

A Stepping Stone Approach to Understanding Harmful Norms^{*}

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Abstract

Harmful social norms often persist despite legal and economic penalties. Can the abandonment of a harmful norm be facilitated by the presence of a “mildly harmful” alternative that may act as a stepping stone in the medium run? Or will this become a new norm? We propose a dynamic, game-theoretic model and derive necessary and sufficient conditions for a stepping stone transition. Using original data, we apply the model to female genital cutting in Somalia, which has transitioned from an invasive to a milder form of cutting. The framework is general and shows that intermediate actions may have unintended consequences.

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1 Introduction

Harmful norms often persist despite the high costs they entail for individuals and society, and despite the presence of legislation against them. The conventional approach taken by governments and NGOs is to push for the outright abandonment of these norms, possibly on a matter of principle. In practice, such an approach is often slow and ineffective. Currently, dowry and early child marriage persist in South Asia despite being outlawed (Anderson, 2007; Ambrus & Field, 2008; Corno *et al.*, 2017); female genital cutting is widespread in Africa despite the fact that many governments have passed laws against it.⁷ Historically, footbinding in China and dueling in Europe persisted for centuries despite repeated attempts by governments to extirpate the practices (Mackie, 1996; Nye, 1993).

If the goal is the elimination of a harmful norm in the long run, can it be beneficial to introduce a “mildly harmful” alternative in the medium run?⁸ Leaving aside moral principles (on which our analysis is silent), the answer to this question is not trivial. On the one hand, people who may be reluctant to abandon a costly practice L (for low utility) in favor of the complete absence of the practice may be persuaded instead to go from L to a slightly less costly practice M (for medium utility). On the other hand, precisely because M is less costly, it may become an absorbing state in the long run, in the sense that the forces that may have led to the ultimate abandonment of L over time may not work on the lower-cost variant M .

In this paper we propose a model of norm dynamics that allows us to analyze the above trade-off and characterize the equilibria and the conditions that govern norm transitions. In particular, we are interested in understanding the conditions under which the existence of an intermediate alternative leads to the elimination of a costly norm – a situation we describe as a *stepping stone* transition.

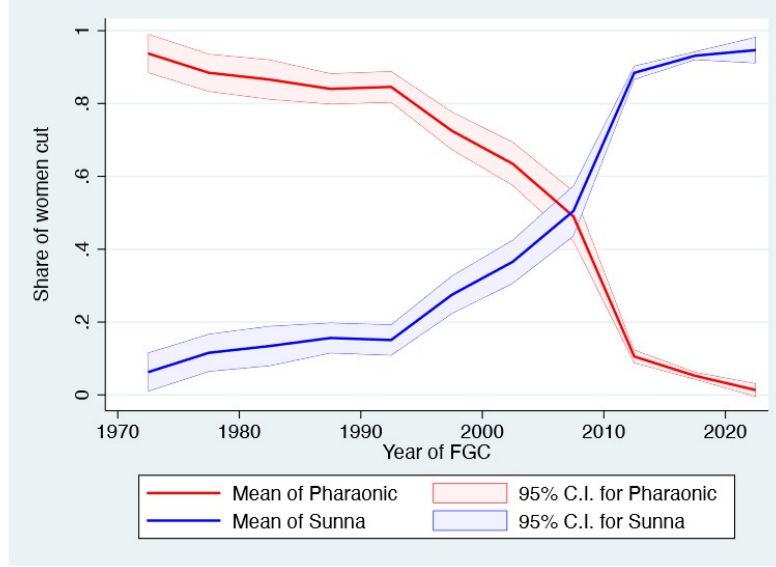
We then provide an empirical illustration of some key features of our model for the case of female genital cutting (FGC) in Somalia, using original survey data. Somalia is an interesting case study for two reasons: First, the prevalence of FGC is extremely high – 98 percent of the women aged 15 to 49 are cut (UNICEF, 2016). Second, in Somalia FGC takes two forms – a highly invasive one called “Pharaonic” circumcision and a milder one called “Sunna”.

Figure 1 draws on original data we collected in Somalia to show the type of FGC performed as a function of the year in which the girl or woman was cut. Until the late

⁷ Among the 28 African countries with the highest prevalence of FGC, 22 had national legislation criminalizing it (28 Too Many, 2018).

⁸ For the examples mentioned above, the “mildly harmful” alternatives might consist of setting a cap on dowry payments, setting a different minimum age for marriage, or allowing for less invasive forms of female genital cutting.

Figure 1: Type of FGC by year of cutting



Source: Authors' calculations on original data from Somalia. Sample includes women aged 17-82 at the time of interview and their daughters aged 12 or older, if cut.

1990s and early 2000s, the vast majority of women who were cut received Pharaonic circumcision. Then a striking transition occurred, reversing the trend, and today the vast majority of girls who are cut receive Sunna. An important question is whether there will be a further transition from Sunna to a norm of no cutting, or whether Sunna will persist. This paper provides a framework in which to tackle this question, as well as related questions about norm transitions in general.

We propose a discrete choice model in which a finite population of players choose an action to maximize a utility that has two components: (i) the *intrinsic utility* of the action for the individual, and (ii) a *social utility* that is decreasing in the shares of players who choose actions different from the individual's. The latter term captures conformity and is commonly used in models with social interactions (Akerlof, 1997; Brock & Durlauf, 2001). Our baseline model has three actions (L , M , and H , for low, medium and high intrinsic utility) and no heterogeneity between players. We later add heterogeneity and generalize to n actions. In the case of FGC, we interpret L as corresponding to Pharaonic circumcision, M as corresponding to Sunna, and H as corresponding to no cutting. A *norm* is a situation in which a given action is dominant.

We define an intermediate action M as a *stepping stone* if it destabilizes the costly norm L but is not itself stable. That is, (i) starting from the costly norm L , people are not willing to switch to H , but are willing to switch to M ; and (ii) starting from the intermediate norm. M , people are willing to switch to H . We show that if M is a stepping

stone, then, from any starting point, the entire population will eventually converge to the high-utility norm H .

We derive necessary and sufficient conditions for the intermediate action to be a stepping stone. Intuitively, these require that M be a good *social substitute* for both L and H , in the sense that the social penalties for going from L to M and then from M to H are small relative to the gains in intrinsic utility that they generate. Failure to satisfy these conditions implies either that the intermediate norm is not attractive enough and will fail to destabilize the costly norm L , or that it is too attractive in which case it will become absorbing (in the sense that starting at M people are not willing to switch to H).

We then characterize the dynamics of stepping stone convergence and derive the expected waiting time to transition to the uncostly norm via the intermediate norm. One of the characteristics of the dynamics in our model is the following threshold property. When M is a stepping stone, at first agents will deviate from L to M , but once a certain fraction of agents have chosen M , deviations to H will start occurring and the system will converge to the uncostly norm.

The baseline version of the model allows us to discuss the welfare implications of policies aimed at eradicating harmful norms. When the costly norm L is stable, introducing an intermediate norm weakly increases welfare, since it may dislodge the costly norm. However, when the costly norm is unstable, introducing an intermediate norm typically decreases welfare. If it is absorbing, then the process may get stuck at the new intermediate norm. If it is not absorbing, the transition to the high-utility norm will tend to be slower. Thus, our analysis highlights that policies aimed at eradicating harmful norms can have unintended consequences, and that it is important to consider potential intermediate norms when designing them.

Next we introduce heterogeneity among agents, which may be due to differences in preferences or to random deviations from best-response behavior. The main intuitions from the model without heterogeneity carry through, but we show that heterogeneity also introduces some complicating elements to the dynamics. First, M can play the role of a stepping stone under a larger set of parameter values than when there is no heterogeneity. The reason is that heterogeneity entails a persistent non-zero proportion of M - and H -players, which reduces the social cost of deviating, first to the intermediate action M , and then to the uncostly action H . Second, an increase in the proportion of agents playing H does not necessarily mean that the process will converge to H . Thus, even if the data showed that some agents have transitioned to the uncostly action, one should be cautious in inferring that this will be the final outcome.

In the Appendix, we extend the model to the case of n actions. Of particular interest is the case where social sanctions are a function of the distance between actions in terms of intrinsic utility and we show that the shape of the sanctions function plays a key role in

the dynamics of the model. In particular, we show that the existence of stepping stones is related to convexity of the sanctions function. The intuition is that when sanctions are convex, deviating to an intermediate action leads to low sanctions relative to the gain in utility; in contrast, when sanctions are concave, the best deviation from a norm is always the action with highest intrinsic utility, hence there is no scope for intermediate actions to serve as stepping stones.

While the model is general and can be used to understand a variety of norms and contexts, in the last part of the paper we apply the model to FGC in Somalia, using originally collected data. Our data cover 4,130 households from 141 communities and include information on whether female respondents and their daughters are cut, the type of cut, their beliefs about the expected costs and benefits from FGC, and about community sanctions against those who deviate from the practice. In this application, the agents are the parents, who are making decisions on behalf of their daughters. To map these data to our model, we interpret Pharaonic circumcision as action L , Sunna as M , and Uncut as H .

We start by exploring whether the necessary conditions for a stepping stone hold in this setting. First, we show that both experienced and perceived health complications are substantially higher for Pharaonic circumcision than for Sunna. To the extent that health costs are a good proxy for intrinsic utilities, this is consistent with the ranking assumed in our model. Second, we elicit beliefs about the extent of social pressure faced by respondents. We find, for example, that someone choosing Pharaonic is viewed as more likely to disapprove of someone choosing not to cut their daughter (which we label as “Uncut”) than someone choosing Sunna. Again, this is in line with the assumptions of the model and suggests that a stepping stone is possible.

We then proceed to explore equilibrium dynamics and model predictions. Figure 1 discussed above shows that, while until the early 1990s virtually all girls who were cut received Pharaonic circumcision, in the late 1990s a sharp switch towards Sunna occurred. This shift roughly corresponds to a period where, following numerous human-rights campaigns against FGC, religious leaders started disavowing Pharaonic circumcision and supporting Sunna as consistent with Islam (Newell-Jones, 2016). In terms of the model, this represents the scenario in which action M successfully invades (and replaces) the existing norm L , where H had been unable to do so.

The question, then, is whether a stepping-stone transition will occur or whether Sunna will instead become the new long-run equilibrium. First, we note that, although the proportion of uncut women and girls has been increasing over time, this does not necessarily imply that a stepping-stone transition will occur. As discussed above, the model shows that with heterogeneity the proportion of uncut women and girls could increase even if Sunna were absorbing. However, we show that there is some evidence that a shift may be occurring *in a subset of communities*. To do so, we exploit variation across communities

in the key parameters of our model – in particular, in perceived sanctions against people who choose Uncut over Sunna. We find that in communities with relatively low sanctions, the threshold property predicted by our model is consistent with the data, leaving room for a transition to Uncut. However, this property fails to hold for the subsample of communities with high sanctions. This pattern is consistent with our model, and suggests that in some communities Sunna may be a stepping stone, while in others it may be absorbing.

We stress that the goal of our empirical analysis is not to make causal statements – something that is intrinsically difficult to do in the context we study, where the “experimental” introduction of a costly norm could be unethical. Rather our aim is to explore transition dynamics in a real-world setting, using a combination of descriptive evidence and features predicted by the theoretical framework. Taken together, our theoretical and empirical analyses suggest that policies that promote an intermediate norm as a stepping stone away from a harmful norm may well have adverse consequences. For example, when evaluating a policy that would disincentivize a costly social norm, one should consider whether this might lead to the permanent adoption of an intermediate norm rather than the intended abandonment of the costly norm. In the case of Somalia, while it is possible that the switch to Sunna will lead to the ultimate abandonment of FGC, this cannot be guaranteed. If instead Sunna proves to be absorbing, then it may be more difficult to dislodge than Pharaonic. We conclude the paper by briefly discussing other potential applications of our model, such as the historical norms of footbinding and dueling, as well as the contemporary norm of child marriage.

Our paper relates to multiple literatures. First, we contribute to the theoretical literature on the evolution of social norms.⁹ Our paper is particularly close to the approaches of Akerlof (1980, 1997), and Brock & Durlauf (2001), who explicitly model conformity motives and their impact on the existence of norms equilibria.¹⁰ Our paper also relates to work in evolutionary game theory that analyzes how systems of interacting agents converge to normative behaviors from out-of-equilibrium conditions (Young, 1993, 1998; Kandori *et al.*, 1993; Blume, 1993, 1995; Bowles, 2006; Newton, 2020).¹¹ This framework has been used to study, for example, the evolution of property rights (Bowles & Choi, 2013, 2019), as well as Pareto inferior institutions and cultures (Belloc & Bowles, 2013).

⁹ Schelling (1978) was one of the first to introduce a game-theoretic explanation of norms. For overviews of the subject, see Young (1998, 2015); Bowles (2004); and Bicchieri (2005).

¹⁰ Related work on social interactions includes the literatures on networks (Jackson, 2008; Goyal, 2012) and identity (Akerlof & Kranton, 2000, 2010). There is also a literature on the empirical estimation of social interactions (Manski, 1993; Moffitt, 2001; Blume *et al.*, 2011, 2015).

¹¹ For book-length treatments of evolutionary game theory and its applications see Weibull (1995); Samuelson (1997); Young (1998); Vega-Redondo (1996); Bowles (2004); and Sandholm (2010).

The concept of stepping stones has been studied in evolutionary game theory, but with a different interpretation. Most prominently, Ellison (2000) and Norman (2009) showed that intermediate actions can speed up long-run transitions when noise (that is, the degree of heterogeneity in the population) becomes vanishingly small. In contrast, we focus on how intermediate actions affect the intermediate-run dynamics with non-vanishing noise. This is quite relevant for applications where decision revisions are made infrequently (e.g., in the case of FGC, a new choice can be made only when another daughter reaches a certain age). In such cases, the analysis of the welfare implications along the transition paths becomes important: policymakers want not only to be able to predict what the equilibrium will be, but also to understand how long it will take and/or what route society will take to get there.¹²

More broadly, we speak to a growing literature in economics that has studied the persistence and welfare effects of gender norms (e.g., Alesina *et al.*, 2013; Ashraf *et al.*, 2020), including norms around fertility and female labor force participation (Fernandez *et al.*, 2004; Fernandez & Fogli, 2009), and signalling norms such as veiling among Muslim women (Carvalho, 2013). Only recently has female genital cutting come to the forefront of the analysis. Among others, Bellemare *et al.* (2015) study the individual and household level correlates of attitudes towards FGC in West Africa, while Becker (2018) and Corno *et al.* (2020) trace the origins of FGC to historical characteristics of societies. Mackie (1996) was the first to interpret FGC as a social interactions equilibrium. Subsequent work seeks to extend and test this theory (Shell-Duncan *et al.*, 2011; Efferson *et al.*, 2015; Bicchieri & Marini, 2016; Kudo, 2019; Novak, 2020; Efferson *et al.*, 2020; McGavock & Novak, 2021). However, this literature does not formalize the dynamics of the adjustment process and it is silent on the role that intermediate actions may play.

Finally, our empirical results contribute to an emerging literature on the evaluation of policies aimed at eradicating FGC (e.g., Diop *et al.*, 2004; UNICEF, 2008; Camilotti, 2016; Vogt *et al.*, 2016; Platteau *et al.*, 2018; Hombrados & Salgado, 2020). These studies consider a binary choice, whereas here we show that intermediate actions are potentially important for policy.

The remainder of the paper is organized as follows. Section 2 presents our theoretical model. Section 3 contains our empirical application and section 4 concludes. Appendix A contains the extension to n actions; appendix B contains supplementary proofs; and the online appendix O contains additional tables and figures.

¹² Stepping stones are also of interest in other economic contexts, such as dynamic mechanism design (Ely & Szydlowski, 2020), and biology (Kimura & Weiss, 1964; Kimura, 1983).

2 Theory

We present our theoretical framework starting from the simplest version that conveys the main intuition for the dynamics, before generalizing it. In section 2.1 we set up the model with three actions. In section 2.2 we consider best-response dynamics for the case without heterogeneity and in section 2.3 we add heterogeneity. In appendix A we generalize the model to more than three actions.

2.1 Model setup

Consider a population of players who can choose from actions L , M , and H (for low, medium, and high intrinsic utility, respectively). In the case of FGC, L represents Pharaonic circumcision, M represents Sunna, and H represents not cutting. Let $A = \{L, M, H\}$. Throughout we shall assume that the number of players m is large but finite. Let $\delta = 1/m$. Let $p_i \in [0, 1]$ denote the proportion of agents playing action i and $p = (p_L, p_M, p_H)$ denote the *state* of the process. Let $\Delta = \{p \in \mathbb{R}_+^3 : \sum_{i \in A} p_i = 1\}$ denote the three-dimensional simplex and $\tilde{\Delta}$ denote the set of feasible states; that is,

$$\tilde{\Delta} = \{p \in \Delta : \forall i \in A, p_i \in \{0, \delta, 2\delta, \dots, 1\}\}. \quad (1)$$

The utility of an agent playing action i consists of an intrinsic and a social component. The *intrinsic utility* from playing action $i \in A$ is denoted by u_i . Assume actions are ranked in the following order:

$$u_L < u_M < u_H. \quad (2)$$

The social component of an agent's utility represents the pressure to conform to others' actions, as in Akerlof (1997) and Brock & Durlauf (2001). The *social utility* of an agent playing action i is:

$$-\sum_{j \in A} s_{ji} p_j,$$

where s_{ji} represents how much pressure an agent choosing j exerts on someone choosing i . As is common in the literature, we assume $s_{ii} = 0$ for all i , $s_{ij} > 0$ for all $i \neq j$, and $s_{ij} = s_{ji}$ for all i, j . There are therefore three distinct parameters: s_{LM} , s_{LH} , and s_{MH} . Assume

$$s_{LH} > s_{LM} \text{ and } s_{LH} > s_{MH}. \quad (3)$$

This means that agents disapprove more of actions that are more different from theirs (as measured in terms of their intrinsic utilities). For example, in the case of FGC, agents choosing Pharaonic disapprove more of agents not cutting than of agents choosing

Sunna.¹³

In summary, the utility of an agent choosing action i in state p is

$$v_i(p) = u_i - \sum_{j \in A} s_{ji} p_j. \quad (4)$$

In section 2.3 we introduce heterogeneity and relax the assumption that all agents have the same utility functions.

The population size m , the action set A , and the payoff function $v_i : \tilde{\Delta} \rightarrow \mathbb{R}$ define a stage game, which we will call $\mathcal{G}$.

For $i \neq j$, define the unit-switching vector $e^{ij} \in \mathbb{R}^3$ as follows: $e_i^{ij} = -\delta$, $e_j^{ij} = \delta$, and $e_k^{ij} = 0$ for $k \neq i, j$. Thus if the current state is p and an agent switches from i to j , the new state is $p + e^{ij}$. It will be convenient to let $e^{ii} = (0, 0, 0)$ for all i . Let $B_i(p)$ denote the set of best responses in state p for an agent playing i ; that is,

$$B_i(p) = \arg \max_{j \in A} v_j(p + e^{ij}). \quad (5)$$

The unit-switching vector is necessary because an agent who switches actions does not sanction herself.

Time is continuous and agents update their actions via independent Poisson arrival processes with unit expectation. Thus, every agent updates once per unit of time in expectation. In the version of the model without heterogeneity (section 2.2), agents always choose a best response to the current state when they update. In the version with heterogeneity (section 2.3), agents will usually choose a best response but sometimes deviate due to preference shocks or simply mistakes. Let $\sigma_{ij}(p)$ be the probability that an agent playing i switches to j when the current state is p . Let $\sigma(p) = (\sigma_{ij}(p))_{i,j \in A}$ represent the process thus defined. The process is a *perturbed best-reply process* if $\sigma_{ij}(p)$ is positive and small for all non-best replies.

The analysis below will be simplified by observing that the game $\mathcal{G}$ is a potential game (Monderer & Shapley, 1996). In a potential game, the incentive to change action at any state is captured by a single function for all players.

Claim 1. $\mathcal{G}$ is a potential game with potential function $\rho : \tilde{\Delta} \rightarrow \mathbb{R}$ given by

$$\rho(p) = m \sum_{i \in A} p_i u_i - \frac{m}{2} \sum_{i \in A} \sum_{j \in A} p_i p_j s_{ij}. \quad (6)$$

¹³ In section 3.3.2 we provide evidence that the assumption holds in Somalia for the actions considered. Note that it need not hold in other applications. For instance, one may conjecture that in a setting where different actions are markers for different identities, adopting an intermediate action that was characteristic of an outsider group could be more heavily sanctioned than adopting an extreme action.

Proof. See appendix. □

Let ρ^* be the maximum potential across all states; that is,

$$\rho^* = \max_{p \in \tilde{\Delta}} \rho(p). \quad (7)$$

Let γ be the smallest nonzero increase in payoff a player can get from switching actions. To be precise, let γ be the solution to:

$$\begin{aligned} \min_{i,j \in A, p \in \tilde{\Delta}} \quad & v_j(p + e^{ij}) - v_i(p) \\ \text{s.t.} \quad & p_i > 0, \text{ and} \\ & v_j(p + e^{ij}) > v_i(p). \end{aligned} \quad (8)$$

2.2 Best-response dynamics

We start by considering the case without heterogeneity, so that agents always choose best responses to the current state. In case of a tie, they pick an action at random. The probability of a player switching from i to j in state p is therefore

$$\sigma_{ij}(p) = \frac{\mathbf{1}_{B_i(p)}(j)}{|B_i(p)|}, \quad (9)$$

where $\mathbf{1}_{B_i(p)}(j)$ equals 1 if $j \in B_i(p)$ and 0 otherwise.

Let $p^i \in \tilde{\Delta}$ denote the state in which all players choose i . We will refer to p^i as a *norm*. We first observe that any strict equilibrium must be a norm.

Claim 2. If $p \in \tilde{\Delta}$ is a strict Nash equilibrium of $\mathcal{G}$, then p is a norm. Moreover, p^H is always a strict Nash equilibrium of $\mathcal{G}$.

Proof. For the first part, suppose to the contrary that p is a strict Nash equilibrium of $\mathcal{G}$ but is not a norm. Then there exist two actions i and j such that $p_i, p_j > 0$, $v_i(p) > v_j(p + e^{ij})$, and $v_j(p) > v_i(p + e^{ji})$. Since $v_i(p + e^{ji}) > v_i(p)$, we have $v_j(p) > v_i(p)$. But similarly $v_j(p + e^{ij}) > v_j(p)$, so $v_i(p) > v_j(p)$, which contradicts the previous statement.

For the second part, note that $v_H(p^H) = u_H$ and that for all $p \in \tilde{\Delta}$, $v_L(p) < u_H$ and $v_M(p) < u_H$. □

We say that a norm is *stable* if it is a Nash equilibrium of $\mathcal{G}$; it is *strictly stable* if it is a strict Nash equilibrium. As a shorthand, we will refer to p^i as norm i and we will say i is stable if p^i is stable. Claim 2 implies that there exists at least one strictly stable norm.

Clearly, if the process starts at a strictly stable norm, it will stay there. Next, we establish that the process converges to a strictly stable norm from any initial state. Recall that γ is the smallest nonzero increase in payoff from switching actions.

Theorem 1. From any initial state $p \in \tilde{\Delta}$, the process converges to a strictly stable norm in finite time with probability one, and the expected waiting time is at most

$$4 \frac{\rho^* - \rho(p)}{\gamma}. \quad (10)$$

Proof. The theorem is a special case of theorem 2 below. $\square$

Note that theorem 1 rules out the possibility of converging to a weakly stable norm; intuitively, this is because from any weakly stable norm there is a positive probability of entering the basin of attraction of a strictly stable norm. Theorem 1 also rules out converging to a state that isn't a norm.

We can now define the concept of stepping stone. For any two actions i, j , we will say i is j -stable if $v_i(p^i) \geq v_j(p^i + e^{ij})$. Clearly, i is stable if and only if it is j -stable for all $j \neq i$. Action i is *strictly* j -stable if $v_i(p^i) > v_j(p^i + e^{ij})$.

We will say that action M is a stepping stone if it destabilizes L and is not strictly stable. Intuitively, this means that players at p^L will deviate to M but not H , after which players at M will deviate to H .

Definition 1. M is a *stepping stone* in the best-response model if L is H -stable and is not strictly M -stable, and M is not strictly stable. M is a *strict stepping stone* if, in addition, L is strictly H -stable.

If M is a stepping stone, then theorem 1 immediately implies that from any starting state, the process will converge to p^H . This is because when M is a stepping stone, H is the only strictly stable norm.

Proposition 1 establishes necessary and sufficient conditions for M to be a stepping stone. Recall that $\delta = 1/m$.

Proposition 1. M is a stepping stone if and only if

$$\begin{aligned} \frac{s_{LH}}{u_H - u_L} &\geq \frac{1}{1 - \delta}, \\ \frac{s_{LM}}{u_M - u_L} &\leq \frac{1}{1 - \delta}, \text{ and} \\ \frac{s_{MH}}{u_H - u_M} &\leq \frac{1}{1 - \delta}. \end{aligned} \quad (11)$$

Proof. i is j -stable if and only if

$$v_i(p^i) \geq v_j(p^i + e^{ij}) \quad (12)$$

$$\iff u_i - \sum_{k \in A} s_{ik} p_k^i \geq u_j - \sum_{k \in A} s_{jk} (p_k^i + e_k^{ij}) \quad (13)$$

$$\iff u_i - u_j \geq \sum_{k \in A} (s_{ik} - s_{jk}) p_k^i - \sum_{k \in A} s_{jk} e_k^{ij} \quad (14)$$

$$\iff u_i - u_j \geq -s_{ij} + \delta s_{ij} \quad (15)$$

$$\iff u_i - u_j \geq -(1 - \delta) s_{ij}. \quad (16)$$

Thus if $u_i \geq u_j$, i is always j -stable. If $u_i < u_j$, i is j -stable if and only if

$$\frac{s_{ij}}{u_j - u_i} \geq \frac{1}{1 - \delta}. \quad (17)$$

Then the inequalities in expression (11) follow. $\square$

Intuitively, the first inequality in expression (11) means that the social sanction for going from L to H should be high relative to the corresponding gains in intrinsic utility. The last two inequalities mean that the social sanctions for going from L to M and then from M to H should be small relative to the corresponding gains in intrinsic utility. In other words, M must be a good *social substitute* for both L and H .

A way to see this directly is to note that a necessary condition for M to be a stepping stone is the *reverse triangle inequality*:

$$s_{LH} \geq s_{LM} + s_{MH}. \quad (18)$$

One can thus think of stepping stones as requiring a form of convexity of sanctions, which does not depend on the intrinsic utilities. In the Appendix, where we extend to n actions, we provide a formal justification for this intuition.

Claim 3. If the inequalities in expression (11) hold, then inequality (18) holds.

Proof. Expression (11) implies

$$s_{LM} + s_{MH} \leq \frac{u_M - u_L}{1 - \delta} + \frac{u_H - u_M}{1 - \delta} \quad (19)$$

$$= \frac{u_H - u_L}{1 - \delta}. \quad (20)$$

But $s_{LH} \geq (u_H - u_L)/(1 - \delta)$, so $s_{LH} \geq s_{LM} + s_{MH}$. $\square$

We now ask how a stepping-stone transition happens. To avoid degeneracy, we con-

sider the case where M is a strict stepping stone. Let

$$q^* = \frac{u_M - u_H + (1 - \delta)(s_{LH} - s_{LM})}{s_{LH} - s_{LM} - s_{MH}}. \quad (21)$$

We will see that q^* is the proportion of M -players at which agents start to switch to H .

Proposition 2. Suppose M is a strict stepping stone and the process starts at p^L . At first, all agents who get a revision opportunity will deviate to M . When at least q^* of agents are playing M , L -players will start to switch to H , after which M -players also switch to H .

Proof. Let q be the proportion of agents at M and $1 - q$ the proportion at L , so there are none at H . Let $v_{ij}(q)$ be the payoff a player at i gets from playing j given q . Since M is a strict stepping stone, we know that $v_{LM}(0) \geq v_{LL}(0) > v_{LH}(0)$. That is, at p^L , L -players switch to M with positive probability.

L -players start to switch to H when

$$v_{LH}(q) \geq v_{LM}(q) \quad (22)$$

$$\iff u_H - (1 - q - \delta)s_{LH} - qs_{MH} \geq u_M - (1 - q - \delta)s_{LM} \quad (23)$$

$$\iff q \geq \frac{u_M - u_H + (1 - \delta)(s_{LH} - s_{LM})}{s_{LH} - s_{LM} - s_{MH}} \quad (24)$$

$$\iff q \geq q^*. \quad (25)$$

Similarly, M -players start to switch to H when

$$v_{MH}(q) \geq v_{MM}(q) \quad (26)$$

$$\iff u_H - (1 - q)s_{LH} - (q - \delta)s_{MH} \geq u_M - (1 - q)s_{LM} \quad (27)$$

$$\iff q \geq \frac{u_M - u_H + s_{LH} - s_{LM} - \delta s_{MH}}{s_{LH} - s_{LM} - s_{MH}} \quad (28)$$

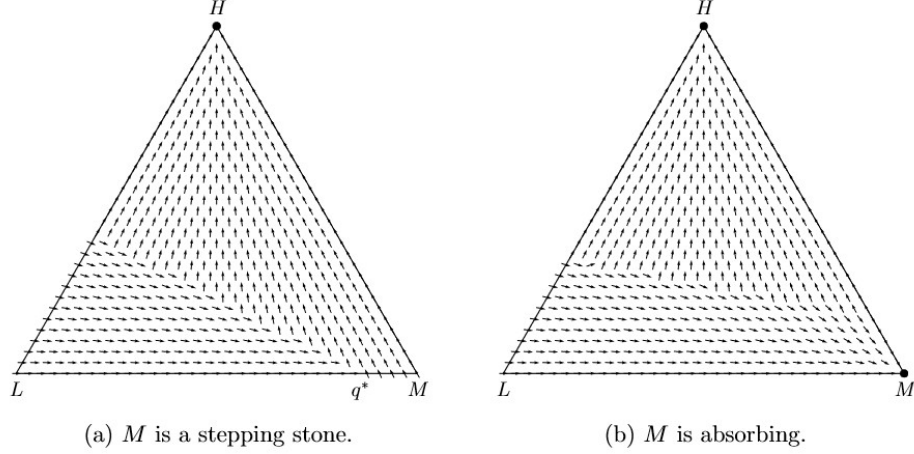
$$\iff q \geq q^* + \delta. \quad (29)$$

So L -players will start to switch to H when least q^* of agents are playing M , after which M -players will also switch to H . $\square$

Proposition 2, and the behavior of the process in general, can be illustrated using phase diagrams. These become increasingly exact for large m .

Example 1 ($u_L = 0$, $u_M = 0.5$, $u_H = 1$, $s_{LM} = 0.4$, $s_{LH} = 1.5$, $s_{MH} = 0.4$). Figure 2a shows an example where M is a stepping stone. The arrows show the direction of travel and the filled circle shows the unique stable state of the process. Starting at p^L , the norm is destabilized as agents switch to M . Once the process reaches q^* , action H becomes a best response and agents start to switch to H . The process converges to p^H .

Figure 2: Dynamics when M is a stepping stone and when it is absorbing.



Example 2 ($u_L = 0$, $u_M = 0.5$, $u_H = 1$, $s_{LM} = 0.4$, $s_{LH} = 1.5$, $s_{MH} = 0.75$). Figure 2b shows an example where M is not a stepping stone. The only difference in the parameters is that s_{MH} is higher than in example 1. As before, from p^L , agents start to switch to M . However H never becomes a best response because M is stable. Instead the process converges to p^M .

Proposition 2 suggests a possible drawback of stepping stones: because the dynamics must spend time travelling towards the intermediate norm before converging to the high-utility norm, the introduction of a stepping stone does not unambiguously improve welfare. If it is possible to convince players to switch to the high-utility action directly this could take less time overall and lead to higher total welfare. In proposition 3, we provide estimates of the waiting time for direct and indirect transitions. In contrast to the result in theorem 1, which was an upper bound on convergence time, here we provide an estimate that becomes exact as m becomes large.

Recall that q^* is the fraction of M -players needed for agents to start switching to H when M is a stepping stone.

Proposition 3. Given $q \in (0, 1)$, starting from p^L , let T be the expected waiting time to reach a state in which at least q of agents play H . If H is the unique best response at p^L , then $T \approx \ln\left(\frac{1}{1-q}\right)$ when m is large. If M is a strict stepping stone, then $T \approx \ln\left(\frac{1}{1-q^*-\delta}\right) + \ln\left(\frac{1}{1-q+\delta}\right)$ when m is large.

Proof. First, consider the case in which H is the unique best response at p^L . Starting at p^L , each time a revision opportunity arises, if an L -player is selected she switches to H , and if an H -player is selected she stays at H . Recall that $\delta = 1/m$. In expectation, it takes 1 revision opportunity for the first switch to occur, $\frac{1}{1-\delta}$ for the second to occur,

$\frac{1}{1-2\delta}$ for the third, and so on. In expectation, m revision opportunities occur per unit of time. Therefore, when m is large, the expected waiting time to reach a state in which q of players have switched to H is approximately

$$\delta + \frac{\delta}{1-\delta} + \frac{\delta}{1-2\delta} + \cdots + \frac{\delta}{1-q} \quad (30)$$

$$\approx \int_{1-q}^1 \frac{1}{x} dx \quad (31)$$

$$= \ln \left(\frac{1}{1-q} \right). \quad (32)$$

Next, consider the case in which M is a stepping stone. Again, we start at p^L . Initially, each time a revision opportunity arises, if an L -player is selected she switches to M , and if an M -player is selected she stays at M . By proposition 2, this continues until the fraction of players having switched to M is q^* or more. Thereafter, any L -player who revises switches to H , and as soon as this happens at least once, M -players also switch to H . The first step of the transition takes approximately a proportion $q^* + \delta$ of agents switching; the second step takes approximately a proportion q of agents. Thus by an analogous argument to the one in the preceding paragraph, when m is large, the expected waiting time to reach a state in which at least q of players have switched to H is approximately $\ln \left(\frac{1}{1-q^*-\delta} \right) + \ln \left(\frac{1}{1-q+\delta} \right)$. $\square$

Thus, it is always faster to go from L to H directly (when that is possible) than via the intermediate action M . The time it takes to converge to H depends on the frequency of agents' revision opportunities. In the context of FGC we may think of the parents as taking the decision, and the frequency of decisions will depend on the spacing between daughters. Thus the rate of convergence to a higher-welfare equilibrium could be quite slow with or without a stepping stone.

To conclude our analysis, we look at convergence under different parameter values, starting at p^L . First, consider the case in which L is H -stable. If M is a stepping stone, the process will converge to H . Otherwise, it will either stay at L or converge to M . Figure 3 shows which norm the process converges to for different values of the parameters. In figure 3a we take $u_L = 0$, $u_M = 1/2$, $u_H = 1$, and $s_{LH} = 3/2$, and we study the process as s_{LM} and s_{MH} vary. (We also take the population size m to be arbitrarily large.) When s_{LM} is too large, the process never leaves L as it is stable. When s_{LM} is small but s_{MH} is large, the process stays at M . Only when both s_{LM} and s_{MH} are small enough – that is, when M is a close enough “social substitute” for both L and H – does the process converge to H . This corresponds to the conditions for M to be a stepping stone in expression (11).

How is the process affected by changes in the intrinsic utility of different actions? In figure 3b, we increase u_M to $3/4$. Changing u_M has two effects: on the one hand,

Figure 3: Convergence under different values of s_{LM} and s_{MH} when $s_{LH} = 3/2$.

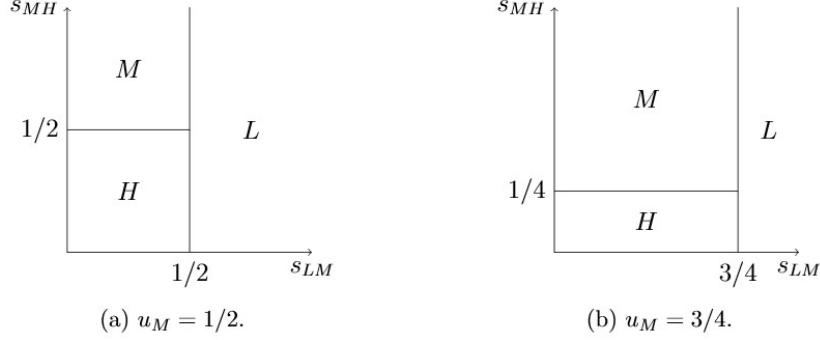
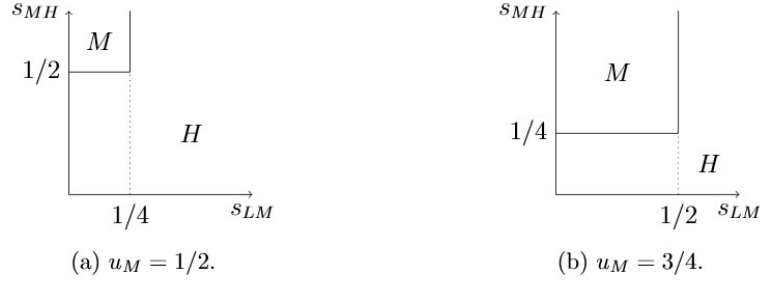


Figure 4: Convergence under different values of s_{LM} and s_{MH} when $s_{LH} = 3/4$.



L becomes less stable, in the sense that there are fewer parameter values for which the process stays at L ; on the other hand, M becomes more stable and the process is more likely to stay stuck at M .

Next, consider the case in which L is not H -stable. Then the process will either converge to H or M . In figure 4a we keep $u_L = 0$, $u_M = 1/2$, and $u_H = 1$, and reduce s_{LH} to $3/4$. The figure shows that the process will converge to M if s_{LM} is small enough and s_{MH} is large enough. If s_{LM} is too large, then H is more attractive than M starting from L , and the process converges directly to H . If s_{MH} is too small, then M is not stable so the process doesn't stay there. In figure 4b, we increase u_M to $3/4$. This unambiguously increases the set of values of s_{LM} and s_{MH} for which the process converges to M .

Finally, we summarize the welfare implications of the introduction of an intermediate norm. The analysis above allows us to distinguish two main cases:

Case 1: L is H -stable. In this case, introducing the intermediate norm M weakly improves welfare. The process will either stay at L , converge to M , or converge to H . But since it would otherwise stay at L , welfare is at least as high as before.

Case 2: L is not H -stable. In this case, the welfare impact of introducing M is ambiguous. In particular:

- (i) if H remains the unique best response when M is introduced, then welfare is unaffected;
- (ii) if M becomes a best response and is absorbing, then welfare is reduced;
- (iii) if M becomes a best response and is not absorbing, then the process still converges to H but at a slower pace, so that welfare is reduced.

The main takeaway is therefore that intermediate norms have the potential to increase welfare when starting from a situation in which society is “locked” into a bad equilibrium (in the sense that L would not be abandoned in favor of H). However, if the prevailing norm is L but society would spontaneously transition to H , then the introduction of M can only reduce welfare –or at best leave it unchanged.

2.3 Heterogeneity

We now consider the case with heterogeneity and show that this can result in novel dynamics. Heterogeneity can arise from differences in agents’ preferences (whether persistent or transitory) on the one hand, and from random deviations due to inattention, misperceptions, experiments, and the like on the other hand.

A standard model for heterogeneity arising from preference shocks is the logit distribution. This results when an agent’s utility for different actions is subjected to i.i.d. shocks that are extreme-value distributed (Blume, 1993; McKelvey & Palfrey, 1995; Brock & Durlauf, 2001). In this case

$$\sigma_{ij}(p) \approx \frac{e^{\beta v_j(p)}}{\sum_{k \in A} e^{\beta v_k(p)}}, \quad (33)$$

with the approximation becoming increasingly exact as the population size increases.

A standard model for heterogeneity arising from random deviations is the *uniform error process* (Kandori *et al.*, 1993; Young, 1993; Jackson, 2008) defined by

$$\sigma_{ij}(p) = \frac{\varepsilon}{3} + (1 - \varepsilon) \frac{\mathbf{1}_{B_i(p)}(j)}{|B_i(p)|}, \quad (34)$$

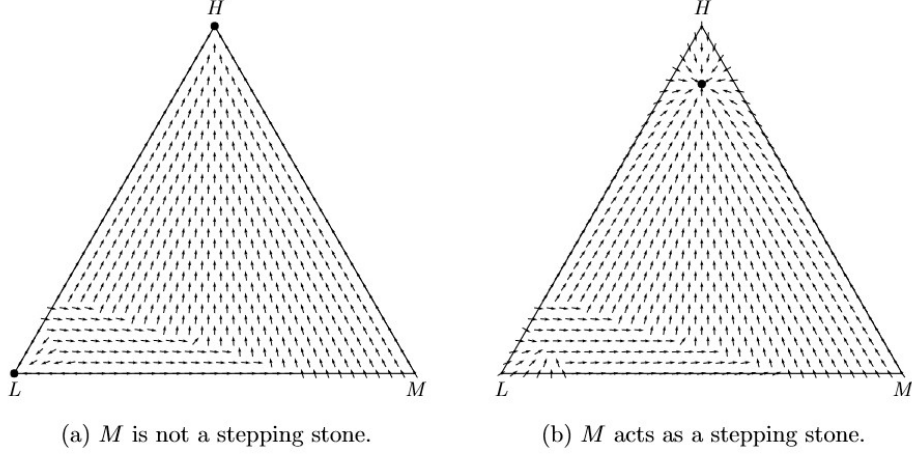
for some small $\varepsilon > 0$.

We don’t take a position on which form of heterogeneity is most applicable to the present context; instead, we focus on how heterogeneity in general affects the qualitative properties of the dynamics.¹⁴

Heterogeneity means that at any given point in time, the prevailing norm will be

¹⁴ For experimental evidence on heterogeneity in games, see Lim & Neary (2016) and Mäs & Nax (2016). Platteau *et al.* (2018) model preference heterogeneity in the context of FGC assuming that individuals differ in their cost of following the custom. They then derive predictions on how coordination devices (such as public declarations) or laws affect the equilibrium norm.

Figure 5: M acts as a stepping stone with enough heterogeneity.



followed by most people but not by everyone, which is typically what we see in practice. The distribution $\sigma(p)$ determines the expected degree of heterogeneity in the population. Heterogeneity is decreasing in β (in the logit model) and increasing in ε (in the uniform model). It is important to note, however, that the *realized* degree of heterogeneity is constantly in flux due to the random nature of the process.

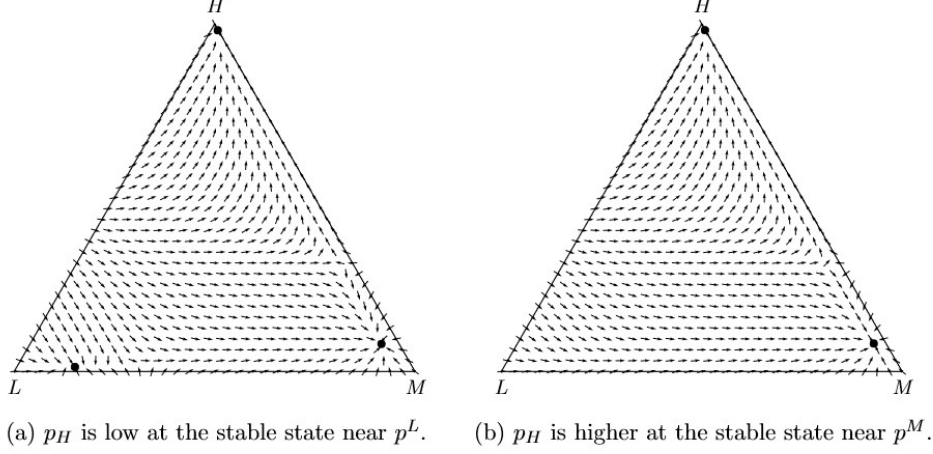
We now turn to the ways in which heterogeneity introduces novel dynamics. It is possible to analyze the dynamics formally using stochastic approximation theory (Benaim & Weibull, 2003; Hofbauer & Sandholm, 2007), but the key intuitions are more easily grasped by means of examples.

First, when heterogeneity is present the intermediate action M *can play the role of a stepping stone even if it is not one in the best-response process*. The intuition is that, in the presence of heterogeneity, there is typically a strictly positive fraction of the population that is not playing L ; hence it is easier to destabilize the norm p^L . We illustrate with the following example.

Example 3 ($u_L = 0$, $u_M = 0.5$, $u_H = 1$, $s_{LM} = 0.75$, $s_{LH} = 1.5$, $s_{MH} = 0.4$). Initially, consider the best-response process. This is illustrated in figure 5a. L is stable, so M is not a stepping stone. Indeed, the conditions in expression (11) fail as $s_{LM}/(u_M - u_L) = 1.5 > 1/(1 - \delta)$ for $m \geq 4$.

Now consider the same parameters, but under the uniform error process with $\varepsilon = 0.25$. Then random deviations push the process away from the boundaries, which results in the dynamics illustrated in figure 5b. Consider a starting state near p^L . Initially, the process travels towards p^M . Once the proportion of M -players reaches a certain level, agents start to switch to H . Eventually, the process converges to a stable state in the vicinity of p^H . Thus, in this case, M plays the role of a stepping stone, even though it isn't one

Figure 6: p_H can increase even when M is absorbing.



under the best-response process.

Another interesting feature introduced by heterogeneity is the following. In the best-response process, we saw that when M was a stepping stone, starting at p^L , people first switched to M and only then switched to H (proposition 2). In contrast, when M was absorbing, no agents ever switched to H . Thus any increase in the proportion of H -players would imply that M is a stepping stone. In the process with heterogeneity, however, this need not be true: *the proportion of H -players can increase even if M is absorbing*. We illustrate with the following example.

Example 4 ($u_L = 0.25$, $u_M = 0.5$, $u_H = 1$, $s_{LM} = 2.5$, $s_{LH} = 5$, $s_{MH} = 3$). Consider the logit process with $\beta = 1.2$. Initially, suppose $u_L = 0.25$. The dynamics are illustrated in figure 6a. Suppose we start at the stable state near p^L : the majority of agents are playing L , with a significant fraction playing M , and a negligible fraction playing H .

Then suppose an exogenous change makes u_L drop to 0. The dynamics are now as shown in figure 6b. The previous state is no longer stable. Instead, starting in the vicinity of p^L , the process converges to the stable state near p^M . At that stable state, the majority of agents play M , with a negligible fraction playing L and non-negligible fraction playing H . Thus an increase in the proportion of H -players does not allow us to conclude that M is a stepping stone.

Intuitively, when the majority of agents are playing L , the sanctions for playing H are high. So very few agents are willing to play H . In contrast, when the majority of agents are playing M , the sanctions for playing H are relatively low. So a larger fraction of agents are willing to play H .

2.4 Discussion

In the interest of analytical tractability the preceding model makes several simplifying assumptions that are fairly standard in the social interactions literature, but that may or may not be empirically valid. One is the assumption that everyone knows the current prevalence of each action in society, and can therefore accurately predict social sanctions. This assumption is most plausible in small communities; in larger communities it may be more reasonable to assume agents only have partial information, say based on the actions of a subset of the community. Another assumption is that social sanctions are symmetric ($s_{ij} = s_{ji}$). This is common in the literature and is made for analytical convenience. Both assumptions can be relaxed and the resulting process can be analyzed using the theory of perturbed Markov processes (Young, 1993, 1998; Kandori *et al.*, 1993).

A final assumption concerns the ordering of the intrinsic utilities of the various actions. In the context of our application, we assume that the intrinsic utility of Uncut is higher than that of Sunna, which is higher in turn than that of Pharaonic. This is plausible – and indeed in section 3.3.1 we provide evidence that this is the case – if intrinsic utilities reflect, for example, health costs. However, intrinsic utilities could also reflect other considerations and some of these considerations may reverse the ranking. For instance, some agents might prefer Sunna to Uncut for religious reasons, regardless of what other agents chose. To take an extreme case, suppose the intrinsic utilities of M and H are flipped in the model, so that $u_M > u_H > u_L$. In this case, M will be absorbing and cannot serve as a stepping stone. In what follows, we focus on the case where stepping-stone transitions via M are, at least in principle, possible, hence our assumption on the ranking of intrinsic utilities.

3 Empirical Application: FGC in Somalia

In this section we apply the model to the case of FGC using originally collected data from Somalia.

3.1 Context

We start by giving some background on FGC in general and on FGC in Somalia in particular. FGC is the practice of cutting or removing part of the external female genitalia for non-medical reasons. An estimated 200 million women are cut worldwide (UNICEF, 2016) and every year, 3 million female infants and children are at risk of undergoing FGC (Spisma *et al.*, 2012). This practice is also quite geographically dispersed, being present in 29 African and Middle Eastern countries (Camilotti, 2016). In some of these countries FGC is almost universal: the share of cut women is 98% in Somalia, 96% in Guinea, 93% in Djibouti, and 91% in Egypt and Sierra Leone (Yoder *et al.*, 2013). FGC is a

harmful practice, as it leads to serious health consequences both at the time of cutting (e.g., excessive bleeding and increased mortality) and in the long run (e.g., birth-related complications).¹⁵ Also, given that FGC is generally performed on young girls without their informed consent, it is considered a human rights violation (Mackie, 1996).

The WHO distinguishes three main types of female circumcision: *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*, also known as infibulation, is the narrowing of the vaginal orifice with the creation of a covering seal by cutting and appositioning the labia minora and/or the labia majora, sometimes through stitching.¹⁶

We will focus on this difference in Somalia, where FGC is divided into two broad categories: “Sunna” (types I–II) and “Pharaonic” (type III). Historically, Pharaonic circumcision was the dominant type in Somalia, practiced almost universally (Abdalla, 1982). Sunna was introduced in Somalia much later than the Pharaonic type.¹⁷ In 1984 the Inter-African Committee on harmful traditional practices affecting the health of women and children was established and in the 1990s pushes for abandonment gained momentum. Anecdotal evidence suggests that there was “a shift from infibulation to Sunna [...] as a result of FGC campaigns that have been emphasizing health effects of infibulation” (MOLSA, 2009). This shift was facilitated by religious leaders who started opposing Pharaonic as harmful and non-Islamic, but supported Sunna as in line with Islam (Newell-Jones, 2016). More recently, a religious Fatwa issued in 2018 in Somaliland banned the practice of Pharaonic circumcision, but not of the Sunna type.¹⁸

3.2 Data Description

We use data from a household survey that we conducted in 141 communities in Somalia between January and May 2020. The communities are located in Somaliland and Puntland regions of Somalia, specifically in the districts of Badhan, Buraou, Erigabo, Galdagob, Galkayo and Hargeisa. Online Appendix Figure O.1 shows the locations of these communities. The survey collected information on a sample of 4,130 individuals – on av-

15 Adam *et al.* (2010) estimate that across six African countries and within a cohort of 15-year-old women, a loss of 130,000 life years is expected due to FGC’s association with obstetric hemorrhage.

16 A fourth type includes “all other harmful procedures to the female genitalia for non-medical purposes, e.g. pricking, piercing, incising, scraping and cauterizing the genital area,” but traditionally the main types considered are types I to III.

17 Historical accounts suggest that the intermediate type of cutting was first introduced in Sudan, as a result of the prohibition of infibulation by the British colonial authorities in 1945 (El Dareer, 1982; Slack, 1988).

18 The text of the Fatwa is the following: “It’s forbidden to perform any circumcision that is contrary to the religion which involves cutting and sewing up, like the pharaoh circumcision. (...) Any one proven to be performing the practice will receive punishment depending on the extent of the violation.” (Ahmed *et al.*, 2018)

erage 29 per community – roughly equally split by gender (2,040 men and 2,090 women). The respondents were sampled from the list of participants in community meetings that were conducted as part of an ongoing project (Gulesci *et al.*, 2020).¹⁹

The survey collected information on household demographics, socioeconomic status, and detailed questions on gender norms. In particular, we elicited information on respondents’ own attitudes as well as their perceptions of community members’ attitudes towards different types of FGC. We also collected the history of FGC types in the respondents’ family, a list of those among their daughters that were cut (or were intended to be cut) and those that were uncut (and intended to remain so). For all cut daughters, we asked what type of FGC was performed on them. Finally, we elicited expectations about community reactions to deviations from FGC, to understand the degree of social pressure that may be faced by people deciding not to comply with local norms.

In our sample of women and girls aged 12 to 82, 41 percent are Pharaonic cut, 55 percent are Sunna cut, and 3 percent are uncut. Online Appendix Table O.1 presents summary statistics on the age at cutting and the relevant decision makers by type of FGC. We see that on average, girls are cut at the age of nine and this is true for both Sunna and Pharaonic. The decision to cut is most often taken by the mother: mothers are reported as making the decision about circumcision for 78 percent of girls who are Pharaonic cut and 90 percent of the girls who are Sunna cut.

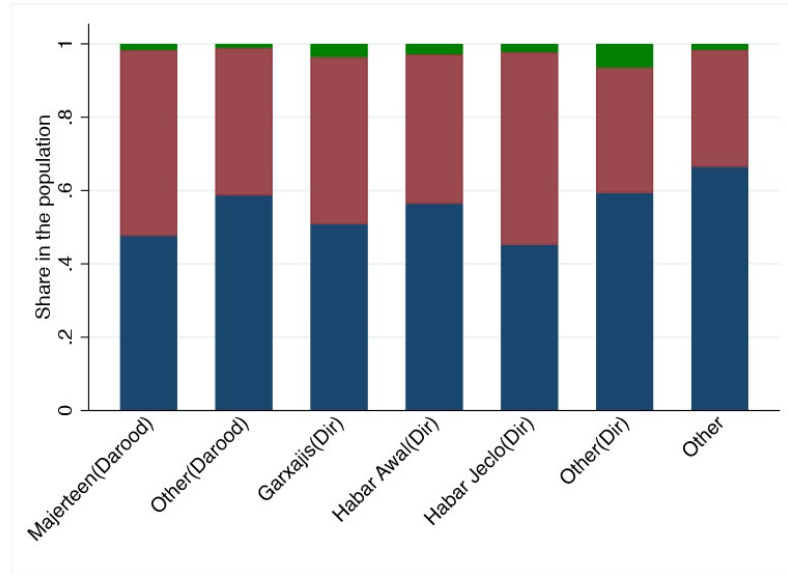
Due to the sensitive nature of the questions related to FGC status, one may worry about reporting bias. In order to assess this, we followed Dhar *et al.* (2020) and collected information on respondent’s propensity to give socially desirable answers using the scale developed by Crowne & Marlowe (1960). In Online Appendix Table O.2 we compare the type of FGC reported by respondents with high and low social desirability, as measured by the index. We do not find any evidence of differential reporting in types of FGC, suggesting that reporting bias in FGC status due to social desirability may not be a significant concern in our context.

Figure 7a shows the prevalence of FGC by type for girls and women aged 12 and above, across sub-clans. Our sample includes two main clans, Darood and Dir, which can be further subdivided into two and four sub-clans, respectively. Two facts emerge from the figure: first, the fraction of uncut girls and women is very small across all sub-clans. Second, neither clans nor sub-clans specialize in a given type of FGC: while not exactly a 50:50 split, all sub-clans have sizeable fractions of women who are Pharaonic-cut and women who are Sunna-cut.

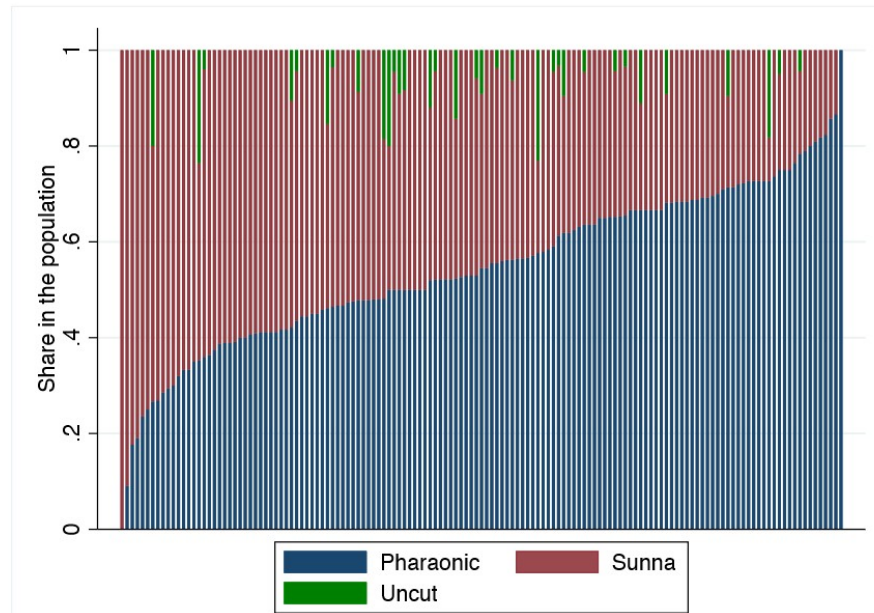
¹⁹ These meetings were organized in collaboration with the NGO *Save the Children* and were facilitated by local personnel trained in interpersonal communication on sensitive topics. When participants were recruited to take part in the meetings, they were not informed that FGC would be discussed. The meetings were advertised as part of a research effort aimed towards better understanding local conditions and community life.

Figure 7: FGC Types

(a) By sub-clan



(b) By community



Notes: Sample is restricted to respondents and their daughters aged 12 or older. Sample shares: 17% Majerteen(Darood), 28% Other(Darood), 16% Garxajis(Dir), 14% Habar Awal(Dir), 13% Habar Jeclo(Dir), 7% Other(Dir), 5% other.

In Figure 7b we show the prevalence of FGC types at the community level: each bar corresponds to one of the 141 communities in our sample. At this level we find considerably more variation, both in the share of uncut women and, especially, in the share of Pharaonic vs. Sunna-cut. While in many communities the two types of FGC are almost equally prevalent, there is a sizeable number of communities in which one form dominates. Below we relate this heterogeneity to the predictions of our model.

3.3 Evidence on model parameters

We start by using our data to assess the relative magnitudes of the model parameters, and whether action M (i.e., Sunna) is likely to be playing the role of a stepping stone.

3.3.1 Ranking of intrinsic utilities

One of the pre-conditions for the existence of a stepping stone in our model is that the ranking of intrinsic utilities satisfies $u_L < u_M < u_H$. To explore this condition empirically, we use as a proxy for the u_j 's the health costs associated to the various alternatives, as reported by respondents in our survey. In other words, we test whether respondents are aware that Pharaonic circumcision is more likely to lead to health complications, compared to Sunna (not cutting obviously has no health complications).

Table 1 shows that women in our sample are more likely to have experienced health complications if they had Pharaonic circumcision as opposed to Sunna: about 63 percent of Pharaonic-cut respondents report complications due to FGC, while the corresponding rate is 12 percent for Sunna-cut women. When asked about their daughters, 59 percent of respondents whose daughters had Pharaonic circumcision report that their daughter(s) experienced complications, while the corresponding rate for Sunna is only 3 percent.

In line with this, the bottom panel of Table 1 shows that, when we break down responses by type of health complication expected from the different procedures, each and every category is perceived as more likely under Pharaonic circumcision. For example, 40 percent of respondents believe infection is a likely consequence of Pharaonic circumcision, ten times more than for Sunna; 57 percent associate severe bleeding with Pharaonic, and only 3 percent with Sunna. Similarly, 61 percent believe Pharaonic circumcision may cause difficulties in giving birth, while only 4 percent think that Sunna would do so. Reductions in sexual feeling and difficulty in penetration are also much more associated with Pharaonic than with Sunna.

One important aspect to notice in Table 1 – to which we return below – is that the perceived health costs of Sunna are rather low: when asked a separate question about expected (not experienced) health complications, only 6 percent of respondents think that Sunna circumcision would lead to any health complications.

In practice, u_i will depend on many factors besides health consequences, factors that

Table 1: Evidence on ranking: $u_L < u_M < u_H$

	(1)		(2)	
	<i>Pharaonic</i>		<i>Sunna</i>	
	Mean	Std. dev.	Mean	Std. dev.
Panel A: Complications experienced by respondents				
Any health complication (Yes=1)	0.626	(0.484)	0.115	(0.319)
<i>N</i>	1,437		406	
Panel B: Complications experienced by daughters				
Any health complication (Yes=1)	0.586	(0.493)	0.030	(0.170)
<i>N</i>	1,641		3,161	
Panel C: Perceived health complications				
Any perceived complication	0.749	(0.434)	0.062	(0.241)
Infection	0.402	(0.491)	0.043	(0.202)
Bleeding	0.566	(0.496)	0.030	(0.170)
Difficulty in delivery	0.606	(0.489)	0.036	(0.186)
Reduction in sexual feeling	0.463	(0.499)	0.032	(0.176)
Difficulty in penetration	0.326	(0.469)	0.004	(0.063)
Other	0.013	(0.115)	0.004	(0.063)
Number of complications	2.376	(1.732)	0.165	(0.731)
<i>N</i>	975		3,779	

Notes: In Panel A, the sample in column 1 (2) includes female respondents who reported that they were cut Pharaonic (Sunna). In Panel B, the sample in column 1 (2) includes respondents who reported that their daughter/s was/were cut Pharaonic (Sunna). In Panel C, the sample in column 1 (2) includes respondents who reported that Pharaonic (Sunna) cut was practiced in their community.

may be difficult to measure and to aggregate into a single parameter.²⁰ Nevertheless, one would expect health consequences to be one of the most important factors entering intrinsic utilities. To the extent that this is true, our data support the ranking $u_L < u_M < u_H$.

3.3.2 Ranking of social costs

Another important necessary condition for a stepping stone to exist concerns the ranking of the social parameters s_{ji} (expression (3)). As discussed in section 2.1, it is not obvious that this condition should hold – in particular, it might depend on the social meaning assigned to the different actions. To evaluate this assumption, we asked respondents a series of questions specifically designed to elicit bilateral comparisons between Pharaonic, Sunna, and Uncut.

We presented each respondent with different situations where hypothetical parents have cut their daughter with a certain type of FGC, but their daughter-in-law may have a different type of FGC.²¹ For example, we asked: “Suppose a mother and father in your community chose Pharaonic circumcision for their daughter, but their son wants to marry a girl with Sunna. How would these parents feel?” The possible answers were: “happy”, “indifferent”, or “unhappy”. We repeated the same question for Sunna vs. Uncut and for Pharaonic vs. Uncut. Appendix Figure O.4 provides a visual summary of the responses. The rationale underlying these questions about hypothetical parents is not to ask respondents how *they themselves* would feel, but to elicit second-order beliefs about the attitudes of other community members. This is because it is other people’s views that matter if we want to measure expected sanctions for noncompliance with local norms.²²

Using these data, we can shed some light on the ranking of social costs provided in expression (3) – namely that $s_{LH} > s_{LM}$ and $s_{LH} > s_{MH}$. To do so, we calculate the fraction of female respondents who said that parents who chose type j for their daughter would be unhappy if their son married a girl of type i .²³

20 For example, financial considerations may be thought to enter intrinsic utilities: circumcisers are typically paid by the family to perform FGC, and the cost can be significant. However, we find no significant difference in financial cost between Pharaonic and Sunna. For each daughter who had been circumcised, we asked the mother how much money had been spent and the average amounts were \$17.7 for Pharaonic and \$18.9 for Sunna. This corresponds to about 134 and 149 percent of daily wage in our sample, respectively.

21 We chose to frame this in the context of marriage choices because most of the literature on FGC highlights consequences in the marriage market as a potential cost for deviating from prevailing norms (see Wagner, 2015, for cross-country evidence). The idea is that, in each vignette, the hypothetical parents’ choice about their daughter would reveal their own preferred action. The daughter in law represents someone these parents would also care about (e.g., in terms of reputation concerns), hence the comparison is made between two scenarios that both affect the hypothetical family.

22 Bicchieri (2005, p. 15 and ff.) emphasizes that this is a key feature of social norms.

23 We pool “happy” and “indifferent” into one category because the model parameter $s_{ji} > 0$ captures a

Table 2: Evidence on ranking: $s_{LH} > s_{LM}$ and $s_{LH} > s_{MH}$

$\hat{s}_{LH}$	0.594 (0.312)
$\hat{s}_{LM}$	0.415 (0.311)
$\hat{s}_{MH}$	0.459 (0.267)
<i>Hypothesis</i>	p-value
$H_0 : \hat{s}_{LH} \leq \hat{s}_{LM}$	0.000
$H_0 : \hat{s}_{LH} \leq \hat{s}_{MH}$	0.000

Notes: $\hat{s}_{ji}$ is based on the question “Suppose a mother and father in your community chose type j circumcision for their daughter, but their son wants to marry a girl with type i circumcision. How would the parents feel?”. The responses are “Happy”, “Indifferent” or “Unhappy”. We code them as **Happy=0, Indifferent=0, Unhappy=1** so that $\hat{s}_{ji}$ is increasing in the degree of disapproval of the parents (as in the model) and take the community average.

Table 2 shows that 59.4 percent of respondents in the average community think that parents who chose Pharaonic for their daughter would be unhappy if their son married an uncut girl. Call this fraction $\hat{s}_{LH}$. It can be viewed as a rough proxy for the true parameter s_{LH} . The corresponding figures for $\hat{s}_{LM}$ and $\hat{s}_{MH}$ are 41.5 and 45.9 percent, respectively. Statistically, we can reject the null hypotheses that $\hat{s}_{LH} \leq \hat{s}_{LM}$ or that $\hat{s}_{LH} \leq \hat{s}_{MH}$ at the 99 percent confidence level. This provides suggestive evidence that the ranking of social costs in expression (3) holds for the average community in our sample.

3.4 Evidence on transition dynamics

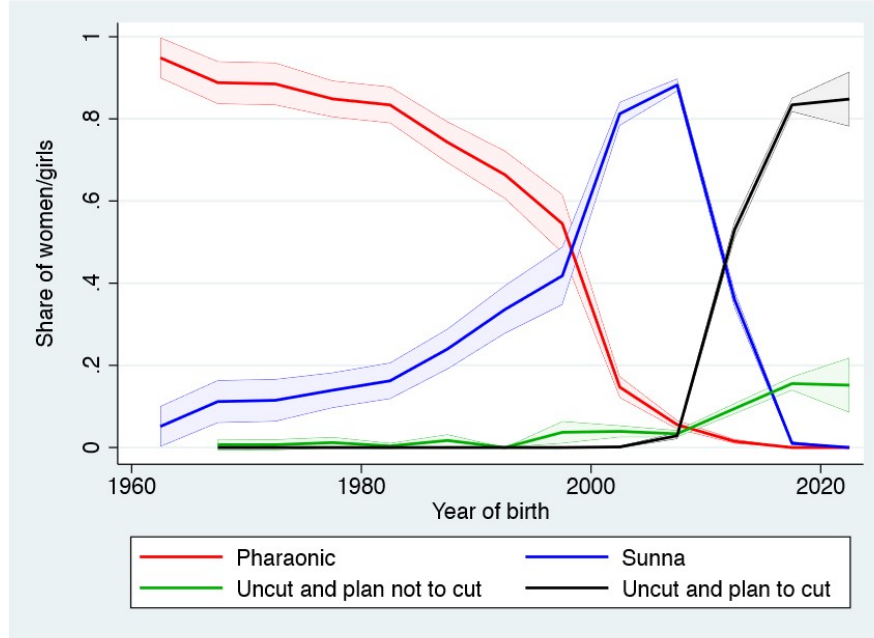
Next, we explore the transition dynamics generated by our model.

3.4.1 Evolution across cohorts

We start by exploring the “big picture” of how adherence to different cutting norms has evolved over time. Figure 1, briefly discussed in the Introduction, plots the share receiving Pharaonic circumcision (red line) or Sunna (blue line) against the year in which cutting occurred. The sample includes female respondents and those among their daughters (aged 12 and above) *who have been cut*. Figure 8 includes *all* female respondents and daughters

utility cost, hence we need a measure of disapproval – embedded in the response “unhappy”. We focus on female respondents throughout the analysis since the pattern in Table O.1 shows that matriarchs play a greater role in the FGC decision. Therefore, their perceptions of the social costs are likely to matter more.

Figure 8: Type of FGC by year of birth



Source: Authors' calculations on original data from Somalia. Sample includes women aged 17–82 at the time of interview and their daughters aged 12 or older (including uncut ones).

aged 12 and above – whether they were cut or not – and plots cutting shares against the individual's year of birth.

Figure 1 shows that, until the early 1990s, virtually all the women who were cut were Pharaonic-cut. Figure 8 shows that, for the same time period, virtually every woman born in those years was cut, as the share uncut (green and black lines) is flat at zero. Based on these data, it is realistic to study the transition dynamics as starting from an equilibrium where Pharaonic circumcision is the dominant trait.

Figure 1 also shows that, starting from the mid-1990s, the rate of Sunna-cut women has been steadily rising and girls circumcised in the mid-2000s or after are more likely to be Sunna-cut as opposed to Pharaonic. Nowadays, Sunna has clearly replaced Pharaonic circumcision as the dominant trait for younger generations in the average community.²⁴ The pattern is very similar if we use the most recent nationally representative dataset with information on FGC for Somalia, the 2011 Multiple Indicator Cluster Survey (see Appendix Figure O.2). This is reassuring for the external validity of our findings.²⁵

²⁴ Note that the pattern in Figure 1 does not necessarily prove or disprove our theory, it merely shows that a transition from Pharaonic to Sunna has happened in Somali communities in our sample, which motivates the theory. Our model is about the mechanisms behind this transition and their implications.

²⁵ We pooled data from the 2001 Multiple Indicator Cluster Survey (MICS) for Somaliland and Northeast

The timing of the transition from Pharaonic to Sunna roughly coincides with the period in which human rights campaigns made a strong push against Pharaonic circumcision and religious leaders started emphasizing that this type of FGC was not a requirement of Islam – as discussed in Section 3.1.²⁶ In terms of our model, this can be represented in two, non-mutually exclusive ways. The first is a reduction in the value of s_{LM} , that is, the social sanction imposed by people who support Pharaonic on those who choose Sunna. In a religious country like Somalia, the Imams’ endorsement of the latter clearly makes it more socially acceptable to abandon the prevailing Pharaonic norm and shift to the less prevalent Sunna. The second interpretation is that the human rights campaigns and the position taken by religious leaders may have conveyed new information on the intrinsic (dis)utility of the various alternatives, decreasing u_L and/or increasing u_M . In both cases, these parameter changes make it more likely that M destabilizes L starting from equilibrium p^L (see the discussion about figures 3 and 4 in section 2.2).

The next question is whether the now dominant Sunna trait is a “stepping stone” and will ultimately disappear, leaving “Uncut” as the norm in the long run, or if it has become the new norm and will remain so in the future (in the absence of new exogenous shocks). To address this question we take several steps.

First, to understand if the trait “Uncut” may begin to penetrate, one needs to study the full sample, including girls who are not cut. In Figure 8 we plot the shares of cut and uncut girls/women by birth cohort. The red and blue lines represent the shares of Pharaonic and Sunna-cut, respectively. For uncut girls, we asked their mothers whether they intended to cut them in the future or not. The black line represents the share of girls/women who are currently uncut, but intended to be cut in the future. For this group, “Uncut” may be interpreted as a temporary condition, most likely due to the (young) age of the girl. The green line represents girls who are currently uncut and whose mothers state that they will *not* be cut in the future: these are the families that have chosen trait H .

Figure 8 shows that from the early 2000s we start seeing a slight increase in the fraction of girls who are not cut (black and green lines). Given that the average age of cutting in our sample is 9, cohorts born after 2011 are still at risk of being cut (recall that our data

Somalia. Each of these are representative household surveys, with the Somaliland MICS covering 5,865 women aged 15-49 and their children, while the Northeast Somalia MICS entails information on 5,492 women aged 15-49 and their children. As Appendix Figure O.2 shows, the share of Pharaonic (Sunna) cut women gradually declines (rises) over time, with girls circumcised in the mid-2000s or after being more likely to be Sunna-cut as opposed to Pharaonic. Since the MICS data are from 2011, we are not able to replicate the corresponding trends post-2011 with these data and, as far as we are aware, no other recent data (except ours) is available for this time period. Nevertheless, the similarity between Figures 1 and O.2 is reassuring.

²⁶ The push by human rights campaigns and religious leaders is one possible explanation for the the transition from Pharaonic to Sunna. We cannot (and do not need to) rule out that there could be other events and mechanisms driving this transition.

was collected in 2020). For the youngest cohorts in our sample, approximately 15 to 20 percent of the mothers report that they intend not to cut them (green line). Given that this share was virtually zero for most of the period, this may be seen as encouraging. However, more than 80 percent of the respondents whose daughters are young and uncut report that they intend to cut their daughters, suggesting that Sunna may as well remain the dominant trait. One reason why the increase in the share who plan not to cut does not allow us to infer that the process will eventually transition to Uncut is that, in the presence of heterogeneity, our model predicts that we may see an increase in the share of Uncut even if Sunna is ultimately absorbing (see the discussion of figure 6 in section 2.3).

3.4.2 Transitions and model parameters

The two conditions embedded in proposition 1 for a stepping stone transition are that social costs of moving from Pharaonic to Sunna (s_{LM}) and from Sunna to Uncut (s_{MH}) are low relative to the respective gains in intrinsic utility ($u_M - u_L$ and $u_H - u_M$). We explore our empirical proxies for these parameters in a descriptive way, assuming that communities where a larger share of respondents report complications due to type i have lower u_i and communities where more respondents think parents choosing type j for their daughter would be unhappy if their son married a type i girl have higher s_{ji} . The results we present should be seen more as suggestive of a certain direction than as a proof that a specific equation or inequality is satisfied.

We start by discussing the average values of these parameters as reported in tables 1 and 2. Recall that our proxy for s_{LM} is the share of respondents who think that parents choosing Pharaonic for their daughters would be unhappy if their son married a Sunna-cut girl. This share is .41 in Table 2. Our proxies for u_L and u_M are the shares reporting complications from Pharaonic and Sunna, respectively. Table 1 showed that, among mothers, 63 percent had complications from Pharaonic and 11 percent from Sunna, while among daughters the corresponding figures were 59 and 3 percent. The difference $u_M - u_L$ is thus .51 for mothers and .56 for daughters, in both cases greater than .41. Although these are only imperfect proxies that may not capture the full extent of intrinsic benefits or social sanctions related to cutting, the order of magnitude suggests that qualitatively it is plausible that the conditions for transitioning from Pharaonic to Sunna hold in the aggregate. Indeed, we saw this transition taking place in the cohort analysis (Figure 1).

A similar statement cannot be made for the relation between s_{MH} and $u_H - u_M$. Table 2 shows that on average 46 percent of respondents thought that parents who chose Sunna for their daughter would be unhappy if their son married an uncut girl, indicating a relatively high value for s_{MH} . Furthermore, Table 1 shows that the share of health complications from Sunna is quite low. In addition, when asked about “perceived” complications from Sunna (in a separate question), we found that only 6 percent of respondents associate

any complications with Sunna, and that the share perceiving a risk of specific problems (those in the bottom panel of Table 1) is 4 percent or less for all items. This suggests that $u_H - u_M$ may be quite small and that the condition for transitioning from M to H may not hold in the average community. Thus, *if one looks at the aggregate picture, Sunna appears less as a stepping stone and more like a new equilibrium norm.*

Inferences made on the basis of average values of the parameters in the full sample may be misleading if the relevant reference group for individual decision makers is smaller than the whole region, for example if it is their community. In other words, the fact that the conditions for transitioning from Sunna to Uncut seem unlikely to be satisfied in the aggregate does not mean that this holds for each and every community. Recall that Figure 7b displayed a significant degree of variation across communities both in the type of FGC and in the share of women who were not cut. Appendix Figure O.5 shows that the social factors s_{ij} also vary considerably across communities. We thus proceed to assess whether the conditions of our model for a successful stepping stone transition may hold when we exploit variation across communities.

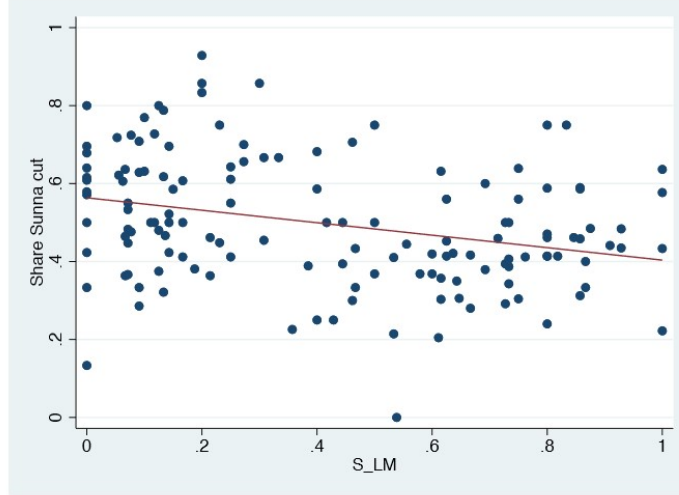
First, we assess whether communities with lower s_{LM} are more likely to have made the first step (that is, to have transitioned from Pharaonic to Sunna).²⁷ In Panel (a) of Figure 9 we plot the actual share of Sunna-cut women in a community against the estimated s_{LM} for that community. Panel (b) reports a similar plot, but the vertical axis shows the residual from a regression of the share Sunna-cut on u_L and u_M , in order to isolate the correlation with s_{LM} after conditioning on intrinsic utilities – in line with the inequality in proposition 1. In both cases we see that communities with higher sanctions (higher s_{LM} or higher residual) have a smaller share of Sunna-cut girls, as expected. In the top panel the correlation is -0.16 (p-value 0.000), which implies that a 10 percentage point increase in s_{LM} is associated with a 1.6 percentage point reduction in the share of Sunna-cut. The magnitude and significance are very similar in the “conditional” version (bottom panel): the estimated correlation is -0.13 with a p-value of 0.001. This is due to the fact that in our data u_L and u_M exhibit very little variation across communities. Therefore, the pattern in Figure 9 is consistent with the stepping stone conditions in proposition 1. Communities with lower s_{LM} are more likely to have made the first step of transitioning from Pharaonic to Sunna.

One caveat in interpreting the correlation in Figure 9 is that our data is collected after the transition from Pharaonic to Sunna has taken place in most communities. For this reason, one may be concerned about reverse causality, i.e., communities where more women have been Sunna-cut may be less likely to perceive a high social cost of transitioning from Pharaonic to Sunna. In other words, as Sunna becomes more prevalent,

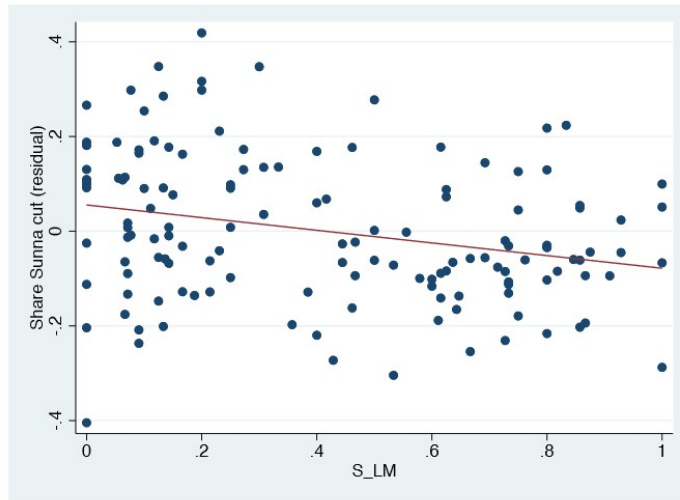
²⁷ The proxies for s_{ji} and u_i are the same as above, only calculated at the community level for each one of our 141 communities.

Figure 9: Sunna cut and social sanctions

(a) Unconditional



(b) Conditional on u_L and u_M



Notes: The variable on the x -axis is $\hat{s}_{LM}$ – the share of female respondents within the community who thought that parents who chose *Pharaonic* circumcision for their daughter would be unhappy if their son wanted to marry a girl with *Sunna* circumcision. In Panel A, the variable on the y -axis is the share of Sunna-cut girls within the community; the sample includes female respondents' daughters aged 0–18. In Panel B, the variable on the y -axis is the predicted residual from regressing share of Sunna-cut girls on u_L and u_M at the community level where u_L (u_M) is the share of female respondents who perceive any health complications or experienced (directly or indirectly via their daughters) any complications due to Pharaonic (Sunna) circumcision.

sanctions against its adoption might weaken due to conformity effects. Note that this does not invalidate the hypothesis that M is a stepping stone; in fact, it will tend to reinforce transitions away from L and towards M .

To address the possibility of reverse causality, we conduct a number of robustness checks. First, we assess whether the reported social sanctions (s_{ji}) vary across birth cohorts. If reverse causality were driving the pattern, one may expect the cohorts that have experienced Sunna to be more likely to justify it. Table O.3 shows that there is no significant correlation between respondents' age and the perceived social sanctions, neither across (columns 1, 3, 5) nor within (columns 2, 4, 6) communities. Second, we calculate the social sanction parameter $\hat{s}_{LM}$ at the community level, taking into account responses of women who are at least one generation older than individuals whose FGC status we analyze.²⁸ As Figure O.3 shows, the pattern we observed in Figure 9 is robust to this restriction. While these checks are reassuring, in the absence of data on social sanctions prior to the transition to Sunna (i.e. pre-1990s) it is not possible to rule out endogeneity concerns entirely. For this reason, we interpret the pattern in Figure 9 not in a causal sense, but as a correlation consistent with our theory.

Next, we study the transition dynamics at the community level. Recall that our model predicts that, if Sunna is a stepping stone, people will switch from Sunna to Uncut when s_{MH} is small relative to $u_H - u_M$ and that the switch will be triggered by a threshold q^* of people having already chosen Sunna (proposition 2). To assess the empirical relevance of this prediction, we separate communities into those with relatively low estimated sanctions $\hat{s}_{MH}$ and those with relatively high sanctions. It is only in the former set of communities that we expect a stepping stone transition might take place.

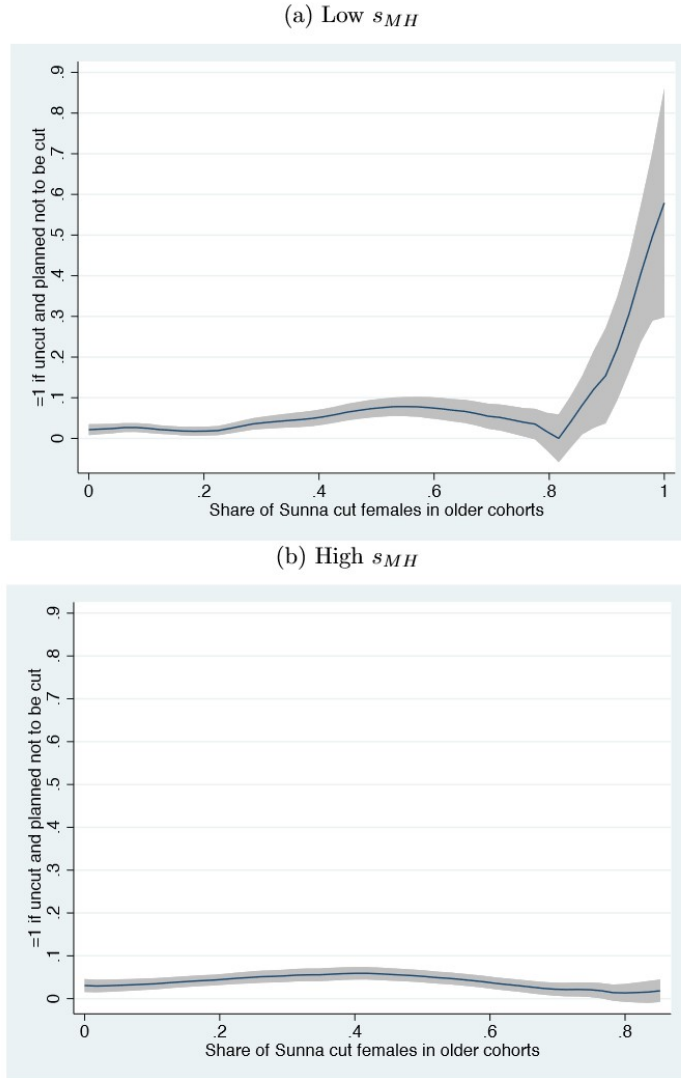
In Figure 10, we plot the relationship between the likelihood that a girl is currently “uncut and planned not to be cut” (on the vertical axis), against the share of Sunna-cut girls in older cohorts within her community (on the horizontal axis).²⁹ We do this separately for communities with below-median $\hat{s}_{MH}$ (top panel), and above-median $\hat{s}_{MH}$ (bottom panel).³⁰ Figure 10a shows that, in communities with lower $\hat{s}_{MH}$, the likelihood that a girl is uncut begins to rise steeply when the share of Sunna-cut girls in older cohorts reaches around 80 percent. This is in line with proposition 2, which predicts that in communities satisfying the stepping stone conditions, once a threshold q^* of people have already chosen Sunna, the switch to Uncut will be triggered. By contrast, in communities

28 Since the variable on the y -axis is the share of 0–18 year old girls who are Sunna-cut, we calculate $\hat{s}_{LM}$ based on respondents aged 35 or older (i.e., at least 17 years older than the girls on the y -axis).

29 The sample on the vertical axis includes daughters of female respondents. Since in our model decisions at a point in time depend on the shares of people cut until that point in time, each daughter in the graph is associated with the share of girls/women in her community who are seven or more years older than herself (horizontal axis). Results are robust to using different age gaps between cohorts.

30 As before, we calculate $\hat{s}_{MH}$ using the responses of women aged 35 or older, to mitigate endogeneity concerns.

Figure 10: Threshold for stepping stone transition



Notes: Sample includes female respondents' daughters aged younger than 18. Sample size is 1859 individuals in 70 communities in Panel (a); 1815 individuals in 70 communities in Panel (b). Each figure plots a local polynomial smooth of a dummy variable =1 if the individual is currently "uncut and planned not to be cut" on the share of Sunna-cut females in her community, along with a 90% confidence interval. "Share of Sunna-cut females" takes into account females 7+ years older than the girl within her community.

with relatively high $\hat{s}_{MH}$ we see no discernible relationship between a girl’s likelihood to be Uncut and the share of Sunna cut girls (Figure 10b). In these communities, it is plausible that Sunna may have become an absorbing state.

To sum up, the predictions of our model regarding transition dynamics seem consistent with three patterns that emerge from the data. First, a transition has taken place from Pharaonic circumcision (L) to Sunna (M). This occurred in an environment where, in the face of moderate social sanctions for moving from L to M , the health costs of the former greatly exceed those of the latter. Communities with lower estimated social sanctions $\hat{s}_{LM}$ exhibit a higher share of Sunna-cut women.

Second, no transition from Sunna (M) to Uncut (H) has materialized in communities where the social sanctions $\hat{s}_{MH}$ are relatively high. In these communities, Sunna appears to be absorbing.

Third, in a subset of communities that have relatively low social sanctions for transitioning from Sunna to Uncut ($\hat{s}_{MH}$) and where the share of Sunna-cut women has reached a certain threshold (in our data this is around 80 percent), a switch to Uncut seems to be underway. These are the communities where Sunna is most likely to be a stepping stone, following the threshold dynamics predicted by our model.

4 Conclusions

We have proposed a model that allows us to analyze the intermediate-run dynamics of the evolution of social norms and to assess the conditions under which intermediate versions of prevailing norms may act as a stepping stone to transition to a superior norm in the long run, or else become absorbing. The key parameters governing the transition are the social sanctions imposed on those who abandon the prevailing option in favor of another, relative to the difference in intrinsic utilities of the two options. We have also characterized the waiting time associated with these transitions and their welfare consequences.

The evidence presented in the paper shows how, in the Somali context, the transition dynamics characterized by our model can help interpret the evolution of FGC over the past three decades. First, starting from virtually universal Pharaonic circumcision, a change in the social sanctions and/or in the perceived health costs associated with Pharaonic relative to Sunna triggered a dramatic shift in norms. Nowadays Sunna has replaced Pharaonic as the dominant trait for younger generations. Second, whether this new condition represents a stepping stone in the transition to not cutting depends on the characteristics of the community. While perceived health costs from Sunna are low everywhere, there is significant variation in attitudes towards people who choose Uncut over Sunna – which we interpret as a proxy for social sanctions. In communities with relatively low sanctions, the threshold property predicted by our model seems to hold in

the data, leaving room for a transition to Uncut. In the other communities, Sunna may have become the new absorbing state.

These patterns provide insights into potential policy responses. Since the key condition for transitioning from Sunna to Uncut requires that sanctions are low relative to perceived utility gains, policymakers may work on two fronts. On the one hand, they may try to reduce sanctions associated with the decision not to cut, for example by changing the narrative around the value of circumcision in the marriage market. This is what NGOs like Tostan have been proposing, for example through “public declarations” by community members that pledge not to cut their daughters and not to marry their sons to cut girls. On the other hand, policymakers may work on changing perceptions and knowledge of the health costs of FGC, e.g., through health information campaigns. Clearly, the two approaches are not exclusive and rather complement each other, as is evident from our theoretical predictions.

Finally, while our main example and empirical application concerns FGC in Somalia, our theoretical framework is general and can be applied to a variety of settings.

An interesting historical example is the case of dueling. In the United Kingdom, dueling died out suddenly in the mid-nineteenth century (Banks, 2008), while in France it endured up to the turn of the century (Hopton, 2007, 323). Part of the reason why this harmful norm persisted longer in France is that the form of dueling changed during this period, allowing for a less harmful alternative to replace the costlier norm. Swords became popular again, replacing pistols (Nye, 1993, 186), and, increasingly, the risks involved in dueling were made explicit.³¹ These changes had the effect of drastically reducing fatality rates. It is estimated that more than 1/3 of duels in the early nineteenth century ended in the death of one of the duellists; during the second half of the century the number was around 2 percent (Banks, 2012, 49–50). These changes are consistent with a shift to a mild absorbing intermediate norm in our model.

A different, contemporary application of the stepping stone concept concerns child marriage. Most countries outlaw marriage before adult age (typically 18 years). This approach has failed to eradicate child marriage in developing countries, most notably in South Asia. Our stepping stone approach suggests that an intermediate step may be that of reducing the legal age for marrying to, say, 16 and seeing if this triggers a transition. Of course there could be a risk that this becomes the new norm, but this can only be assessed with data. An interesting avenue for future research is to explore these implications in countries that have indeed changed the legal age of marriage at different points in time (e.g., Bangladesh).

Finally, another setting in which our model could be applied is that of cigarette

³¹ Duels were announced in advance as being *au premier sang*, to serious wounds, or, rarely, *à la mort* (Hopton, 2007, 79).

smoking, particularly among communities where smoking is the majority norm. Recent years have seen the introduction of electronic cigarettes, and the share of consumers that have substituted tobacco with e-cigarettes has risen sharply. Will e-cigarettes ultimately lead people to quit smoking for good, or will they become the new norm? Again, as more data becomes available, it may be possible to explore transition patterns and give an answer to this question.

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Appendices

A More than three actions

We consider the general case with more than three actions. This will allow us to show that stepping stones are related to *increasing average sanctions*. For simplicity, we consider the case without heterogeneity, as in section 2.2 of the main text.

There is a set of n actions $A = \{1, 2, \dots, n\}$. Let u_i be the intrinsic utility of action i . We assume that utilities are distinct and indexed such that

$$u_1 > u_2 > \dots > u_n. \quad (35)$$

We assume that the degree of social pressure that an agent imposes on another depends on the perceived distance between their two actions, as measured by the difference in their intrinsic utilities. Specifically, we will assume that there is a weakly increasing function $s : \mathbb{R} \rightarrow \mathbb{R}_+$ such that $s(0) = 0$ and for all actions $i \neq j$, the sanction is equal to

$$s(|u_i - u_j|) > 0. \quad (36)$$

As before, there are m agents and p_i represents the proportion of agents playing action i . Let $p = (p_1, p_2, \dots, p_n)$ be the *state* of the game and let $\hat{\Delta}$ be the set of possible states.

The utility of an agent choosing action i in state p is

$$v_i(p) = u_i - \sum_{j \in A} p_j \cdot s(|u_i - u_j|). \quad (37)$$

Note that the n -action game remains a potential game with the potential function defined in equation (6).

As before, time is continuous and agents update their actions via independent Poisson arrival processes with unit expectation. We consider the best-response dynamics defined as in section 2.2.

Let A^* be the set of stable norms. Action 1 is always stable, and action $i > 1$ is stable if and only if for all $j < i$,

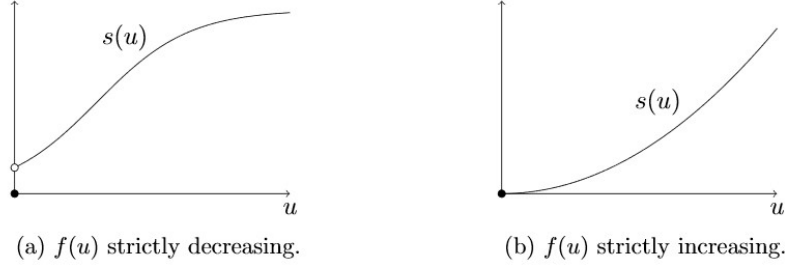
$$\frac{s(u_j - u_i)}{u_j - u_i} \geq \frac{1}{1 - \delta}. \quad (38)$$

The shape of the sanctions function plays a key role in the dynamics of the model. Define the *average sanctions function* as

$$f(u) = \frac{s(u)}{u} \quad (39)$$

for all $u > 0$. Of particular interest will be the case where f is (weakly) monotone,

Figure A.1: Two sanctions functions.



either increasing or decreasing. When f is decreasing, small differences in utility have a relatively greater impact than do large differences in utility. This condition is implied by concavity of s but is more general. When f is increasing, small differences in utility have a relatively smaller impact than do large differences in utility. This condition is implied by convexity of s but is more general.

The definitions of stability and j -stability carry over from section 2.2. Proposition 4 characterizes the set of stable norms A^* when f is monotone.

Proposition 4. If f is weakly decreasing, then there exists i such that $A^* = \{j \in A : j \leq i\}$. If f is weakly increasing, then $i > 1$ is stable if and only if

$$\frac{s(u_{i-1} - u_i)}{u_{i-1} - u_i} \geq \frac{1}{1 - \delta}. \quad (40)$$

Proof. For the first part, suppose f is monotone decreasing. Suppose i is a norm. We show that any $j < i$ is also a norm. If $j = 1$ this holds straightforwardly, so suppose $j > 1$. Since i is a norm, we have for all $k < j$,

$$f(u_k - u_i) \geq \frac{1}{1 - \delta}.$$

But since f is monotone decreasing, we have for all $k < j$,

$$f(u_k - u_j) \geq f(u_k - u_i) \geq \frac{1}{1 - \delta}.$$

So j is a norm.

For the second part, suppose f is monotone increasing. Action i is a norm if and only if for all $j < i$,

$$f(u_j - u_i) \geq \frac{1}{1 - \delta}.$$

But since f is monotone increasing, $f(u_j - u_i)$ is minimized for $j = i - 1$. Therefore i is a norm if and only if

$$f(u_{i-1} - u_i) \geq \frac{1}{1 - \delta}, \quad (41)$$

as required. $\square$

Proposition 4 follows from the fact that when f is decreasing, the best action for a player to deviate to (starting from a norm) is always action 1. This is because social pressure is less important relative to individual utility for actions that are further away. In contrast, when f is increasing, the best action for a player to deviate to is always the next closest action, because actions that are further away have a higher relative social pressure. This dynamic is the core of the n -action model.

We now show that the process will tend to converge to a norm in finite time; this result is a generalization of theorem 1. Recall that γ is the smallest nonzero increase in payoff from an agent switching actions.

Theorem 2. From any initial state $p \in \tilde{\Delta}$, the process converges to a strictly stable norm in finite time with probability one, and the expected waiting time to reach a norm is at most

$$4 \frac{\rho^* - \rho(p)}{\gamma}. \quad (42)$$

Proof. See appendix B. $\square$

We define the concept of stepping stone in the n -action model as follows:

Definition 2. Given actions $i < j < k$, action j is a stepping stone from k to i if k is i -stable but not j -stable, and j is not i -stable.

Proposition 5. Suppose there exist actions $i < j < k$ such that j is a stepping stone from k to i . Then f is not monotone decreasing.

Proof. Since j is a stepping stone from k to i , we have

$$f(u_i - u_k) \geq \frac{1}{1 - \delta} > f(u_j - u_k). \quad (43)$$

But $u_i - u_k > u_j - u_k$, so f is not monotone decreasing. $\square$

Proposition 6. If f is monotone decreasing, then from any unstable state p^i , the process converges to p^1 .

Proof. Let $i > 1$ be unstable. Let $v_{ii} = u_i$ be the utility agents get from playing i at p^i . Let $v_{ij} = u_j - (1 - \delta)s(u_j - u_i)$ be the utility agents get from playing $j < i$. Note that

$$v_{ij} - v_{ii} = u_j - u_i - (1 - \delta)s(u_j - u_i), \quad (44)$$

$$= (u_j - u_i)(1 - (1 - \delta)f(u_j - u_i)). \quad (45)$$

If f is monotone decreasing, then $v_{ij} - v_{ii}$ is uniquely maximized when $u_j - u_i$ is maximized. So $j = 1$ is the unique best response. Hence the process converges to p^1 . $\square$

B Proofs

B.1 Proof of claim 1

We need to show that for any $p \in \tilde{\Delta}$ and $i, j \in A$,

$$v_j(p + e^{ij}) - v_i(p) = \rho(p + e^{ij}) - \rho(p); \quad (46)$$

that is, the change in utility from switching from i to j is the same as the change in potential.

First, we have

$$v_j(p + e^{ij}) - v_i(p) = u_j - \sum_{k \in A} s_{jk}(p_k + e_k^{ij}) - u_i + \sum_{k \in A} s_{ik}p_k \quad (47)$$

$$= u_j - u_i - \sum_{k \in A} (s_{jk} - s_{ik})p_k - \sum_{k \in A} s_{jk}e_k^{ij} \quad (48)$$

$$= u_j - u_i - \sum_{k \in A} (s_{jk} - s_{ik})p_k + \delta s_{ij}. \quad (49)$$

Second, we have

$$\begin{aligned} \rho(p + e^{ij}) - \rho(p) &= m \sum_{k \in A} (p_k + e_k^{ij})u_k - \frac{m}{2} \sum_{k \in A} \sum_{l \in A} (p_k + e_k^{ij})(p_l + e_l^{ij})s_{kl} \\ &\quad - m \sum_{k \in A} p_k u_k + \frac{m}{2} \sum_{k \in A} \sum_{l \in A} p_k p_l s_{kl} \end{aligned} \quad (50)$$

$$= m \sum_{k \in A} e_k^{ij} u_k - \frac{m}{2} \sum_{k \in A} \sum_{l \in A} (p_k e_l^{ij} + p_l e_k^{ij} + e_k^{ij} e_l^{ij}) s_{kl} \quad (51)$$

$$= u_j - u_i - m \sum_{k \in A} p_k \sum_{l \in A} e_l^{ij} s_{kl} - \frac{m}{2} \sum_{k \in A} e_k^{ij} \sum_{l \in A} e_l^{ij} s_{kl} \quad (52)$$

$$= u_j - u_i - m \sum_{k \in A} p_k \delta(s_{jk} - s_{ik}) - \frac{m}{2} \sum_{k \in A} e_k^{ij} \delta(s_{jk} - s_{ik}) \quad (53)$$

$$= u_j - u_i - \sum_{k \in A} p_k (s_{jk} - s_{ik}) - \frac{m}{2} (-2\delta^2 s_{ij}) \quad (54)$$

$$= u_j - u_i - \sum_{k \in A} p_k (s_{jk} - s_{ik}) + \delta s_{ij}. \quad (55)$$

Hence $\mathcal{G}$ is a potential game with potential function ρ .

B.2 Proof of theorem 2

The argument will be more transparent if we consider the associated discrete-time process in which one agent is drawn uniformly at random to update each period. This process is m times slower than the original process and amounts to looking at the embedded chain of updates in the original process.

Note that in any given state, potential can only weakly increase. Recall that γ is the smallest nonzero increase in payoff from switching from one action to another. We begin with the following lemma:

Lemma 1. In any inhomogenous state $p \in \tilde{\Delta}$, the expected change in potential is at least $\delta\gamma$.

Proof. First, we show that in any inhomogenous state $p \in \tilde{\Delta}$, there is at least one agent who can increase her payoff by at least γ . Since γ is the smallest nonzero increase in payoff, it is sufficient to show that there is at least one agent who can increase her payoff. Since p is inhomogenous, let $i, j \in A$ be two actions played by a positive proportion of agents. Suppose to the contrary that neither i -players nor j -players can increase their payoff. Then $u_i - s_{ij}p_j \geq u_j - s_{ij}(p_i - \delta)$ and $u_j - s_{ij}p_i \geq u_i - s_{ij}(p_j - \delta)$. But this implies $u_i - s_{ij}p_j \geq u_i - s_{ij}(p_j - \delta)$, which is a contradiction. Hence, there exists at least one agent who can increase her payoff by at least γ . The probability of selecting that agent is δ , and any other agent will either increase the potential or keep it constant. Therefore the expected change in potential is at least $\delta\gamma$, as required. $\square$

Thus if p^t is inhomogenous, the expected change in ρ viewed at t satisfies $\mathbf{E}_t[\rho(p^{t+1}) - \rho(p^t)] \geq \delta\gamma$. But since potential will not decrease in the following period, we also have $\mathbf{E}_t[\rho(p^{t+2}) - \rho(p^t)] \geq \delta\gamma$.

Now suppose that p^t is homogenous but is not strictly stable. If it is unstable, then some agent will move at t . The expected increase in potential is at least γ . Hence $\mathbf{E}_t[\rho(p^{t+2}) - \rho(p^t)] \geq \gamma$. If p^t is homogenous and weakly stable, agents are indifferent between two or more options. Then with probability at least $1/2$, the updating agent switches action. Although the potential does not increase, p^{t+1} is now inhomogenous, so from $t+1$ to $t+2$ the expected increase in potential is at least $\delta\gamma$ by lemma 1. Therefore $\mathbf{E}_t[\rho(p^{t+2}) - \rho(p^t)] \geq \frac{\delta\gamma}{2}$.

It follows that for any $p^t \in \tilde{\Delta}$ that is not strictly stable,

$$\mathbf{E}_t[\rho(p^{t+2}) - \rho(p^t)] \geq \frac{\delta\gamma}{2}. \quad (56)$$

Starting from $p^0 \in \tilde{\Delta}$, let the random variable T be the first even time such that the process is in a strictly stable homogenous state.

Define the function

$$h(t) = \rho(p^t) - t\frac{\delta\gamma}{4}. \quad (57)$$

By inequality (56),

$$\mathbf{E}_t[h(t+2) - h(t)] \geq 0. \quad (58)$$

Hence $h(t)$ is a submartingale on the even periods. The value of the stopping time T is finite with probability one, hence by Doob's optional-stopping theorem (e.g., Williams,

1991, section 10.10)

$$\mathbf{E}[h(T)] \geq h(0) \tag{59}$$

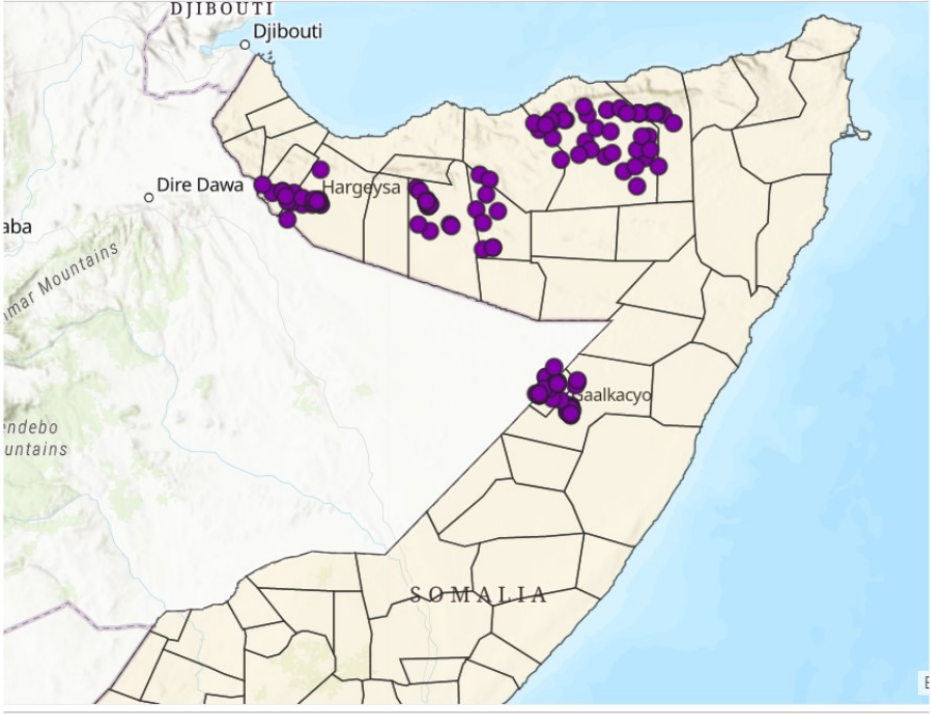
$$\implies \mathbf{E}[T] \leq 4 \frac{\rho^* - \rho(p^0)}{\delta\gamma}, \tag{60}$$

where ρ^* is the maximum potential across all states.

The expected waiting time in the continuous process is $\mathbf{E}[T]/m$. This concludes the proof of theorem 2.

O Additional Tables and Figures (Online)

Figure O.1: Location of the Study



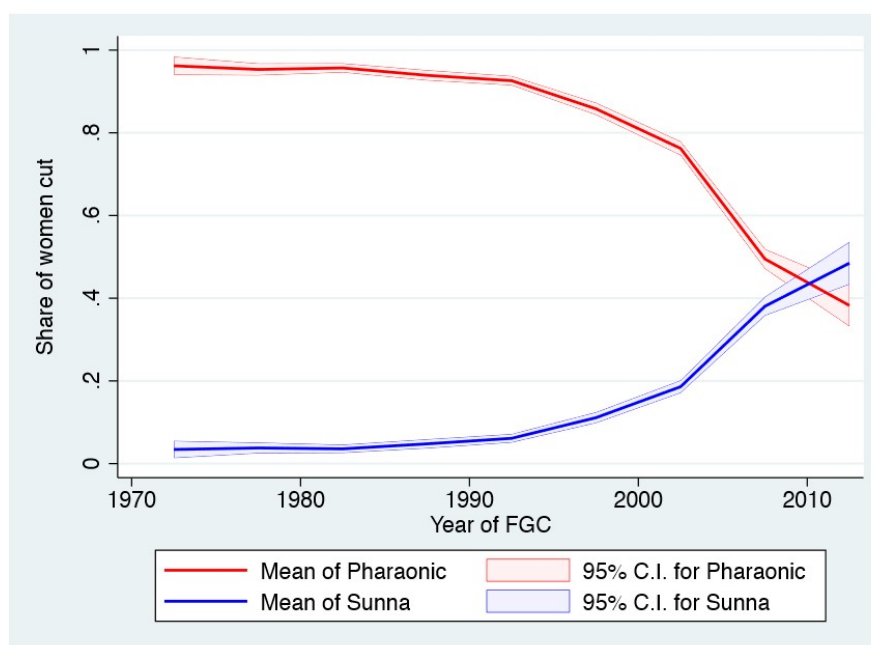
Notes: The map shows the location of communities included in the study, along with district boundaries of Somalia.

Table O.1: Summary statistics

	(1)		(2)	
	<i>Pharaonic</i>		<i>Sunna</i>	
	Mean	Std. dev.	Mean	Std. dev.
Age of FGC	9.090	(2.088)	8.543	(1.745)
Decision to cut by:				
Mother	0.779	(0.417)	0.895	(0.307)
Father	0.326	(0.471)	0.408	(0.492)
Grandmother	0.137	(0.346)	0.041	(0.199)

Notes: Sample is restricted to women (female respondents and their daughters) who have been cut. “Age of FGC” is the age at which the individual was cut. “Decision to cut by” is the fraction of respondents reporting that the decision to cut was taken by, respectively, their mother, father, or grandmother.

Figure O.2: Type of FGC by year of cutting, MICS 2011 data for Somalia



Source: Authors’ calculations based on Somalia Multiple Indicator Cluster Survey 2011. The sample includes all respondents (all female household members aged 15-50) and their daughters aged 0-18. Pharaonic is the fraction of females who are reported as being circumcised with their genital area sewn closed, Sunna is the fraction of females who are circumcised without their genital area being sewn closed.

Table O.2: Testing for Social Desirability Bias

	(1)	(2)	(3)	(4)
	High social desirability	Low social desirability	Basic difference	Normalized difference
Pharaonic cut	0.024 (0.153)	0.031 (0.174)	-0.007 (0.006)	-0.032
Sunna cut	0.480 (0.500)	0.497 (0.500)	-0.017 (0.017)	-0.024
Uncut	0.479 (0.500)	0.460 (0.499)	0.019 (0.017)	0.027
Uncut nor planned to be	0.046 (0.210)	0.040 (0.197)	0.006 (0.007)	0.020
Observations	1,552	2,124		

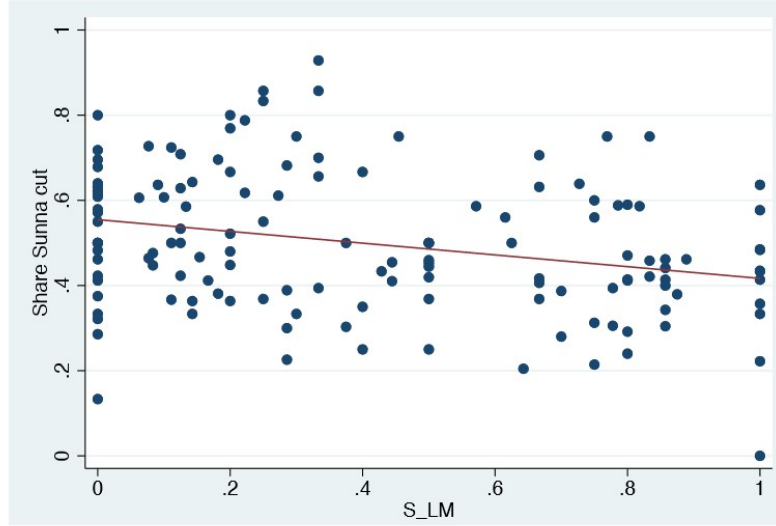
Notes: The sample includes female respondents' daughters aged 0-18. "Pharaonic cut" is a dummy variable =1 if the girl was reported to be Pharaonic cut. "Sunna cut" is a dummy variable =1 if the girl was reported to be Sunna cut. "Uncut" is a dummy variable =1 if the girl was reported to be uncut. "Uncut nor planned to be" is a dummy variable =1 if the girl was reported to be uncut and planned not to be cut. Column 1 (2) provides the mean and standard deviation of the relevant variables for respondents whose social desirability score is above (below) median. Column (3) provides the difference between columns 1 and 2 with stars corresponding to the p-value for the null hypothesis that the difference is equal to 0 (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$). Column (4) provides the normalized difference between columns 1 and 2.

Table O.3: Correlation between $\hat{s}_{ji}^i$ and Respondents' Age

	$\hat{s}_{LH}^i$		$\hat{s}_{LM}^i$		$\hat{s}_{MH}^i$	
	(1)	(2)	(3)	(4)	(5)	(6)
Respondent's age	-0.001 (0.001)	-0.001 (0.001)	0.000 (0.001)	0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)
Observations	1755	1755	1766	1766	1809	1809
Outcome mean	0.610	0.610	0.409	0.409	0.480	0.480
Community F.E.s	No	Yes	No	Yes	No	Yes

Notes: Regressions in columns 2, 4 and 6 control for community fixed effects. Standard errors are clustered by respondent's age cohort. (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)

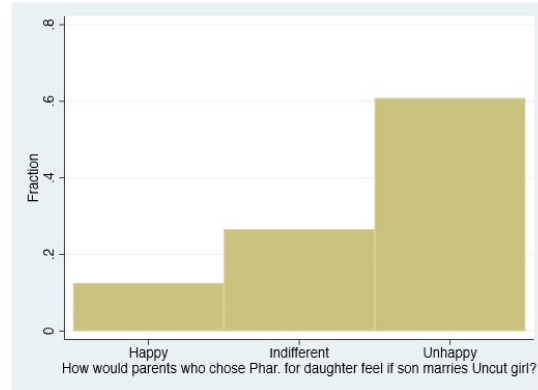
Figure O.3: Sunna cut and social sanctions



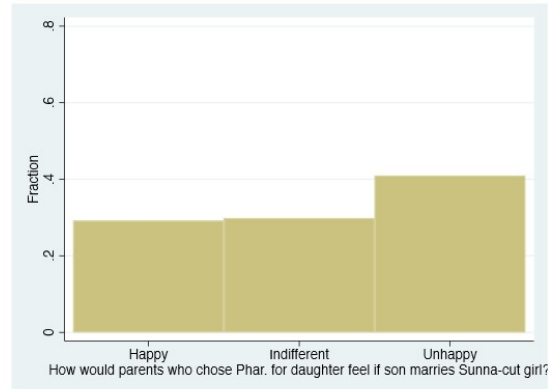
Notes: The figure corresponds to Panel A of Figure 9 with the only difference being that $\hat{s}_{LM}$ (the variable on the x -axis) is calculated based on responses of women aged 35 or older. Since the variable on the y -axis is the share of 0–18 year old girls who are Sunna-cut, this ensures that the social sanction ($\hat{s}_{LM}$) is based on respondents from at least one generation older.

Figure O.4: $\hat{s}_{LH}$, $\hat{s}_{LM}$ and $\hat{s}_{MH}$

(a) Pharaonic v.s. Uncut $\hat{s}_{LH}$



(b) Pharaonic v.s. Sunna $\hat{s}_{LM}$



(c) Sunna v.s. Uncut $\hat{s}_{MH}$

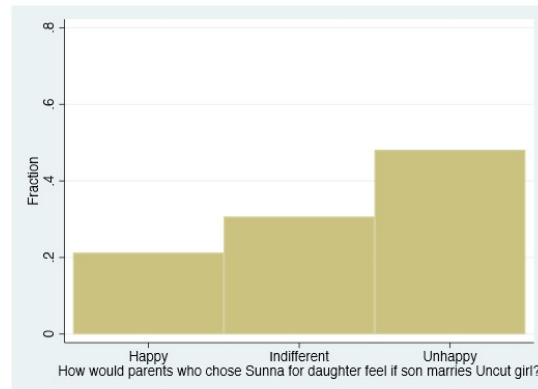
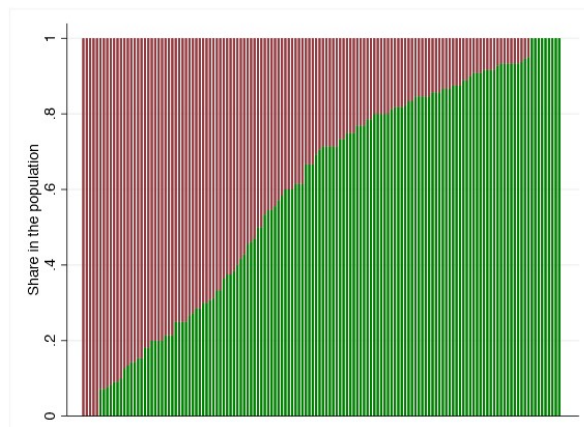
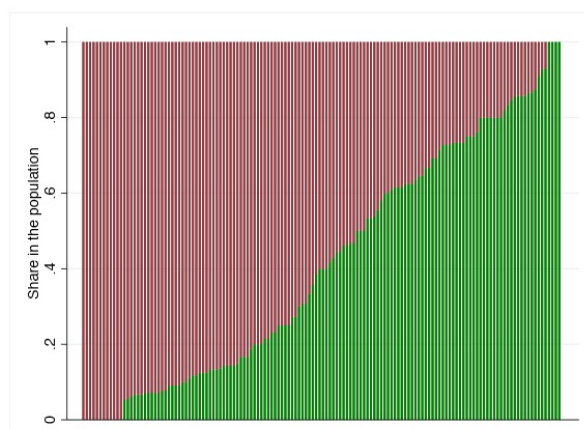


Figure O.5: Distribution of social sanction factors across communities

(a) $\hat{s}_{LH}$



(b) $\hat{s}_{LM}$



(c) $\hat{s}_{MH}$

