Persistent Norms and Tipping Points: Female Genital Cutting in Burkina Faso*

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Abstract

Female genital cutting (FGC) is prevalent across many parts of Africa, the Middle East, and Asia. This practice can have profound negative effects on women's physical and psychological well-being. Even with these negative effects, FGC is often perpetuated for generations because the cost of deviating from the social norm can be high. The prevailing theory in the study of FGC is that it is a social coordination norm—that is, households will abandon FGC if and only if a sufficient proportion of households within the community agree to abandon the practice. Under this theory, if a sufficient number of community members agree to abandon the practice, a tipping point is reached and the rate of FGC should fall to zero. Recent empirical evidence rejects that theory. I draw on Schelling's 1978 model of critical mass to contribute to this important debate and generate a new data-supported theory that has important implications for the types of policies that should be introduced. Using a dataset of more than 7,500 women born between 1949 and 1995 in Burkina Faso, I show that households within a community have heterogeneous preferences for FGC such that each household contained therein may require a different proportion of community members to abandon FGC before they decide to also reject the practice. I show that the presence of this heterogeneity makes the existence of a tipping point uncertain and that stable interior equilibria in FGC rates are possible. My findings suggest that individuals and households are in fact able to deviate from an entrenched, gender-biased social norm and that policies aimed at reducing the prevalence of FGC should target changing individual and household, rather than village-level, preferences.

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1 Introduction

Each year more than three million girls are subjected to the practice of female genital cutting (WHO, 2012). Female genital cutting[1]—a practice wherein a woman's genitalia are partially or totally removed for nonmedical reasons—has no documented health benefits, and this procedure can have profound negative health effects on the women subjected to the practice. Women who have undergone FGC are more than twice as likely to experience birthing complications (Jones et al., 1999) and 25 percent more likely to contract sexually transmitted diseases (Wagner 2014). They are also more likely to experience anxiety, depression, and marital conflict (Dorkenoo, 1999). These complications can create barriers to women working effectively both inside and outside of the household, which can contribute to economic underdevelopment in communities that practice FGC. Yet the practice persists because of beliefs that FGC will discourage infidelity among women subjected to the practice (Shell-Duncan and Hernlund, 2001), as well as beliefs that women who have undergone FGC attain higher standards of beauty, cleanliness, and femininity (Toubia and Sharief, 2003).

In this paper I propose a new theory of why female genital cutting persists as a norm when there are no medical benefits and there are many potential physical and psychological costs, and I test this theory using observational data from Burkina Faso's Demographic and Health Survey. Additionally, I investigate whether there is a tipping point in the proportion of community members abandoning FGC, and I investigate how educated and uneducated parents interact with the norm differently.

Gender-biased harmful practices, including FGC, child marriage, and sex-selective abortion, have become a significant topic of public and political discourse. Many gender-biased

[1]Female genital cutting (FGC) is also referred to as "female circumcision" and "female genital mutilation." Throughout this paper I use the terminology FGC because it makes larger a distinction between FGC and male circumcision than does the term female circumcision, and it is more value-neutral than the term "mutilation." Throughout this manuscript I use the terminology FGC, "cut," and "cutting" interchangeably.

harmful practices are a result of entrenched social norms that, once in place, are very difficult to alter without external stimuli such as public policy interventions. Whether those external stimuli can change individual behavior or they must be targeted toward changing community-wide beliefs and behavior is the subject of an important debate. If FGC is a social coordination norm—that is, communities will abandon FGC if and only if a sufficient proportion of households within the community agree to abandon the practice—as posited by Mackie (1996), deviating from the social norm is so costly that individuals will not do so on their own. Many development organizations and governments that are working to reduce the prevalence of FGC design interventions with the belief that FGC is a social coordination norm. Agencies and governments that operate under this assumption advocate for public declarations by community members that they will abandon FGC if a sufficient number of community members also agree to abandon the practice.

Recent empirical findings show that FGC is not a social coordination problem in Sudan (Efferson et al., 2015) and that individual-level and household-level factors contribute to a larger share of the practice's persistence than community-level factors in West Africa (Bellemare, Novak, & Steinmetz, 2015). This suggest that development agencies could broaden the set of policy interventions in order to address the support for and the perpetuation of FGC. Specifically, agencies could design policies aimed to change individual- or household-level preferences.

With this paper, I make three contributions to the literature. First, the recent empirical findings that FGC is not a social coordination norm suggest the need for a new theory for why FGC persists as a practice in many communities. I draw on Schelling's 1978 model of critical mass to posit a new theory that highlights preference heterogeneity, and I test that theory with observational data. My findings suggest that while households may wait to abandon FGC until a certain proportion of community members have already abandoned the practice, each household may require a *different* proportion of community members to abandon FGC before they decide to also abandon the practice. This heterogeneity has important insights into why FGC persists because in a community with heterogeneous preferences there may not be a tipping point in the rate of FGC, and there may in fact be stable internal equilibria.

Second, I explore whether there is a tipping point in the proportion of community members abandoning FGC, beyond which the prevalence of the practice should shrink to zero. I show that such a tipping point exists in many communities in Burkina Faso, and that this tipping point has likely been reached, though other societies may not have such a tipping point.

Third, I show that educated parents are willing to deviate from the norm when a higher proportion of community members are practicing FGC than are uneducated parents. This suggests that certain members of the community may be more willing than others to deviate from the norm when faced with similar community norms. These findings provide suggestive evidence of a way forward for agencies aiming to design interventions that can alter individual- and household- level preferences.

The strength of my approach comes from the long timeframe I am able to analyze using three cross-sectional datasets from 1998, 2003, and 2010 from Burkina Faso that include women born between 1949 and 1995. The use of this 61 year timeframe is important when considering an intergenerational problem and long-term dynamics in FGC.

The remainder of this paper is organized as follows. In Section 2 of this paper, I provide background information on FGC. Section 3 provides a conceptual framework for this analysis. Section 4 introduces the data and descriptive statistics, Section 5 discusses the empirical framework and estimation strategy, and Section 6 present the results of the analysis. In Section 7 I interpret the results and conclude.

2 Background

The practice of FGC is concentrated in 29 countries across parts of Africa, Asia, and the Middle East (UNICEF 2013), as well as among diasporas from those parts of the world. The World Health Organization classifies FGC into four types. Clitoridectomy (Type I) includes any partial or total removal of the clitoris, excision (Type II) includes partial or total removal of the clitoris and the labia minora, and infibulation (Type III) consists of narrowing the vaginal opening by sewing or stitching the labia together. Type IV includes all other procedures including pricking, piercing, incising, scraping or cauterizing the female genitals for non-medical reasons.

In Burkina Faso, the vast majority of girls who undergo FGC, experience either a clitoridectomy or excision. In my data, less than four percent of girls who undergo FGC experience infibulation.[2] The majority of procedures occur at very young ages in Burkina Faso. In my data, more than 94 percent of girls who undergo the procedure are cut before the age of 11, and approximately 42 percent of procedures occur during infancy.

The cultural norms surrounding FGC vary widely. Most scholars agree that the practice originated as a way to reduce premarital and extramarital sex and thus ensure the paternity of children (Mackie, 1996; Boyle, 2005; Dorkenoo, 1999). Though FGC arose and may persist, in part, in response to male preferences, today women are primarily responsible for the perpetuation of the practice (Mackie, 1996; Toubia & Sharief, 2003). Undergoing FGC is seen as a rite of passage, or a way to join the society of women in the community (Toubia & Sharief, 2003). Some societies view the clitoris as a masculine part of a woman's body that must be removed in order for the girl to be fully female (Gruenbaum, 2000; Shell-Duncan and Hernlund, 2001). Other societies believe that girls who have not undergone FGC are

[2]This is in line with Jones, et.al. (1999), who show, using gynecological exams, that five percent of women in their Burkina Faso sample had undergone infibulation.

"unclean" and these girls are not allowed to wash dishes or touch certain items (Molloy, 2013).

Burkina Faso is well suited to studying the how and why the norm of FGC persists or wanes. The rate of FGC in Burkina Faso, while still high, fell substantially during the 60 year period for which I have data. This heterogeneity in rates of FGC by year of birth allows me to explore how household decisions change when faced with different rates of FGC. Further, it is possible to speculate regarding the trends in countries where the rate of FGC remains high. Guinea, Mali, and Sierre Leone are three countries in such a situation. Rates of FGC are approximately 96 percent, 89 percent, and 88 percent, respectively (UNICEF, 2013).

3 Theoretical Model

In order to analyze a household's decision of whether their daughter should undergo FGC, I present an adapted version of the social coordination norm model proposed by Mackie (1996) and add to it the threshold model of collective behavior proposed by Granovetter's (1978) threshold model of collective behavior, as well as Schelling's (1978) model of critical mass.

3.1 Social Coordination Norm

Consider a household's decision of whether their daughter will undergo FGC. Assume that the household knows the extent to which community members practice FGC. Let $r \in [0, 1]$ represent the rate of FGC at the community level.

I first normalize to zero the payoff accruing to a household that does not cut their daughter in a community in which the cutting rate equals zero ($r = 0$). Let $s_{0i}(r) \geq 0$ represent the social cost that household i derives if they do not cut their daughter. This social cost depends on r. Let $s_{1i}(r) \geq 0$ be the social costs that household i derives from cutting their daughter. These social costs include reduced marriage prospects of the girl (Wagner, 2014) and reduced acceptance into the community (Molloy, 2013). Additionally, $s_{0i}(r)$ may include perceived disregard for religious edicts (Cloward, 2016) and inferior perceived beauty and femininity (Shell-Duncan & Hernlund, 2000). Finally, let $c_i \geq 0$ be the perceived monetary, psychological, and physical costs associated with cutting their daughter.

Before generalizing over the full interval, let us first consider a dichotomous case in which all members of the community practice FGC or all members abstain. Table 1 displays the payoff the household accrues depending on (i) whether their community practices FGC and (ii) the action they choose, i.e., whether their daughter will undergo FGC. Recall the normalization of the payoffs such that $s_{0i}(0) = 0$. Let $s_{0i}(1) = \hat{s}_{1i}$, let $s_{1i}(0) = \hat{s}_{1i}$, and assume that $s_{1i}(1) = 0$.

Table 1: Payoff Accruing to the Household

	Proportion of Households Practicing FGC	
	0	1
Girl Does Not Undergo FGC	0	$-\hat{s}_{0i}$
Girl Undergoes FGC	$-\hat{s}_{1i} - c_i$	$-c_i$

Most households receive a higher payoff if they adhere to local norms. That is, in most cases, a household in a community in which all members practice FGC will achieve a higher payoff if the daughter undergoes FGC, i.e., $-c_i > -\hat{s}_{0i}$. Conversely, a household in a community in which no members practice FGC will achieve a higher payoff if the daughter does not undergo FGC, i.e., $0 > -(\hat{s}_{1i} + c_i)$.

Next, consider rates of FGC within a community that are between 0 and 1. The payoff accruing to a household if their daughter undergoes FGC is dependent upon the proportion of households in the community that practice FGC. I assume that the payoff accruing to a household that abstains from FGC is decreasing in the proportion of community members that practice FGC, that is $\frac{\partial s_{0i}(r)}{\partial r} < 0$. Conversely, the payoff accruing to a household that practices FGC is increasing in the proportion of community members that practice FGC, that is $\frac{\partial s_{1i}(r)}{\partial r} > 0$. Further, I assume that there is no benefit to a household for going against the norm or "sticking out."

Assumption 1. $\frac{\partial s_{0i}(r)}{\partial r} < 0$, *i.e. the payoff accruing to a household that abstains from practicing FGC is monotonically decreasing in the proportion of community members that practices FGC.*

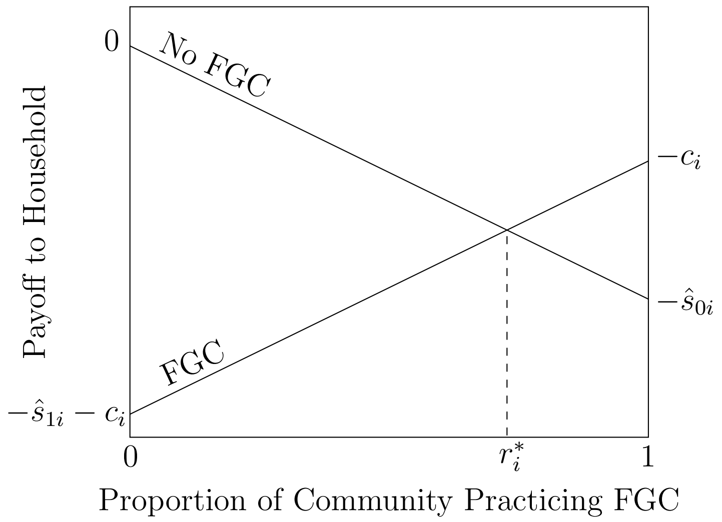
Assumption 2. $\frac{\partial s_{1i}(r)}{\partial r} > 0$, *i.e. the payoff accruing to a household that practices FGC is monotonically increasing in the proportion of community members that practices FGC.*

It is not necessary to assume a functional form for the payoff functions. It is, however, important to consider the number of times the payoff functions for the two strategies could cross. Assumptions 1 and 2 allow us to conclude that the payoff functions can cross at most once in the space of FGC rates.

Proposition 1. *Under assumptions 1 and 2, the potential payoffs accruing to households under each strategy cross once, at most, in the space of community FGC rates.*

Figure 1 displays the potential payoff accruing to a household if it practices FGC or abstains from FGC, dependent on the proportion of community members practicing FGC. For ease of exposition, but without loss of generality, I use a payoff structure that is a linear function of the rate of FGC in the community. Figure 1 shows that when the proportion of community members practicing FGC is above r_i^*, the household derives a higher payoff from practicing FGC than from abstaining. This situation flips if the proportion of practicing households is below r_i^*.

Figure 1: Household $i's$ Payoff Structure



Assumption 3. *If $r < r_i^*$, household i will abstain from FGC for its daughter.*

Assumption 4. *If $r > r_i^*$, household i will choose to have its daughter undergo FGC.*

3.2 The Threshold Model of Collective Behavior

Mackie (1996) assumes homogeneous community members such that each individual is facing the same costs and benefits. This implies that $r_i^* = r^* \ \forall \ i \in \mathcal{H}$, where $\mathcal{H}$ is the set of households in the community. According to this model, if a community can gather $1 - r^*$ community members to declare that they will abandon FGC, all community members will abandon FGC. That is, $1 - r^*$ is the *tipping point* in this community. This is the crux of the policies that arrange public declarations for the abandonment of FGC. Bellemare, Novak, & Steinmetz (2015) and Efferson et al. (2015) show that heterogeneous cutting rates—between zero and 1—exist across communities. These findings are inconsistent with the implications of Mackie's theory.

I suggest that Granovetter's (1978) and Schelling's (1978) models of collective behavior explains the heterogeneous cutting rates that are observed across communities. If each individual values the benefits and costs to cutting differently, there are as many variations to Figure 1 as there are community members. This implies that each individual will require a different proportion of community members to abandon FGC before deciding to switch from practicing to abandoning FGC. In Granovetter's (1978) model, each individual's costs and benefits of participating in an event (he models the decision to participate in a riot) or a practice can be represented in a single value which is the individual's threshold. This threshold is the proportion of community members that must abandon FGC in order for the individual to abandon the practice. In Figure 1, r_i^* is this household's *threshold*.

Hypothesis 1. *Households have heterogeneous thresholds* r_i^*.

3.3 Tipping Point

A key insight from Efferson et al. (2015) is that if thresholds are heterogeneous within a community, a tipping point as proposed in Mackie (1996) may not exist. Schelling (1978, pg 105) makes the point that in the face of heterogeneous thresholds (what he refers to as "cross-over points"), multiple stable equilibria may exists, some of which are interior solutions. Drawing on Schelling's 1978 model of critical mass, I investigate whether there is a tipping point for the practice of FGC in communities in Burkina Faso. To do this, I analyze the cummulative distribution function (CDF) of community member thresholds.

Continue to assume that a household observes the rate of FGC in the community before making the decision for their daughter. Let $f(r^*)$ be the probability density function (PDF) and $F(r^*)$ be the CDF of the thresholds of the community members. Then, $F(r_i^*) = \int_0^{r_i^*} f(r)dr$ represents the proportion of community members with a threshold that is lower than or equal to household i's threshold.

If all households have the same threshold, the PDF of community thresholds would be a horizontal line at the level r^*, and the CDF of the proportion of households favoring FGC would resemble Curve 1 in Figure 2. In this curve, no household favors FGC if the rate of FGC is below r^*, and all households favor FGC for their daughter if the rate is above r^*. Alternatively, if thresholds are heterogeneous, the CDF of the proportion of households favoring FGC could resemble Curve 2 (or a myriad of other curves). In this particular rendering of a CDF in a community with heterogeneous thresholds, a small proportion of community members will practice FGC even if they believe that no one else will. The proportion of community members favoring FGC is higher if the proportion of community members practicing FGC is larger. In this fictitious community there are some members who will abstain from practicing FGC even if they expect that everyone else in the community will practice FGC.

Figure 2

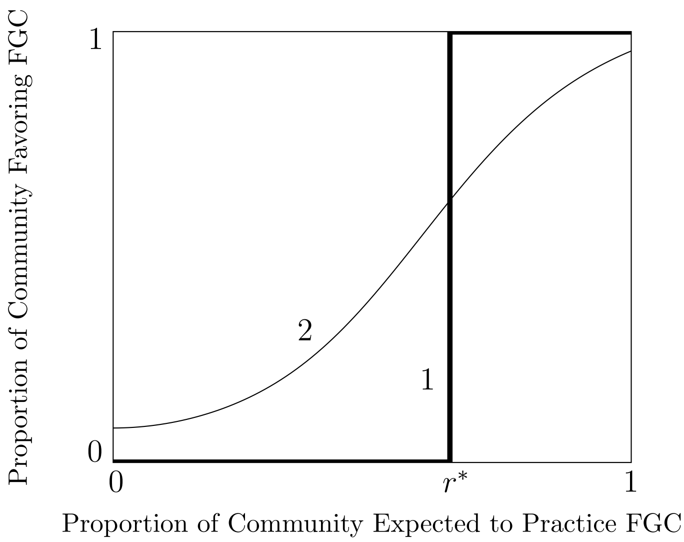
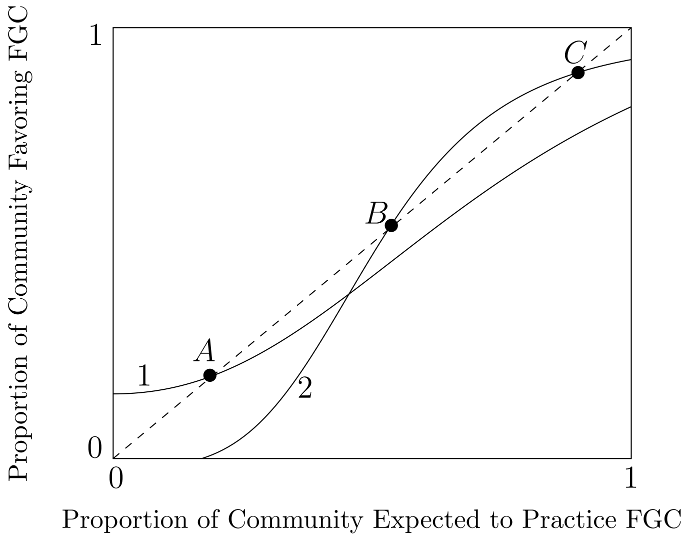


Figure 3 shows hypothetical CDFs of the proportion of community members favoring FGC as a function of the proportion of community members that are expected to practice

FGC. The dashed line is the 45-degree line.

Figure 3



Any point at which the CDF crosses the 45-degree line, or $F(r^*) = r^*$, is an equilibrium—either stable or unstable. Curve 1 of Figure 3 shows a community in which a small portion of community members value FGC sufficiently that they will practice FGC even if no one else is practicing. Because these members practice FGC, they will draw a few more community members with a low threshold into practicing FGC. If instead the rate of FGC is higher than the rate at Point A, there are fewer households favoring FGC (as a function of practicing community members) than there are practicing community members. This would lead these additional households to abandon FGC, pushing the equilibrium to Point A. Thus, Point A is a stable equilibrium, and it is the only equilibrium on Curve 1.

If instead the community's distribution of thresholds resembles Curve 2, there are three equilibria, two of which are stable. If the proportion of community members practicing FGC is below Point B, fewer community members favor FGC than those expected to practice, so the proportion of community members practicing FGC will fall to zero. If instead, the proportion of community members practicing FGC is above Point B, more community members will be drawn to practicing FGC until Point C is reached. If the proportion of community members practicing FGC is higher than at Point C, some will decide to stop practicing, and the proportion of practicing community members will return to Point C. A community with thresholds, r_i^* of community members distributed as shown in Curve 2 has two stable equilibria—one at a high rate of FGC and one at zero.

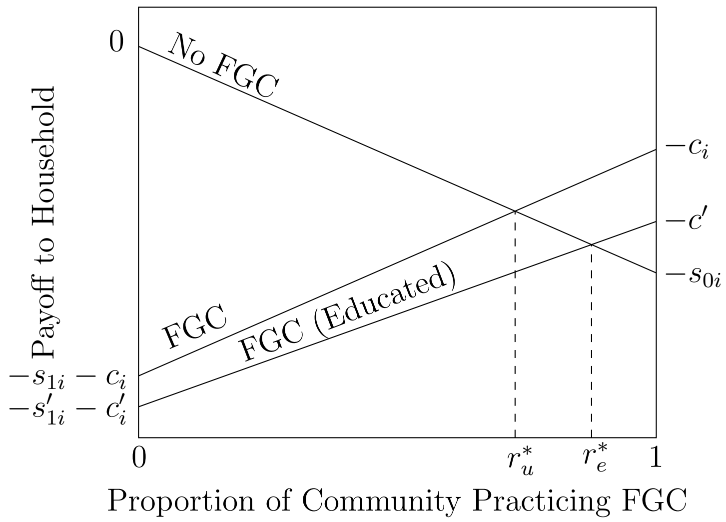
Thus, with heterogeneous rates of cutting it is possible that there is a tipping point, as is illustrated with Curve 2. It is however also possible that a tipping point does not exist, as is illustrated with Curve 1. Thus, if community members have heterogeneous thresholds, the existence of a tipping point is not guaranteed and it is possible that there are stable equilibria at interior rates of cutting. Below, I use data from Burkina Faso to determine which phenomenon is most likely in communities across Burkina Faso.

3.4 Education

In addition to analyzing CDFs at the community level, I analyze how preferences among groups of community members may differ. Specifically, I analyze how educated and uneducated community members interact differently with the social norms. Let r_u^* be the proportion of community members that practice FGC that is required by an uneducated woman to induce her to practice FGC. Let r_e^* be similarly defined for an educated woman. I test whether an educated woman requires a smaller proportion of the community to have abandoned FGC before she decides to also abandon the practice, i.e., that $(1-r_u^*) > (1-r_e^*)$. This shift in a woman's threshold will occur if education alters the perceived costs of FGC such that c_i shifts to c_i' (see Figure 4) and/or education alters the perceived social costs of FGC such that $s_{1i}(r)$ shifts to $s_{1i}'(r)$. Educated women may be more likely to understand, for example, that there is an absence of clear religious edicts prescribing FGC and that there are women who do not practice FGC and no harm befalls them. Educated women may have more influence within their community and be more able to withstand social pressure. Further, education may cause women to better understand the negative health consequences associated with FGC.

Hypothesis 2. *An educated woman requires fewer community members to abandon FGC in order for her to abandon the practice. That is* $r_u^* < r_e^*$.

Figure 4

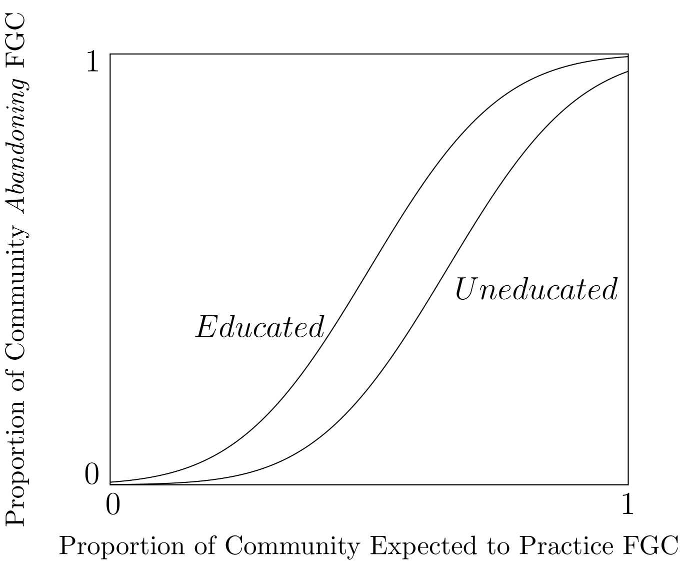


If educated women are more likely than uneducated women to abandon FGC when fewer community members have abandoned the practice, the CDF for uneducated women will first-order stochastically dominate the CDF for uneducated women, as is shown in Figure 5.

3.5 Bounds

A household's threshold is difficult, if not impossible, to measure because the household's threshold is function of individual preferences and individual bargaining power. Additionally, each individual may have difficulty articulating their threshold if asked via survey. It is,

Figure 5



however, possible to create bounds on a household's threshold.

Let r_i^* be the household's threshold rate of FGC in the community that makes it indifferent between practicing and abstaining from FGC for its daughter. Let r be the observed rate of cutting in the community.[3] While it is not possible to observe r_i^*, it is possible to observe r and the daughter's FGC status, y_i. Let

$$y_i = \begin{cases} 1, & \text{if } r > r_i^* \\ 0, & \text{if } r \leq r_i^* \end{cases} \tag{1}$$

where y_i equals one if the girl has undergone FGC. If a household chooses to cut their daughter, it is possible to conclude that $r > r_i^*$, therefore I claim that r is an upper bound for r_i^*. If instead a household does not cut their daughter, I can conclude that r is a lower bound of the household's threshold r_i^*.

Assumption 5. *If a household chooses to cut its daughter, the rate of cutting in a commu-*

[3]Community will be defined in the Data section of this paper.

nity, r, is an upper bound for the household's threshold r_i^*.

Assumption 6. *If a household chooses to abstain from cutting its daughter, the rate of cutting in a community, r, is a lower bound for a household's threshold r_i^*.*

4 Data

To estimate community thresholds and CDFs, I use publicly available, nationally representative data from the Demographic and Health Survey (DHS) for Burkina Faso. I use three cross-sectional datasets collected in 1998, 2003, and 2010. The DHS includes female respondents aged 15 to 49 at the time of survey, thus I have data from women born between 1949 and 1995. A respondent provides information on her health and her children's health, along with many characteristics of her partner, if relevant, and the household in which she lives. I match provinces over time using the geographic coordinate information provided by the DHS. There are 45 provinces in Burkina Faso.[4] Provinces are the second administrative level in Burkina Faso, one level below region, one level above departments, and two levels above villages. Combining three cross-sectional datasets facilitates the investigation of a much longer timeframe than any one dataset provides, which is important when considering long-term dynamics in FGC.

These three cross-sections provide information from 24,569 women born between 1949 and 1995 who report their FGC status. In many specifications, I use data only from the 7,629 women who have a daughter who is old enough to have undergone FGC and who report their daughter's FGC status. I restrict the sample to women with a daughter that is 11 years or older because 94 percent of women who underwent FGC were cut before the age

[4] In 1998 there were 30 provinces. The provinces were redrawn between 1998 and 2003. I use the geographic coordinates of the villages sampled in 1998 to determine in which modern province the village lies.

of 11. Including women with a daughter less than 11 would risk counting girls as uncut when in fact they will undergo FGC at a later date. In a small number of analyses I include only the 6,580 women who report their daughter's FGC status and who themselves underwent FGC.

Table A1 in the Appendix shows descriptive statistics for three samples used in my analyses. Column (1) of Table A1 includes 6,580 women who underwent FGC themselves and who also report the FGC status of their daughter. Column (2) of Table A1 includes information on 7,629 respondents who report their daughter's FGC status. Column (3) includes information from all 24,569 women for whom I observe the province in which they live.

Approximately 75 percent of women surveyed have undergone FGC. Only 28 percent of surveyed women have attended at least some formal schooling, 75 percent have been or are currently married, the average year of birth of respondents is 1981, 45 percent of respondents are Catholic and 29 percent are Muslim, 19 percent of respondents own a television and 74 percent own a radio. Fifty-four percent of respondents are from the Mossi ethnic group, the remaining 46 percent belong to 10 other ethnic groups. Thirty-one percent of respondents live in an urban area.

Thirty-eight percent of women who have a daughter 11 years of age or older state that their daughter has undergone FGC. Due to data limitations, I use the information on the woman's oldest daughter's FGC status only. The data collected in 1998 and 2003 include information on the oldest daughter only, data collected in 2010 include data on all daughters and show that there is very little variation in FGC status of a woman's daughters. Thus, using the woman's oldest daughter only should yield very similar results to using information on multiple daughters. In most specifications of my results, I consider a parent to be educated if he or she attended any amount of formal education. The women included in the daughter analyses (Column (2)) are, on average, older, less educated, and have a higher rate of FGC than the full sample of women. This is intuitive since these are women with relatively old daughters, and the rates of FGC have been decreasing over time in Burkina Faso while the rate of education has been rising.

Figure 6 displays the rate of FGC by year of birth, and shows why Burkina Faso is an ideal place to study shifting practices of FGC. There is a substantial amount of heterogeneity in rates of FGC over time in Burkina Faso which makes it possible to analyze changing norms.

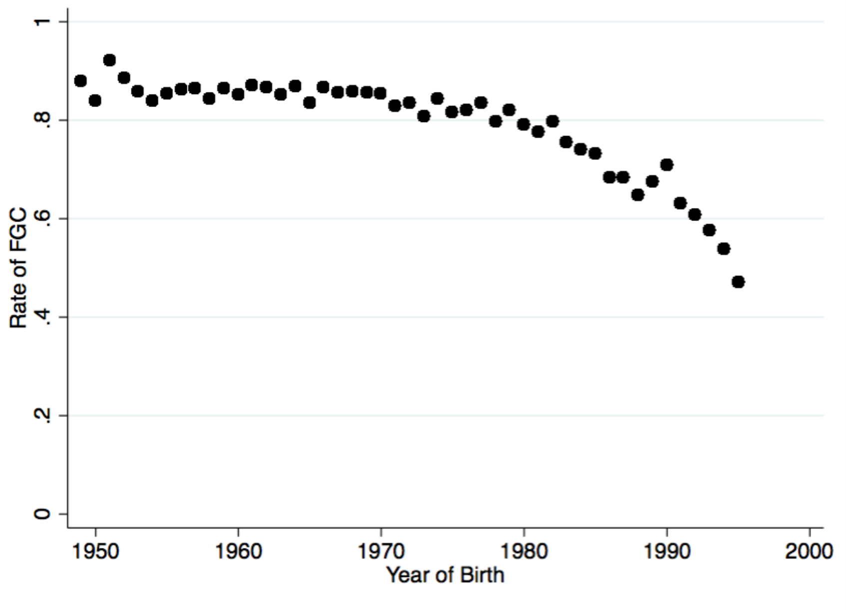


Figure 6

In order to estimate the rate of FGC at the community level, I first identify the year of birth of the respondent and the year of birth of the respondent's oldest daughter. Year of birth of respondents and daughters (of different women) do overlap, given that my data provide such a long timeframe. I combine information on self-reported FGC status of the respondents (using the full sample of 24,569 women) with the reported FGC status of daughters (7,629 daughters). I then estimate the rate of FGC in the daughter's cohort within her community. I define cohort as the girls born five years prior to the birth of the daughter in question. I use the information on girls born five years prior in order to assume that the mother is able to observe the rate of FGC for girls in her daughter's cohort before making the decision for her own daughter, as well as to minimize the reflection problem (Manski, 1993).[5] I define community in two ways—(i) all girls in the same province, and (ii) all girls in the same province within the same ethnicity. I use ethnicity to define the community as marriages typically happen within ethnicities in Burkina Faso (Sarker et al., 2004). Rates of FGC within a community-cohort, range between 0.09 and 1.

5 Empirical Framework

In this section I explain the estimation strategy, identification, and threats to identification. I begin by testing Hypothesis 1, that is, whether thresholds are heterogeneous among households in Burkina Faso. Second, I test whether there is a tipping point in Burkina Faso, i.e., a proportion of people who have abandoned FGC beyond which everyone will abandon the practice. Finally, I test Hypothesis 2, that is, relative to a household with uneducated parents, does a household with a educated parents require that fewer community members have abandoned FGC in order for it to abandon the practice?

5.1 Thresholds and Tipping Point

I begin by analyzing whether thresholds are heterogenous among households in Burkina Faso by plotting (i) the CDF of the proportion of households that decide to cut their daughter as a function of the proportion of community members practicing FGC (where community is defined in the two ways specified above), as well as (ii) the CDF of the proportion of

[5]The reflection problem arises when attempting to identify the effect of a group's behavior on an individual when that individual's behavior simultaneously affects the group's behavior.

households that abstain from cutting their daughter as a function of the proportion of community members practicing FGC. As stated in Assumptions 5 and 6, it is not possible to observe each woman's threshold r_i^*. Instead, I am able to observe bounds on r_i^*. Therefore I analyze the decision to practice or abandon FGC as a function of the rate of FGC in the community-cohort. The CDF for those who practice FGC shows the upper bound of thresholds r_i^*, and the CDF for those who abandon FGC shows the lower bound for r_i^*. The true CDF of r_i^* lies somewhere in between. If the CDFs looks like Curve 1 in Figure 2, households have homogenous thresholds. Otherwise, we can conclude that thresholds are heterogeneous among households.

I then turn to analyzing whether there may be a tipping point (i.e., a proportion of the population that is willing to abandon FGC, beyond which everyone else will also abandon FGC) in communities in Burkina Faso. I do this by plotting the CDFs of (i) the proportion of households that decide to cut their daughters, and (ii) the proportion of households that do not cut their daughters as a function of the proportion of community members practicing FGC, and I compare these CDFs to Figure 3.

5.2 Threshold of Households with Educated vs Uneducated Women

I compare the thresholds of educated and uneducated parents in two ways. First, I estimate Equation 2 for daughters who have a mother who has undergone FGC. I restrict the sample to mothers who have undergone FGC because it is extremely rare for a woman who has not undergone FGC to have a daughter who has undergone FGC.

$$y_{icp} = \beta_0 + \beta_1 r_{cp} + \beta_2 m_{icp} + \beta_3 f_{icp} + \beta_4 \mathbf{x}_{icp} + \beta_5 \mathbf{d}_c + \beta_6 \mathbf{d}_m + \beta_7 \mathbf{d}_f + \beta_8 \mathbf{t} + \epsilon_{icp} \qquad (2)$$

The subscripts denote girl i from cohort c whose mother is in cohort m, whose father is in cohort f, and who lives in community p. Let y_{icp} equal one if the respondent's daughter has undergone FGC and zero if her daughter has not undergone FGC. Let r_{cp} denote the rate of FGC in the girl's community-cohort, let m_{icp} denote the level of education of the girl's mother, and f_{icp} denote the level of education of the girl's father. Let $\mathbf{x}_{icp}$[6] be a vector of other control variables, $\mathbf{d}_c$ is a vector of the girl's year of birth fixed effects, $\mathbf{d}_m$ is a vector of mother's year of birth fixed effects, $\mathbf{d}_f$ is a vector of father's year of birth fixed effects, and $\mathbf{t}$ is a vector of survey wave fixed effects. Finally, ϵ_{icp} is an error term with mean zero. If $\beta_2 < 0$ and/or $\beta_3 < 0$, we can conclude that households with educated parents have lower thresholds because for a given rate of FGC that household is less likely to cut their daughter.

The second way in which I compare the thresholds of educated and uneducated parents is by comparing the CDFs of the thresholds of educated and uneducated mothers. While the theoretical model and analyses have thus far analyzed a household making the decision for their daughter, the remaining empirical results hone in on the mother's preferences and education level. I focus on mothers based on evidence that the decision-making process surrounding FGC is primarily conducted by women (Cloward, 2016; Shell-Duncan & Hernlund, 2000; Mackie, 1996). I generate the CDFs of the proportion of women who decide to cut their daughters as a function of the rate of FGC within the community-cohort. If Hypothesis 2 is correct, i.e., if an educated woman requires fewer community members to abandon FGC in order for her to abandon the practice, the CDF for uneducated women should first-order stochastically dominate the CDF for educated women, i.e., the CDF for uneducated women should lie entirely to the right of the CDF for educated women.

[6] Boldface is used throughout this paper to denote vectors.

5.3 Estimation Strategy

I estimate all equations using Ordinary Least Squares (OLS) regression. Because y_{icp} is binary, my use of OLS implies that each equation I estimate is a linear probability model (LPM). In estimating an LPM rather than a logit or a probit model, I follow the recommendations of Angrist and Pischke (2008). The primary benefits of using LPMs are (i) LPMs do not rely on distributional assumptions required by logit and probit estimators, and (ii) LPMs do a much better job than probit models of handling a large number of fixed effects (Angrist & Pischke, 2008 page 98). The primary drawback to using LPMs is that LPMs produce errors that are heteroskedastic. I use robust standard errors in all estimations in order to address this concern.

5.4 Identification

While much of the analyses of the thresholds of community members do not depend on a casual identification, it is useful to discuss why the coefficients I estimate on parental education do not estimate a causal effect of attending formal school on the likelihood that a household chooses to have their daughter undergo FGC. There are three important sources of statistical endogeneity to consider: (i) reverse causality, (ii) measurement error, and (iii) unobserved heterogeneity. I discuss each in turn.

In this case, reverse causality would be an issue if a daughter's FGC status impacts the parents' educational attainment. Most parents have completed their education by the time their daughter would be old enough to undergo FGC. This is especially true since the majority of education in this context is primary education. Thus reverse causality is not a concern in this case.

Measurement error would bias estimates if educational attainment were measured with error. While it is possible that a person could misreport the number of years of school she completed, it is unlikely that she would misreport whether she attended any school or the level of school (primary, secondary, or higher) that she attended. Further, level of education is not a sensitive topic, so it is unlikely that a respondent would feel compelled to misrepresent her level of education.

It is also important to consider possible measurement error in the outcomes of interest, i.e. whether the respondent's daughter has undergone FGC. If a respondent misreports her daughter's FGC status, this will not bias the estimated coefficient on education, unless the misreporting systematically differs by level of education. If, for example, educated women are more likely than uneducated women to *falsely* state that their daughters have not undergone FGC, then my estimates of the effect of education would overstate the real effect of education. The data do not allow me to verify a mother's report of her daughter's FGC status. There are two things that assuage concerns of any substantial amount of misreporting. First, when I compare the rate of self-reported FGC within the year of birth to the rate of reported FGC for (other women's) daughters in the same year of birth, there is very little difference. This suggests that women are not misreporting their daughter's FGC status anymore than they may be misreporting their own FGC status. With an overall reported rate of FGC of 77 percent, there is not a large concern that women are underreporting their own FGC status. Second, the DHS data that I use give very similar estimates of the prevalence of infibulation as do Jones, et.al. (1999) who use gynecological exams to estimate the prevalence of infibulation in Burkina Faso.

Unobserved heterogeneity is the most important threat to validity in this analysis. It is highly likely that there are unobserved variables that affect both educational attainment and preferences for FGC. My use of province fixed effects controls for everything—both observed and unobserved—that is time-invariant at the province level. This accounts for a large amount of shared culture at a geographic level. Second, my use of year-of-birth fixed effects for mothers and fathers accounts for all geographic-invariant observed and unobserved factors that may affect preferences for FGC of men and women from each year of birth. One can think of this as controlling for the average generational preferences for FGC. Third, I use fixed effects for the daughter's year of birth which controls for all geographic-invariant factors that may affect a parent's preference for FGC for daughters in a given year. Additionally, I control for ethnicity of the respondent. Ethnicity accounts for a large amount of the preference for FGC since the practice is typically heavily concentrated in particular ethnic groups. Finally, the use of survey year fixed effects allows me to control for the average level of support for FGC in any given year. While this strategy removes a large portion of what would compromise the identification of the effect of education, it is still possible that there are factors that are correlated with both educational attainment and preference for FGC that are not accounted for with these fixed effects. One example of such a factor is that educated parents may have been raised in more "progressive" homes, which contributed to their ability to be educated and may have caused them to have less favorable opinions about FGC. By restricting the sample to mothers who have undergone FGC, I remove a portion of the bias that could arise due to this unobservable characteristic. It is, however, possible that a progressive parent was raised in a home that encouraged education and expressed opposition to FGC, but cut their daughter (the respondent) despite these views because they were constrained by the social norms.

6 Results

I begin by examining whether households have heterogeneous thresholds. I then analyze whether there is a tipping point in the rate of FGC in communities in Burkina Faso. Next,

Figure 7: Province Cohort

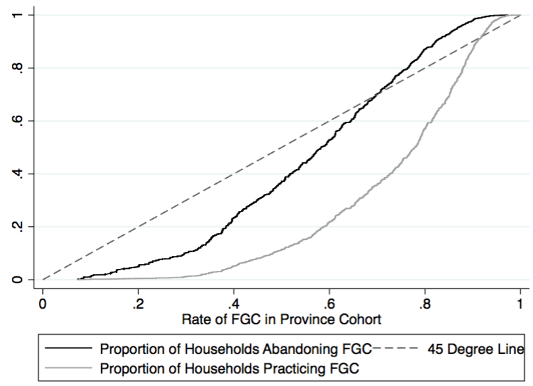
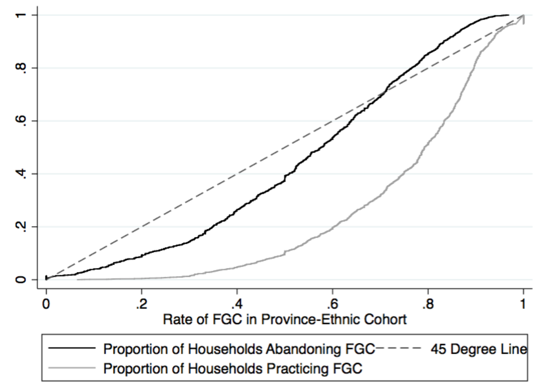


Figure 8: Province-Ethnic Cohort



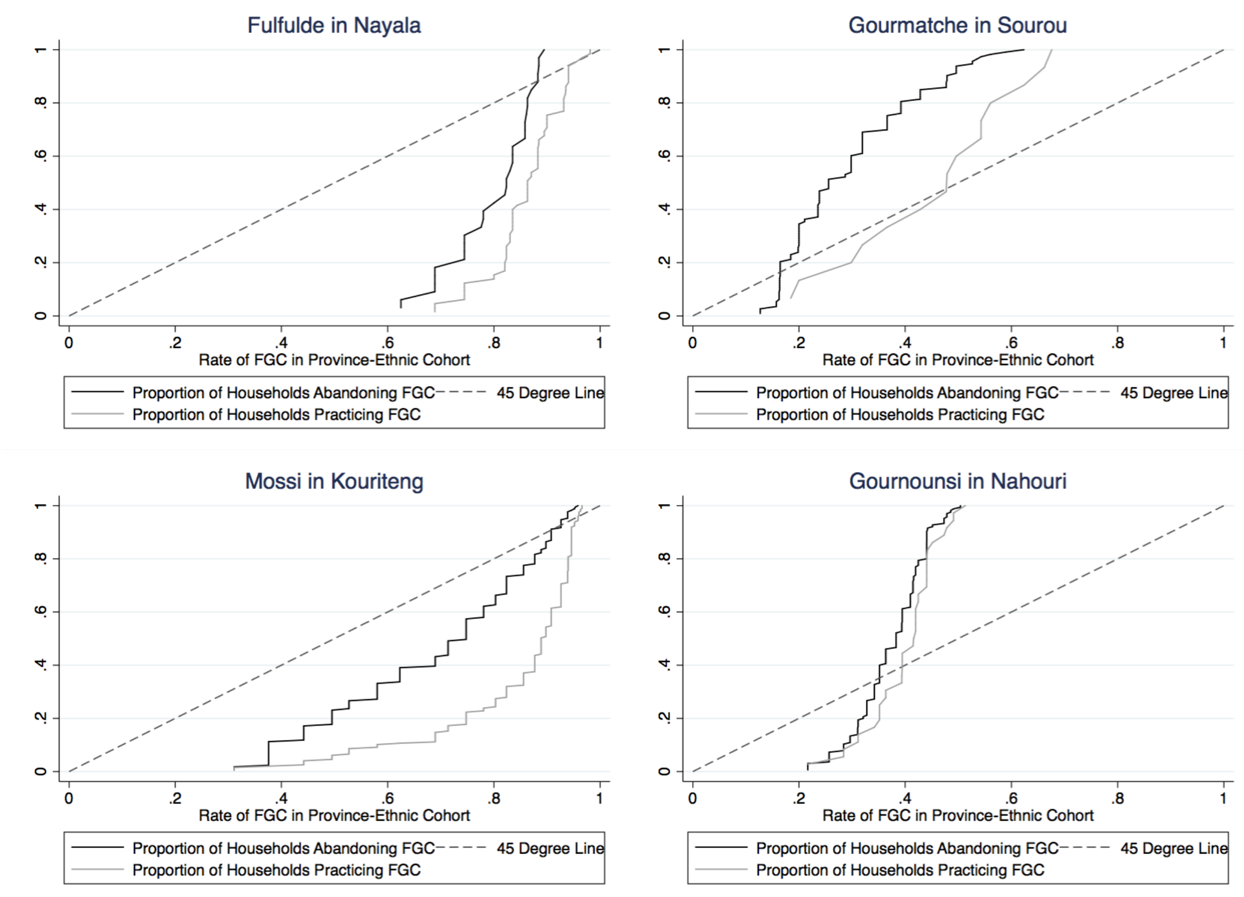
I analyze the results of estimating Equation (2) in order to determine whether educated parents have a different threshold than that of uneducated parents, and I plot the CDFs for educated and uneducated women.

6.1 Thresholds and Tipping Point

I begin by showing that thresholds are heterogeneous amoung households in Burkina Faso. Figure 7 uses the province as the definition of community while Figure 8 uses the ethnic group within the province as the definition of community. I plot both the CDF for households who cut their daughters (upper bound, Assumption 5) and the CDF those who do not (lower bound, Assumption 6). The CDF for the true distribution of household thresholds should lie somewhere in between these two plotted CDFs. One can easily see that thresholds are heterogeneous. Additionally, notice that the CDF for women who abandon FGC for their daughters lies entirely to the left of the CDF for women who practice FGC. This indicates that women who abandon FGC face lower rates of FGC in their community, which is precisely what one would expect given the theory put forth in Section 3.

I now turn to analyzing whether there is a tipping point in the proportion of community members practicing FGC in Burkina Faso. These country-level CDFs cross the 45 degree line from underneath (if they cross at all), which suggests that the these interior equilibria are unstable, so the rates of FGC should diverge to either zero or one (see Section 3.3 for a more thorough discussion). This is consistent with the rather large decline in rates of FGC that is observed in Burkina Faso during this 60 year period for which I have data. A more precise method of investigating the tipping point entails analyzing community-level CDFs. A random selection of community-level CDFs appear in Figure 9 and tell a very similar story the country-level CDFs.

Figure 9: CDFs by Province-Ethnic Cohort



6.2 Threshold of Educated vs. Uneducated Parents

Table 2 presents the results of estimating Equation (2) using two definitions of the girl's community-cohort. Columns (1)-(3) define the daughter's community-cohort as all girls born five years prior to the girl in question who live in her province, and Columns (4)-(6) define the daughter's community-cohort as all girls born five years prior to the girl in question who live in her province and are part of her ethnic group. Columns (1) and (4) include parental education separately, columns (2), (3), (5), and (6) include an interaction term for parental education, and columns (3) and (6) include non-linear terms of the rate of FGC in the girl's community-cohort.

Table 2 shows that girls within a community-cohort with a higher rate of FGC are much more likely to undergo FGC. For every additional 10 percentage points of the community-cohort that practices FGC, a girl is between 7.0 and 7.7 percentage points more likely to undergo FGC herself. Columns (3) and (6) include non-linear terms for the rate of cutting in the community-cohort. The squared and cube terms are insignificant in Column (3), but significant in Column (6). Overall, these results suggest that there could be some non-linearities in the importance of the rate of cutting, but that there is a strong positive relationship between the rate of FGC in the community-cohort and the likelihood that a girl undergoes FGC.

Table 2

Likelihood that Daughter Undergoes FGC

	(1) Province Cohort	(2) Province Cohort	(3) Province Cohort	(4) Province-Ethnic Cohort	(5) Province-Ethnic Cohort	(6) Province-Ethnic Cohort
Rate of FGC in Cohort	0.695***	0.702***	0.784	0.762***	0.771***	1.026**
	(0.056)	(0.062)	(0.530)	(0.063)	(0.067)	(0.418)
Rate of FGC^2			-0.654			-1.238
			(1.057)			(0.787)
Rate of FGC^3			0.628			1.090**
			(0.657)			(0.471)
Mother Educated	-0.057***			-0.053**		
	(0.019)			(0.020)		
Father Educated	-0.049**			-0.046**		
	(0.020)			(0.021)		
Parental Education [Omitted: Neither Parent is Educated]						
Only Mother Educated		-0.034	-0.034		-0.032	-0.034
		(0.024)	(0.023)		(0.024)	(0.024)
Only Father Educated		-0.035	-0.037		-0.034	-0.037
		(0.024)	(0.024)		(0.024)	(0.024)
Both Parents Educated		-0.086***	-0.087***		-0.074**	-0.076**
		(0.030)	(0.029)		(0.030)	(0.030)
Constant	0.680***	0.777***	0.798***	0.433***	0.503***	0.500***
	(0.170)	(0.166)	(0.172)	(0.149)	(0.152)	(0.161)
Observations	6,580	6,580	6,580	6,250	6,250	6,250
R-squared	0.219	0.205	0.206	0.232	0.218	0.220

Controls included: Ethnicity, religion, proxies for wealth, rural indicator, polygamy indicator, mother's year of birth FE, father's year of birth FE daughter's year of birth FE

Standard Errors Clustered at the Province Level

***p<0.01 **p<0.05 *p<0.1

Table 2 also shows that educated women are between 5.3 and 5.7 percentage points less likely to have a daughter who has undergone FGC, and educated men are between 4.6 and 4.9 percentage points less likely to have a daughter who has undergone FGC. Recall that 42 percent of respondents have a daughter who has undergone FGC, thus this represents a decline in the likelihood of FGC by between 11 and 14 percent. Girls who have two educated parents are between 7.4 and 8.7 percentage points less likely to undergo FGC, suggesting important complementarities between parental education. In an alternative specification I interact parental education with the rate of FGC at the community level and find that those interaction terms are insignificant. This suggests that the decrease in likelihood that an educated parent's daughter undergoes FGC does not change over the interval of cutting rates at the community level.

Figure 10: Province Cohort

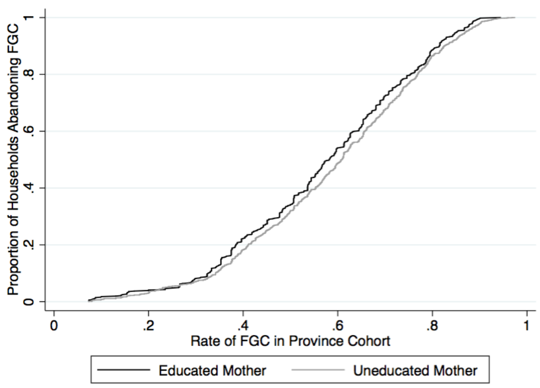
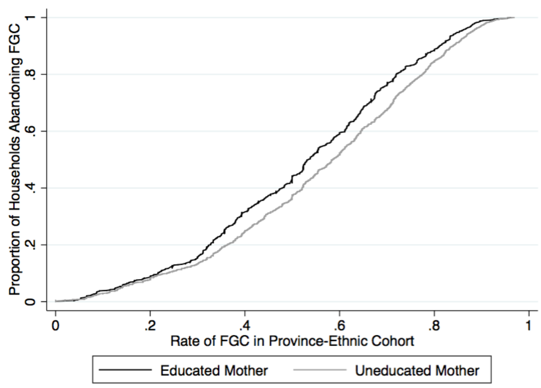


Figure 11: Province-Ethnic Cohort



I now turn to the CDFs of the proportion of women abandoning FGC for their daughter as a function of the rate of FGC in the community-cohort. Figure 10 uses the province as the definition of community while Figure 11 uses the ethnic group within the province as the definition of community. One can see that the CDF for educated women lies almost entirely to the left of the CDF for uneducated women. This difference is even more pronounced when using the ethnic group within the province as the definition of community. This suggests that for any given rate of FGC within the community-cohort, a larger proportion of households with educated mothers, compared to those with uneducated mothers, will abandon FGC (except at very low rates of FGC where there is no difference between educated and uneducated women in the likelihood that their daughter will undergo FGC). This suggests that educated mothers required fewer community members to abandon the practice before they decide to abandon FGC themselves—i.e., $p_u < p_e$, or Hypothesis 2 is correct.

6.3 Education Categories

Table 3 presents the results of estimating the relationship between different levels of a parental education and the likelihood that their daughter undergoes FGC. Mothers and fathers who have attended primary school are not statistically significantly less likely to have a daughter who has undergone FGC. Mothers who have attended secondary school are approximately 9.5 percentage points less likely, and mothers who have attended higher education are approximately 18.5 percentage points less likely to have a daughter undergo FGC. Fathers who have attended secondary school are approximately 16 percentage points less likely, and fathers who have attended higher education are approximately 13 percentage points less likely to have a daughter undergo FGC. The results from Table 2 are driven by parents who have attended secondary school and more.

6.4 Limitations

I discussed the limitations of causal identification in Subsection 5.4. In addition to those limitations, it is important to mention that I am able to observe only the girls who are 10 years of age or older who have a mother who is 49 year of age or younger at the time of survey. Thus, I am unable to analyze the outcomes for children of older women. Additionally, my

Table 3

	(1) Province Cohort	(2) Province-Ethnic Cohort
Rate of FGC in Cohort	0.699***	0.763***
	(0.056)	(0.063)
Maternal Education Level [Omitted: None]		
Primary School	-0.021	-0.020
	(0.020)	(0.021)
Secondary School	-0.097**	-0.092**
	(0.042)	(0.042)
Higher Education	-0.190***	-0.184***
	(0.070)	(0.054)
Paternal Education Level [Omitted: None]		
Primary School	-0.005	-0.005
	(0.023)	(0.023)
Secondary School	-0.165***	-0.158***
	(0.030)	(0.030)
Higher Education	-0.136***	-0.124***
	(0.040)	(0.041)
Constant	0.672***	0.422***
	(0.171)	(0.149)
Observations	6,580	6,250
R-squared	0.223	0.235

Controls included: Ethnicity, religion, proxies for wealth, rural indicator, polygamy indicator, mother's year of birth FE, father's year of birth FE daughter's year of birth FE
Standard Errors Clustered at the Province Level
***p<0.01 **p<0.05 *p<0.1

analyses rely on direct reporting of the respondent's FGC status and daughter's FGC status. Obtaining physician records would lead to more precise estimates.

Finally, it is important to be aware of the differences between the context of Burkina Faso between 1949 and 2010 and other settings. While my findings are suggestive of how educated parents interact with the norms surrounding FGC, these findings may not translate to other contexts. While higher education is associated with lower support for FGC in Burkina Faso and in the rest of West Africa (Baguet and Novak, 2016) as well as Egypt (Modrek and Liu, 2013), higher education, may be associated with increased support for FGC in Sudan (Mackie, 2003; Obermeyer, 1999).

7 Discussion and Conclusions

Using data from Burkina Faso which include women born between 1949 and 1995, I show that households have heterogeneous thresholds—where threshold is defined as the proportion of community members that they require to abandon FGC before they decide to also abandon FGC for their daughter. Drawing on Schelling's 1978 model of critical mass, I show that heterogenous thresholds make the presence of a tipping point uncertain. Many communities in Burkina Faso do have a tipping point, and that tipping point has likely been reached in those communities. Further, I show that educated women require fewer community members to have abandoned FGC before they decide to also do so for their daughter.

I find suggestive evidence that educated parents interact with the norm of FGC differently. This provides very suggestive evidence that increasing access to education for girls and boys could substantially reduce the prevalence of FGC in subsequent generations. Together these findings suggest that households are able to deviate from the social norm and that education increases the likelihood that they will do so. This broadens the set of possible policy interventions that agencies could use to reduce the prevalence of FGC. Specifically, interventions that target changing individual or household-level preferences can have profound effects on the perpetuation of an entrenched, gender-biased, social norm.

The rate of FGC declined substantially in Burkina Faso between 1949 and 1995. The findings of this study may be applicable to countries in which the rate of FGC remains very high, though it is important to keep in mind that the social norms surrounding FGC are heterogeneous between communities. More research is needed to verify that these findings hold in other settings.

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Table A1

Descriptive Statistics

	(1) Cut Respondents with Daughters	(2) Respondents with Daughters	(3) Full Sample
Respondent Underwent FGC	1.000	0.862	0.749
	(0.000)	(0.004)	(0.003)
Daughter Underwent FGC	0.432	0.379	
	(0.006)	(0.006)	
Respondent Educated	0.105	0.106	0.282
	(0.004)	(0.004)	(0.003)
Respondent Ever Married	1.000	1.000	0.754
	(0.000)	(0.000)	(0.003)
Respondent's Partner Educated	0.128	0.128	
	(0.004)	(0.004)	
Rate of FGC in Province-Ethnic Cohort	0.643	0.616	0.737
	(0.003)	(0.003)	(0.001)
Respondent in Polygamous Marriage	0.561	0.562	
	(0.006)	(0.006)	
Respondent's Year of Birth	1967	1967	1981
	(0.088)	(0.082)	(0.045)
Respondent's Partner's Year of Birth	1956	1956	
	(0.138)	(0.130)	
Daughter's Year of Birth	1989	1989	
	(0.083)	(0.077)	
Religion: Catholic	0.439	0.429	0.453
	(0.006)	(0.006)	(0.003)
Protestant	0.139	0.147	0.163
	(0.004)	(0.004)	(0.002)
Muslim	0.309	0.305	0.290
	(0.006)	(0.005)	(0.003)
Other	0.113	0.120	0.095
	(0.004)	(0.004)	(0.002)
Household Owns TV	0.120	0.119	0.192
	(0.004)	(0.004)	(0.003)
Household Owns Radio	0.714	0.706	0.735
	(0.006)	(0.005)	(0.003)
Ethnic Group: Bobo	0.030	0.030	0.037
	(0.002)	(0.002)	(0.001)
Dioula	0.033	0.031	0.026
	(0.002)	(0.002)	(0.001)
FulFulde/Peul	0.079	0.076	0.068
	(0.003)	(0.003)	(0.002)
Gourmatche	0.054	0.061	0.062
	(0.003)	(0.003)	(0.002)
Gourounsi	0.031	0.042	0.046
	(0.002)	(0.002)	(0.001)
Lobi	0.034	0.033	0.045
	(0.002)	(0.002)	(0.001)
Mossi	0.571	0.560	0.539
	(0.006)	(0.006)	(0.003)
Senoufo	0.051	0.048	0.050
	(0.003)	(0.002)	(0.001)
Touareg/Bella	0.005	0.012	0.013
	(0.001)	(0.001)	(0.001)
Bissa	0.044	0.041	0.041
	(0.003)	(0.002)	(0.001)
Other	0.066	0.066	0.073
	(0.003)	(0.003)	(0.002)
Household is in Urban Area	0.206	0.204	0.310
	(0.005)	(0.005)	(0.003)
Observations	6,580	7,629	24,569

Standard errors in parentheses