	2.10	3006	3.35	2.05	3476
One if Muslim	0.55***	0.49	3004	0.67	0.46	3470
One if Christian	0.19***	0.39	3004	0.16	0.37	3470
Urban (dummy)	0.11***	0.32	3006	0.20	0.40	3476
No. of battles (÷ 10)	0.09***	0.28	3006	0.05	0.16	3476

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 S.12: 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	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 †. (4) The regressors include all controls exploited in Table 2 [panel (A)], Table 4 [panel (B)], and Table 5 [panel (C)].

Table S.13: Robustness checks on multiple-hypothesis testing (OLS)

	Coefficient	Original	Adjusted p-values			R-sqd	No. of
		p-values	Bonferroni	Holm (1979)	Hochberg (1988)		obs.
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 2 [panel (A)], Table 4 [panel (B)], and Table 5 [panel (C)]. (2) An indicator for circumcised women is included in regressors for †. (3) The regressors include all controls exploited in Table 2 [panel (A)], Table 4 [panel (B)], and Table 5 [panel (C)].

Table S.14: Robustness checks on standard errors clustered at different levels (OLS)

Levels of clustering	DHS communities			Administrative units			Ethnic homelands by Murdock (1959)		
	Coefficient	p-values	No. of obs.	Coefficient	p-values	No. of obs.	Coefficient	p-values	No. of obs.
Dependent variables:	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
(A) Impacts on FGC									
One if cut	-0.068***	(0.010)	71921	-0.068**	(0.018)	71828	-0.068*	(0.091)	71596
One if sewn closed (zero if not cut)†	-0.055***	(0.002)	64188	-0.054**	(0.026)	64108	-0.055**	(0.043)	63896
One if traditional cutters (zero if not cut)†	0.005	(0.634)	71627	0.005	(0.683)	71535	0.005	(0.641)	71302
(B) Marriage effects on females aged 25 or below									
One if married	0.010	(0.804)	35645	0.011	(0.771)	35609	0.010	(0.817)	35477
Age at first marriage	0.733**	(0.010)	20706	0.772***	(0.002)	20680	0.728**	(0.018)	20643
No. of children	-0.368***	(0.000)	35645	-0.371***	(0.000)	35609	-0.367***	(0.000)	35477
Education (years)	-0.409	(0.125)	35609	-0.336	(0.173)	35573	-0.415	(0.112)	35441
(C) Marriage effects on married females aged 25 or below									
One if polygyny	0.019	(0.702)	19886	0.024	(0.565)	19860	0.020	(0.742)	19827
A husband's education (years)	0.116	(0.735)	18530	0.166	(0.640)	18509	0.114	(0.749)	18487
A husband's age (years)	-0.598	(0.448)	19072	-0.777	(0.212)	19050	-0.597	(0.435)	19028
Wealth index (1 to 5)	-0.076	(0.363)	14038	-0.086	(0.262)	14017	-0.075	(0.327)	13994
One if inter-ethnic marriage	0.037	(0.520)	5304	0.037	(0.530)	5301	0.041	(0.318)	5289
One if have DM power	-0.049	(0.151)	19297	-0.041	(0.279)	19275	-0.049	(0.140)	19253
One if had any IPV	-0.136*	(0.073)	7117	-0.143**	(0.015)	7105	-0.136***	(0.006)	7082

Notes: (1) *** denotes significance at 1%, ** at 5%, and * at 10%. (2) An indicator for circumcised women is included in regressors for †. (3) The regressors include all controls exploited in Table 2 [panel (A)], Table 4 [panel (B)], and Table 5 [panel (C)].

Table S.15: Selected relocation and health: Females aged 15 to 25 or below, Benin's and Mali's Census (OLS)

	One if migrant	One if any death in HH in the last year	No. of deaths in HH in the last year	One if married	One if ever gave birth	No. of children ever born	One if complete primary education	One if complete secondary education
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
Administrative units located within a 30-km distance to BF								
× Born in or after 1990	-0.028	-0.003	-0.002	-0.066***	-0.061***	-0.159***	-0.006	-0.006
	(0.020)	(0.003)	(0.003)	(0.021)	(0.012)	(0.055)	(0.023)	(0.006)
Mean y for those born before 1990	0.143	0.049	0.056	0.643	0.572	1.376	0.149	0.018
R-squared	0.160	0.011	0.010	0.300	0.299	0.300	0.200	0.068
No. of obs.	609040	594869	595725	617611	571978	571978	617351	617351
Year-of-birth FE	YES	YES	YES	YES	YES	YES	YES	YES
Administrative-unit FE	YES	YES	YES	YES	YES	YES	YES	YES
Year-of-census FE	YES	YES	YES	YES	YES	YES	YES	YES
Sample Census								
Benin 1979	YES	NO	NO	YES	NO	NO	YES	YES
Benin 1992	YES	YES	YES	YES	YES	YES	YES	YES
Benin 2002	YES	YES	YES	YES	YES	YES	YES	YES
Benin 2013	YES	YES	YES	YES	YES	YES	YES	YES
Mali 1987	YES	YES	YES	YES	YES	YES	YES	YES
Mali 1998	YES	YES	YES	YES	YES	YES	YES	YES
Mali 2009	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 administrative unit.

Table S.16: 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 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 (1 or 0)†	0.09	0.28	2346	0.37	0.48	5119
Benefits of FGC if cut (1 or 0)						
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 (1 or 0)†	0.04	0.21	2422	0.16	0.37	4733
Benefits of FGC if FGC prevalence > 0 (1 or 0)						
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 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 (1 or 0)†	0.83	0.37	31362	0.08	0.28	592
Benefits of FGC if cut (1 or 0)						
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 (1 or 0)†	0.75	0.42	10816	0.02	0.14	1700
Benefits of FGC if FGC prevalence > 0 (1 or 0)						
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 ‡.