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Abteilungssprecher:	Prof. Dr. Eckhard Janeba
Referent:	Prof. Michèle Tertilt, PhD
Korreferent:	Prof. Cézar Santos, PhD

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Für meine Familie

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Chapter 1

General Introduction

Family economics is a growing field of research, analyzing decision-making within the family using economic theory. The foundation has been laid by the seminal work of Becker (1973, 1974). Many decisions on different topics are made within the family, including labor division and consumption, as well as marriage, fertility and investment in the children. Thus aggregated outcomes such as demographic change, marriage rates as well as the overall education level are influenced by family decisions. Besides preferences and income, the driving forces of these decisions are the interaction within families, underlying gender roles and gender differences. In particular, gender differences seem to be very pronounced in developing countries, which also becomes evident in the third millennium development goal to "promote gender equality and empower women" (UN, 2013). In many countries, women are still discriminated in political, social and economic activities, through reduced access to education, the labor market, political participation and less influence on family decisions. Furthermore, many different forms of violence against women are observed, ranging from domestic violence, rape to female genital cutting. Understanding the reasons for gender differences and discrimination, as well as their influence on other economic outcomes, has emerged as an active economic research field, to which this dissertation aims to contribute.

This dissertation covers two topics within the research area of family economics: violence against women in the form of female genital cutting and gender differences in fertility choices. In Part I of my dissertation, I analyze the harmful tradition of female genital cutting (FGC) from an economic perspective. It is estimated that 80 to 130 million women are circumcised/mutilated worldwide, with 3 million girls at risk of undergoing this procedure every year. Chapter 2 starts with a cross-country analysis and connects FGC rates with women's status in different countries. Chapter 3 places its emphasis on within-country variation and the interaction of FGC with marriage and education. In both chapters, the analysis and discussion of policies to reduce FGC play an important role. Part II focuses on fertility outcomes, in particular on differences in completed fertility by gender and the role of polygyny for potential fertility gaps in developing countries. All chapters use information from the Demographic and Health Surveys, which are household surveys that focus on health and fertility outcomes.

In Chapter 2, I show that FGC rates vary strongly across countries in sub-Saharan Africa and the Middle East, which prompts seeking an explanation for this variation. Therefore, my research questions are: what can explain cross-country differences in FGC rates? Which policies could reduce FGC rates? Analyzing the first question, I document a negative cross-country correlation between women's status and FGC prevalence rates, i.e. FGC rates are larger in countries with relative higher gender inequality (women being disadvantaged). I provide a simple model with FGC as premarital investment for the marriage market, which is able to generate this relation. Parents decide on the circumcision of their daughter, trading-off the negative health consequences in the form of disutility for their daughter against the potential utility gain from marrying a rich man. Since men prefer circumcised women and women in turn prefer rich to poor men in this model, a stable matching outcome involves a higher probability of circumcised women marrying a rich man. I interpret cross-country differences in the status of women as different levels of female bargaining power within a household, which influences women's consumption. For a large parameter space of the model, an increase in the bargaining power reduces a woman's potential utility gain from marrying a rich man, which in turn reduces the benefits of FGC and thus the FGC prevalence rates. In this model, the equilibrium FGC rate can be inefficiently high, since it is not influenced by the actual level of the male utility from being married to a circumcised women. Only the assumption that men value circumcised women is relevant for the results. Therefore, I analyze two distinct policies with the aim of reducing the FGC rate: first, I introduce a penalty fee for parents who circumcise their daughter; and second, I analyze the effect of a direct consumption subsidy to women financed by a proportional tax on men's income. Both policies succeed in reducing FGC rates with different distributional effects. However, general equilibrium effects in the marriage market dampen the reduction of the FGC rate in the case of penalty fees. If FGC rates fall, the probability of circumcised women marrying a rich man increases. For some rich families, this increase can outweigh the additional cost of FGC, thus inducing them to circumcise their daughter. In contrast, the FGC prevalence among daughters born into a poor household will be reduced since the costs are too high for the parents. This leads to a redistribution from poor to rich households, as opposed to the second policy, which redistributes from rich to poor families, as well as from men to women.

Turning from the cross-country perspective to the within-country variation, the goal of Chapter 3 is to answer the following research questions: how do FGC, marital status and education interact? Could education subsidies to women reduce FGC rates? For Burkina Faso, I find that, first, uncircumcised and single women are better educated than circumcised and married women, respectively. Second, circumcised or non-educated women are more likely to be married than their counterparts, and third, better educated parents are less likely to circumcise their daughters. To answer the question of whether subsidies to female education costs could reduce FGC rates, I augment the model from Chapter 2 to a dynamic model with equilibrium search on the marriage market. Parents not only decide on the circumcision of their daughter but also on the education of their children. The calibrated model is able to replicate the empirical patterns of Burkina Faso. In the model, education and FGC are two potentially competing investments for the daughter. Education not only fosters economic independence but also marriage market prospects, since better educated women have a higher income, which is attractive to men. By contrast, FGC only improves marriage market prospects. If the costs of better education are high, parents may decide to circumcise their daughter instead of investing in her education. This is most likely the case for no or low educated parents with low income. The policy analysis shows that the introduction of female education subsidies first of all increases the female education level, as well as leading to a considerable reduction of the FGC rate. However, even high subsidy rates cannot eradicate FGC prevalence. This is due to the fact that for sufficiently high subsidies, almost all women are highly educated and can only differ in their FGC status. Thus, those women with low costs of FGC will be circumcised to improve their marriage market prospects. Nevertheless, the FGC rate would be lower than in the initial (current) situation. Overall, women are the winner of this policy in welfare terms, partly at the expense of men. For all subsidy rates, the welfare of men is lesser than in the starting situation. For low subsidy rates, their welfare even decreases with the level of subsidy, although it flattens out with an upward trend for higher subsidy rates.

Part II of this dissertation analyzes gender gaps in fertility and represents joint work with Erica Field and Michèle Tertilt. A large strand of the literature in family economics focuses on understanding fertility choices. Information on fertility and particularly "completed fertility" or "children ever born" is a crucial ingredient for building theories on this. At present, this information is predominantly based on surveys about the reproductive behavior of women, whereas almost no work exists measuring the number of children ever born per men. This makes statements about male fertility choices difficult and speculative. In this chapter, we start by analyzing whether and to what extent average fertility is different for men and women. We use survey data from several recent waves of the Demographic and Health Surveys in six developing countries in which men and women were each asked about their reproductive histories. We document a number of novel differences in the fertility outcomes of men and women. First, while one might have assumed that the average rates of completed fertility for men and women must coincide, we document that this is not the case. Comparing completed fertility for men and women of the same birth cohorts, we find that men have more children on average than women in four out of the six countries considered. Positive gaps mean that men must be having children with more than one woman. Indeed, we find that the size of the gap is positively related to the degree of polygyny. Second, we find a higher variance of fertility for men than women: in other words, women are more equal to each other in their reproductive behavior than men are. Third, we find that differences in the desire to have children can to a large extent be explained by differences in realized fertility. Thus, the differences in fertility preferences often emphasized in the literature do not necessarily need to cause conflict, since men and women can realize their fertility individually. Fourth, we document that the demographic transition started earlier and was steeper when considered from a male perspective.

Part I.

Female Genital Cutting: An Economic Perspective

Chapter 2

Female Genital Cutting and Women's Status Across Countries

2.1. Introduction

Female genital cutting (FGC) is a harmful tradition that is predominantly prevalent in the northern countries of sub-Saharan Africa and the Middle East.[1] Nevertheless positive prevalence rates are also observed outside of Africa (e.g. Indonesia, Peru and Pakistan). The estimated numbers of circumcised women range from 80 million (Yoder and Khan, 2008) to more than 130 million (UNICEF, 2005b). Figure 2.1 presents prevalence rates among 15 to 49 year-old women in Africa and Middle East, highlighting the high variation of prevalence rates across countries (ranging from 5% up to 94%).[2] Anthropological and sociological literature has focused on explaining the existence and persistence of FGC, identifying economic considerations as one of the potential driving forces.[3] This is also supported by Marixie Mercado, spokeswoman of UNICEF:

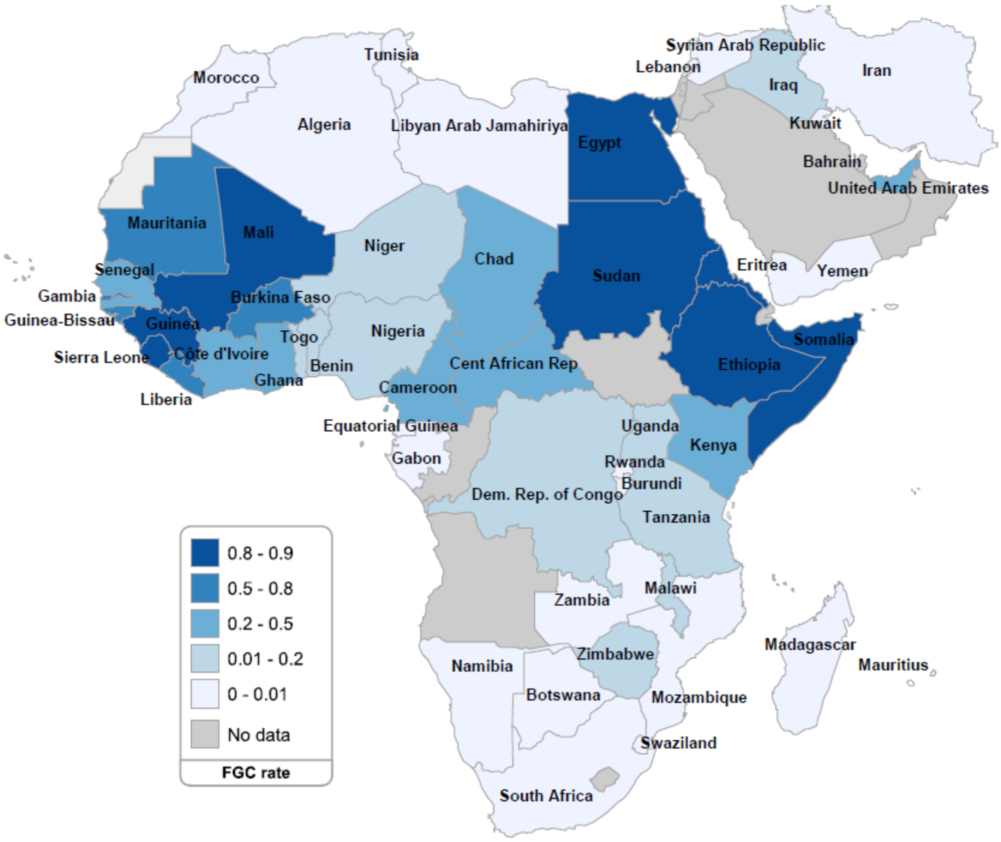
> *"The main reason that parents have their daughters cut or mutilated is really to provide them with economic and social security in a sense. It is to make sure that their daughters are accepted by society, that they can get married and have a chance of a normal life. In many of these cultures and traditions, not being 'cutted' is sanctioned.[4] "*

[1] Alternative expressions are female genital mutilation, as well as female circumcision. In this paper, I will refer to this tradition as either FGC or female circumcision.

[2] The worldwide distribution of prevalence rates are shown in Figure 2.A1 in the Appendix.

[3] See e.g. Mackie (1996, 2000), Shell-Duncan and Hernlund (2000), Yount (2002) and Skaine (2005). Freymeyer and Johnson (2007) analyze the attitudes towards FGC in Nigeria.

[4] http://www.voanews.com/content/unicef-reports-progress-in-eliminating-female-genital-mutilation-108914169/130753.html (accessed June, 2013).



Source: OECD Gender, Institutions and Development Database 2009

Figure 2.1.: FGC Prevalence Rates in Africa and Middle East

This paper focuses on the economic perspective and aims to shed light on the following two questions: what can explain cross-country differences in FGC rates? Which policies can reduce FGC rates? The overall goal is to provide a formalized framework for policy analysis. For policy interventions, it is important to analyze the underlying forces of this tradition and its interactions with other economic variables. This is exactly where the economic perspective and methods can provide a helping hand. Given that there are almost no program evaluations available to date, the effects of certain policies remain ambiguous, which calls for models to investigate possible interventions.

The contribution of this paper is threefold. First, I present cross-country evidence of a negative correlation between the status of women within a country and female circumcision rates. The smaller the inequality between genders, i.e the higher the women's status, the lower the FGC rate. This has not been recognized in the literature so far. Second, I provide a theoretical model that generates this empirical link by modeling FGC as premarital investment, reflecting an explicit decision of parents, to improve the marriage market prospects of their daughter. Third, the framework is used for a systematic policy analysis, including penalty fees and consumption subsidies to women, financed through a tax on men's income. The model allows for the analysis of general equilibrium effects in the marriage market, which turn out to be important for evaluating the effectiveness of different policies in reducing the FGC prevalence rate.

As a first contribution, I find that countries with higher gender inequality towards women have higher female circumcision prevalence rates. As a measure of gender inequality and women's status for different countries, I use the Social Institution and Gender Index (SIGI) 2009 for non-OECD countries, constructed by the OECD. The OLS estimates suggest a positive correlation between gender inequality and FGC prevalence rates. Given that this empirical analysis cannot identify any causality, the model explores the causal link from women's status to the FGC rate.[5]

The second contribution lies in the model, which is able to generate a negative correlation between the status of women and female circumcision rates. The model builds upon the work of Chesnokova and Vaithianathan (2010), who model FGC as a form of premarital investment such that circumcised girls have a higher chance of marrying richer men. In contrast to the model in Chesnokova and Vaithianathan (2010), parents decide upon the circumcision of their daughter. Their utility is based on dynastic preferences in line with Barro and Becker (1988, 1989). In general, a circumcised daughter will suffer negative long-term health consequences in the form of disutility. Marriage to a man provides her with access to resources through his income. All children will be matched to a spouse in the marriage market. While women can differ in their circumcision status (not circumcised versus circumcised), men differ in their wages. I further assume, as in Chesnokova and Vaithianathan (2010), that men value having a circumcised wife, i.e. if they are married to a circumcised woman, they derive positive utility from such a match. With these assumptions, a stable matching in the marriage market involves an assortative mating, whereby the underlying matching process follows the Gale-Shapley algorithm (Gale and Shapley, 1962). Therefore, a circumcised woman has a higher chance of marrying a rich man, which potentially increases her consumption. This consumption gain not only depends on the FGC specific match probabilities, but also the bargaining power of the woman. A female's bargaining power influences her consumption since a couple makes consumption decisions in a collective way through cooperative bargaining.[6] For the FGC

[5]In the model, the effect of the women's status on the FGC rate in equilibrium is analyzed. A possible reversed causality is not analyzed in this paper.

[6]The collective decision process is linked back to the work by Chiappori (1992) and Bourguignon and Chiappori (1992).

decision parents trade off utility costs (negative health consequences) against utility gains (more consumption) of their daughter's circumcision. Despite the marriage market being large and frictionless, the level of the FGC rate in equilibrium can be inefficient.[7] The reason is that parents do not take the actual utility gain of the potential husband into account when deciding upon the circumcision of the daughter.

I interpret cross-country differences in the status of women as different levels of bargaining power for women, in line with Doepke and Tertilt (2009).[8] The model can generate a negative interaction between the female circumcision rates and the status of women: an exogenous increase in the bargaining power of women leads to a decrease of the FGC rates in equilibrium. As a direct effect of a bargaining improvement, the consumption increases for all women. However, for a large parameter space of the model, an increase in the female bargaining power reduces the potential utility gain of a woman from marrying a rich man and hence the benefits of FGC. In turn, this leads to a drop in the FGC prevalence rates. Thus, the model may explain part of the observed cross-country correlation between FGC rate and the Social Institution and Gender Index (status of women).

The third contribution of this paper involves the extended policy analysis of two distinct interventions: penalty fees and direct consumption subsidies to women, the latter of which are financed through proportional income taxes for men. Both policies are able to reduce FGC rates, albeit with different distributional effects. The general equilibrium model uncovers a novel implication of penalty fees, whereby their reducing impact on FGC is attenuated by the general equilibrium effect in the marriage market. When the FGC rate drops, the probability of marrying a high type man increases for circumcised daughters. For rich households, this increase in the probability can outweigh the additional cost of FGC, such that more rich families circumcise their daughter. By contrast, many poor households stop doing so, leading to a redistribution from poor to rich families to some extent. The acknowledgment of this potential effect is highly relevant for policy implementations. The second policy is also able to reduce the FGC rate, comprising two components: a redistribution from rich to poor households and a redistribution from men to women. It is important to stress that a redistribution from rich to poor households does not drive the results alone; rather, it is the combination of both components that reduces the FGC rate even more. Such a detailed policy analysis

[7] Chesnokova and Vaithianathan (2010) detect a comparable inefficiency in their model on top of search frictions in the marriage market.

[8] In the model of Doepke and Tertilt (2009), the bargaining power of husbands and wives is set by the women's legal rights.

would not be possible within the model of Chesnokova and Vaithianathan (2010).[9]

Besides them, there are only a few economic papers that attempt to formalize potential reasons for FGC. Coyne and Coyne (2014) apply the identity model proposed by Akerlof and Kranton (2000) to this tradition. In their model, FGC is a crucial part of the ethnic identity and if a group member challenges this identity by refusing FGC, the rest of the group will punish this behavior to protect their identity. Using data from 13 African countries, Wagner (2013) not only presents empirical evidence of the relevance of ethnic and religious identity, but also of an interaction of the tradition with the marriage market. Rai and Sengupta (2013) explore the latter link, relating FGC to the marriage market as a form of signaling postmarital behavior. Men value feminine virtue but are unable to observe this before marriage due to asymmetric information. Female circumcision is seen as a premarital confinement that signals a docile behavior after marriage. The authors conduct some comparative statics to analyze the rules of descent, wealth inequality and production technology, but do not focus on policy analysis. Ouedraogo and Koissy-Kpein (2014) and Bellemare et al. (2014) also explore the underlying economic forces of FGC. While Ouedraogo and Koissy-Kpein (2014) focus on the interplay of education, FGC and the marriage market in Burkina Faso, Bellemare et al. (2014) analyze data from Senegal and the Gambia, finding that individual- and household-level factors can account for a large share of the FGC persistence, whereby this share is largest in the Gambia. Furthermore, village-level factors play a more important role for FGC support in Senegal compared to the Gambia.

This paper also belongs to a broader strand of literature on the interaction between violence and economic considerations, since I focus on economic forces for a harmful tradition.[10] For example, Miguel (2005) finds evidence that negative income shocks increase the number of witch killings, a form of religious violence, in Tanzania. Bloch and Rao (2002) analyze bridal violence as a bargaining instrument in India. Further related problems are those of missing women in India and China (Sen, 1990) and gender differences in resource allocation and excess female mortality (Rose, 1999). The analysis of the interaction between women's status and female genital cutting also links this paper to the literature on the empowerment of women and development (see Doepke and Tertilt (2009), Duflo (2012), Doepke et al. (2012), Fernández (2014), amongst others).

The paper further contributes to the economic literature on the marriage market, linking

[9] They only very briefly propose as policy interventions an increase in the cost of circumcision and a change of the marriage market expectations.

[10] Most of the following papers in this literature review are also mentioned by Chesnokova and Vaithianathan (2010).

back to the work of Becker (1973, 1974), which represents the foundation of many papers on stable matches in the marriage market (see e.g. Laitner (1991), Burdett and Coles (1997), Fafchamps and Quisumbing (2005) and Lundberg and Pollak (2008)).[11] The premarital investment nature of FGC in this paper relates it to the specific strand of the marriage market literature on premarital investment, e.g. Fernández et al. (2005), Nosaka (2007), Bjerk (2009) and Bhaskar and Hopkins (2011). Many of the papers analyze whether the individually determined investment levels are socially efficient. Depending on the circumstances, it can be the case that the level is efficient (e.g. Cole et al. (2001), Peters and Siow (2002), Iyigun and Walsh (2007), Chiappori et al. (2009) and Bhaskar and Hopkins (2011)), as well as inefficient (e.g. Peters and Siow (2002), Peters (2007) and Burdett and Coles (2001)). The inefficiency can go in both directions, with over-investment, a form of a rat race, or even under-investment. Many of these papers concentrate on education as a premarital investment, but not on FGC, which in contrast to education is a harmful investment. The work of Mariani (2012) on the value of female virginity within the marriage market is also closely related to my work. In this paper, female virginity is the premarital investment instead of FGC and higher male inequality leads to a higher prevalence of virginity, given that the returns to being married to a rich men are relatively larger. This is similar to the underlying mechanism in this paper. Another related paper along these lines is Lee and Ryu (2012), who find evidence for a large beauty premium in labor and marriage markets, using Korean data, but a small premium for plastic surgeries.

The remainder of this chapter is structured as follows. Section 2.2 provides empirical background information and cross-country evidence regarding female circumcision. The model is presented in Section 2.3, followed by a discussion of the inefficiency in Section 2.4. The influence of female bargaining power on FGC rates within the model is discussed in Section 2.5. Policy implications are analyzed in Section 2.6, before I conclude in Section 2.7.

2.2. Empirical Analysis

2.2.1. Background Information

"Female genital mutilation/cutting (FGM/C) refers to several different harmful practices involving the cutting of the female genitals. It is estimated that about three million girls, the majority under 15 years of age, undergo the procedure every year. FGM/C is a practice

[11] Browning et al. (2014) provide an extensive overview of the marriage market literature.

deeply rooted in tradition and persists because it is a social convention upheld by underlying gender structures and power relations." (United Nations Population Fund (UNFPA))[12]

Many attempts to identify the origin of FGC have failed to paint a clear picture. Some documents point towards Egypt as country of origin for this procedure (Skaine, 2005).[13] Yoder and Khan (2008) estimate that around 8 million women are infibulated and exposed to the most severe and harmful form of FGC, which corresponds to 10% of the circumcised women in Africa.[14]

The circumcision usually takes place at a young age between 4 and 14 years, although it is even performed on infants. In some ethnic groups, the circumcision can also take place just before marriage or during the first pregnancy (Skaine (2005) and UNICEF (2005b)). Female circumcision at early ages indicates that girls cannot influence the decision, which is made by their parents or family.

FGC is predominantly performed by traditional practitioners, midwives and barbers, most commonly without medical training (Skaine (2005) and UNICEF (2005b)).[15] Chesnokova and Vaithianathan (2010) cite the US Office of Senior Coordinator for International Women's Issues, which states that excisors receive around USD 2-3 per female circumcision in urban areas, while in rural areas payment is mainly made in grain or other agricultural goods. The instruments used by traditional practitioners vary across countries, but range from saw-toothed knives over pieces of glass, scissors, sharp stones to razors (Skaine, 2005). This can lead to immediate health consequences such as severe pain, shock, excessive bleeding, infections, and psychological consequences. Possible long-term health risks include chronic pain, infections, sexually transmitted infections, birth complications, danger to newborn, as well as psychological consequences, such as post-traumatic stress disorder (Skaine (2005), Shell-Duncan and Hernlund (2000) and Dorkenoo (1999)). Adam et al. (2010) estimate the costs of obstetric complications related to FGC in six African countries, namely Burkina Faso, Ghana, Kenya, Nigeria, Senegal and the Sudan, as ranging from 0.1 to 1% of the governmental

[12]http://www.unfpa.org/topics/genderissues/fgm, accessed on May, 08, 2013.

[13]Female circumcision in Egypt is mentioned on a Greek papyrus from 163 B.C. (Skaine, 2005).

[14]The World Health Organization categorizes female genital mutilation/cutting into four groups: *'Clitoridectomy'* is the partial or total removal of the clitoris, *'Excision'* describes the partial or total removal of the clitoris and the labia minora, *'Infibulation'* refers to the most severe form of circumcision where the vaginal opening is narrowed through the creation of a covering seal and *'Other'* refers to all other harmful procedures to the female genitalia (WHO (2008), WHO (2012)). The 10% is based on the estimated total number of circumcised women from Yoder and Khan (2008), which is around 80 million and not above 130 million, as estimated by UNICEF (2005b).

[15]However, there seems to be a trend towards a so-called "medicalization", whereby the procedure is relocated to hospitals and health clinics (UNICEF, 2005b). The qualified health professionals are in particular employed by richer families (Skaine, 2005).

health spending for women (in total I$ 3.7 million).[16] Jones et al. (1999) also find evidence of a positive correlation between the severeness of FGC and obstetric complications.

In the last 10 to 20 years, the tradition of female genital cutting has attracted large international attention, leading to many campaigns against FGC by international organizations such as UNFPA, UNICEF and WHO.[17] The goal of eliminating this tradition is justified by two prominent arguments, one pointing out the discussed negative health consequences and the other categorizing the tradition as a violation of human rights (WHO, 2008).[18] The most recent report of UNICEF (UNICEF, 2013) finds evidence of lower FGC rates among adolescents compared to the older cohorts in some countries, thus indicating a downward trend.[19] Nevertheless, the prevalence rates are still significantly different from zero.

The perceived benefits of FGC range from direct benefits for man, such as ensuring female virginity and more sexual pleasure, to indirect benefits for women, among which better marriage prospects and social acceptance, hygiene and religious approval are stated. In Côte d'Ivoire, Niger and Eritrea, 25% to 36% of the women think that female circumcision improves the marriage prospects (UNICEF, 2005b), which is also true for around 14% of all women in the African countries analyzed by Wagner (2013).[20] Chesnokova and Vaithianathan (2010) also show that in Burkina Faso in 2003 circumcised women were more likely to live in a wealthier household, which is supported by Sipsma et al. (2012) for Burkina Faso, Nigeria, Niger, Gambia and Guinea-Bissau. These empirical observations support the hypothesis that better marriage market prospects are one of the underlying forces of the FGC tradition.

2.2.2. Cross-Country Differences

The OECD Gender, Institution and Development Database (GID-DB) gathers FGC prevalence rates for non-OECD countries. Most of the FGC rates are based on surveys, such

[16] I$ stands for international (purchasing power parity) dollars.

[17] In 2008, the UNFPA and UNICEF started to work together on a Joint Programme on Female Genital Mutilation/Cutting: Accelerating Change. The focus lies on strengthening the legislation outlawing FGC and supporting communities to coordinate on agreements to abandon FGC. This includes community conversations, education about human rights and fundamental values (http://www.unicef.org/protection/57929_58002.html, accessed August, 2013).

[18] The international point of view does not necessarily coincide with the perception of the people involved, which is actually documented by the fact that FGC still exists and persists.

[19] The sharpest difference is observed for Kenya and the United Republic of Tanzania. In countries like Benin, Central African Republic, Iraq, Liberia and Nigeria the difference of the prevalence rates is around one half. In the Chad, Djibouti, Gambia, Guinea-Bissau, Mali, Senegal, Sudan and Yemen such a difference is not observed.

[20] Wagner (2013) analyzes 13 African countries: Benin, Burkina Faso, Cameroon, Chad, Guinea, Kenya, Mali, Nigeria, Niger, Senegal, Sierra Leone, Ethiopia, Ghana. In Table 2 of her paper she shows the self-declared advantages of FGC, while not having information for the last two countries. The 14% of women includes the stated advantages: "better marriage prospects" and "virginity".

as the Demographic and Health Survey (DHS) and the Multiple Indicator Cluster Survey (MICS). Furthermore, the GID-DB provides different measures of the economic development of women for various countries, e.g. the Social Institution and Gender Index (SIGI). The SIGI is a measure of gender inequality, capturing discriminatory social institutions and inheritance practices, violence against women, son preference, restricted access to public space and restricted access to land and credit.[21] Later on, I interpret cross-country differences in gender inequality, represented by the SIGI, as different levels of bargaining power for women in the model (as in Doepke and Tertilt (2009)). The Social Institution and Gender Index was calculated for 102 non-OECD countries in 2009. Note that FGC is also part of the sub-index of Physical Integrity. Therefore, I adjust the SIGI by excluding this information, which is used yet referred to as SIGI in the following.[22] The SIGI 2009 is based on information that has been available before but closest to 2009 for the different countries. For details on the data, I refer to Section 2.A.2 in the Appendix.

Figure 2.2 shows the correlations between FGC prevalence rates and the Social Institution and Gender Index, whereby 0 indicates equality between genders and 1 inequality, with women being disadvantaged. More precisely, Figure 2.2a includes all countries for which information on FGC and the Social Institution and Gender Index exists. The fitted line is based on a linear regression of FGC rates on the adjusted index. Figure 2.2b only shows countries with positive FGC rates. In both cases, the correlation between FGC rates and the index is positive.[23] This correlation is robust to including further controls. I estimate two cross-country OLS regressions, one including all countries and another conditional on positive FGC prevalence rates:

$$FGC_c = \alpha_0 + \alpha_1 SIGI_c + \mathbf{x}_c^{'} \alpha_3 + \varepsilon_c \text{ and} \tag{2.1}$$

$$\begin{aligned} FGC_c &= \alpha_0 + \alpha_1 SIGI_c + \mathbf{x}_c^{'} \alpha_3 + \varepsilon_c \\ \text{for} \quad & FGC_c > 0, \end{aligned} \tag{2.2}$$

[21]The index consists of 14 variables, which are grouped into five categories: Discriminatory Family Code, Restricted Physical Integrity, Son Bias, Restricted Resources and Entitlements and Restricted Civil Liberties. The index formula is $SIGI = \frac{1}{5}Family^2 + \frac{1}{5}Physical^2 + \frac{1}{5}Son^2 + \frac{1}{5}Resources^2 + \frac{1}{5}Civil^2$(see http://genderindex.org/content/team, accessed September, 2013).

[22]The adjusted SIGI is calculated as $SIGI_{adjust} = \frac{1}{4}Family^2 + \frac{1}{4}Son^2 + \frac{1}{4}Ownership^2 + \frac{1}{4}Civil^2$. All the following analysis are based on this measure, which I refer to as SIGI.

[23]Excluding Afghanistan and Sudan, which are outliers with respect to the SIGI, does not change the significant positive correlation. The correlation of countries with positive FGC rates reduces slightly to 0.42.

with $\mathbf{x}_c^{'}$ capturing controls, namely GDP p.c., GDP growth over the last 10 years, Gini coefficient of income and fraction of Muslim in the country, while the error term is denoted by ε_c.[24] As a robustness check, I also consider the observed FGC rate as a censored latent variable and estimate a Tobit model of the following form:

$$FGC_c = \begin{cases} FGC_c^* & if\ FGC_c^* > 0 \\ 0 & if\ FGC_c^* \leq 0, \end{cases} \tag{2.3}$$

where FGC_c^* is the latent variable: $FGC_c^* = \alpha_0 + \alpha_1 SIGI_c + \mathbf{x}_c^{'}\alpha_3 + \varepsilon_c$ with $\varepsilon_c \sim N(0, \sigma^2)$. Furthermore, almost all countries with a positive FGC prevalence lie above a SIGI value of 0.1 (SIGI). To account for this, I include this threshold to allow for different relationships (Column 4 of Table 2.1). The estimation equation across all countries c is given by:

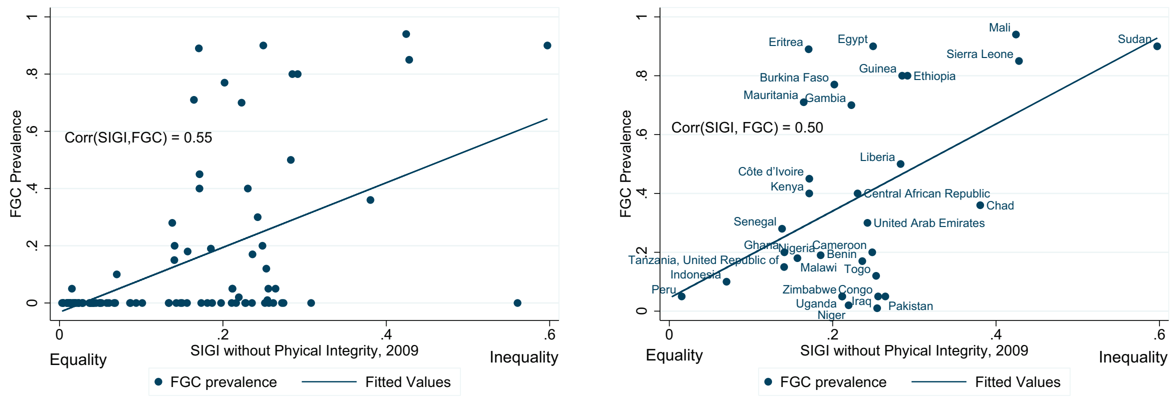
$$FGC_c = \alpha_0 + \alpha_1(SIGI_c \leq 0.1) + \alpha_2(SIGI_c > 0.1) + \mathbf{x}_c^{'}\alpha_3 + \varepsilon_c. \tag{2.4}$$

In all four estimations, I allow for heteroskedastic error terms and the results of the estimations are shown in the Table 2.1. The coefficient of the Social Institution and Gender Index has a significant positive coefficient in all regressions, supporting the positive correlation in Figure 2.2. Considering the whole sample, in Column 1, an increase in the inequality measure (SIGI) by 0.1 points is accompanied by a 12 percentage points increase in the FGC rate. Besides the SIGI, only the fraction of Muslims has a significant positive coefficient, i.e. higher FGC rates are observed in countries with a higher fraction of Muslims. The other variables are mainly insignificant.[25] Table 2.A1 (in Appendix 2.A.2) provides the estimates of the same regression models as presented in Table 2.1, but without the information of Sudan, given that it is an outlier with respect to the SIGI index.[26] The magnitudes of the estimated coefficients slightly change, but importantly the signs of the coefficients remain the same. A further robustness check is presented in Table 2.A2, whereby additional controls are included. The significant positive interaction of the FGC rate and the SIGI remains stable. Clearly, the results do not allow a causal interpretation, which is left to the model.

[24] Not all controls are available for the year 2009, therefore the information which is based on years before and closest to 2009 is used. Information on GDP p.c., GDP growth and the Gini coefficient is taken from the World Bank Indicators and the fraction of Muslims from Alesina et al. (2003). For more information on the data I refer the reader to the Section 2.A.2 in the Appendix.

[25] It might be the case that the Social Institution and Gender Index partly captures such factors.

[26] This is also true for Afghanistan, but it is already excluded from the regression since there is missing information on some controls.



(a) All Countries **(b)** Countries with a Positive FGC Rate

Sources: OECD Gender, Institution and Development Database

Figure 2.2.: SIGI and FGC Rates (2009)

2.2.3. From Empirical Evidence to the Model Assumption

The empirical observations discussed can be summarized as four facts:

1. Girls are circumcised during childhood, which indicates that the family decides on the circumcision, rather than the girls themselves.
2. The procedure involves initial pain and immediate complications, as well as negative long-term health consequences.
3. One of the perceived benefits of FGC is better marriage prospects and in some countries circumcised women are more likely to live in a wealthier household.
4. Countries with a low status and legal rights of women have higher FGC prevalence rates.

Based on these empirical facts, parents jointly decide upon the circumcision of their daughter in the following model (Fact 1). In general, the daughter will suffer negative long-term health consequences if she is circumcised (Fact 2). The driving forces of FGC in the model are the marriage market prospects, as in Chesnokova and Vaithianathan (2010) and Rai and Sengupta (2013), as well as the bargaining power of the women. All children will be matched to a spouse in the marriage market. While women can differ in their utility cost of FGC, men differ in their wages (or abilities). I further assume that a man values having a circumcised wife: if he is married to a circumcised woman, he derives positive utility from such a match, which is a crucial assumption in this model. Based upon these assumptions, a circumcised woman has a higher chance of marrying a rich man, which increases her consumption possibilities (Fact 3). Since parents are altruistic and the utility of the daughter enters their

Table 2.1.: Regression Results: FGC Prevalence Rates

	OLS	OLS (FGC>0)	Tobit	OLS
SIGI	1.182***	1.283***	2.031***	
	(0.205)	(0.312)	(0.354)	
SIGI>0.1				1.130***
				(0.228)
SIGI<=0.1				0.623
				(0.729)
Fract. of Muslim	0.00137*	0.00359**	0.00398***	0.00141*
	(0.000817)	(0.00128)	(0.00149)	(0.000835)
GDP p.c.	0.000000363	0.00000244	-0.000130**	0.000000146
	(0.00000161)	(0.0000519)	(0.0000561)	(0.00000175)
GDP growth	0.00289	0.0334**	-0.00746	0.00368
	(0.00834)	(0.0154)	(0.0151)	(0.00853)
Gini	0.000984	0.0155	0.00523	0.00134
	(0.00252)	(0.00924)	(0.00817)	(0.00271)
Constant	-0.129	-0.859*	-0.543	-0.133
	(0.126)	(0.434)	(0.355)	(0.128)
Sigma			0.340***	
			(0.0409)	
Observations	90	30	90	90
(pseudo) R^2	0.426	0.481	0.547	0.427

Source: OECD Gender, Institution and Development Database, World Bank WDI, Alesina et al. (2003), own calculations. Notes: Heteroskedasticity-robust standard errors in parentheses. * (p<0.10), ** (p<0.05), *** (p<0.01). If information is not available for 2009, data is based on years before and closest to 2009. The GDP growth is the GDP's average annual growth rate over the last 10 years.

own utility, they will trade off utility gains (more consumption) against utility costs (negative health consequences) of the circumcision for the daughter. These consumption possibilities depend on the probabilities of being matched to a richer man. Furthermore, the bargaining power of the woman influences her consumption, since a couple makes consumption decisions through cooperative bargaining. The cross-country differences in the status of women will be translated into different bargaining power for women across countries (Fact 4). A more detailed discussion of the model setup and assumptions follows in the next section.

2.3. Model

The model has two periods with a young (children) and old (parents) generation. In the first period, the economy is populated by parents, father and mother, and their children. Fertility is exogenous, with each couple having two children, a daughter and a son. There is a unit measure of each gender and each generation. While parents make decisions on their own consumption and the circumcision of their daughter as a premarital investment, children cannot make any choices. At the beginning of the second period, the young generation is active on the marriage market, where everyone will be matched to a partner of the opposite sex: in other words, there will be no singles in this economy. The newly-formed couples will subsequently decide on their consumption. The second generation does not have offspring, which allows for closed form solutions but does not influence the main mechanism. The old generation dies at the end of period one. The main structure is illustrated in Figure 2.3. I refer to the couples in the first period as "old couples" and the newly formed couples in the second period as "young couples".

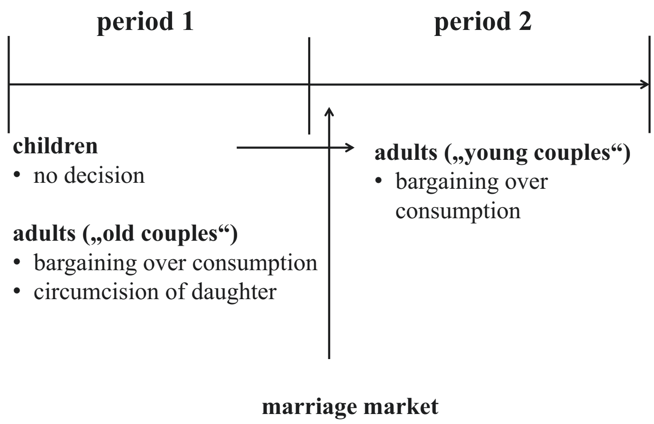


Figure 2.3.: Model Structure

2.3.1. Preferences

Preferences of the parents over their own consumption, circumcision and children's utilities are additively separable with constant relative risk aversion (CRRA) over the individual consumption. The utility of a woman in the first period is the following:

$$u_f = \frac{c_f^{1-\sigma}}{1-\sigma} - \alpha_{f,i}F + \gamma(u_{f'} + u_{m'}), \tag{2.5}$$

with c_f denoting the individual consumption of the female and σ being the CRRA parameter. The indicator F (F') is equal to one if the woman (woman's daughter) is circumcised and equal to zero if not. There is a utility cost to circumcision, which enters additively, $\alpha_{f,i}$. The interpretation is the individual perceived long-term health effect. The degree of altruism towards the children is governed by γ, with $u_{f'}$ and $u_{m'}$ representing the discounted utilities of the daughter and the son, respectively. Given that the FGC status enters separately and linearly in the utility of the woman, the consumption does not depend on it. Within the decision problem of the household, which will be explained in Section 2.3.5, the choice variables are the consumption c_f and the FGC status of the daughter F', affecting $u_{f'}$. The own circumcision status F is a state variable. Similarly, the utility of a husband in the first period is defined as:

$$u_m = \frac{c_m^{1-\sigma}}{1-\sigma} + \alpha_m \hat{F} + \gamma(u_{f'} + u_{m'}), \tag{2.6}$$

with individual consumption c_m. He derives positive utility α_m from being married to a circumcised wife, $\hat{F} = 1$. A man is altruistic towards his children in the same way as a woman. The discounted (ex-ante) utility of a daughter in period one

$$u_{f'} = \beta \mathbb{E}\left(\frac{c_{f'}^{1-\sigma}}{1-\sigma} - \alpha_{f,i} F'\right) \tag{2.7}$$

comprises the discounted expected utility of the second period. Expectations are multiplied by the discount factor β and formed over the marriage market outcome, which will influence the utility in the second period. The underlying probabilities are endogenous equilibrium objects, which will be explained in further detail in Section 2.3.4. Since the model ends after the second period and the second generation does not have offspring, only the consumption (choice variable) and possible long-term effects of the circumcision (state variable) enter the utility. For the son, the expected utility of the second period is given by:

$$u_{m'} = \beta \mathbb{E}\left(\frac{c_{m'}^{1-\sigma}}{1-\sigma} + \alpha_m \hat{F}'\right), \tag{2.8}$$

with $\hat{F}' = 1$ if the son is married to a circumcised woman. The traits of the partner are always indicated by a hat.

2.3.2. Household Budget Constraint

Each adult receives a fixed exogenous wage income for supplying labor inelastically. While each woman earns w_f, the wage income of a man depends on his type ω. The economy does not provide any savings technology. A household pools its income to finance the individual consumption of the spouses, leading to the following budget constraint:

$$c_f + c_m \leq w_f + w_m(\omega). \tag{2.9}$$

The budget constraint in the second period is the same.[27]

2.3.3. Heterogeneity

Women are heterogeneous in their long-term effect of FGC and men differ in their wage income. While the mother and daughter within a household have the same long-term effects of circumcision, the effects differ across households. The perceived long-term effect of FGC for a household with a wife (mother) i is denoted by $\alpha_{f,i}$ and is uniformly distributed over the interval $[\underline{\alpha}_f,\ \overline{\alpha}_f]$. The distribution function is denoted by $U_{\alpha_{f,i}}$. This variation across households can be explained by different perceptions, information and social environment across families. The assumption of the same perceived long-term effect within a household can be justified by the empirical observation of a strong intergenerational transmission of the tradition from the mother to daughter (Yount, 2002). Men can be either of type high or low, $\omega \in \{h,\ l\}$, with the high type earning more than the low type ($w_m(h) > w_m(l)$). For simplicity, the types are randomly distributed, not only across households but also within a household (across generation), meaning that the type of the father is not correlated with the son's type. The fraction of high type men in the economy is given by f_h and $\mathbf{M}$ denotes the distribution of the type of men.

2.3.4. Marriage Market

I assume that there are no binding agreements before marriage and no search frictions in the marriage market. As in Lundberg and Pollak (2008), the marriage market and consumption allocation can be viewed as a two-stage game. In the first stage, couples are formed, taking the consumption allocation that will emerge in the second stage as given. Utility transfers within a couple due to the circumcision are assumed away: a man is not going to compensate a circumcised woman in terms of consumption for deriving positive utility. Put differently, the marriage surplus out of FGC is not divided. In this sense, FGC is not a technology that allows the woman to extract more consumption out of a given marriage match. Furthermore, I assume that staying single is strictly dominated by being married.[28] In the marriage market, first the high type men decide who they want to marry and subsequently the poor men. A woman could in principal reject the proposal of a high type man. However, since a rich man

[27] The female wage stays the same $w_{f'} = w_f$ and a high (low) type men in the second period earns the same as a high (low) type in the first period, $w_{m'}(\omega') = w_m(\omega)$ for $\omega' = \omega$.

[28] For the main mechanism it is not important to model it explicitly, but it could easily be done by either incorporating a high utility gain of marriage, a public good within marriage or a high utility loss of staying single.

is always preferred to a poor man, this will not happen in equilibrium. Furthermore, men prefer circumcised women in this model, such that a high type man always wants to marry a circumcised woman. If there are fewer circumcised women than rich men in the marriage market, not every rich man can marry a circumcised woman. In such a case, the probability of a high type man marrying a circumcised woman, $p_{\hat{F}=1}(h')$, is less than one and he will marry an uncircumcised woman with a positive probability of $(1-p_{\hat{F}=1}(h'))$. The probability of a circumcised woman marrying a high type man is denoted by $p_h(F'=1)$ and for an uncircumcised woman by $p_h(F'=0)$, which of course also depends on the fractions of high type men and circumcised women in equilibrium.[29] One could think of the underlying mating process as follows: men propose to their most favored woman and if a woman has more than one proposal, she only puts the dominant proposal on hold. Every man who was rejected proposes to his preferred woman among those remaining to which he has not proposed before. Women in turn reject the dominated proposals. This process continues until convergence, which is assured by the fact that each woman receives at most one proposal from the same man (Browning et al., 2014).[30] This adjustment process corresponds to the Gale-Shapley algorithm (Gale and Shapley, 1962), which provides a stable matching allocation such that there are no two individuals who are not married to each other but would both strictly prefer to be.

2.3.5. Decision of the Households

Household decisions concerning consumption are made through collective bargaining, where the bargaining power of the wife is denoted by $\theta_f \in (0,1)$.[31] The bargaining power is exogenous and the same for all women, mothers and daughters, in an economy. It is supposed to capture the status of the women. The *old couple's* maximization problem in the first period is:[32]

$$\begin{aligned} \max_{c_m, c_f, F'} U &= \theta_f \frac{c_f^{1-\sigma}}{1-\sigma} + (1-\theta_f)\frac{c_m^{1-\sigma}}{1-\sigma} + \gamma(u_{f'} + u_{m'}) \\ s.t. \quad & c_f + c_m = w_f + w_m(\omega). \end{aligned} \tag{2.10}$$

[29] Mariani (2012) has a comparable framework in his marriage market, where men also differ in their income but women in their virginity status. The marriage market in the baseline model of Laitner (1991) is also similar.

[30] Bjerk (2009) also has a similar marriage market set up in his paper.

[31] This household decision process is modeled as a Pareto problem with different weights for the spouses, following Chiappori (1992) and Bourguignon and Chiappori (1992).

[32] Since the circumcision status of the wife, F, is a state variable for the couple and does not influence the consumption decision, it is ignored in the optimization problem.

The household decides on the individual consumption c_m and c_f, on the circumcision of the daughter F' subject to their budget constraint and taking into account the decision of their children, in particular of their daughter. Even though the son's utility, $u_{m'}$, enters the utility of parents, it can be neglected in the optimization problem, since there is no relevant decision on the son's side and the parents cannot influence his marriage market prospects.[33] Therefore, the optimization reduces to:

$$\begin{aligned}
\underset{c_m,F'}{maxU} &= \theta_f \frac{(w_f + w_m(\omega) - c_m)^{1-\sigma}}{1-\sigma} + (1-\theta_f)\frac{c_m^{1-\sigma}}{1-\sigma} \\
\text{utility of daughter} & \left\{ \begin{array}{l} +\gamma \Big\{ F'\beta \Big(p_h(F'=1)[\frac{c^{*\ 1-\sigma}_{f',\hat{h}'}}{1-\sigma} - \alpha_{f,i}] + \\ (1-p_h(F'=1))[\frac{c^{*\ 1-\sigma}_{f',\hat{l}'}}{1-\sigma} - \alpha_{f,i}] \Big) \\ +(1-F')\beta \Big(p_h(F'=0)\frac{c^{*\ 1-\sigma}_{f',\hat{h}'}}{1-\sigma} + \\ (1-p_h(F'=0))\frac{c^{*\ 1-\sigma}_{f',\hat{l}'}}{1-\sigma} \Big) \Big\}. \end{array} \right.
\end{aligned} \tag{2.11}$$

The discounted expected utility of the daughter depends on her FGC status, the marriage market outcome and the bargaining power of women. The *young couple's* optimization problem in the second period is given by:[34]

$$\begin{aligned}
\underset{c_{m',\omega'},c_{f',\omega'}}{max} U &= \theta_f \frac{c_{f',\omega'}^{1-\sigma}}{1-\sigma} + (1-\theta_f)\frac{c_{m,\omega'}^{1-\sigma}}{1-\sigma} \\
s.t. \quad & c_{f',\omega'} + c_{m',\omega'} = w_{f'} + w_{m'}(\omega').
\end{aligned} \tag{2.12}$$

2.3.6. Equilibrium Definition

Let $F'^*(\alpha_{f,i})$ be an indicator function that is equal to one if the family having a daughter with the long-term effect $\alpha_{f,i}$ decides to circumcise her:

$$F'^*(\alpha_{f,i}) = \begin{cases} 1 \text{ if household } i \text{ does circumcise} \\ 0 \text{ otherwise.} \end{cases}$$

Definition 2.1. The equilibrium consists of matching probabilities $(p_h(F'=1), p_h(F'=0))$, $p_{\hat{F}=1}(h')$ and $p_{\hat{F}=1}(l')$), the optimal consumption rules (c_f^*, c_m^*, $c_{f',\hat{\omega}'}^*$ and $c_{m',\omega'}^*$) and the

[33] The son's utility primarily depends on his own type, which is known to the family, and secondly also on the marriage match.

[34] As in the maximization problem (2.10) of the old couple, the FGC of the wife, F', is a state variable for the couple and does not influence the consumption decision and can be ignored in the optimization problem of a young couple.

circumcision ($F'^{*}(\alpha_{f,i})$) choices for each household, such that:

- consumption choices (c_f^* and c_m^*) and the female circumcision decision ($F'^{*}(\alpha_{f,i})$) solve the household's optimization problem of the couples in the first period (Equation 2.11), given the marriage market probabilities, wages and individual long-term effect of FGC;
- consumption choices ($c^*_{f',\hat{\omega}'}$ and $c^*_{m',\omega'}$) solve the household's optimization problem of the couples in the second period (Equation 2.12); and
- the marriage market clears:
  - the demand for circumcised women is equal to the supply

$$p_{\hat{F}=1}(h')f_h + p_{\hat{F}=1}(l')(1-f_h) = \int_{\underline{\alpha}_f}^{\bar{\alpha}_f} F'^{*}(\alpha_{f,i})dU_{\alpha_{f,i}}(\alpha_{f,i});$$

  - the demand for high type men is equal to the supply

$$\begin{aligned}&\int_{\underline{\alpha}_f}^{\bar{\alpha}_f} F'^{*}(\alpha_{f,i})p_h(F'=1)dU_{\alpha_{f,i}}(\alpha_{f,i}) + \\ \int_{\underline{\alpha}_f}^{\bar{\alpha}_f} &\left(1-F'^{*}(\alpha_{f,i})\right)p_h(F'=0)dU_{\alpha_{f,i}}(\alpha_{f,i}) = f_h; \text{ and}\end{aligned}$$

- the matching is stable such that there are no two individuals who are not married to each other but would both strictly prefer to be.

2.3.7. Equilibrium Characterization

The *optimal consumption decision* of the young couple in the second period is given by:

$$\begin{aligned}(c^*_{f',\omega'}, c^*_{m',\omega'}) &= arg \max_{c_{f',\omega'},c_{m',\omega'}} \theta_f \frac{c_{f',\omega'}^{1-\sigma}}{1-\sigma} + (1-\theta_f)\frac{c_{m',\omega'}^{1-\sigma}}{1-\sigma} \\ &\quad s.t.\ c_{f',\omega'} + c_{m',\omega'} = w_{f'} + w_{m'}(\omega'), \\ c^*_{f',\omega'} &= \frac{\theta_f^{\frac{1}{\sigma}}}{\theta_f^{\frac{1}{\sigma}} + (1-\theta_f)^{\frac{1}{\sigma}}}(w_{f'} + w_{m'}(\omega')) \text{ and} \\ c^*_{m',\omega'} &= \frac{(1-\theta_f)^{\frac{1}{\sigma}}}{\theta_f^{\frac{1}{\sigma}} + (1-\theta_f)^{\frac{1}{\sigma}}}(w_{f'} + w_{m'}(\omega')). \end{aligned} \tag{2.13}$$

The optimal consumption rules of the old couple in the first period are analogous to (2.13).

Parents will decide on the *female genital cutting* of their daughter, taking into account the optimal consumption of the daughter in the second period (see Equation 2.13). If the expected utility of being circumcised is higher than that of being uncircumcised, parents decide to circumcise their daughter: $F'^{*}(\alpha_{f,i}) = 1$ if

$$\underbrace{\begin{array}{l}\gamma\beta p_h(F'=1)\left(\dfrac{c^{*\;1-\sigma}_{f',\hat{h}'}}{1-\sigma}-\alpha_{f,i}\right)\\ +\gamma\beta(1-p_h(F'=1))\left(\dfrac{c^{*\;1-\sigma}_{f',\hat{l}'}}{1-\sigma}-\alpha_{f,i}\right)\end{array}}_{\text{expected utility when circumcised}} \;>\; \underbrace{\begin{array}{l}\gamma\beta p_h(F'=0)\dfrac{c^{*\;1-\sigma}_{f',\hat{h}'}}{1-\sigma}\\ +\gamma\beta(1-p_h(F'=0))\dfrac{c^{*\;1-\sigma}_{f',\hat{l}'}}{1-\sigma}.\end{array}}_{\text{expected utility when uncircumcised}} \tag{2.14}$$

Equation (2.14) can be rewritten in a way that the gain, comprising the probability increase of marrying a high type man and the additional utility of the higher consumption, is weighted against the utility costs of FGC:

$$\big(p_h(F'=1)-p_h(F'=0)\big)\left(\frac{c^{*\;1-\sigma}_{f',\hat{h}'}}{1-\sigma}-\frac{c^{*\;1-\sigma}_{f',\hat{l}'}}{1-\sigma}\right) \;>\; \alpha_{f,i}. \tag{2.15}$$

There exists a threshold for long-term effects, for which Equation (2.15) holds with equality:

$$\alpha^*_f \;=\; \big(p_h(F'=1)-p_h(F'=0)\big)\frac{c^{*\;1-\sigma}_{f',\hat{h}'}-c^{*\;1-\sigma}_{f',\hat{l}'}}{1-\sigma} \tag{2.16}$$

If the individual long-term effect is above this cutoff, the cost of circumcision dominates the benefit, such that the family will refrain from FGC. All households in which the daughter has FGC costs below this threshold will circumcise her. In equilibrium, this threshold defines the fraction of circumcised women f_F in the economy, which has to lay within the interval of $[0,1]$ by definition.

The *equilibrium probabilities* depend on the fraction of circumcised young women in the marriage market f_F, which in turn is determined by this threshold α^*_f:

$$\begin{aligned} f_F &= \frac{\alpha^*_f-\underline{\alpha}_f}{\overline{\alpha}_f-\underline{\alpha}_f}\\ &= \frac{(p_h(F'=1)-p_h(F'=0))}{(\overline{\alpha}_f-\underline{\alpha}_f)(1-\sigma)}\left(c^{*\;1-\sigma}_{f',\hat{h}'}-c^{*\;1-\sigma}_{f',\hat{l}'}\right)-\frac{\underline{\alpha}_f}{\overline{\alpha}_f-\underline{\alpha}_f}. \end{aligned} \tag{2.17}$$

The *stable matching* in the marriage market is characterized by a positive assortative mating with respect to FGC and wealth.[35] This means that a high type man generally marries a circumcised woman and a low type man a uncircumcised woman. If there are more high type men in the economy than circumcised women, all circumcised women are matched with a high type man and the remaining men will marry a uncircumcised woman. The opposite is true if there are more circumcised women than high type men. The matching within these groups is random.[36] Depending on the fraction of high type men, f_h, three different cases can occur in equilibrium (which are also presented in Figure 2.A3 in Appendix 2.A.4):

Case(1) $f_h = f_F$: the fraction of circumcised women (f_F) in equilibrium is determined by the fraction of high type men,

$$f_F = \frac{{c^*_{f',\hat{h}'}}^{1-\sigma} - {c^*_{f',\hat{l}'}}^{1-\sigma}}{(\overline{\alpha}_f - \underline{\alpha}_f)(1-\sigma)} - \frac{\underline{\alpha}_f}{\overline{\alpha}_f - \underline{\alpha}_f} = f_h \tag{2.18}$$

with the following probabilities:[37]

$$p_h(F' = 1) = 1 \quad \text{and} \quad p_h(F' = 0) = 0.$$

Case(2) $f_h > f_F$: the fraction of high type men is larger than the fraction of circumcised women in equilibrium. Therefore, the probabilities are:

$$p_h(F' = 1) = 1 \quad \text{and} \quad p_h(F' = 0) = \frac{f_h - f_F}{1 - f_F},$$

such that the fraction of circumcised women is determined by:

$$\begin{aligned} f_F = & -\frac{\overline{\alpha}_f - 2\underline{\alpha}_f}{2(\underline{\alpha}_f - \overline{\alpha}_f)} \\ & \pm \left(\frac{\left(\overline{\alpha}_f - 2\underline{\alpha}_f\right)^2}{4(\underline{\alpha}_f - \overline{\alpha}_f)^2} + \frac{(1-f_h)({c^*_{f',\hat{h}'}}^{1-\sigma} - {c^*_{f',\hat{l}'}}^{1-\sigma})}{(1-\sigma)(\underline{\alpha}_f - \overline{\alpha}_f)} \right. \\ & \left. - \frac{\underline{\alpha}_f}{(\underline{\alpha}_f - \overline{\alpha}_f)} \right)^{\frac{1}{2}}. \end{aligned} \tag{2.19}$$

Denoting the solution involving the positive sign before the root as Case (2.19a)

[35]This assortative mating is comparable in this special setup to Chesnokova and Vaithianathan (2010) and Rai and Sengupta (2013) but also in general to the assortative mating in Becker (1965).
[36]Bjerk (2009) has a comparable matching process.
[37]If the fraction of high type men is actually zero, then the probabilities turn to $p_h(F' = 1) = 0$ and $p_h(F' = 0) = 1$.

and the other as Case (2.19b).

Case(3) $f_h < f_F$: the fraction of high type men is smaller than that of circumcised women in equilibrium, which leads to the following probabilities:

$$p_h(F' = 1) = \frac{f_h}{f_F} \quad \text{and} \quad p_h(F' = 0) = 0.$$

The corresponding fraction of circumcised women is:

$$f_F \quad = \quad \frac{-\underline{\alpha}_f}{2(\overline{\alpha}_f - \underline{\alpha}_f)} \pm \left(\frac{\underline{\alpha}_f^2}{4(\overline{\alpha}_f - \underline{\alpha}_f)^2} + \frac{f_h({c^*_{f',\hat{h}'}}^{1-\sigma} - {c^*_{f',\hat{l}'}}^{1-\sigma})}{(1-\sigma)(\overline{\alpha}_f - \underline{\alpha}_f)} \right)^{\frac{1}{2}}. \quad (2.20)$$

Again, the solution based on the positive sign before the root is denoted by (2.20a) and the other by (2.20b).

Propositions 2.3 and 2.4 in Appendix 2.A.5 show that at least one equilibrium exists for a relatively large parameter space, although there are some multiplicity problems. I solve for all possible equilibria in the numerical example (see Section 2.5.2), however, there are no multiplicity issues.

2.4. Inefficiency of the Equilibrium Outcome

In this section, I discuss inefficiencies of the marriage market equilibrium. As in Chesnokova and Vaithianathan (2010), the degree of valuation of circumcision from the husband's perspective (α_m) does not influence the level of the FGC rate, as long as α_m is positive. For the parents, it does not matter how much utility a potential husband of their daughter gains from having a circumcised wife, parents do not maximize social welfare. It only matters that he actually values the circumcision and that thus the circumcision increases the probability of the daughter marrying a high type man. Chesnokova and Vaithianathan (2010) point out that the FGC rate can be inefficiently high in such a set-up.

As briefly mentioned in the introduction, the discussion concerning inefficiencies is at the heart of many papers in the literature on premarital investment. Depending on the assumptions, market outcomes can be efficient, e.g. if markets are large, no frictions exist and/or utilities are transferable (Cole et al. (2001), Peters and Siow (2002), Iyigun and Walsh (2007) and Chiappori et al. (2009)) but also inefficient, e.g. if markets are small and/or frictions are prevalent (Burdett and Coles (2001), Peters and Siow (2002), Peters (2007) and Baker and Jacobsen (2007)). The inefficiency can go in both directions, namely either underinvestment (e.g. Burdett and Coles, 2001) or over-investment (e.g Peters, 2007).[38] For example, Mariani (2012) shows that the virginity level in the private equilibrium is not socially optimal. Depending on the parameter, the level is either inefficiently high or inefficiently low.

As Mariani (2012), I compute the social planner allocation to investigate whether the private allocation is socially optimal. Preferences of men and women are taken as given. However, it is not obvious which degree of freedom a social planner has, i.e. which allocations he can enforce. This makes the welfare analysis not trivial. Therefore, I also analyze equivalent consumption variations (EV) from a ex-post perspective in this section. For a woman, the EV represents the amount of consumption she would be willing to give up to get rid of the negative FGC long-term consequences. For the man, it is the compensation in terms of consumption that he would call for not having a circumcised wife. Throughout this analysis of inefficiencies one should keep in mind that FGC is a particularly harmful investment, in contrast to other premarital investments such as education and that the preferences are taken as given.

2.4.1. Social Planner Solution

Assuming that the social planner can enforce the circumcision status, the consumption and mating allocation, the weighted sum of utilities (social welfare) is maximized subject to the aggregate feasibility constraint. Women are indexed by i and men by j, where $\mathbf{U}_{\alpha_{f,i}}$ is the distribution of women and $\mathbf{M}$ the distribution of men. The weight on women's welfare is denoted by $0 < \mu < 1$. The optimization problem reads as follows:

$$\begin{aligned} \max_{c_{f',i}, c_{m',j}, F_i', \mathbb{I}_{i,j}} \quad & \mu \int_{\underline{\alpha}_f}^{\bar{\alpha}_f} \left(\frac{c_{f',i}^{1-\sigma}}{1-\sigma} - \alpha_{f,i} F_i' \right) d\mathbf{U}_{\alpha_{f,i}}(\alpha_{f,i}) \\ & + (1-\mu) \int_j \left(\frac{c_{m',j}^{1-\sigma}}{1-\sigma} + \mathbb{I}_{i,j}(\alpha_m F_i') \right) d\mathbf{M}(j) \end{aligned} \tag{2.21}$$

$$s.t. \quad \int_{\underline{\alpha}_f}^{\bar{\alpha}_f} c_{f',i} d\mathbf{U}_{\alpha_{f,i}}(\alpha_{f,i}) + \int_j c_{m',j} d\mathbf{M}(j) = w_f + f_h w_m(h') + (1-f_h) w_m(l').$$

$$\mathbb{I}_{i,j} = \begin{cases} 1 \text{ if } i \text{ and } j \text{ are a couple} \\ 0 \text{ if } i \text{ and } j \text{ are no couple.} \end{cases} \tag{2.22}$$

[38] The model of Burdett and Coles (2001) is a two-sided search market with non-transferable utility. The setup leads to two externalities: An underinvestment externality, since the person does not take into account that the partner is better off and a desertion externality, due to the fact that self-improved individuals are more selective, which might lead to over-investment.

The optimality conditions for the consumption allocations are:

$$\begin{aligned} \mu c_{f,i}^{-\sigma} &= \lambda \,\forall i \\ (1-\mu) c_{m,j}^{-\sigma} &= \lambda \,\forall j, \end{aligned} \tag{2.23}$$

where λ is the Lagrange multiplier. The optimal allocation is defined by $c_{f,i} = (\frac{\mu}{1-\mu})^{\frac{1}{\sigma}} c_{m,j}$ $\forall i, j$. Taken the preferences as given, a woman i will be circumcised, $F_i = 1$, if:

$$\alpha_{f,i} < \frac{\mu}{1-\mu} \alpha_m \,\forall i. \tag{2.24}$$

Those women with FGC utility costs below the weighted utility gain for men ($\alpha_{f,i} < \frac{\mu}{1-\mu}\alpha_m$) are circumcised. The fraction of circumcised women is then $f_F^{SP} = \frac{\alpha_f^{SP*} - \underline{\alpha}_f}{\bar{\alpha}_f - \underline{\alpha}_f} = \frac{\frac{\mu}{1-\mu}\alpha_m - \underline{\alpha}_f}{\bar{\alpha}_f - \underline{\alpha}_f}$, with the threshold value being $\alpha_f^{SP*} = \frac{\mu}{1-\mu}\alpha_m$. In this setup, the couples are matched randomly, $\mathbb{I}_{i,j}$ is randomly assigned, given that the matches do not matter for the maximization of this social welfare function. The resulting level of the FGC rate would be the same if the social planner could only influence the mating outcome and the FGC decision (see Appendix 2.A.6). By chance, it can happen that the weighted FGC valuation of the men is equal to the decentralized competitive threshold, $\frac{\mu}{1-\mu}\alpha_m = \alpha_f^*$. However, if this is not the case, the FGC rate of the private equilibrium is not socially optimal and thus inefficient. The main reason for the inefficiency is that parents do not internalize the utility gain of the potential husband in their decision. If the FGC valuation of men is very low, i.e. $\alpha_m = \varepsilon \to 0$ and women's welfare has a sufficiently high weight in the social welfare function (μ is not too small), the decentralized FGC rate will be inefficiently high.[39]

2.4.2. Equivalent Consumption Variation

It can further happen that for a certain couple the woman would be willing to give up more consumption to get rid of the negative FGC consequences than the husband would require as compensation for not having a circumcised wife. For such a couple, a transfer allowing this reallocation would be pareto improving.

Depending on the parameters of the model, the FGC status can be inefficient for some couples from an *ex-post perspective*. The following exercise is only a thought experiment, given that the circumcision cannot be reversed in the second period. The equivalent consumption

[39] Taking the individual preferences in this model as given, and particularly that men value female circumcision, it could happen that the decentralized FGC rate is lower than the social planner solution. However, this should not be interpreted as a normative statement in favor of a higher FGC rate.

variation ($EV^{post}_{f',i}$) for a wife is defined as the amount of consumption she would give up to get rid of the FGC utility costs.

$$\begin{aligned}\frac{(c_{f',\omega'})^{1-\sigma}}{1-\sigma} - \alpha_{f,i} &= \frac{(c_{f',\omega'} - EV^{post}_{f',i})^{1-\sigma}}{1-\sigma} \\ EV^{post}_{f'} &= c_{f',\omega'} - \left((c_{f',\omega'})^{1-\sigma} - (1-\sigma)\alpha_{f,i}\right)^{\frac{1}{1-\sigma}}. \end{aligned} \quad (2.25)$$

For a husband of type ω', married to a circumcised wife, the equivalent consumption variation ($EV^{post}_{m',\omega'}$) is:

$$EV^{post}_{m',\omega'} = \left(c_{m',\omega'}{}^{1-\sigma} + (1-\sigma)\alpha_m\right)^{\frac{1}{1-\sigma}} - c_{m',\omega'}. \quad (2.26)$$

This is the amount of consumption that would equalize the utilities of being married with a circumcised and uncircumcised woman. If $EV^{post}_{f',i} > EV^{post}_{m',\omega'}$, the FGC of the wife is ex-post inefficient for this couple. The woman could have been better off in terms of utility without making the husband worse off. She could have compensated her husband with additional consumption ($EV^{post}_{m',\omega'}$) to avoid the circumcision in the previous period and the associated negative utility $\alpha_{f,i}$. The remaining difference $EV^{post}_{f',i} - EV^{post}_{m',\omega'}$ would have increased the utility of the wife. Such an inefficiency most likely occurs for a couple with the wife having a high FGC cost, equal or close to the threshold ($\alpha_{f,i} = \alpha^*_f$).

2.5. Explaining Cross-Country Differences

In Section 2.2.2, I documented a negative correlation between women's rights and FGC rates. The model sheds light on a possible link, pointing to a causality from the lack of women's rights (represented by the female bargaining power as in Doepke and Tertilt (2009)) to FGC. Accordingly, this is discussed in the following section.

2.5.1. Comparative Statics: Bargaining Power

The equilibrium fraction of circumcised women depends on the female bargaining power, which determines their consumption within the marriage. The higher the bargaining power of a woman, the higher her individual consumption. However, the expected utility gain in consumption due to FGC is relevant for the parents' FGC decision. If the preferences exhibit CRRA with $\sigma > 1$, the magnitude of the utility gain in consumption depends on the initial level of consumption. In particular, the utility gain is decreasing in the level of consumption, i.e. the higher the initial consumption level, the lower the utility gain of a certain consumption increase. The same consumption increase would yield a higher utility gain if the initial consumption level were lower (see Figure 2.A4 in Appendix 2.A.4). Due to this relation, an increase in the female bargaining power can lead to a decrease in the FGC prevalence rates.[40] Interpreting the female bargaining power as women's status, the model is able to generate the negative cross-country correlation between women's status and FGC prevalence rates, which I will now prove in two steps. First of all, I will analyze the effect of an increase in the bargaining power on the FGC threshold α_f^*, holding the marriage market probabilities fixed.

Proposition 2.1. ***Bargaining Power (PE)***. *Holding the marriage market probabilities unchanged, the threshold α_f^* decreases with an increase in the bargaining power if $\sigma > 1$.*

Proof. See Appendix 2.A.5. □

Such a decrease in the threshold-value means that fewer families want to circumcise their daughter if the female bargaining power increases, ceteris paribus. However, in a general equilibrium framework, the decrease in the fraction of circumcised women in turn influences the probabilities in the marriage market, which is not covered by Proposition 2.1. It is also important to note that this proposition only holds for CRRA preferences with $\sigma > 1$. This determines the degree of curvature in the utility function, which can be interpreted as relative risk aversion.[41] The relevance and importance of this range can be seen for example in the marriage market literature, which also uses CRRA preferences with a relative risk aversion above unity (see Greenwood et al. (2012) and Santos and Weiss (2013)). Furthermore, the macroeconomic literature employs a relative risk aversion, which mostly ranges from one to five (Yang, 2009).[42] In a second step, I take the general equilibrium effects into account.

Proposition 2.2. ***Bargaining Power (GE)***. *For $\underline{\alpha}_f = 0$, the general equilibrium effect of an increase in the bargaining power θ_f on the FGC rate f_F^* is*

[40]It is important to note that there is no disagreement between the spouses about the decision of circumcising the daughter. In this simple model, the wife does not have a preference against circumcising the daughter and a higher bargaining power would subsequently turn the decision towards no circumcision. The bargaining power only influences the female circumcision over the potential consumption level and the corresponding consumption gain of the daughter.

[41]In this setup a woman can be in two different states related to consumption: a low consumption state when married to a low type men or a high consumption state when married to a high type man. The probabilities of each state are the marriage market probabilities, which depend on the circumcision status of the woman.

[42]Yang (2009) uses a relative risk aversion of 1.5, which is close to the estimates of Attanasio et al. (1999) and Gourinchas and Parker (2002).

(a) negative if $\sigma > 1$ and Cases (2.18), (2.19b) or (2.20a) apply; and

(b) positive if $\sigma > 1$ and Case (2.19a) applies.

Proof. See Appendix 2.A.5. □

Given that Case (2.19a) for $\underline{\alpha}_f = 0$ never occurs alone, as shown in Proposition 2.4 and Figure 2.A5, there is always a solution for which the FGC rate decreases due to an increase in the bargaining power of the women.

2.5.2. Numerical Example

To assess the quantitative relevance of this channel, I provide a numerical example of the impact of female bargaining power on the equilibrium FGC rates. I calibrate parameters to a country, Burkina Faso in 2009/10, before subsequently varying the bargaining power exogenously. The parameters are presented in Table 2.2. For a brief overview of the situation in Burkina Faso, I refer to Appendix 2.A.3.

Table 2.2.: Parameters for Burkina Faso

Preset Parameter		Value	Source
Fraction of high type men	f_h	0.4	
Average income of the lowest 60% (USD, p.a)	$w_m(l)$	$296 * 20$	WDI, World Bank
Average income of the highest 40% (USD, p.a)	$w_m(h)$	$940 * 20$	WDI, World Bank
Average income of the women	w_f	$296/2 * 20$	
Bargaining power = transformed SIGI-Index	θ_f	0.4	OECD
Discount Factor	β	0.98^{20}	Standard
Utility gain of FGC	α_m	0.1	

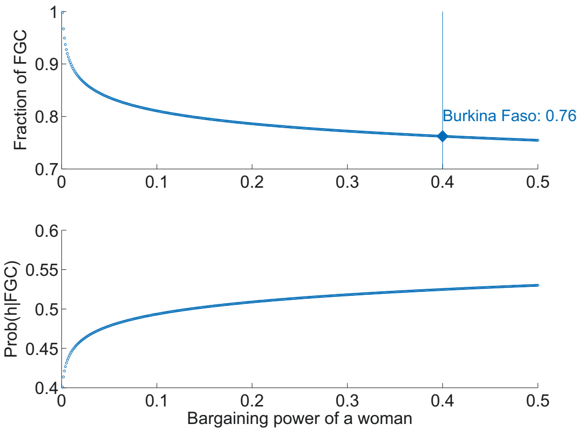
Note: The average income is calculated based on the GDP in 2010 and the population share within the income deciles. The utility gain of FGC does not influence the equilibrium outcome, but clearly the welfare analysis.

Calibrated Parameters		Value	Target	Source
Utility cost of circumcision	$\alpha_{f,i}$	$[0, 0.26]$	FGC rate = 0.76	DHS 2010
CRRA parameter	σ	1.1	FGC rate = 0.76	DHS 2010

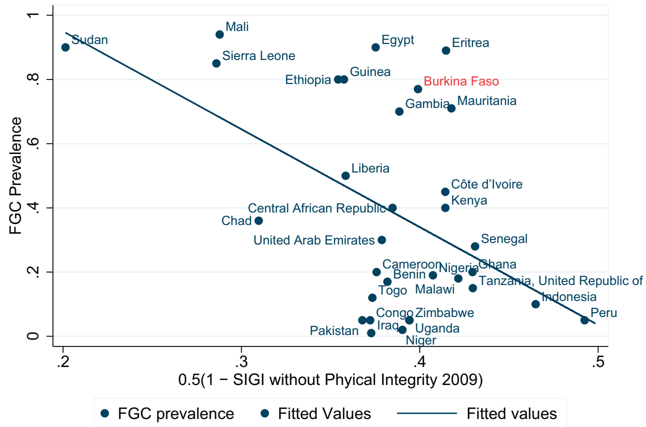
The length of one period is set to 20 years. In 2010, 76% of the women aged 15 to 49 years in Burkina Faso had undergone FGC.[43] The value of the female bargaining power is

[43] The FGC prevalence rate for just the younger cohorts is lower, alternatively this lower rate could be targeted. Since this model is not a dynamic OLG model, a distinction between different FGC rates across cohorts does not make sense. The FGC rate within the old cohort would be closely related to the one within the young cohort, since the environment is the same and there are no different forces leading to a distinct equilibrium outcome.

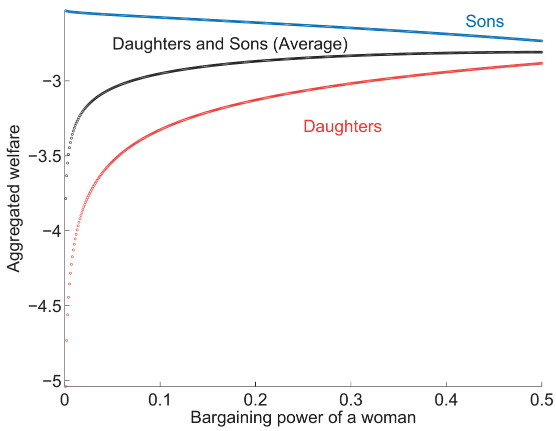
chosen according to the Social Institution and Gender Index (SIGI) 2009, excluding physical integrity. An index value of 0 represents gender equality, which corresponds to a bargaining power of 0.5. In order to translate the index value for Burkina Faso (BF) into the bargaining power of women, I apply the following transformation: $\theta_f = 0.5(1 - SIGI_{BF}) = 0.4$.



(a) Different Marriage Market Equilibria



(b) Cross-Country Evidence



(c) Welfare

Figure 2.4.: Different Exogenous Bargaining Power

Based on these parameters, the FGC rate in equilibrium is equal to 76%.[44] Figure 2.4a shows the FGC rates for different values of female bargaining power and the corresponding probabilities of a circumcised woman marrying a high type man, which are presented in the lower panel. This probability is higher the lower the FGC rates. Each point of the graph represents a separate equilibrium and can be interpreted as a country with the same parameters yet a different value of the female bargaining power. The resulting equilibria are unique and belong to the third case, whereby the fraction of circumcised women is higher

[44]For the chosen set of parameters, the equilbria are unique and no multiplicity exists with respect to the FGC rate.

than the fraction of high type men (see Equation (2.20), Case (2.20a)).[45]

The numerical results show that the FGC rate decreases with the woman's increased bargaining power.[46] Qualitatively, the model is able to explain the cross-country correlation between women's status and female circumcision rates (Figures 2.4a (model) and 2.4b (data)). The Social Institution and Gender Index is transformed to line up with the definition of female bargaining power in the model, such that an increase in this transformed index corresponds to an increase in the women's status. Therefore, the relationship between the transformed index and FGC rates now decreases.[47]

The ex-ante welfare, namely the aggregated discounted expected utilities of daughters and sons together, is shown in Figure 2.4c for every equilibrium.[48] While the ex-ante expected utility increases in the bargaining power for the daughters, it decreases for sons. The overall averaged welfare of the daughters and sons is also illustrated and increases in the bargaining power up to $\theta_f = 0.5$. The difference between the welfare of the daughters and sons for $\theta_f = 0.5$ is purely driven by the utility costs of circumcised women and utility gains of the men with a circumcised wife.

2.6. Policy Implications

I now apply the inefficiency measures from Section 2.4 to the numerical example. For the decentralized set-up, the men's valuation of FGC (α_m) does not influence the FGC rate in equilibrium, whereas it is an important parameter for the discussion of inefficiency. A

[45] For all those equilibria it holds that $f_h < 0.5$ and $\frac{1}{f_h} \geq \frac{1}{\bar{\alpha}_f}(\frac{{c^*_{f',\hat{h}'}}^{1-\sigma}}{1-\sigma} - \frac{{c^*_{f',\hat{l}'}}^{1-\sigma}}{1-\sigma}) > f_h$. Therefore, no other cases than Case (3) apply (see Table 2.A7 in Appendix 2.A.5).

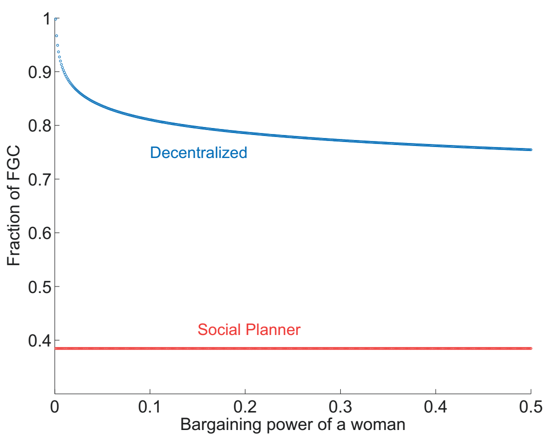
[46] The results are shown for the relevant value range of the bargaining power, $\theta_f \epsilon (0, 0.5]$. A value of 0 means that a woman has no bargaining power at all, while a value of 0.5 represents equal rights for a wife and her husband. Values above 0.5 would mean that the husband is disadvantaged, which does not seem to be relevant for the analyzed countries. Nevertheless, the described pattern also holds in this value range.

[47] The range of empirical FGC rates is higher than the one of the model implied prevalence rates, but the numerical example is only "calibrated" to Burkina Faso. Only the female bargaining power differs across the equilibria, all other parameters are the same. Such a one-dimensional comparison is most likely not able to replicate the right FGC levels for all countries, which differ in many dimensions.

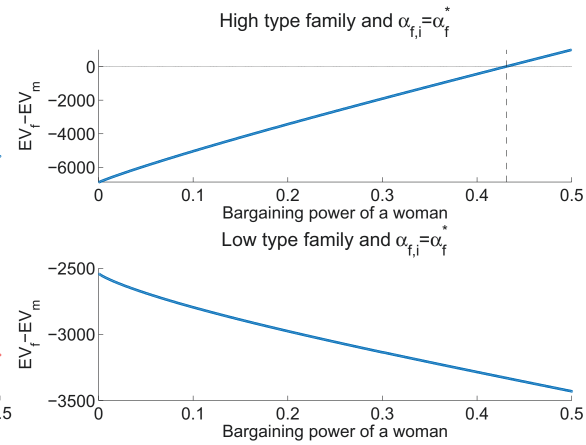
[48] $W_{ex-ante} = 0.5W_d + 0.5W_s$ with

$$
\begin{aligned}
W_d \quad = \quad & \int_{\underline{\alpha}_f}^{\alpha^*_f} \left[\beta \left(p_h(F'=1)\left(\frac{{c^*_{f',\hat{h}'}}^{1-\sigma}}{1-\sigma} - \alpha_{f,i}\right) + (1-p_h(F'=1))\left(\frac{{c^*_{f',\hat{l}'}}^{1-\sigma}}{1-\sigma} - \alpha_{f,i}\right)\right)\right] dU_{\alpha_{f,i}}(\alpha_{f,i}) \\
& + \int_{\alpha^*_f}^{\bar{\alpha}_f} \left[\beta \left(p_h(F'=0)\frac{{c^*_{f',\hat{h}'}}^{1-\sigma}}{1-\sigma} + (1-p_h(F'=0))\frac{{c^*_{f',\hat{l}'}}^{1-\sigma}}{1-\sigma} - \alpha_{f,i}\right)\right] dU_{\alpha_{f,i}}(\alpha_{f,i}) \\
W_s \quad = \quad & f_h\beta\left[p_{\hat{F}'=1}(h)\left(\frac{{c^*_{m',h'}}^{1-\sigma}}{1-\sigma} + \alpha_m\right) + (1-p_F(h))\frac{{c^*_{m',h'}}^{1-\sigma}}{1-\sigma}\right] + \\
& +(1-f_h)\beta\left[p_F(l)\left(\frac{{c^*_{m',l'}}^{1-\sigma}}{1-\sigma} + \alpha_m\right) + (1-p_F(l))\frac{{c^*_{m',l'}}^{1-\sigma}}{1-\sigma}\right].
\end{aligned}
$$

comparison of the social planner with the private equilibrium FGC rate is presented in Figure 2.5a. The valuation of the men is $\alpha_m = 0.1$ and the utility cost of FGC for women is uniformly distributed on the interval $[0, 0.34]$. In this case, the social planner, with the same weight of women's and men's welfare ($\mu = 0.5$), would choose a FGC rate of 0.38, independent of the bargaining power. All decentralized equilibrium rates are above this social planner FGC rate.[49] Figure 2.5b shows the difference in equivalent consumption variation of the spouses for the "marginal" wife with $\alpha_{f,i} = \alpha_f^*$. The difference $EV_f^{post} - EV_m^{post}$ for a rich household is displayed in the upper panel.[50] In an economy with a female bargaining power above 0.43, a wife would be willing to compensate her husband for not being circumcised. In such cases, a compensation in consumption would be pareto-improving for the couple. If the bargaining power is lower, the amount of consumption she is willing to give up would be smaller than what the husband would demand as compensation. Since a circumcised woman faces a positive probability of marrying a low type man, the lower panel also presents this difference for poor households, which is not positive. Summing up, the FGC rate can be inefficiently high, which yields another argument for FGC rate reducing policies from an economic perspective, along with the conventional arguments of human rights violation and negative health consequences.



(a) Social Planner Solution



(b) Equivalent Consumption Variation: Ex-post

Notes: The social planner FGC rate is based on the symmetric social planner problem, where the weights are the same for women and man ($\mu = 0.5$).

Figure 2.5.: Inefficiencies of the FGC Rate ($\alpha_m = 0.1$)

Based on the model, there are at least four different policies that one could consider to reduce FGC. First, the comparative static in Section 2.5 shows that an increase in the bar-

[49]However, this would be not the case if the FGC valuation of the men were much higher.
[50]In the following a household with a high (low) type man is defined as rich (poor) household.

gaining power of women leads to a decrease in FGC rates.[51] Every policy that increases the bargaining power directly could reduce FGC prevalence rates according to the model. For example, the Coptic Evangelical Organization for Social Services (CEOSS) is active in Egypt and focuses in particular on the improvement of women's status (UNICEF, 2005a), while the UNFPA-UNICEF Joint Programme on Female Genital Mutilation/Cutting: Accelerating Change also relies on these elements.[52] Such policies are in line with the theory that the expansion of women's rights should lead to a reduction in FGC prevalence rates (see Yount (2002), Bellemare et al. (2014), Finke (2006) and Dawla (1999)).

Second, explaining the potential health costs and the harmfulness of this tradition could increase the perceived costs, which in turn would reduce the number of circumcised daughters. Existing programs are starting at these points, such as the Tostan Community Empowerment Programme to promote human rights, which was initiated in Senegal. This non-formal education program has been able to rise the awareness of women and men of FGC consequences to some extent, leading to some community-based declarations to abandon this practice. The program has also been implemented in some villages in Burkina Faso (UNICEF, 2005a). However, rising awareness can only be effective in reducing FGC rates if parents do not have full information about the utility cost of their daughter ($\alpha_{f,i}$). If parents know the utility costs and are not subject to incomplete information, as in the model, such a policy cannot affect the FGC rate.

The third and fourth policies are now discussed in more detail. The third policy involves the introduction of penalty fees, which is supposed to represent a ban of the tradition. The fourth policy consists of direct consumption subsidies to women, financed through proportional income taxes for men. The analysis is based on the numerical example of Section 2.5.2.

2.6.1. Penalty Fees

Twenty-six African and Middle East countries have outlawed FGC, through legislation ranging from a ban of female circumcision in medical centers to arrests. Burkina Faso already enacted a law against FGC in 1996, including fines against practitioners and people being silent about the execution of the procedure. Furthermore, harmful reproductive practices were banned by law in 2005 (UNICEF, 2013).[53] Diop et al. (2008) argue that, in contrast to the other

[51] This is true for certain types of equilibria (see Proposition 2.2).
[52] http://www.unicef.org/protection/57929_58002.html, accessed August, 2013.
[53] Detailed information can be found on pages 8 and 88 in UNICEF (2013).

African countries, Burkina Faso systematically enforces the law. Burkina Faso even has an "SOS Excision" hotline for anonymous reports on the performance.[54] To analyze such a policy within the model, I assume that parents have to pay a penalty fee p if they decide to circumcise their daughter. The revenue of these fees is not redistributed in the economy.

$$\begin{aligned} \max_{c_m,c_f,F'} U &= \theta_f \left(\frac{{c_f}^{1-\sigma}}{1-\sigma} - \alpha_{f,i}F\right) + (1-\theta_f)\left(\frac{c_m^{1-\sigma}}{1-\sigma} + \alpha_m F\right) + \gamma(u^*_{f'} + u^*_{m'}) \\ & s.t.\ \ c_f + c_m + pF' = w_f + w_m(\omega) \end{aligned} \tag{2.27}$$

This policy creates a link between the consumption of the parents and the circumcision of the daughter by reducing their budget. Therefore, the optimal consumption decision of the parents changes to:

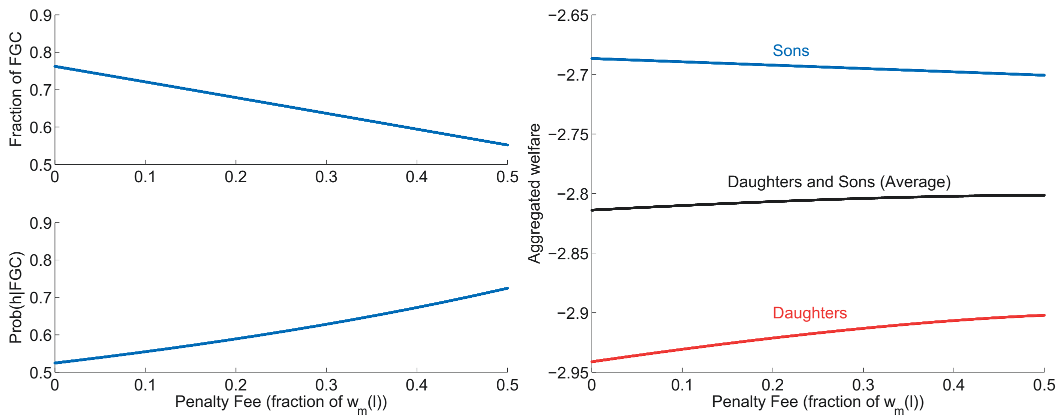
$$\begin{aligned} c_f^*(\omega, F') &= \frac{\theta_f^{\frac{1}{\sigma}}}{\theta_f^{\frac{1}{\sigma}} + (1-\theta_f)^{\frac{1}{\sigma}}}(w_f + w_m(\omega) - pF') \\ c_m^*(\omega, F') &= \frac{(1-\theta_f)^{\frac{1}{\sigma}}}{\theta_f^{\frac{1}{\sigma}} + (1-\theta_f)^{\frac{1}{\sigma}}}(w_f + w_m(\omega) - pF'). \end{aligned} \tag{2.28}$$

The threshold value for the utility costs, below which the parents decide to circumcise their daughter, is then defined as

$$\alpha^*_{f,\omega} = \big(p_h(F'=1) - p_h(F'=0)\big)\frac{{c^*_{f',\hat{h}'}}^{1-\sigma} - {c^*_{f',\hat{l}'}}^{1-\sigma}}{1-\sigma} + C_\omega, \tag{2.29}$$

where $C_\omega \equiv \theta_f \frac{c_f^*(\omega,F'=1)^{1-\sigma} - c_f^*(\omega,F'=0)^{1-\sigma}}{1-\sigma} + (1-\theta_f)\frac{c_m^*(\omega,F'=1)^{1-\sigma} - c_m^*(\omega,F'=0)^{1-\sigma}}{1-\sigma}$. There are now two threshold values $\alpha^*_{f,h}$ and $\alpha^*_{f,l}$, for a rich and a poor family, respectively. The difference between the threshold values is given by $\alpha^*_{f,h} - \alpha^*_{f,l} = C_h - C_l$.

[54] The low rate of women, who state having at least one circumcised daughter (around 16%), supports this view but the issue of potential under-reporting, as briefly discussed in Section 2.A.3, should not be underestimated and the number should be treated with caution.



(a) FGC Prevalence Rate **(b)** Welfare

Figure 2.6.: Different Penalty Fees

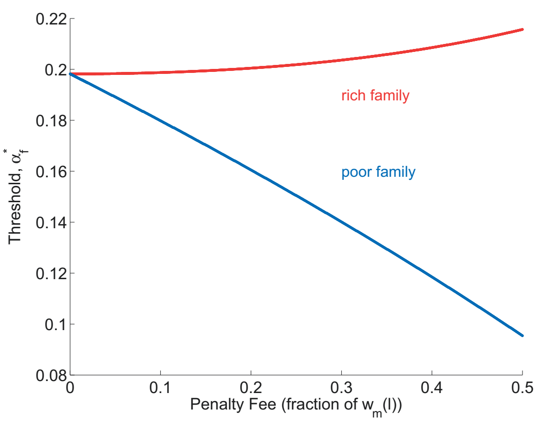


Figure 2.7.: Threshold α_f^* for Different Penalty Fees

Using the previous calibration for Burkina Faso, the left panel of Figure 2.6 shows the corresponding equilibrium FGC rates for different penalties. As an example, a penalty of 592 USD corresponds to 10% of the period income of a low type man and 3% of the income of a high type man.[55] The female circumcision rate decreases in equilibrium for higher fines, although the general equilibrium effects on the probabilities of marrying a high type man slow down the reduction. This can be seen in Figure 2.7, where the two threshold values are shown. The negative effect of a penalty fee is stronger for a poor than for a rich family, whereby the penalty fee places a higher burden on the budget constraint of poor families. Therefore, less poor families will circumcise their daughters (decreasing threshold of the circumcision costs $\alpha_{f,l}^*$). This reduces the FGC rate on the one hand, but increases the probability of circumcised daughters to marry a high type man on the other. For some rich families this rise outweighs

[55]The model period is 20 years; therefore, the period income of a poor men is 5,920 USD and a rich men 18,800 USD.

the negative effect on the disposable income, which leads to an increase of their threshold $\alpha^*_{f,h}$. In turn, this leads to more rich families circumcising their daughters. For poor families, the opposite is true, with the threshold ($\alpha^*_{f,l}$) falling relatively sharply. Thus, in a sense, the penalty fee redistributes from poor to rich families, given that more rich than poor daughters now have the chance to marry a rich man. The welfare of sons decreases slightly, while the welfare of daughters increases. Aggregate welfare increases, even though the changes are small.[56]

2.6.2. Taxes and Consumption Subsidy

Since the potential consumption gain is one of the driving forces, a reduction of this gain should reduce the equilibrium FGC rates. This reasoning leads to an indirect policy, namely a consumption subsidy to the women (s'), financed through proportional taxes (τ') on the wages of the men in the second period.[57] In this policy set-up, I force the couple to give a certain level of consumption to the wife. It is meant to mimic a policy capable of providing women with a direct consumption subsidy that cannot be consumed by her husband. The optimization problem of the old couples remains the same, but changes for the young couples in the second period:

$$\begin{aligned} \max_{c_{m',\omega'},c_{f',\omega'}} U &= \theta_f \left(\frac{(c_{f',\omega'}+s')^{1-\sigma}}{1-\sigma} - \alpha_{f,i}F' \right) + (1-\theta_f) \left(\frac{c_{m',\omega'}^{1-\sigma}}{1-\sigma} + \alpha_m F' \right) \\ s.t.\ c_{f',\omega'} + c_{m',\omega'} &= w_f + (1-\tau')w_m(\omega'). \end{aligned} \tag{2.30}$$

In the second period, the government budget needs to be balanced:

$$s' = \tau' \left(w_{m'}(h')f_h + w_{m'}(l')(1-f_h) \right).$$

The optimal consumptions are then given by:

$$\begin{aligned} c^*_{f',\hat{\omega}'}(s) &= \frac{\theta_f^{\frac{1}{\sigma}}}{\theta_f^{\frac{1}{\sigma}} + (1-\theta_f)^{\frac{1}{\sigma}}}(w_f + (1-\tau')w_m(\hat{\omega}')) - \frac{(1-\theta_f)^{\frac{1}{\sigma}}}{\theta_f^{\frac{1}{\sigma}} + (1-\theta_f)^{\frac{1}{\sigma}}} s \\ c^*_{m',\omega'}(s) &= w_f + (1-\tau')w_m - c^*_{f,\omega'} \text{ and} \end{aligned} \tag{2.31}$$

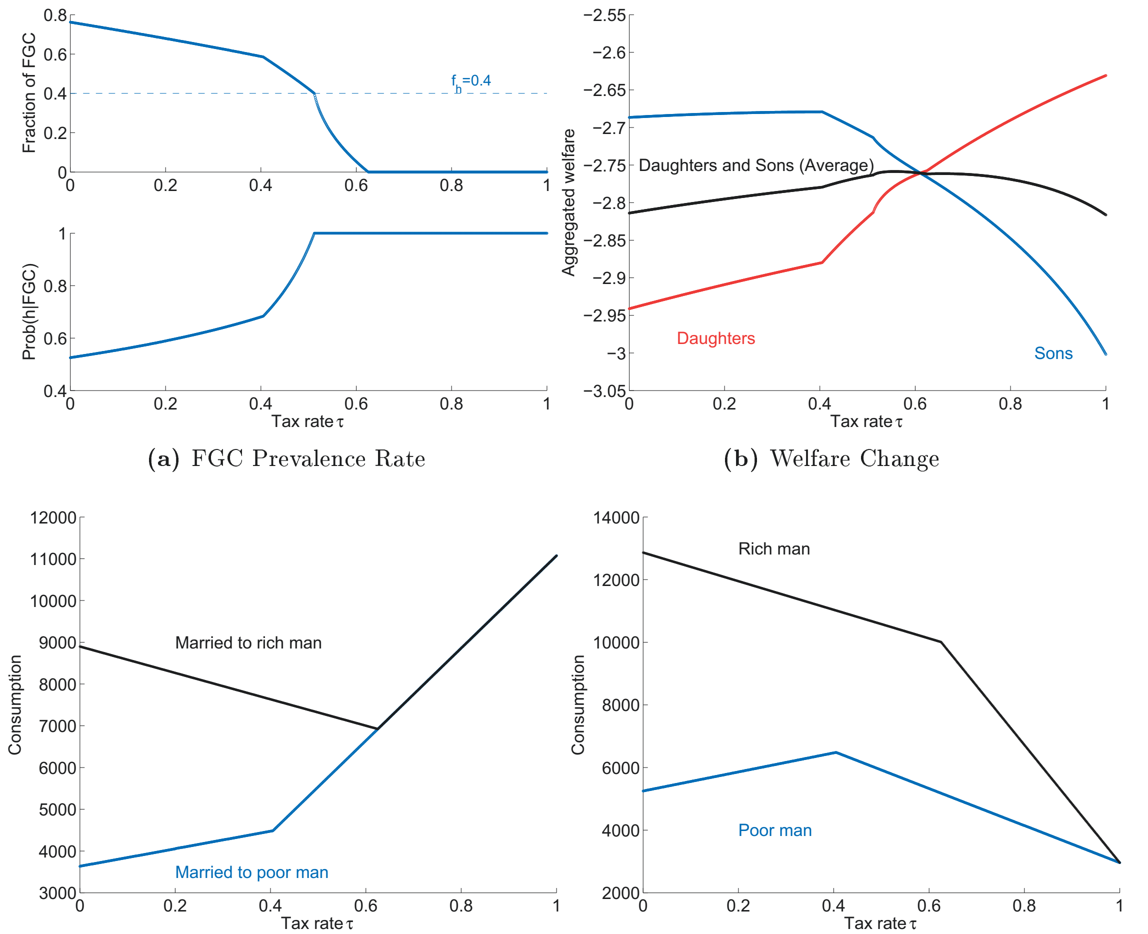
[56] The welfare of parents is not considered here. For those who circumcise their daughter consumption decreases, which influences their utility.

[57] Admittedly, this policy is very abstract and it could be argued to some extent that it is out of the model setup. Since there is only one bundle of consumption goods/one consumption good and the consumption decision is based on a cooperative model of the household, the income is pooled and there is no direct way of giving resources in the woman's hand only. Such a consumption discrimination against a husband in this framework would not reflect an optimization result.

the resulting threshold for the FGC costs depends on theses changed optimal consumption rules:

$$\alpha_{f*} \quad = \quad \big(p_h(F'=1) - p_h(F'=0)\big)\,\frac{c^*_{f',\hat{h}'}(s)^{1-\sigma} - c^*_{f',\hat{l}'}(s)^{1-\sigma}}{1-\sigma}.$$

Referring to the previous numerical example of Burkina Faso, the FGC rate drops for each tax rate τ, as Figure 2.8a shows. Since the policy is anticipated, a couple takes the fixed



(a) FGC Prevalence Rate

(b) Welfare Change

(c) Consumption of Women

(d) Consumption of Men

Figure 2.8.: Different Tax Rates

consumption subsidy of the woman into account. For low taxes and subsidies, the household just reduces the additional consumption of the wife, since the weighted marginal utilities of each spouse still have to be equal. At the point where the subsidy is higher than the "optimal" consumption of the wife, she only receives the subsidy and the remaining household income is used to finance the consumption of the husband. Furthermore, the proposed policy also redistributes from rich to poor households, as the government budget shows $s' = \tau' \left(w_m(h')f_h + w_m(l')(1 - f_h) \right)$. The consumption subsidy in the poor household to the wife relaxes the family's budget constraint, which not only allows higher consumption of the wife, but also of the husband. Only for higher tax rates, the reduction of the poor household's budget is too high to finance an increase in the man's consumption. This pattern is demonstrated in Figure 2.8c, which shows the consumption of a woman in the second period either living in a rich or poor household. Figure 2.8d focuses on the consumption of a man. For a woman married to a rich man, the consumption initially decreases, since the budget of the family falls. The increase in consumption for high tax rates is due to the high subsidy. In this region, the bargaining process is removed. The woman receives a predefined subsidy, which is higher than the optimal consumption level resulting from the household optimization problem. The FGC rate drops since the redistribution reduces the expected gain from circumcision. This lowers the threshold for the FGC utility costs and thus the number of circumcised women. The changes in welfare are documented in Figure 2.8b, where the kinks are related to those in the consumption. Such a policy has an overall positive effect for women in the second period (daughters), for each value of bargaining power it increases their welfare in equilibrium. The picture is different for men in the second period (sons), with an overall decrease in aggregated welfare.

Essentially, this policy comprises two components: a redistribution across households and a redistribution between genders within households. To better understand the effect of this policy, I analyze the first part separately. The redistribution across households only includes the component of a proportional tax to men's wage, which is then redistributed to all households as a lump-sum transfer. This only affects the budget constraints of the households: $c_{f',\omega'} + c_{m',\omega'} = w_f + (1 - \tau')w_m(\omega') + T$ with $T = \tau' \left(w_m(h')f_h + w_m(l')(1 - f_h) \right)$. The resulting equilibrium FGC rates for different tax rates are presented in Figure 2.9, showing that this policy alone ("across") has a less stronger effect for tax rates above 0.4 than the combined policy ("both"). For lower tax rates, the effect is the same. Even though this is not a "true" composition of this combined policy, given that general equilibrium outcomes are compared, Figure 2.9 indicates that the redistribution across households for tax rates below 0.4 is driving the results. This is due to the above-mentioned effect that for low tax rates the forced within-household redistribution of consumption from the husband to the wife is still lower than the optimal consumption level, which leads to no adjustment along this margin. For higher tax rates, the within-household distribution is kicking in, meaning that the combination of those policies rapidly drives down the FGC rates.

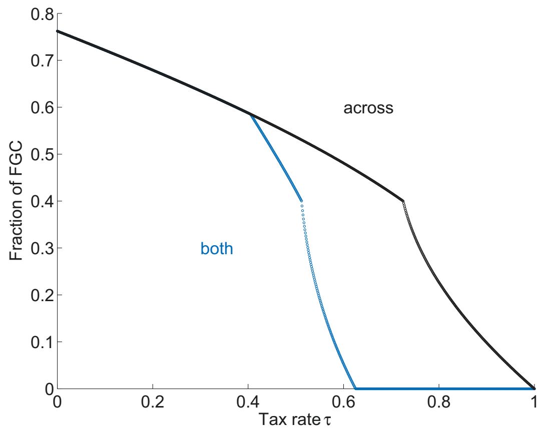


Figure 2.9.: Combined Policy vs. Redistribution across Households

The results of this section show the relevance of general equilibrium effects that need to be taken into account when considering different policies. Even though a fine decreases FGC rates in equilibrium, the circumcision rate for rich families increases, which is to some degree a redistribution from poor to rich families in the sense that more rich daughters now marry a rich husband. The alternative of a direct consumption subsidy financed through a tax on men's income is also able to reduce the female circumcision rate, accompanied by a slightly higher overall welfare increase. However, such a comparison is unfair to the extent that the penalty revenues are not redistributed, meaning that resources are wasted, while in the alternative policy this is not true, with tax income being redistributed. It is important to note that the policy of transfer and subsidies not only redistributes from men to women, but also from rich to poor households, as opposed to the penalty fee.

2.7. Conclusion

In this paper, I present novel cross-country evidence of a negative correlation between women's status and FGC rates. In countries in which women are disadvantaged compared to men, FGC prevalence rates tend to be higher. Unfortunately, the cross-country analysis does not allow for a causal interpretation.

However, I provide a model in which women's status influences the FGC prevalence rates. In the model, a higher status of women in the economy – captured as female bargaining power within a household – leads to lower FGC prevalence rates. The key feature of the model is the marriage market with FGC as premarital investment. Parents decide about the circumcision of their daughter trading off the costs of FGC against its benefits, which lie in the improved marriage market prospects (higher chance of marrying a rich man). The female bargaining power influences the consumption allocation within a household and consequently the utility gain from consumption, which can be achieved by marrying a rich versus a poor man. Depending on the model parameters, this utility gain is decreasing in the female bargaining power. Such a reduction of the FGC benefits, while costs remain unchanged, leads to lower FGC prevalence rate.

Another important insight of the model is that the equilibrium FGC rate can be inefficient, which rationalizes policy interventions from a further perspective besides human rights violation and negative health effects. The model allows for structured policy analysis, showing that general equilibrium effects in the marriage market can have a dampening effect on the reduction of FGC. This should be taken into account for policy considerations, e.g. for penalty fees, the probability of marrying a high type man increases for circumcised daughters, since the FGC rate falls. For many poor households, the penalty fee places a high burden on their budget constraint, such that they refrain from circumcising the daughter. However, the picture is different for rich households. For some, the increased probability outweighs the additional cost of FGC, which induces them to circumcise their daughter. Therefore, a penalty indirectly redistributes from poor to rich families, besides the overall reduction of the FGC rate. The second policy of a direct consumption subsidy to all women, financed through a proportional tax rate on men's income, is also able to reduce FGC rates. However, in contrast to the first policy, the redistribution goes in the opposite direction, namely from rich to poor households, but also from men to women.

Returning to the empirical observation, one obvious open question is why the status of women differs across countries and whether the tradition of FGC in turn affects the women's status in an economy. There might be a form of "vicious circle" at work, whereby patriarchal systems perpetuate the FGC practice (see e.g. Monagan, 2010), which in turn reinforces the gender role and with that the women's status. A better understanding of the interaction between FGC and women's status, including a potentially reversed causality, represents an important step towards well-informed policy advices and is left to future research.

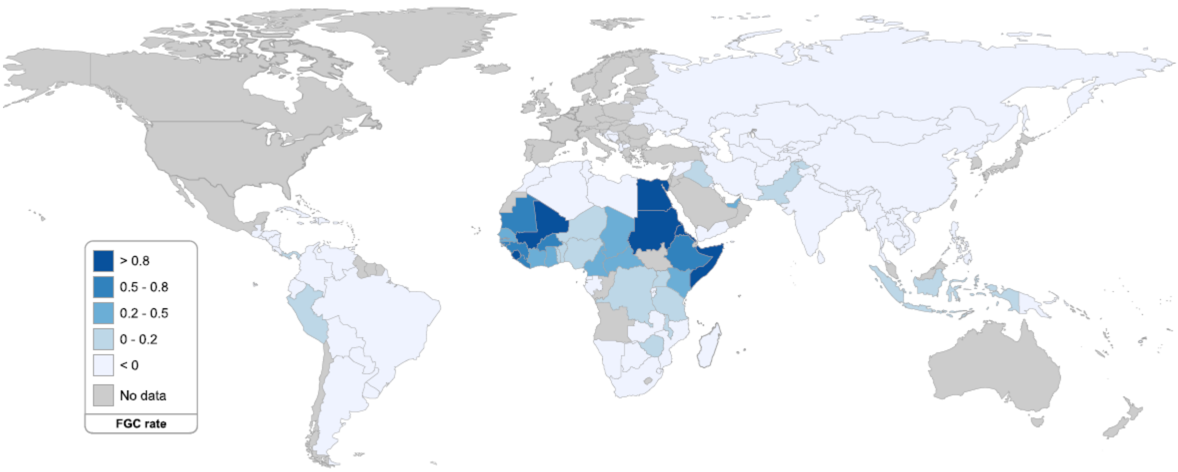
Furthermore, there is not only a large variation across countries with respect to the FGC practice, but also within countries. Despite some studies having worked on the within-country variation, it has not been conclusively explored to date. For example, the role of education for FGC remains unexplained.

Finally, even though the model already allows for many insights, it is relatively simple and leaves room for improvement. First, it has only two periods, thus rendering the analysis of dynamics over generations difficult. Second, parents can only invest in the FGC of the daughter and have no other dimension, such as education. Third, the marriage market is modeled without search frictions, which might not reflect reality. These caveats will be addressed in the following Chapter 3.

2.A. Appendix

2.A.1. FGC Prevalence Rates in non-OECD Countries

Even though FGC is predominantly observed in African countries and the Middle East, there are low FGC prevalence rates outside this region. The OECD provides a collection of FGC prevalence rates in non-OECD countries, which are shown in Figure 2.A1. Small but positive rates are recorded in countries such as Peru, Indonesia and Pakistan. This map does not include the fraction of circumcised women in OECD countries, since numbers are barely available, although the practice is continued by immigrants in Europe, North America, Australia and New Zealand (Dorkenoo et al., 2007). For England and Wales, it is estimated that more than 20,000 girls are at risk of being circumcised (Dorkenoo et al., 2007).



Source: OECD Gender, Institutions and Development Database 2009, Notes: These are prevalence rates across women aged 15-49 years.

Figure 2.A1.: FGC Prevalence Rates Worldwide

2.A.2. Data and Robustness Checks

In this section, I provide a brief overview of the data sources used in the empirical analysis in Section 2.2.2. The Social Institution and Gender Index (SIGI) 2009 is provided by the OECD Gender, Institution and Development Database. This index consists of 14 variables, which are grouped into 5 categories: Discriminatory Family Code, Restricted Physical Integrity, Son Bias, Restricted Resources and Entitlements and Restricted Civil Liberties. The index formula is $SIGI = \frac{1}{5}Family^2 + \frac{1}{5}Physical^2 + \frac{1}{5}Son^2 + \frac{1}{5}Resources^2 + \frac{1}{5}Civil^2$.[58] Since FGC rates are part of the subindex "Restricted Physical Integrity", I adjust the SIGI by excluding this subindex. The formula for the adjusted index, which is used throughout the analysis, is $SIGI_{adjust} = \frac{1}{4}Family^2 + \frac{1}{4}Son^2 + \frac{1}{4}Ownership^2 + \frac{1}{4}Civil^2$. The FGC rates provided by the OECD are based on national Demographic and Health Surveys (DHS) and Multiple Indicator Cluster Surveys (MICS), conducted before and closest to 2009.

Most of the further controls in the regressions, such as GDP p.c., GDP growth, Gini coefficient of income, primary education completion rate are taken from the World Development Indicators of the World Bank. The GDP growth is the average annual GDP growth over the last 10 years, while the primary completion rate is the percentage of students completing the last year of primary school. The estimated earned incomes for males and females (in PPP US$) are taken from the OECD Gender, Institution and Development Database and are only available for 2006. The fraction of Muslims in all countries is provided by Alesina et al. (2003). If information on these variables is not available for 2009, data based on the years before and closest to 2009 is used.

Table 2.A1 shows the estimated coefficients for the same regression model as in Table 2.1, with the only difference being that information on Sudan is excluded. As Figure 2.2b shows, Sudan is an outlier with respect to the value of the SIGI index; therefore, I exclude the country to check its influence on the estimation results. Even though the magnitudes of the effects change slightly, the sign of the coefficients remain the same and the significant positive interaction between the FGC rate and the SIGI stays. Afghanistan is another outlier in this respect, although is excluded from the regressions regardless since there is missing information concerning some controls. The second robustness check is presented in Table 2.A2, where additional controls are added to the regressions. As for the first robustness check, the relevant significant positive interaction between the FGC rate and the SIGI remains true.

[58] For more information, see http://genderindex.org/content/team, accessed 10.09.2013.

Table 2.A1.: Regression Results: FGC Prevalence Rates (Excluding Sudan)

	OLS	OLS (FGC>0)	Tobit	OLS
SIGI	1.097***	1.404**	2.087***	
	(0.247)	(0.589)	(0.495)	
SIGI>0.1				1.015***
				(0.276)
SIGI≤0.1				0.303
				(0.764)
Fract. of Muslim	0.00140*	0.00356**	0.00399***	0.00146*
	(0.000812)	(0.00129)	(0.00150)	(0.000828)
GDP p.c.	-0.000000158	0.00000979	-0.000130**	-0.000000526
	(0.00000170)	(0.0000647)	(0.0000573)	(0.00000187)
GDP growth	0.00248	0.0334**	-0.00785	0.00354
	(0.00827)	(0.0158)	(0.0152)	(0.00840)
Gini	0.00107	0.0155	0.00515	0.00158
	(0.00252)	(0.00918)	(0.00835)	(0.00271)
Constant	-0.120	-0.892**	-0.552	-0.125
	(0.126)	(0.425)	(0.352)	(0.127)
Sigma			0.347***	
			(0.0419)	
Observations	89	29	89	89
R^2	0.366	0.430	0.524	0.370

Source: OECD Gender, Institution and Development Database, World Bank WDI, Alesina et al. (2003)), own calculations. Notes: Heteroskedasticity-robust standard errors in parentheses. * (p<0.10), ** (p<0.05), *** (p<0.01). If information is not available for 2009, data based on years before and closest to 2009 is used. Sudan is excluded. The GDP growth is the GDP's average annual growth rate over the last 10 years.

Table 2.A2.: Robustness: FGC Prevalence Rates and SIGI

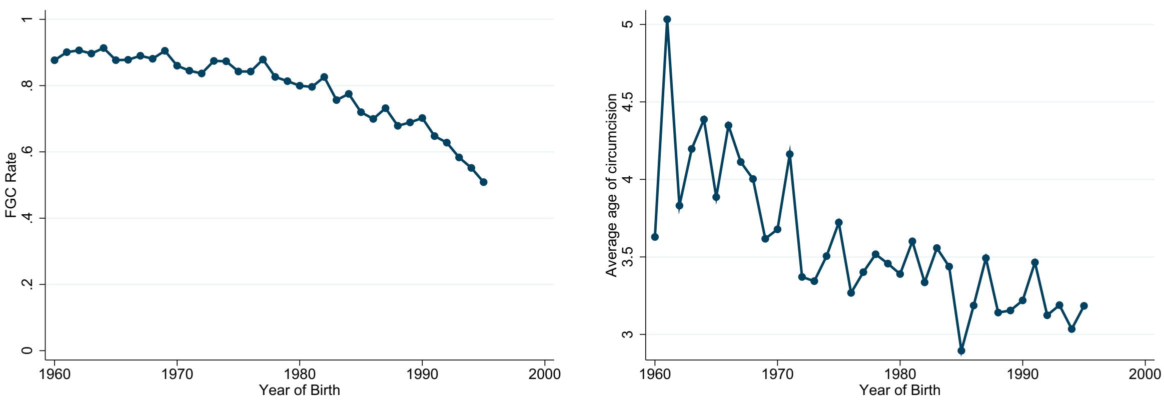
	OLS	OLS (FGC>0)	Tobit	OLS
SIGI	1.189***	1.765**	2.411***	
	(0.338)	(0.680)	(0.517)	
SIGI>0.1				1.134***
				(0.340)
SIGI≤0.1				0.500
				(0.746)
Fract. if Muslim	0.00160*	0.00197	0.00405***	0.00157*
	(0.000819)	(0.00209)	(0.00131)	(0.000800)
GDP p.c.	0.0000163	-0.000170	0.0000139	0.0000231*
	(0.0000136)	(0.000305)	(0.0000607)	(0.0000119)
GDP growth	-0.00739	-0.00621	-0.0369*	-0.00584
	(0.00936)	(0.0297)	(0.0221)	(0.00912)
Gini	-0.000586	0.0103	-0.00164	-0.000221
	(0.00274)	(0.0124)	(0.00793)	(0.00282)
Prim. educ. comp. rate (f)	0.00501	0.0124	0.00814	0.00504
	(0.00412)	(0.00874)	(0.00654)	(0.00414)
Prim educ. comp. rate (m)	-0.00676	-0.0130	-0.00920	-0.00676
	(0.00480)	(0.0112)	(0.00747)	(0.00482)
Income (f)	0.0000109	-0.00000474	0.0000705	
	(0.0000203)	(0.000211)	(0.000110)	
Income (m)	-0.0000194	0.0000820	-0.0000917	-0.0000171*
	(0.0000130)	(0.000104)	(0.0000621)	(0.00000977)
Constant	0.188	-0.364	-0.0306	0.181
	(0.253)	(0.885)	(0.565)	(0.257)
Sigma			0.317***	
			(0.0431)	
Observations	79	27	79	79
(pseudo)R^2	0.489	0.510	0.595	0.490

Source: OECD Gender, Institution and Development Database, World Bank WDI,Alesina et al. (2003)), own calculations. Notes: Heteroskedasticity robust standard errors in parentheses. * (p<0.10), ** (p<0.05),*** (p<0.01). If information is not available for 2009, data based on years before and closest to 2009 is used. The GDP growth is GDP's average annual growth rate over the last 10 years. The estimated income is given in PPP US$. "Prim. educ. comp. rate" stands for primary completion rate and is the percentage of students completing the last year of primary school.

2.A.3. Empirical Evidence: Burkina Faso (DHS 2010)

The analysis for Burkina Faso is based on data from the Demographic and Health survey in 2010, based upon interviews with 17,087 women (aged 15-49) and 7,307 men (aged 15-59) (Institut National de la Statistique et de la Démographie and ICF-International, 2012). The DHS program was established by the United States Agency for International Development (USAID) in 1984 as a follow-up to the World Fertility Survey and the Contraceptive Prevalence Survey projects. In over 90 countries, 300 surveys have already collected representative household data on health and demographic questions. Depending on the country, women aged 15-49 are asked questions concerning their fertility, health status (including of their children) and circumcision status. Women and men are surveyed on their general opinion on female circumcision.[59]

As an example, Figure 2.A2 shows the FGC rates and average ages of circumcision by cohort of Burkina Faso, a high prevalence rate country (76%).[60] The female circumcision rate had been relatively stable for the cohorts born before 1980, whereas the FGC rate had slightly decreased for the younger cohorts. Information on girls younger than 15 years is only available through their mothers. Only 16% of the women who have a daughter report that at least one daughter is circumcised. This would indicate a sharp decrease in FGC rates, but this measure makes no distinction between the number of circumcised daughters. Furthermore, the girls might still be at risk of undergoing the procedure at a later stage and there might be an under-reporting problem due to the ban against FGC.[61] Further information on the data and summary statistics are presented in Tables 2.A3 - 2.A5.



(a) FGC Rates by Cohorts **(b)** Average Age of Circumcision by Cohort

Figure 2.A2.: FGC Rates and Age at FGC by Cohorts (Burkina Faso)

[59] http://www.measuredhs.com/, accessed March, 2013.

[60] Chesnokova and Vaithianathan (2010) have two comparable figures on cohort levels of FGC and cohort average age at circumcision for Burkina Faso, albeit based on the DHS 2003.

[61] Burkina Faso already enacted a law prohibiting FGC in 1996, which includes fines against practitioners and people knowing about the procedure without reporting it (UNICEF, 2013). Therefore, the incentive of reporting that the daughter is circumcised might be low (UNICEF (2013), p. 100).

Table 2.A3.: Summary Statistics - Burkina Faso (1)

	FGC rates of women (15-49 years)		**Women with circumcised daughters**	
	Mean	Total	Mean	Total
Total	0.7610	17031	0.1632	10716
Wealth				
poorest quintile	0.7746	2825	0.2072	2003
poorer quintile	0.7841	3074	0.1905	2130
middle quintile	0.7814	3264	0.1660	2208
richer quintile	0.8000	3583	0.1569	2343
richest quintile	0.6873	4285	0.0893	2032
Education (wife)				
no education	0.8068	12425	0.1813	8915
primary	0.6977	2397	0.0972	1166
secondary	0.5608	2087	0.0221	597
higher	0.5194	115	0.0000	36
Education (husband)				
no education	0.8255	10863	0.1826	8583
primary	0.7625	1715	0.1165	1198
secondary	0.6984	1133	0.0297	694
higher	0.6230	145	0.0106	76
Marital status				
never married	0.5548	3096	0.0314	109
ever married	0.8044	13935	0.1643	10607

Source: DHS 2010 Burkina Faso, own calculations. Observations are weighted by individual sampling weights. The FGC rates for different marital status and educational attainment of women are tested on equality based on a two-sample t-test with sampling weights. FGC rates between ever and never married women are significantly different at the 1% level. This is also the case for all differences in FGC rates between education groups. Only the difference in FGC rates between secondary and higher educated women is not significant.

Table 2.A4.: Summary Statistics - Burkina Faso (2)

	FGC rates of women (15-49 years)		**Women with circumcised daughters**	
	Mean	Total	Mean	Total
Religion				
no religion	0.6210	128	0.2006	78
muslim	0.8169	10207	0.1892	6515
catholic	0.6632	4164	0.0995	2425
protestant	0.6036	1070	0.0856	615
traditionnal/animist	0.7590	1415	0.1857	1044
Ethnicity				
bobo	0.6874	644	0.1633	395
dioula	0.7282	155	0.1589	102
fulfuldé/peul	0.8438	1346	0.2842	909
gourmatché	0.6445	1045	0.1054	701
gourounsi	0.6052	790	0.1175	476
lobi	0.8322	617	0.1833	411
mossi	0.7881	8912	0.1437	5537
sénoufo	0.8715	906	0.2340	595
touareg / bella	0.2224	254	0.0464	154
dagara	0.6942	560	0.1893	342
bissa	0.8338	672	0.1898	401
others	0.7557	1097	0.1994	671
Region				
boucle de mouhoun	0.7065	1344	0.1775	940
cascades	0.8213	1106	0.1121	712
centre	0.6662	1690	0.0522	801
centre-est	0.8963	1262	0.1954	796
centre-nord	0.8683	1156	0.1381	779
centre-ouest	0.5529	1517	0.1146	949
centre-sud	0.6828	1150	0.1009	753
est	0.7015	1353	0.1091	926
hauts basins	0.8289	1538	0.2388	922
nord	0.8776	1299	0.2302	825
plateau central	0.8769	1253	0.1367	777
sahel	0.7823	1151	0.2901	755
sud-ouest	0.7933	1212	0.1926	781
urban	0.6902	5354	0.0838	2689
rural	0.7872	11677	0.1835	8027

Source: DHS 2010 Burkina Faso, own calculations. Observations are weighted by individual sampling weights.

Table 2.A5.: Summary Statistics - Burkina Faso (3)

	Circumcised (15-49 years)		**Uncircumcised (15-49 years)**	
	Mean	Total	Mean	Total
Current age	30.07	12897	24.80	4134
Ever married	0.87	12897	0.68	4134
Age at first cohabitation	17.47	11247	17.56	2688
Circumcised daughters	0.20	8863	0.01	1853
Age of circumcision	3.49	12842		
Education				
no education	0.78		0.60	
primary	0.12		0.17	
secondary	0.08		0.21	
higher	0.01		0.02	
		12892		4132
Wealth				
poorest quintile	0.18		0.17	
poorer quintile	0.19		0.17	
middle quintile	0.20		0.17	
richer quintile	0.21		0.17	
richest quintile	0.22		0.33	
		12897		4134
Form of circumcision				
cut, no flesh removed	0.17			
cut, flesh removed	0.77			
sewn closed	0.01			
don't know/missing	0.05			
		12897		
Circumcision performed by				
health professional	0.00			
traditional circumciser	0.97			
don't know	0.03			
		12897		

Source: DHS 2010 Burkina Faso, own calculations. Observations are weighted by individual sampling weights. The differences between circumcised and uncircumcised women are signficant at the 1% level, with two exceptions. The difference for the lowest wealth quintile (poorest) is only significant at the 10% level and the difference in the ages at first cohabitation is not significant. The means are tested on equality based on a two-sample t-test with sampling weights.

2.A.4. Figures of the Model

Figure 2.A3 illustrates the three different cases that can occur in the marriage market equilibrium. The resulting equilibrium probabilities vary for the different cases. In Case (1), the fraction of circumcised women is the same as for high type men. The fraction of high type men is higher than that of circumcised women for the Case (2), while the opposite is true for Case (3).

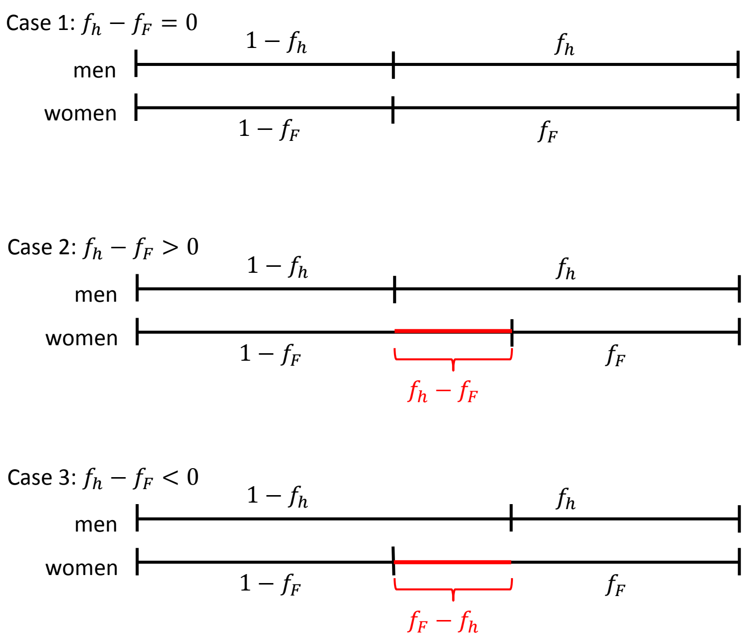


Figure 2.A3.: Structure of the Marriage Market

Figure 2.A4 provides an example of the functional form of CRRA preferences. It shows that, depending on the level of consumption, an 50% increase in the consumption translates differently into an increase in the utility. The higher the consumption level, the lower the induced increase in the utility.

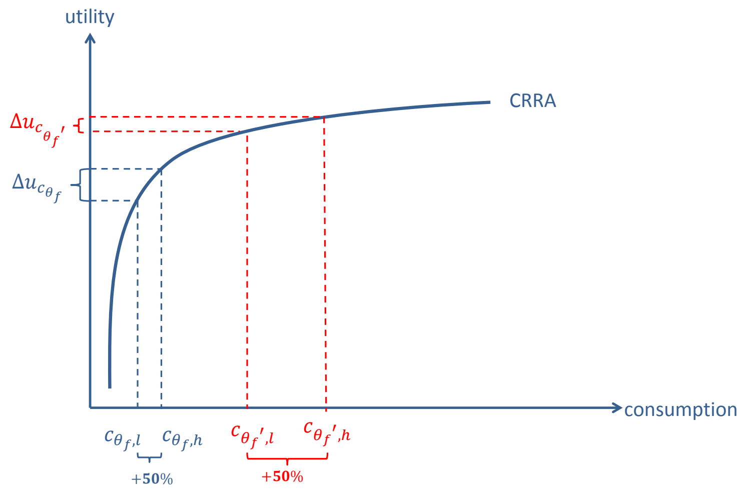


Figure 2.A4.: Utility Gain - CRRA Preferences

2.A.5. Propositions and Proofs

The *existence of an equilibrium* depends on the model parameter, which is formalized in Proposition 2.3.

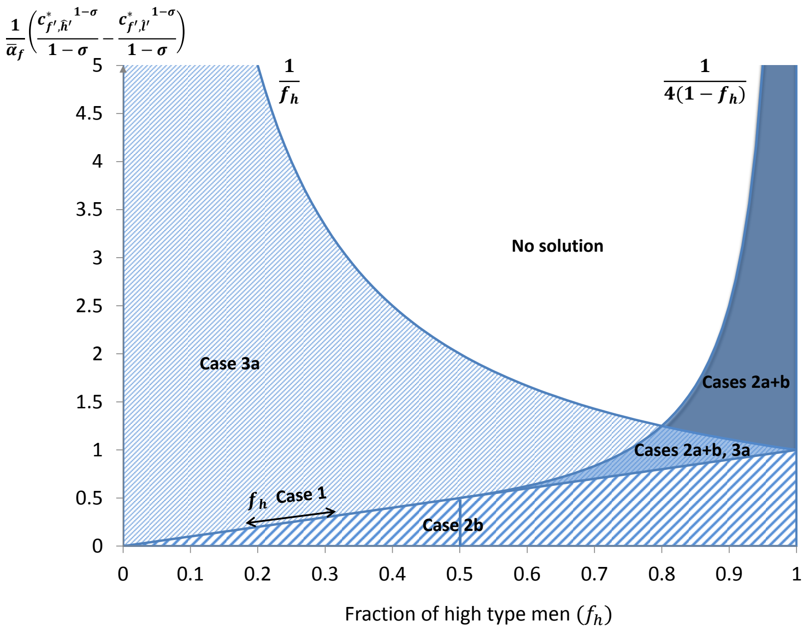
Proposition 2.3. ***Existence***. *For* $\underline{\alpha}_f = 0$*, there exists at least one solution if:*

$$\underbrace{\frac{1}{\overline{\alpha}_f}\left(\frac{{c^*_{f',\hat{h}'}}^{1-\sigma}}{1-\sigma} - \frac{{c^*_{f',\hat{l}'}}^{1-\sigma}}{1-\sigma}\right)}_{G_u \equiv \textit{utility gain}} \leq \frac{1}{f_h} \quad \textit{and} \quad \frac{1}{\overline{\alpha}_f}\left(\frac{{c^*_{f',\hat{h}'}}^{1-\sigma}}{1-\sigma} - \frac{{c^*_{f',\hat{l}'}}^{1-\sigma}}{1-\sigma}\right) \leq \frac{1}{4(1-f_h)}.$$

Proof. See below. □

The conditions for existence link the fraction of high type men, f_h, to the utility gain in consumption of being married to a high type men, G_u, which is weighted by the highest possible cost of FGC in the economy, $\overline{\alpha}_f$. Figure 2.A5 illustrates the parameter ranges for which a solution exists, given $\underline{\alpha}_f = 0$. If the parameters fall within the colored regions, at least one solution exists and the relevant cases are displayed. No solution exists for the region where $\frac{1}{\overline{\alpha}_f} G_u \geq \frac{1}{f_h}$ and $\frac{1}{\overline{\alpha}_f} G_u \geq \frac{1}{4(1-f_h)}$.[62] Furthermore, there are parameter spaces for which multiple solutions exist, as Proposition 2.4 establishes.

[62] $G_u = \frac{{c^*_{f',\hat{h}'}}^{1-\sigma}}{1-\sigma} - \frac{{c^*_{f',\hat{l}'}}^{1-\sigma}}{1-\sigma}$.



Note: For this figure $\underline{\alpha}_f$ is equal to zero.

Figure 2.A5.: Existence and Multiplicity of Equilibria

Proposition 2.4. ***Multiplicity****.* *For $\underline{\alpha}_f = 0$ there exist two solutions, Cases (2a) and (2b), if:*

$$\frac{1}{f_h} < \frac{1}{\bar{\alpha}_f}\left(\frac{c^{*\,1-\sigma}_{f',\hat{h}'}}{1-\sigma} - \frac{c^{*\,1-\sigma}_{f',\hat{l}'}}{1-\sigma}\right) \leq \frac{1}{4(1-f_h)}$$

and three solutions, Cases (2a), (2b) and (3a), if:

$$f_h < \frac{1}{\bar{\alpha}_f}\left(\frac{c^{*\,1-\sigma}_{f',\hat{h}'}}{1-\sigma} - \frac{c^{*\,1-\sigma}_{f',\hat{l}'}}{1-\sigma}\right) \leq \frac{1}{4(1-f_h)} \text{ and}$$

$$f_h < \frac{1}{\bar{\alpha}_f}\left(\frac{c^{*\,1-\sigma}_{f',\hat{h}'}}{1-\sigma} - \frac{c^{*\,1-\sigma}_{f',\hat{l}'}}{1-\sigma}\right) \leq \frac{1}{f_h}.$$

Proof. See below. □

Within Case (2), two equilibria are possible due to the quadratic equation. However, it can also happen that different cases, namely Cases (2) and (3), apply at the same time. These equilibria can potentially be pareto ranked, for which Section 2.4 establishes a basis. Note that in Section 2.3.7, the notation is slightly different: Case (1) is referred to as Case (2.18), Cases (2a) and (2b) as Cases (2.19a) and (2.19b), respectively. Finally, Cases (3a) and (3b) are referred to as Cases (2.20a) and (2.20b), respectively.

A further, more technical multiplicity exists due to the random matching within the group, making a stable equilibrium not unique. If for example, the fraction of high type men equals the fraction of circumcised women in equilibrium, all circumcised women will be matched to a high type man. Within this group, all matches between people of the opposite sex can happen and are stable.

Proof. Proposition 2.3 (Existence) and Proposition 2.4 (Multiplicity).
For $\underline{\alpha}_f = 0$, the equilibrium fractions reduces to the following equations in the different cases.

Case(1) For this case to hold, the fraction of high type men has to equal the fraction of circumcised women, $f_h = f_F$. Therefore, the FGC prevalence rate is equal to the utility gain in consumption of being married to a high type men, weighted by the highest cost of circumcision:

$$f_F = \underbrace{\frac{1}{\overline{\alpha}_f}}_{\text{highest cost of FGC}} \underbrace{\left(\frac{{c^*_{f',\hat{h}'}}^{1-\sigma}}{1-\sigma} - \frac{{c^*_{f',\hat{l}'}}^{1-\sigma}}{1-\sigma} \right)}_{\text{utility gain}} = f_h. \tag{2.32}$$

Case(3) If the FGC prevalence rate is higher than the fraction of high type men $f_h < f_F$, the FGC fraction is given by:

$$f_F = \sqrt{\frac{f_h}{\overline{\alpha}_f} \left(\frac{{c^*_{f',\hat{h}'}}^{1-\sigma}}{1-\sigma} - \frac{{c^*_{f',\hat{l}'}}^{1-\sigma}}{1-\sigma} \right)}. \tag{2.33}$$

This case allows for only one solution, namely Case (3a), since the fraction f_F has to be positive, $f_F \epsilon [0,1]$. This solution exists if $f_h < \underbrace{\sqrt{\frac{f_h}{\overline{\alpha}_f} \left(\frac{{c^*_{f',\hat{h}'}}^{1-\sigma}}{1-\sigma} - \frac{{c^*_{f',\hat{l}'}}^{1-\sigma}}{1-\sigma} \right)}}_{=f_F} \leq 1$, meaning:

$$\frac{1}{f_h} \geq \frac{1}{\overline{\alpha}_f} \left(\frac{{c^*_{f',\hat{h}'}}^{1-\sigma}}{1-\sigma} - \frac{{c^*_{f',\hat{l}'}}^{1-\sigma}}{1-\sigma} \right) > f_h. \tag{2.34}$$

Case(2) The fraction of high type men has to be larger than the FGC prevalence rate,

$f_h > f_F$. The prevalence rate reduces to:

$$f_F \;=\; \frac{1}{2} \pm \sqrt{\frac{1}{4} - \frac{(1-f_h)}{\overline{\alpha}_f}\left(\frac{{c^*_{f',\hat{h}'}}^{1-\sigma}}{1-\sigma} - \frac{{c^*_{f',\hat{l}'}}^{1-\sigma}}{1-\sigma}\right)}. \tag{2.35}$$

For this case to deliver a real solution,

$$\begin{aligned} \frac{1}{4} &\geq \frac{(1-f_h)}{\overline{\alpha}_f}\left(\frac{{c^*_{f',\hat{h}'}}^{1-\sigma}}{1-\sigma} - \frac{{c^*_{f',\hat{l}'}}^{1-\sigma}}{1-\sigma}\right) \\ \frac{1}{4(1-f_h)} &\geq \frac{1}{\overline{\alpha}_f}\left(\frac{{c^*_{f',\hat{h}'}}^{1-\sigma}}{1-\sigma} - \frac{{c^*_{f',\hat{l}'}}^{1-\sigma}}{1-\sigma}\right) \end{aligned} \tag{2.36}$$

has to hold. Furthermore the inequalities

$$0 \;\leq\; \underbrace{\frac{1}{2} \pm \sqrt{\frac{1}{4} - \frac{(1-f_h)}{\overline{\alpha}_f}\left(\frac{{c^*_{f',\hat{h}'}}^{1-\sigma}}{1-\sigma} - \frac{{c^*_{f',\hat{l}'}}^{1-\sigma}}{1-\sigma}\right)}}_{=f_F} < f_h \tag{2.37}$$

have to hold. The lower bound of the inequality, $f_F \geq 0$, holds for both solutions $(+/-)$, since as long as the root is real it is also smaller than $\frac{1}{2}$. To investigate the second inequality, I have to analyze both solutions, starting with the one based on the positive sign, followed by the negative sign:

Case(2a)

$$\frac{1}{2} + \sqrt{\frac{1}{4} - \frac{(1-f_h)}{\overline{\alpha}_f}\left(\frac{{c^*_{f',\hat{h}'}}^{1-\sigma}}{1-\sigma} - \frac{{c^*_{f',\hat{l}'}}^{1-\sigma}}{1-\sigma}\right)} \;<\; f_h. \tag{2.38}$$

If $f_h > \frac{1}{2}$, then the following inequality has to hold to satisfy Inequality (2.38):

$$\begin{aligned} \underbrace{\sqrt{\frac{1}{4} - \frac{(1-f_h)}{\overline{\alpha}_f}\left(\frac{{c^*_{f',\hat{h}'}}^{1-\sigma}}{1-\sigma} - \frac{{c^*_{f',\hat{l}'}}^{1-\sigma}}{1-\sigma}\right)}}_{>0} &< \underbrace{f_h - \frac{1}{2}}_{>0} \\ \frac{1}{4} - \frac{(1-f_h)}{\overline{\alpha}_f}\left(\frac{{c^*_{f',\hat{h}'}}^{1-\sigma}}{1-\sigma} - \frac{{c^*_{f',\hat{l}'}}^{1-\sigma}}{1-\sigma}\right) &< \left(f_h - \frac{1}{2}\right)^2 \\ \frac{1}{\overline{\alpha}_f}\left(\frac{{c^*_{f',\hat{h}'}}^{1-\sigma}}{1-\sigma} - \frac{{c^*_{f',\hat{l}'}}^{1-\sigma}}{1-\sigma}\right) &> f_h. \end{aligned} \tag{2.39}$$

If $f_h \leq \frac{1}{2}$, Inequality (2.38) does not hold.

Case(2b)

$$\frac{1}{2} - \sqrt{\frac{1}{4} - \frac{(1-f_h)}{\overline{\alpha}_f}\left(\frac{c^{*}_{f',\hat{h}'}{}^{1-\sigma}}{1-\sigma} - \frac{c^{*}_{f',\hat{l}'}{}^{1-\sigma}}{1-\sigma}\right)} \quad < \quad f_h. \tag{2.40}$$

If $f_h \geq \frac{1}{2}$, Inequality (2.40) holds because the following inequality is true:

$$\underbrace{-\sqrt{\frac{1}{4} - \frac{(1-f_h)}{\overline{\alpha}_f}\left(\frac{c^{*}_{f',\hat{h}'}{}^{1-\sigma}}{1-\sigma} - \frac{c^{*}_{f',\hat{l}'}{}^{1-\sigma}}{1-\sigma}\right)}}_{<0} \quad < \quad \underbrace{f_h - \frac{1}{2}}_{\geq 0}.$$

If $f_h \leq \frac{1}{2}$, the following inequality needs to be satisfied such that Inequality (2.40) holds:

$$\begin{aligned}
\underbrace{-\sqrt{\frac{1}{4} - \frac{(1-f_h)}{\overline{\alpha}_f}\left(\frac{c^{*}_{f',\hat{h}'}{}^{1-\sigma}}{1-\sigma} - \frac{c^{*}_{f',\hat{l}'}{}^{1-\sigma}}{1-\sigma}\right)}}_{<0} \quad &< \quad \underbrace{f_h - \frac{1}{2}}_{<0} \\
\frac{1}{4} - \frac{(1-f_h)}{\overline{\alpha}_f}\left(\frac{c^{*}_{f',\hat{h}'}{}^{1-\sigma}}{1-\sigma} - \frac{c^{*}_{f',\hat{l}'}{}^{1-\sigma}}{1-\sigma}\right) \quad &> \quad \left(f_h - \frac{1}{2}\right)^2 \\
\frac{1}{\overline{\alpha}_f}\left(\frac{c^{*}_{f',\hat{h}'}{}^{1-\sigma}}{1-\sigma} - \frac{c^{*}_{f',\hat{l}'}{}^{1-\sigma}}{1-\sigma}\right) \quad &< \quad f_h. \qquad (2.41)
\end{aligned}$$

Summing up, as long as $\frac{1}{\overline{\alpha}_f}\left(\frac{c^{*}_{f',\hat{h}'}{}^{1-\sigma}}{1-\sigma} - \frac{c^{*}_{f',\hat{l}'}{}^{1-\sigma}}{1-\sigma}\right) \leq \frac{1}{4(1-f_h)}$, at least one solution exists if the conditions in Table 2.A6 are satisfied. If $f_h > \frac{1}{2}$, two solutions exist based on Case (2).

Table 2.A6.: Conditions for Equilibrium Case (2)

	$\mathbf{f_h > \frac{1}{2}}$	$\mathbf{f_h < \frac{1}{2}}$	$\mathbf{f_h = \frac{1}{2}}$
(+)	$\frac{1}{\overline{\alpha}_f}\left(\frac{c^{*}_{f',\hat{h}'}{}^{1-\sigma}}{1-\sigma} - \frac{c^{*}_{f',\hat{l}'}{}^{1-\sigma}}{1-\sigma}\right) > f_h$	✗	✗
(-)	always	$\frac{1}{\overline{\alpha}_f}\left(\frac{c^{*}_{f',\hat{h}'}{}^{1-\sigma}}{1-\sigma} - \frac{c^{*}_{f',\hat{l}'}{}^{1-\sigma}}{1-\sigma}\right) < f_h$	always

Note: ✗ means that no solution exists.

Furthermore, if $\frac{1}{\overline{\alpha}_f}\left(\frac{c^{*}_{f',\hat{h}'}{}^{1-\sigma}}{1-\sigma} - \frac{c^{*}_{f',\hat{l}'}{}^{1-\sigma}}{1-\sigma}\right) < f_h$ and therefore Cases (1) and (3) do not hold, Case (2) has one solution, namely:

$$f_F = \frac{1}{2} - \sqrt{\frac{1}{4} - \frac{(1-f_h)}{\overline{\alpha}_f}\left(\frac{{c^*_{f',\hat{h}'}}^{1-\sigma}}{1-\sigma} - \frac{{c^*_{f',\hat{l}'}}^{1-\sigma}}{1-\sigma}\right)}$$

as long as $\frac{1}{\overline{\alpha}_f}\left(\frac{{c^*_{f',\hat{h}'}}^{1-\sigma}}{1-\sigma} - \frac{{c^*_{f',\hat{l}'}}^{1-\sigma}}{1-\sigma}\right) \leq \frac{1}{4(1-f_h)}$, which holds in this case since $f_h \leq \frac{1}{4(1-f_h)}$, with $f_h \epsilon [0,1)$. An overview of the existence conditions for all cases is given in Table 2.A7.

Table 2.A7.: Conditions for all Equilibrium Cases

Case		Conditions for the Existence of an Equilibrium		
		$\mathbf{f_h \in [0,1]}$		
1		$\frac{1}{\overline{\alpha}_f}\left(\frac{{c^*_{f',\hat{h}'}}^{1-\sigma}}{1-\sigma} - \frac{{c^*_{f',\hat{l}'}}^{1-\sigma}}{1-\sigma}\right) = f_h$		
3a	(+)	$\frac{1}{f_h} \geq \frac{1}{\overline{\alpha}_f}\left(\frac{{c^*_{f',\hat{h}'}}^{1-\sigma}}{1-\sigma} - \frac{{c^*_{f',\hat{l}'}}^{1-\sigma}}{1-\sigma}\right) > f_h$		
		$\mathbf{f_h > \frac{1}{2}}$	$\mathbf{f_h < \frac{1}{2}}$	$\mathbf{f_h = \frac{1}{2}}$
2a	(+)	$\frac{1}{\overline{\alpha}_f}\left(\frac{{c^*_{f',\hat{h}'}}^{1-\sigma}}{1-\sigma} - \frac{{c^*_{f',\hat{l}'}}^{1-\sigma}}{1-\sigma}\right) > f_h$	✗	✗
2b	(-)	✓	$\frac{1}{\overline{\alpha}_f}\left(\frac{{c^*_{f',\hat{h}'}}^{1-\sigma}}{1-\sigma} - \frac{{c^*_{f',\hat{l}'}}^{1-\sigma}}{1-\sigma}\right) < f_h$	✓

Notes: ✓ holds without condition, ✗ does not hold

□

Proposition. ***Bargaining Power (PE)***. *Holding the marriage market probabilities unchanged, the threshold α_f^* decreases with an increase in the bargaining power if $\sigma > 1$.*

Proof. Proposition 2.1 (Bargaining Power (PE)).

The equilibrium threshold-value for the FGC cost is given by:

$$\begin{aligned}\alpha_f^* &= \big(p_h(F'=1) - p_h(F'=0)\big)\,\frac{{c^*_{f',\hat{h}'}}^{1-\sigma} - {c^*_{f',\hat{l}'}}^{1-\sigma}}{1-\sigma} \\ &= \big(p_h(F'=1) - p_h(F'=0)\big) * \\ &\left(\frac{\theta_f^{\frac{1}{\sigma}}}{\theta_f^{\frac{1}{\sigma}} + (1-\theta_f)^{\frac{1}{\sigma}}}\right)^{1-\sigma} \frac{(w_{f'} + w_{m'}(\hat{h}'))^{1-\sigma} - (w_{f'} + w_{m'}(\hat{l}'))^{1-\sigma}}{1-\sigma}.\end{aligned}$$

Since $w_{m'}(\hat{h}') > w_{m'}(\hat{l}')$, the partial derivative of the threshold with respect to the bargaining power is negative:

$$\begin{aligned}
\frac{\partial \alpha_f^*}{\partial \theta_f} &= \underbrace{\left(p_h(F'=1) - p_h(F'=0)\right)}_{>0} \underbrace{\frac{\frac{1}{\sigma}\theta_f^{\frac{1}{\sigma}-2}(1-\theta_f)^{\frac{1}{\sigma}-1}}{\left(\theta_f^{\frac{1}{\sigma}} + (1-\theta_f)^{\frac{1}{\sigma}}\right)^{2-\sigma}}}_{>0} \\
&\quad \underbrace{*((w_{f'} + w_{m'}(\hat{h}'))^{1-\sigma} - (w_{f'} + w_{m'}(\hat{l}'))^{1-\sigma})}_{<0} \\
\frac{\partial \alpha_f^*}{\partial \theta_f} &< 0.
\end{aligned}$$

□

Proposition. ***Bargaining Power (GE)***. *For $\underline{\alpha}_f = 0$, the general equilibrium effect of an increase in the bargaining power θ_f on the FGC rate f_F^* is:*

(a) negative if $\sigma > 1$ and Cases (2.18), (2.19b) or (2.20a) apply; and

(b) positive if $\sigma < 1$ and Case (2.19a) applies.

As already noted, the notation in Section 2.3.7 is slightly different, and thus the cases have different numbers in this proposition. In the following, Case (1) represents Case (2.18), Cases (2a) and (2b) represent Cases (2.19a) and (2.19b), respectively. Finally, Cases (3a) and (3b) stands for Cases (2.20a) and (2.20b), respectively.

Proof. Proposition 2.2 (Bargaining Power (GE))

Case (1) $f_F = f_h$: The equilibrium fraction of FGC for $\underline{\alpha}_f = 0$ is given by:

$$\begin{aligned}
f_F &= \frac{1}{\overline{\alpha}_f}\left(\frac{{c^*_{f',\hat{h}'}}^{1-\sigma}}{1-\sigma} - \frac{{c^*_{f',\hat{l}'}}^{1-\sigma}}{1-\sigma}\right) \\
&= \frac{1}{\overline{\alpha}_f}\left(\frac{\theta_f^{\frac{1}{\sigma}}}{\theta_f^{\frac{1}{\sigma}} + (1-\theta_f)^{\frac{1}{\sigma}}}\right)^{1-\sigma} \frac{((w_{f'} + w_{m'}(\hat{h}'))^{1-\sigma} - ((w_{f'} + w_{m'}(\hat{l}'))^{1-\sigma}}{1-\sigma}.
\end{aligned}$$

The derivative of this fraction with respect to the bargaining power of the woman is as follows:

$$\frac{\partial f_F}{\partial \theta_f} = \underbrace{\frac{((w_{f'}+w_{m'}(\hat{h}'))^{1-\sigma} - ((w_{f'}+w_{m'}(\hat{l}'))^{1-\sigma}}{\overline{\alpha}_f}}_{if\ \sigma>1 \Rightarrow <0} \underbrace{\frac{\frac{1}{\sigma}\theta_f^{\frac{1}{\sigma}-2}(1-\theta_f)^{\frac{1}{\sigma}-1}}{\left(\theta_f^{\frac{1}{\sigma}}+(1-\theta_f)^{\frac{1}{\sigma}}\right)^{2-\sigma}}}_{>0} \overset{(\sigma>1)}{<} 0.$$

If $\sigma > 1$, the equilibrium FGC fraction declines if θ_f increases, but in this case for an unchanged value of α_h Case (1) would no longer apply, since then $f_f < f_h$. Even though there would be a switch to Case (2), this still means that the FGC prevalence rate would be lower after an increase in θ_f.

Case (3a) $f_h < f_F$: The FGC prevalence rate for $\underline{\alpha}_f = 0$ is given by:

$$f_F = \sqrt{\frac{f_h}{\overline{\alpha}_f}\left(\frac{{c^*_{f',\hat{h}'}}^{1-\sigma}}{1-\sigma} - \frac{{c^*_{f',\hat{l}'}}^{1-\sigma}}{1-\sigma}\right)}$$

$$= \sqrt{\frac{f_h}{\overline{\alpha}_f}\left(\frac{\theta_f^{\frac{1}{\sigma}}}{\theta_f^{\frac{1}{\sigma}}+(1-\theta_f)^{\frac{1}{\sigma}}}\right)^{1-\sigma}\frac{(w_{f'}+w_{m'}(\hat{h}'))^{1-\sigma}-(w_{f'}+w_{m'}(\hat{l}'))^{1-\sigma}}{1-\sigma}} \tag{2.42}$$

$$= \sqrt{\frac{f_h}{\overline{\alpha}_f}\frac{(w_{f'}+w_{m'}(\hat{h}'))^{1-\sigma}-(w_{f'}+w_{m'}(\hat{l}'))^{1-\sigma}}{1-\sigma}}\left(\frac{\theta_f^{\frac{1}{\sigma}}}{\theta_f^{\frac{1}{\sigma}}+(1-\theta_f)^{\frac{1}{\sigma}}}\right)^{\frac{1-\sigma}{2}} \tag{2.43}$$

and with that the derivative is:

$$\frac{\partial f_F}{\partial \theta_f} = \underbrace{\sqrt{\frac{f_h}{\overline{\alpha}_f}\frac{(w_{f'}+w_{m'}(\hat{h}'))^{1-\sigma}-(w_{f'}+w_{m'}(\hat{l}'))^{1-\sigma}}{1-\sigma}}}_{>0} * \underbrace{\frac{(1-\sigma)}{2}}_{if\ \sigma>1\Rightarrow<0} \underbrace{\frac{\frac{1}{\sigma}\theta_f^{\frac{1}{2\sigma}-\frac{3}{2}}(1-\theta_f)^{\frac{1}{\sigma}-1}}{\left(\theta_f^{\frac{1}{\sigma}}+(1-\theta_f)^{\frac{1}{\sigma}}\right)^{\frac{3-\sigma}{2}}}}_{>0} \overset{(\sigma>1)}{<} 0.$$

Therefore, the fraction of circumcised women decreases. Case (3) only holds if $f_h < f_F$. For an unchanged f_h, it could be the case that the induced change by an increase in θ_f is too high, such that $f_h > f_F$ and cases are switched. This would mean that either Case (1) or Case (2) are relevant, meaning that $f_F \leq f_h$ and thus the equilibrium FGC fraction is lower.

Case (2a+b) $f_h > f_F$: The FGC prevalence rate for $\underline{\alpha}_f = 0$ is given:

$$
\begin{aligned}
f_F &= \frac{1}{2} \pm \sqrt{\frac{1}{4} - \frac{(1-f_h)}{\overline{\alpha}_f}\left(\frac{{c^*_{f',\hat{h}'}}^{1-\sigma}}{1-\sigma} - \frac{{c^*_{f',\hat{l}'}}^{1-\sigma}}{1-\sigma}\right)} \\
&= \frac{1}{2} \pm \sqrt{\frac{1}{4} - \frac{(1-f_h)}{\overline{\alpha}_f}\left(\frac{\theta_f^{\frac{1}{\sigma}}}{\theta_f^{\frac{1}{\sigma}} + (1-\theta_f)^{\frac{1}{\sigma}}}\right)^{1-\sigma} \frac{(w_{f'} + w_{m'}(\hat{h}'))^{1-\sigma} - (w_{f'} + w_{m'}(\hat{l}'))^{1-\sigma}}{1-\sigma}}
\end{aligned}
$$

$$
\begin{aligned}
(2a): \frac{\partial f_F}{\partial \theta_f} &\overset{(+)}{=} \frac{1}{2}\left(\frac{1}{4} - \frac{(1-f_h)}{\overline{\alpha}_f}\left(\frac{{c^*_{f',\hat{h}'}}^{1-\sigma}}{1-\sigma} - \frac{{c^*_{f',\hat{l}'}}^{1-\sigma}}{1-\sigma}\right)\right)^{-\frac{1}{2}} * \\
&\quad -\frac{(1-f_h)}{\overline{\alpha}_f}\frac{(w_{f'} + w_{m'}(\hat{h}'))^{1-\sigma} - (w_{f'} + w_{m'}(\hat{l}'))^{1-\sigma}}{1-\sigma}(1-\sigma) * \\
&\quad \frac{\frac{1}{\sigma}\theta_f^{\frac{1}{\sigma}-2}(1-\theta_f)^{\frac{1}{\sigma}-1}}{\left(\theta_f^{\frac{1}{\sigma}} + (1-\theta_f)^{\frac{1}{\sigma}}\right)^{2-\sigma}} \\
&= \underbrace{-\frac{1}{2}\left(\frac{1}{4} - \frac{(1-f_h)}{\overline{\alpha}_f}\left(\frac{{c^*_{f',\hat{h}'}}^{1-\sigma}}{1-\sigma} - \frac{{c^*_{f',\hat{l}'}}^{1-\sigma}}{1-\sigma}\right)\right)^{-\frac{1}{2}}}_{>0 \text{ otherwise no solution}} * \\
&\quad \underbrace{\frac{(1-f_h)\left((w_{f'} + w_{m'}(\hat{h}'))^{1-\sigma} - (w_{f'} + w_{m'}(\hat{l}'))^{1-\sigma}\right)}{\overline{\alpha}_f}}_{\text{if } \sigma>1 \Rightarrow <0} * \\
&\quad \underbrace{\frac{\frac{1}{\sigma}\theta_f^{\frac{1}{\sigma}-2}(1-\theta_f)^{\frac{1}{\sigma}-1}}{\left(\theta_f^{\frac{1}{\sigma}} + (1-\theta_f)^{\frac{1}{\sigma}}\right)^{2-\sigma}}}_{>0} \\
&\overset{(\sigma>1)}{>} 0
\end{aligned}
$$

$$
\begin{aligned}
(2b):\ \frac{\partial f_F}{\partial \theta_f} \overset{(-)}{=} & \underbrace{\frac{1}{2}\left(\frac{1}{4}-\frac{(1-f_h)}{\overline{\alpha}_f}\left(\frac{{c^*_{f',\hat{h}'}}^{1-\sigma}}{1-\sigma}-\frac{{c^*_{f',\hat{l}'}}^{1-\sigma}}{1-\sigma}\right)\right)^{-\frac{1}{2}}}_{>0 \text{ otherwise no solution}} * \\
& \underbrace{\frac{(1-f_h)\left((w_{f'}+w_{m'}(\hat{h}'))^{1-\sigma}-(w_{f'}+w_{m'}(\hat{l}'))^{1-\sigma}\right)}{\overline{\alpha}_f}}_{\text{if } \sigma>1 \Rightarrow <0} * \\
& \underbrace{\frac{\frac{1}{\sigma}\theta_f^{\frac{1}{\sigma}-2}(1-\theta_f)^{\frac{1}{\sigma}-1}}{\left(\theta_f^{\frac{1}{\sigma}}+(1-\theta_f)^{\frac{1}{\sigma}}\right)^{2-\sigma}}}_{>0} \\
\overset{(\sigma>1)}{<} & \ 0.
\end{aligned}
$$

For Case (2b), the equilibrium FGC rate decreases, while for Case (2a) the FGC rate increases.

□

2.A.6. Inefficiency – Further Analysis

As mentioned in Section 2.4.1, it is not obvious what allocations a social planner can enforce. Here, I assume that the social planner can only enforce the FGC rate and the mating outcome on the marriage market. The social planner has no influence on the intra-household bargaining structure over the consumption and cannot distribute resources across men. This means the optimal consumption decision within a couple is taken as given, the budget constraint for each couple has to hold and income is not redistributed across couples. Accordingly, the optimization problem of the social planner is:

$$
\begin{aligned}
\underset{F_i',\mathbb{I}_{i,j}}{max} \quad & \mu \int_{\underline{\alpha}_f}^{\bar{\alpha}_f} \left(\frac{c_{f',i}^{1-\sigma}}{1-\sigma}-\alpha_{f,i}F_i'\right) dU_{\alpha_{f,i}}(\alpha_{f,i}) + (1-\mu)\int_j \left(\frac{c_{m',j}^{1-\sigma}}{1-\sigma}+\alpha_m F_i'\right) dM(j) \\
s.t. \quad & (c_{f',\omega,i}, c_{m',\omega,j}) = \underset{c_{f',\omega,i},c_{m',\omega,j}}{arg\ max}\ \mathbb{I}_{i,j}\left\{\theta_f\left(\frac{c_{f',\omega,i}^{1-\sigma}}{1-\sigma}-\alpha_{f,i}F_i'\right)+(1-\theta_f)\left(\frac{c_{m',j}^{1-\sigma}}{1-\sigma}+\alpha_m F_i'\right)\right\} \\
& c_{f',\omega,i}+c_{m',\omega,j} = s.t.\ w_f + w_m(\omega'),\ \forall \mathbb{I}_{i,j}=1 \\
& \mathbb{I}_{i,j} = \begin{cases} 1 \text{ if } i \text{ and } j \text{ are a couple} \\ 0 \text{ if } i \text{ and } j \text{ are no couple.} \end{cases} \qquad (2.44)
\end{aligned}
$$

The consumption allocations for the couple are the same as in the decentralized framework:

$$c_{f',\omega'} = \frac{\theta_f^{\frac{1}{\sigma}}}{\theta_f^{\frac{1}{\sigma}} + (1-\theta_f)^{\frac{1}{\sigma}}}(w_{f'} + w_{m'}(\omega')) \quad \text{and} \quad c_{m',\omega'}\frac{(1-\theta_f)^{\frac{1}{\sigma}}}{\theta_f^{\frac{1}{\sigma}} + (1-\theta_f)^{\frac{1}{\sigma}}}(w_{f'} + w_{m'}(\omega')),$$

and are taken as given by the social planner, who can only decide on the circumcision status $F_i^{'}$ and the matches $\mathbb{I}_{i,j}$. However, the optimality condition for the FGC is the same as in the social planner problem in Section 2.4.1 (see Equation (2.24)). A woman woman i will be circumcised, $F_i = 1$, if $\alpha_{f,i} < \frac{\mu}{1-\mu}\alpha_m$, which leads to the same fraction of circumcised women as in the other social planner allocation: $f_F^{cSP} = \frac{\alpha_f^{cSP*} - \underline{\alpha}_f}{\bar{\alpha}_f - \underline{\alpha}_f} = \frac{\frac{\mu}{1-\mu}\alpha_m - \underline{\alpha}_f}{\bar{\alpha}_f - \underline{\alpha}_f}$. The assignment of the couples, $\mathbb{I}_{ij}$ does not influence this FGC rate.

In Section 2.4.2, I have discussed the equivalent consumption variation and the gender differences in this measure from an ex-post perspective. Now, I turn to an *ex-ante perspective*, where the thought experiment is the abolishment of FGC. For this evaluation, I aggregate the equivalent consumption variation of all women ($\sum_i EV_{f',i}^{ante}$) of not being circumcised and compare this to the aggregated equivalent consumption variations of all men ($f_h EV_{m',h'}^{ante} + (1 - f_h)EV_{m',l'}^{ante}$) for not having the possibility to marry a circumcised woman. For daughters with $\alpha_{f',i} \leq \alpha_f^*$, the equivalent consumption variation is determined by the following equation:

$$\begin{aligned} p_h(F'=1)\left(\frac{c_{f',h'}^{1-\sigma}}{1-\sigma} - \alpha_{f,i}\right) & \\ +(1-p_h(F'=1))\left(\frac{c_{f',l'}^{1-\sigma}}{1-\sigma} - \alpha_{f,i}\right) &= f_h\left(\frac{(c_{f',h'} - EV_{f',i}^{ante})^{1-\sigma}}{1-\sigma}\right) \\ &\quad +(1-f_h)\left(\frac{(c_{f',l'} - EV_{f',i}^{ante})^{1-\sigma}}{1-\sigma}\right). \end{aligned} \tag{2.45}$$

The right-hand side of (2.45) is the expected utility of a daughter if FGC was not possible and women are matched randomly to a man. The probability of marrying a high type man is subsequently equal to the fraction of high type men in the economy, f_h. The marriage prospects of daughters with $\alpha_{f',i} > \alpha_f^*$ are also affected by the change in marriage probabilities, even though they would not have been circumcised. The equivalent consumption variation for them is thus defined as in Equation (2.45), albeit with no FGC costs and a different marriage probability, namely $p_h(F'=0)$, on the left hand side.[63]

[63] The equivalent consumption variation is defined by $p_h(F'=0)\frac{c_{f',h'}^{1-\sigma}}{1-\sigma} + (1-p_h(F'=0))\frac{c_{f',l'}^{1-\sigma}}{1-\sigma} = f_h\frac{(c_{f',h'} - EV_{f',i}^{ante})^{1-\sigma}}{1-\sigma} + (1-f_h)\frac{(c_{f',l'} - EV_{f',i}^{ante})^{1-\sigma}}{1-\sigma}$.

For a man of type ω', the equivalent consumption variation is defined as:

$$EV_{m',\omega'}^{ante} = (1-\sigma)[p_{F=1}(\omega')(\frac{c_{m',\omega'}^{1-\sigma}}{1-\sigma} + \alpha_m) + (1-p_{F=1}(\omega'))\frac{c_{m',\omega'}^{1-\sigma}}{1-\sigma}\}^{\frac{1}{1-\sigma}} - c_{m',\omega'}. \quad (2.46)$$

The aggregated equivalent consumption variation for men is $EV_{m'}^{ante} = f_h EV_{m',h'}^{ante} + (1-f_h)EV_{m',l'}^{ante}$ and for the women $EV_{f'}^{ante} = \int_{\underline{\alpha}_f}^{\bar{\alpha_f}} EV_{f',\alpha_{f,i}}^{ante} d\mathbf{U}_{f,i}$. If $EV_{f'}^{ante} > EV_{m'}^{ante}$ the equilibrium outcome is inefficient according to this measure. Alternatively put the focus on the "marginal" couple, where the wife has long-term effects equal to the threshold $\alpha_{f,i} = \alpha_f^*$. The consumption equivalent variation $EV_{f',i*}^{ante}$ of this wife is defined as in Equation (2.45), albeit with $\alpha_{f,i} = \alpha_f^*$. The husband's ex-ante EV is not obvious, since in some equilibria it could happen that either a high or low type is married to this "marginal" women. The equivalent consumption variation from an ex-ante point of view is then determined by Equation (2.46) for $\omega' = h'$ and $\omega' = l'$, respectively.

Chapter 3

Female Genital Cutting vs. Education – Two Competing Investments?

3.1. Introduction

"Two things that will ensure the sustainability of FGM/C abandonment are women's education and economic empowerment. One reason why women are subjected to FGM/C is their economic dependence on men. If they are empowered, they can say no to FGM/C and they can protect their children, too. Their negotiation skills increase. When women are economically capable, they can send their girls to school and the girls, in turn, will also stand up for their rights." (Asmelash Woldemariam)[1]

This quote establishes a link between women's education and the harmful tradition of female genital cutting (FGC), namely that women's education and economic empowerment will help to eliminate female circumcision.[2] The aim of this chapter is to get to the bottom of this statement and analyze the role of women's education and their economic dependence on men through marriage for FGC.[3] The underlying research questions are: how do FGC, education and the marriage market interact? Could female education subsidies reduce FGC rates? The first question is empirically analyzed and the second question is answered within a structural search model capable of replicating relevant empirical patterns.

[1]Executive director of Rohi Weddu Pastoral Women Development Organization in Ethiopia (UNFPA and UNICEF, 2011).

[2]FGC is also referred to as female genital mutilation (FGM). As in Chapter 2, I will use FGC and female circumcision as synonyms for this tradition.

[3]For background information on female circumcision, I refer to the Introduction (Section 2.1) and the Empirical Background Section 2.2.1 of Chapter 2.

To investigate the first question, I use information from the Demographic and Health Survey (DHS) 2010 in Burkina Faso and estimate logit and ordered logit models. First, I find for Burkina Faso that uncircumcised as well as single women are better educated than circumcised or married women. Second, circumcised or non-educated women are more likely to be married than their counterparts. Third, better educated parents (mother and father) are less likely to have a circumcised daughter.

Based on these empirical findings, I hypothesize that education and FGC are two competing investments for the daughter, with education fostering economic independence and possibly also marriage market prospects and FGC only improving marriage market prospects. While better educated parents will focus on the education investment, low educated parents will decide in favor of FGC, since they cannot afford the education of their daughter. This is one of the first papers to analyze and document these interactions. Ouedraogo and Koissy-Kpein (2014) also analyze the link between FGC, marriage market and education, finding a negative correlation between the education and FGC of daughters. However, they use the Burkina Faso DHS 2003, which has a smaller sample size and is older than the DHS 2010. Yount (2002) and Wagner (2013) find that only the education of the mother is negatively correlated with the daughter's FGC status, but they do not investigate the relationship between the daughter's education and her FGC status.

To answer the question of whether female education subsidies are able to reduce FGC, I provide a dynamic model with equilibrium search in the marriage market in which parents decide upon the circumcision of their daughter and the education of their children. Some of the ingredients, particularly the premarital investment nature of FGC, are the same as in Chapter 2. However, this model has more than two periods and the marriage market is modeled differently, involving search frictions. In each period, singles meet randomly in the marriage market and mutually decide whether to marry. If one person does not agree to marry, there is a high probability that both stay single for this period but reenter the marriage market in the next period. This equilibrium search model is closely related to Greenwood et al. (2012), as well as the literature on marriage search models (e.g. Mortensen (1988), Aiyagari et al. (2000), Fernández and Rogerson (2001) and Santos and Weiss (2013)).[4] For the education and FGC decision, parents trade-off the costs against the benefits of each of the investments. Children are heterogeneous in their ability, which influences the education cost and girls have different costs of FGC.

[4]See Section 2.1 for a selection of papers. For an extensive overview of the marriage market literature, I refer the reader to Browning et al. (2014).

I calibrate the model to match some moments for Burkina Faso and it is able to qualitatively reproduce the empirical patterns. More precisely, the model generates that uncircumcised women and single women are better educated than their counterparts, i.e. circumcised and married women. Circumcised women as well as low educated women are more likely to be married than uncircumcised and low educated women. Furthermore, better educated parents are less likely to circumcise their daughter. The competition between the two forms of investment for daughters, namely education and FGC, is mainly driving the results. Parents with low education, involving lower disposable income, tend to invest less in the education of the daughter. They may decide to circumcise her if they cannot afford the costs of a better education and the utility cost of FGC is low enough.[5] Low education reduces the future income of the daughter, which makes a marriage relatively more attractive than staying single. Put differently, a better educated woman has a higher income, which increases her outside options to marriage ("independence" margin). However, this is not the only margin of the education investment; moreover, higher income also increases women's attractiveness to men and with that her marriage market prospects ("marriage" margin). In contrast, Ouedraogo and Koissy-Kpein (2014) only focus on the "independence" margin in their two period model, in which parents can decide to circumcise their daughter and thus invest in the marriage market, or to educate her. Education only generates returns on the labor market, with the authors concluding that FGC seems to be more profitable than education in poor countries. However, Ouedraogo and Koissy-Kpein (2014) do not model the marriage market and thus cannot account for general equilibrium effects, which are particularly important for policy analysis. Other FGC papers, such as Chesnokova and Vaithianathan (2010), Coyne and Coyne (2014), Rai and Sengupta (2013) and Bellemare et al. (2014) (see the embedded literature review in Section 2.1 of Chapter 2), also do not consider general equilibrium effects and also do not look at education. The goal of this chapter is to fill this gap in the literature. The investment nature of FGC and education further relates the paper to the literature on premarital investments, e.g. Peters and Siow (2002), Fernández et al. (2005), Baker and Jacobsen (2007), Iyigun and Walsh (2007), Nosaka (2007), Peters (2007), Bjerk (2009), Chiappori et al. (2009) and Bhaskar and Hopkins (2011). While most of the papers focus on education as premarital investment, some analyze the investment in beauty (e.g. Burdett and Coles (2001) and Lee and Ryu (2012)) or even premarital chastity (e.g. Mariani, 2012), although none of the papers investigate FGC as premarital investment. In particular, the interaction between education

[5] This is an indirect comparison, since education costs are monetary, but FGC costs are formulated in terms of utility.

and FGC is not analyzed. I refer to Section 2.1 of Chapter 2 for a discussion of this literature.

Based on the calibrated version of the model, I analyze the effect of a subsidy to female education, finding that this can reduce FGC rates but not eradicate the tradition. For example, a reduction of the education costs for women by 50% leads to a 54 percentage point decrease in the FGC rate (or a decrease of 75%). At the same time, the marriage rate of uncircumcised women increases. This suggests that in equilibrium, the "marriage" margin of the education investment dominates the "independence" margin: namely, for lower costs of female education, daughters receive better education, which makes them more attractive in the marriage market. However, education subsidies are only effective to a certain extent, since the FGC prevalence no longer decreases for sufficiently high subsidy rates, leveling off at a rate around 20%. Owing to an almost costless female education, most of the women are highly educated and do not differ from each other with respect to this characteristic. Accordingly, the only heterogeneity lies in the FGC status. Since men prefer circumcised to uncircumcised women in this model, the daughters with low FGC costs will be circumcised to increase their marriage market prospects. The welfare analysis shows that women are the winners of this policy, partly at the expense of men, who are confronted with a welfare decrease for subsidies up to 50% of the female education cost. However, men's welfare slightly increases again for higher subsidy rates, while remaining below the starting point's welfare. This policy analysis of female education subsidies yields interesting and novel insights for the literature.

The remainder of this chapter is structured as follows. Section 3.2 provides empirical analysis concerning the interaction between female circumcision, education and marriage. The model is presented in Section 3.3. In Section 3.4, I discuss the numerical example. Section 3.5 covers the policy analysis, before Section 3.6 concludes.

3.2. Evidence from Burkina Faso

In this section, I provide evidence on the interaction between FGC, the marriage market and education in Burkina Faso. The first part focuses on the description of the data and the summary statistics, before the empirical analysis is presented in the second part.

3.2.1. Data and Summary Statistics

The analysis for Burkina Faso is based on data from the Demographic and Health survey in 2010, involving interviews with 17,087 women (aged 15-49) and 7,307 men (aged 15-59)

(Institut National de la Statistique et de la Démographie and ICF-International, 2012).[6] The important feature of the survey is the module of questions on FGC. Women are asked whether they and their daughters are circumcised. The module includes questions on the form of female circumcision, the age at the time the procedure was performed and the circumcisor. This information can be related to socio-economic characteristics of the women, such as marital status, education, as well as characteristics of both the household and the husband. The DHS provides individual sampling weights, which are used to calculate means and fractions.

In total, 17,031 women provide information on their own FGC status. The summary statistics and averages are presented for women of the age group 15-39, for the following reason. All circumcised women older than 34 have been married (see Table 3.A1 in Appendix 3.A.1). Only 1% of the uncircumcised women have never been married at age 35, which switches to 0% at the age of 40.[7] In any case, women above 39 have all been married, and thus there is no heterogeneity in this dimension.[8] This means that only women up to age 39 are still single and potentially searching for a man on the marriage market and thus relevant for the analysis.[9] However, summary statistics for all women aged 15 to 49 are also provided in Appendix 2.A.3 of Chapter 2.[10]

Some numbers are presented here before proceeding with the analysis of the interaction between FGC, the marriage market and education. 73% of all women aged 15-39 are circumcised.[11] While more than 78% of the non-educated women are circumcised, only 54% of the women with secondary education have undergone the procedure. This pattern also holds for ever vs. never married women (with FGC rates of 78% vs. 55 %). For younger age groups, 15-29, there are significantly more circumcised than uncircumcised women married. See Tables 3.A2 and 3.A3 for further FGC rates of different socio-economic groups. Differences between circumcised and uncircumcised women are displayed in Table 3.A4 (see

[6]The DHS program was established by the United States Agency for International Development (USAID) in 1984 as a follow-up to the World Fertility Survey and the Contraceptive Prevalence Survey projects.

[7]Concerning the marital status, I distinguish between "ever married" and "never married". The "ever married" group not only includes people who are currently in a union or living with the partner, but also those who have been formerly in a union. All other people, namely those who have not yet been married, belong to the "never married" group. For the sake of convenience, I will also refer to "ever married" as " married" and "never married" as "single". Note that under this definition, an "ever married" person could be divorced, separated or widowed at the time of the interview. However, this only applies to a fraction of around 3% of the sample population.

[8]Men marry later in life than women, with all men having been married at the age of 45.

[9]This is not quite correct, since some of the women aged 40 or older might be divorced, separated or widowed and therefore also searching for a partner. However, as discussed, this is only relevant for a negligible small fraction.

[10]In the regression analysis (next Section), I consider all women but control for their age.

[11]The overall FGC rate (76%) is higher when women of the age 40-49 are also considered. The numerical example in Section 2.5.2 (Chapter 2) is based on this larger sample of women (aged 15-49).

Appendix 3.A.1), e.g. 84% of the circumcised women have been married, compared to only 65% of uncircumcised women.

3.2.2. Female Genital Cutting, Marriage and Education

In this section, I focus on the interaction analysis between FGC, marriage and education. First, I analyze the education levels of women and contrast them for different groups, such as circumcised vs. uncircumcised and single vs. married women. Second, I investigate the influence of the FGC status and educational attainment on the marriage probability of a woman. In a final step, the parents' decision to circumcise at least one daughter is studied.

Starting with the education levels, Table 3.1 shows the education distribution of ever married women and singles, aged 15 to 39, who are further divided into two subgroups, namely those who are circumcised (FGC) and those who are uncircumcised (no FGC).[12] While 80% of all ever married women have no education, only 39% of single women are non-educated. A large fraction of singles, 35%, have secondary education, whereas this fraction is much lower for the married women, i.e. 7%. Comparing the education of circumcised with uncircumcised women yields a similar picture (last two columns of Table 3.1). The highest share, 76%, of circumcised women are non-educated, which is only true for 58% of the uncircumcised women. Furthermore, only 10% of the circumcised women received secondary education, compared to 22% of the uncircumcised women.[13]

Table 3.1.: Education Distribution of Women

	Ever Married			**Singles**				**no**
Education	FGC	no FGC	both	FGC	no FGC	both	**FGC**	**FGC**
no education	0.81	0.73	0.80	0.46	0.29	0.39	0.76	0.58
primary	0.12	0.14	0.12	0.24	0.25	0.25	0.14	0.18
secondary	0.06	0.11	0.07	0.29	0.44	0.35	0.10	0.22
higher	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.02
Total	8598	2361	10959	1642	1444	3086	10240	3805

Source: DHS 2010 Burkina Faso, own calculations. Observations are weighted by individual sampling weights. Only women of ages 15 to 39 years. The differences within the aggregated groups of circumcised (FGC) vs. uncircumcised (no FGC) as well as ever married vs. single women are significant at the 1% level. Only the difference in higher education between ever married and single women is significant at the 5% level. The fractions are tested on equality based on a two-sample t-test with sampling weights.

[12]Table 3.A5 in Appendix 3.A.1 provides the distributions for all women, women aged 15 to 30 and women aged 15 to 25. The patterns are the same and independent of the considered age group. Note, that all fractions are calculated at a higher precision than two decimal places and are subsequently rounded; therefore, they might not exactly add up to one. This also holds for all following calculations.

[13]For information on the education distribution of ever married and never married men, I refer to Table 3.A7

The joint distribution of education and FGC within the group of married and single women aged 15 to 39 years is reported in Table 3.2.[14] For example, only 26% of the singles are non-

Table 3.2.: Joint Distribution of Education and FGC of Women

	Ever Married		**Singles**	
Education	FGC	no FGC	FGC	no FGC
no education	0.64	0.16	0.26	0.13
primary	0.09	0.03	0.13	0.11
secondary	0.05	0.02	0.16	0.19
higher	0.00	0.00	0.01	0.01
Total	10959		3086	
	8598	2361	1642	1444

Source: DHS 2010 Burkina Faso, own calculations. Observations are weighted by individual sampling weights. Only women of ages 15 to 39 years. The differences between ever married and single women are signficant at the 1% level. For the group of higher educated uncircumcised women the difference is only significant at the 5% level. For higher educated circumcised women there is no significant difference. The fractions are tested on equality based on a two-sample t-test with sampling weights.

educated and circumcised, while 19% have secondary education and are uncircumcised. This is different for ever-married women, 64% of whom are non-educated and circumcised, while 16% are non-educated and uncircumcised. These facts suggest that both the FGC status and marriage are negatively correlated with a women's educational attainment.[15]

In addition, I find evidence that those women who were circumcised before the age of school enrollment are less educated than women who have never been circumcised.[16] Table 3.3 presents the estimation results of two ordered logit models. A woman's own educational attainment is regressed on her FGC status and further controls. Educational attainment has four categories, i.e. no education, primary, secondary and higher education.[17] The estimation is based on a setup in which $Educ_i^* = \mathbf{x}_i^{'}\alpha + \varepsilon_i$ is a latent variable with unknown thresholds, i.e. the real level of education, and the stated educational attainment is defined by $Educ_i = j$

in Appendix 3.A.1.

[14]Table 3.A6 in Appendix 3.A.1 includes the joint distributions for all women, women aged 15 to 30 years and 15 to 25, which display the same patterns.

[15]This negative correlation is also observed, when comparing the FGC rates and average years of schooling for different cohorts. Figure 3.A1 in Appendix 3.A.1 shows that the FGC rates have been decreasing for younger cohorts. In contrast, the average years of schooling have been increasing.

[16]The official age of school enrollment in Burkina Faso is 6 years, according to the Education Act on the Rights of the Child (UN 2002, p. 10).

[17]Primary education consists of incomplete and complete primary education. This structure also holds for the category of secondary education.

if $\beta_{j-1} < Educ_i^* < \beta_j$.[18] The probability of each education category is:

$$\begin{aligned} Pr[Educ_i = j] &= Pr[\beta_{j-1} < Educ_i^* < \beta_j] \\ &= Pr[\beta_{j-1} < \mathbf{x}_i^{'}\alpha + \varepsilon_i < \beta_j] \\ &= F(\beta_j - \mathbf{x}_i^{'}\alpha) - F(\beta_{j-1} - \mathbf{x}_i^{'}\alpha), \end{aligned} \tag{3.1}$$

with the error term ε following a logistic distribution and $\mathbf{x}_i$ including FGC status and further controls.[19] The regression in the first column of Table 3.3 is based on non-married daughters above the age of 14 years who still live at their parental home. The FGC dummy is equal to one if the daughter was circumcised before the age of 7 and zero if she has not yet been circumcised. Daughters who are circumcised at an age between 7 and 14 are excluded, since the interaction between education and circumcision might be different.[20] The second column considers all women, rather than only daughters, excluding those who have been circumcised between the ages of 7 and 14. Given that this sample includes the characteristics of daughters still living at home, as well as married women living with their husband, controls such as wealth, region and urban area refer to some women's parental home and that of their family in-law for others. Therefore, I exclude these controls for the regression based on the whole sample.

For both samples, I find a significant negative effect of FGC on educational attainment.[21] Women who are circumcised before the age of 7 are less educated than uncircumcised women.[22] This strongly supports the previous finding of a negative correlation between FGC and educational attainment. Even though the female circumcision took place before the education started, a causal statement that FGC influences education is problematic. The decision whether to circumcise the daughter could have been affected by the plans for her education, which in turn does not contradict the hypothesis that education and FGC are competing investments.

[18]See Cameron and Trivedi (2005) for more details, p. 519-520.

[19]The logistic distribution is given by $F(z) = e^z/(1+e^z)$ and the controls are the number of older siblings, age, religion, ethnicity, urban, wealth and region.

[20]It still might happen that a young adult will undergo FGC in the future, although the likelihood is low since the average age of FGC in Burkina Faso is below 4 years.

[21]Table 3.A8 in Appendix 3.A.1 shows the estimated coefficients of all controls.

[22]This finding is robust to changes in the classification of educational attainment. Table 3.A9 in Appendix 3.A.1 shows the results of an ordered logit model where incomplete education belongs to the lower category, such that incomplete primary education belongs to no education, for example. Table 3.A10 shows the regression results including all women, even those who have been circumcised between the ages of 7 and 14. The results also remain robust for this classification.

Table 3.3.: Education of Women

	Daughters		All	
Circumcised before age 7	-0.668***	(0.110)	-0.586***	(0.0488)
Current age, religion, ethnicity	✓		✓	
Number of older siblings	✓		✓	
Wealth, region, urban	✓		✗	
Observations	2008		13376	
Pseudo R^2	0.201		0.116	

Source: DHS, own calculations. Notes: Ordered logit model with estimated coefficients. Standard errors are in parentheses and clustered at the household level. * (p<0.10), ** (p<0.05), *** (p<0.01). The education categories are no education, primary education, secondary education and higher education. The dummy "circumcised before age 7" is equal to one if the woman was circumcised before age 7 and zero if she never has been circumcised. Column 1 only considers unmarried daughters, older than 14 years, who are still living at their parental home. Column 2 considers all women. ✓ controlling for, ✗ not controlling for. The dummy urban is equal to one if the person lives in an urban area, otherwise it is zero.

To analyze the influence of the FGC status and educational attainment on the marriage probability of a woman, I estimate a logistic regression model of the marriage status (married vs. single) on the FGC status, education and further controls. The underlying equation for this estimation is:

$$Pr[Ever\,married_i = 1|\mathbf{x}_i] \quad = \quad \frac{exp(\alpha_0 + \mathbf{x}_i^{'}\alpha_1)}{1 + exp(\alpha_0 + \mathbf{x}_i^{'}\alpha_1)}, \tag{3.2}$$

with $\mathbf{x}_i$ representing the FGC status, education and further controls.[23] Table 3.4 shows the results. First of all, the FGC status increases the likelihood of being married, as does the age. Secondly, a woman with primary education is less likely to be married than a woman with no education, which also holds for women with secondary and higher education.[24] These findings are in line with the literature (see Wagner, 2013).

[23]See Cameron and Trivedi (2005) for a detailed expression on p.464. The controls are current age, number of all and older siblings, urban area, region, ethnicity and religion.

[24]The estimation results for the remaining controls are presented in Table 3.A11 in Appendix 3.A.1.

Table 3.4.: Probability of Marriage

	Marriage	
FGC	0.159**	(0.072)
Primary education	-0.704***	(0.080)
Secondary education	-2.022***	(0.103)
Higher education	-2.616***	(0.427)
Age	0.498***	(0.016)
Observations	16688	
Pseudo R^2	0.599	

Source: DHS, own calculations. Notes: Logistic regression model with estimated coefficients. Standard errors are in parentheses and clustered at household level. * (p<0.10), ** (p<0.05), *** (p<0.01). Controlling for the number of siblings and older siblings, urban area, region, religion and ethnicity. The reference group for education is "no education".

Finally, I focus on the driving forces of parents' decision to circumcise their daughter. Each woman is asked whether she has at least one circumcised daughter.[25] I estimate a logistic regression model of the probability of having at least one circumcised daughter on covariates that refer to either the mother, the father or the whole family.[26] The education of the mother and her partner are included in the regression as dummies.[27]

The main results are presented in Table 3.5. The estimated coefficients of the remaining controls are displayed in Table 3.A12 (see Appendix 3.A.1).[28] A woman with secondary education is significantly less likely to have at least one circumcised daughter than a woman with no education.[29] The same holds true for the education of the father. Furthermore, the probability that at least one daughter is circumcised increases with the number of children and particularly with the number of daughters in a household. Finally, the FGC status of the mother has a high significant and positive influence, indicating a strong intergenerational

[25] 16% (15%) of women aged 15-49 (15-39) report that they have at least one circumcised daughter. Compared to the overall FGC rate, this is a low fraction. As discussed in Appendix 2.A.3 in Chapter 2, there are some caveats to this measure. For instance, it does not distinguish between the number of circumcised daughters and the daughters who might still be at risk of undergoing the procedure at a later stage. Furthermore, there might be an under-reporting problem due to the law against FGC in Burkina Faso.

[26] Individual information on daughters is not included. The underlying equation of the regression corresponds to Equation (3.2) but with the daughters' FGC status as dependent variable.

[27] Again, the education categories are no education, primary, secondary and higher education. No education is taken as the reference group. The education information about the partner is given by the woman. It could be the case that the current partner is not the father of the daughters. However, since divorce is relatively rare, I assume the partner to be the father of the children.

[28] The age gap between parents (father's age minus mother's age) is added as a control in the second column of Table 3.A12, but has only a low influence on the FGC probability.

[29] The dummy for higher education is omitted. However, this does not affect the results, since there are only 36 observations.

transmission of the tradition.[30] The relevance of the mother's education for the FGC decision is supported by Yount (2002), who focuses on Minia (Egypt), as well as Wagner (2013), who analyzes 13 African countries. Both find that the mother's education is negatively correlated with the circumcision status of the daughter; however, in contrast to the presented results, they do not find a significant effect of the father's education.

Table 3.5.: Probability of Circumcising Daughters

	FGC Daughter	
Mother:		
Primary education	-0.186	(0.121)
Secondary education	-0.786***	(0.299)
FGC	2.694***	(0.235)
Father:		
Primary educ. (partner)	-0.142	(0.112
Secondary educ. (partner)	-0.952***	(0.271)
Higher educ.(partner)	-0.926	(1.001)
Family:		
Children ever born	0.0556***	(0.0211)
Daughters living	0.240***	(0.0265)
Observations	10491	
Pseudo R^2	0.147	

Source: DHS, own calculations. Notes: Logistic regression model with estimated coefficients. Standard errors are in parentheses and clustered at household level. * (p<0.10), ** (p<0.05), *** (p<0.01). Controlling for religion and ethnicity, mother's current age and her age at first cohabition, number of household members, sex of household head, wealth, region and urban area. The reference group is "no education". For the mother's education "highest educ" is omitted.

To summarize, the main empirical findings of this section are:

1. Uncircumcised as well as never married women are better educated than circumcised and married women, respectively.
2. Circumcised or non-educated women are more likely to be married than their counterparts.
3. Parents with secondary education are less likely to circumcise their daughters than parents with no education.

These findings lead to the following hypothesis:

[30] The separate estimation results for the two subgroups, circumcised and non-circumcised mothers, are presented in Table 3.A13 in Appendix 3.A.1. Accordingly, it becomes evident that the characteristics of the circumcised mothers are driving the results.

Education and FGC are two competing investments for the daughter. While education fosters economic independence and possibly also improves marriage market prospects, FGC only improves marriage market prospects. Better educated parents focus on the education investment and low educated parents on FGC, since they cannot afford education for the daughter.

3.3. The Model

Based on these empirical facts, I provide a structural model to test the hypothesis of competing investments. Parents can decide upon two forms of investment, namely the circumcision of the daughter and the education of both children, daughter and son. The model is a dynamic equilibrium search model of the marriage market. The marriage market takes place every period and people have the option to stay single.[31] The main mechanism is as follows: if the costs of education are high, parents with low education, associated with low disposable income, may prefer circumcising their daughter to investing in her education. In turn, this lowers the future income of the daughter, which makes a marriage relatively more attractive than staying single.

3.3.1. General Framework

The following framework is closely related to the model of Greenwood et al. (2012). This economy has the same number of females, f, and males, m. Every person starts her life with childhood, which lasts for T_c periods. During adulthood, people are confronted with a constant dying probability of δ, meaning there is a positive likelihood that they do not survive into the next period.[32] Adults make a living from working in the labor market. Furthermore, starting with adulthood, a person is active in the marriage market, randomly meets a person of the opposite sex and can decide at the beginning of the period whether to marry or stay single. The decision to marry cannot be revoked, meaning divorce is not possible, but a single will re-enter the marriage market in the next period. A married couple has two children, a son and a daughter, while a single remains childless. After the marriage market has taken place

[31] Chesnokova and Vaithianathan (2010) also present an alternative approach of modeling the marriage market, comparable to Burdett and Coles (2001). People meet randomly and decide whether to marry. If they marry, they leave the market and are replaced by a male and a female, where the female still has to decide on the circumcision. Besides the differences in the marriage market setup and replacement, they neither have an alternative investment in education nor is the FGC decision made by the parents.

[32] I assume that children survive childhood and enter adulthood with certainty. Furthermore, the dying probability is the same for everyone and not higher for circumcised women. This seems to be a very strong assumption in the context of FGC, but information on the number of women/children who die due to the tradition rarely exists. In the model, a higher dying probability could also be interpreted as an additional cost of FGC.

and couples are formed, people decide upon consumption and investments in their children (if they have some). In this economy, couples die together. Figure 3.1 displays the basic time line of the model.

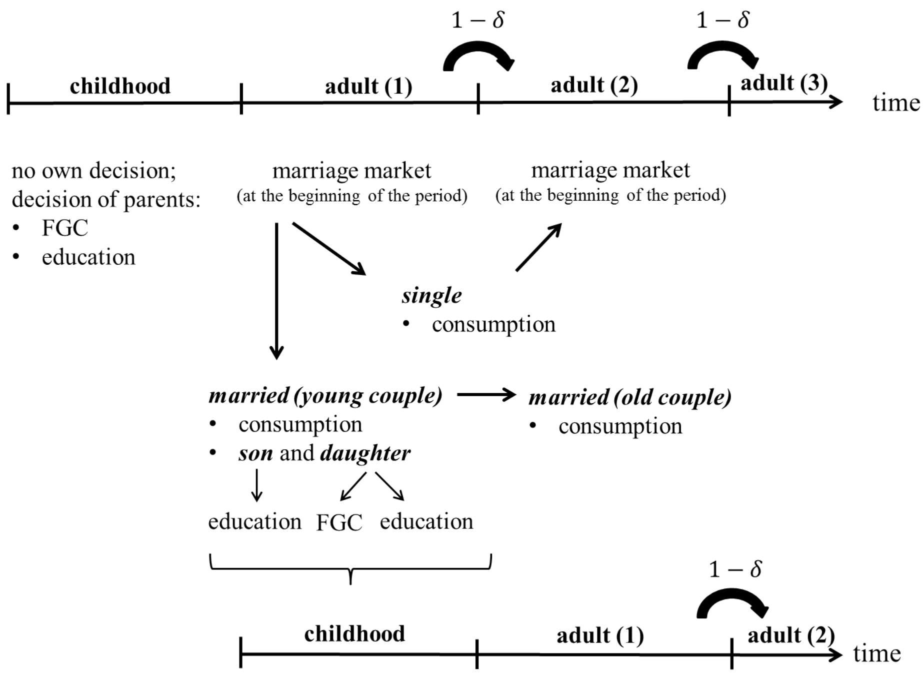


Figure 3.1.: Time Structure of the Model

As in Chapter 2, women can differ in their *utility costs of FGC*, α_f, but they will pass the same utility cost on to their daughter, such that the utility cost of FGC does not vary between mother and daughter. Thus, utility costs of FGC are potentially different for each family of woman i, but for simplicity I refrain from indexing them, $\alpha_f \equiv \alpha_{f,i}$. The distribution function of this utility cost over all women is log-normally distributed $ln(\alpha_f) \sim N(\mu_{\alpha_f}, \sigma^2_{\alpha_f})$ and labeled by $\mathbf{D}_\alpha$.

The labor supply on the *labor market* is exogenous, although the wage function depends on the individual's education. An adult can earn money in the labor market, according to the wage function $w(e, g) = \psi_g w_e$ with $w_e = w_{min} + \eta e$. The wage depends on the education of the individual, e, with $\frac{\partial w_e}{\partial e} > 0$, as well as the gender, g. The private return to education is governed by η and everyone receives a minimum income of w_{min}. A female is confronted with a gender wage gap of $\psi_f \in (0, 1)$, with $\psi_m = 1$.[33]

[33]This is a critical assumption, since many women and men are working in agriculture. Furthermore, women might not even be employed. Accordingly, the question is whether there are returns to education in agriculture. For example, Ram and Singh (1988) find private returns to education (years in schooling) of around 10% for rural households in Burkina Faso. Kazianga (2004) estimates returns to schooling between 9% and 16% for a year of schooling, depending on the type of education (primary, secondary or tertiary) for Burkina Faso. For further evidence on positive schooling returns (also for agriculture) in sub-Saharan

The *education* decision for the children is made by their parents, who also bear its costs in terms of consumption goods. The cost of education is given by $\kappa(a, e) = \frac{\kappa_g}{a} e$, where κ_g is a constant and potentially different for genders and a is the ability of a person, in this case the child. People differ in their ability, which is independently and randomly distributed $ln(a) \sim N(0, \sigma_{a_g}^2)$ across people, as in Greenwood et al. (2012). The distribution can be different for genders and is denoted by $\mathbf{A}_g$. In order to be precise, the ability would have to be indexed by i (for women) and j (for men) to highlight that people are heterogeneous, but for readability the index is dropped. Parents can observe the ability of their son and daughter before the education decision is made, albeit only after the children are born. The education decisions are discrete, with the categories $e \in \{0, .., k\}$ and k being an integer.

The *gains from marriage* are manifold. First, a married person derives additional utility from having children in the first period of marriage. Parents are altruistic towards their children, such that the children's utility enters their utility. Since a single person does not have children in this set-up, this additional utility cannot be derived. Second, a couple enjoys economies to scale in form of a cost reduction of the consumption good, which is governed by ϕ. Third, a married person randomly derives utility from being in love with the partner, denoted by $l_g \sim N(\mu_l, \sigma_l^2)$ with the distribution function $\mathbf{L}$. This love parameter is different for the spouses, in contrast to the altruism and economies to scale, which are the same for the wife and her husband.

Starting from a unit measure of female and male singles in the very first period of the economy, the *population* is either increasing, decreasing or stays constant, depending on the fraction of singles who marry and the survival probability. This is due to the assumptions that people die with a probability of δ after their first year of adulthood and that fertility for a couple is exogenous at a replacement rate of one. If more people marry than die, the population grows. I further assume that couples die together. In the steady state of the economy, which will be explained in further detail in Section 3.3.6, the number of people in the single pool and their characteristics are constant.

Furthermore, there is no savings technology in this economy.

African countries, I refer to Psacharopoulos (1994), Glewwe (1996), Siphambe (2000), Oyelere (2010), Alene and Manyong (2007) and Foltz and Gajigo (2012). The estimated private returns to education go up to 18%.

3.3.2. Preferences

The *preferences of a woman* are represented by the following period utility function:

$$u_f = \frac{c_f^{1-\sigma}}{1-\sigma} - \alpha_f F + l_{f,1} + \gamma_1 \mathbb{E}(u_{f'} + u_{m'}), \tag{3.3}$$

$$F = \begin{cases} 1 & \text{if circumcised} \\ 0 & \text{otherwise,} \end{cases} \qquad \{\gamma_1, l_{f,1}\} = \begin{cases} \{\beta^{T_c}\gamma, l_f\} & \text{first period of marriage} \\ \{0, 0\} & \text{otherwise.} \end{cases}$$

The relative risk aversion of the CRRA preferences is determined by σ for the private good c_f. The indicator F is equal to one when the woman is circumcised and zero if not. FGC ($F = 1$) leads to a utility cost of α_f each period. In the first period of the marriage, a woman derives utility from being in love, l_f.[34] She has dynastic preferences in the fashion of Barro and Becker (1988, 1989), whereby the degree of altruism towards her children is represented by γ, with $u_{f'}$ and $u_{m'}$ being the lifetime utilities of the daughter and son, respectively. The children's future utility is discounted by β^{T_c}, since they will first derive utility after their childhood (lasting T_c periods), when they are grown-ups.[35]

The *period utility of a man* is defined as:

$$u_m = \frac{c_m^{1-\sigma}}{1-\sigma} + \alpha_m \hat{F} + l_{m,1} + \gamma_1 \mathbb{E}(u_{f'} + u_{m'}) \tag{3.4}$$

$$\hat{F} = \begin{cases} 1 & \text{if wife circumcised} \\ 0 & \text{otherwise,} \end{cases} \qquad \{\gamma_1, l_{m,1}\} = \begin{cases} \{\beta^{T_c}\gamma, l_m\} & \text{first period of marriage} \\ \{0, 0\} & \text{otherwise.} \end{cases}$$

If he is married to a circumcised wife, $\hat{F} = 1$, he derives a positive utility of α_m each period. This utility gain α_m is the same for every man. The altruism enters the utility in exactly the same way as it enters the wife's utility.

[34]Here, this random love shock is only relevant in the first period of marriage. Nevertheless, it could be easily transformed into a constant period love shock or interpreted as the discounted aggregated love shock over the whole marriage.

[35]Here, parents only derive utility from having children in the first period of the marriage. This is also the time when they decide upon the investment into their children, which cannot be revoked later on.

3.3.3. Budget Constraint

The period budget constraint for a *single* of gender $g = \{m,\ f\}$ is as follows:

$$c_g \quad \leq \quad w(e_g, g). \tag{3.5}$$

For a *young couple*, i.e. a couple that just got married in this period, the budget constraint is given by:

$$\phi(c_f + c_m) + \kappa(a_{f'}, e_{f'}) + \kappa(a_{m'}, e_{m'}) \quad \leq \quad w(e_f, f) + w(e_m, m) \tag{3.6}$$

with $\phi < 1$ being the additional gain from marriage, representing economies to scale in the household. The costs of education for the daughter and son are given by $\kappa(a_{f'}, e_{f'}) = \frac{\kappa_f}{a_{f'}} e_{f'}$ and $\kappa(a_{m'}, e_{m'}) = \frac{\kappa_m}{a_{m'}} e_{m'}$, respectively.[36] The variables of the children are marked by a prime, where $e_{f'}$ and $a_{f'}$ ($e_{m'}$ and $a_{m'}$) are the education and ability of the daughter (son), respectively.

For an *old couple*, i.e. a couple that has been married for longer than one period, the budget constraint is:

$$\phi(c_f + c_m) \quad \leq \quad w(e_f, f) + w(e_m, m). \tag{3.7}$$

3.3.4. Marriage Market

The marriage market takes place at the beginning of each period, where only singles meet. There is no divorce or remarriage. Furthermore, polygamy is not allowed in this model.[37] If two people mutually agree upon marrying, they will exit the marriage market forever. Within the market, everyone randomly meets a person of the opposite sex, independent of their age. Consequently, marriages can take place across generations and are not restricted to cohorts. In particular, this means that children enter the marriage market after their childhood and

[36] The costs are denominated in terms of the consumption good, which parents only have to pay in the first period of their marriage. This is not a crucial assumption, since the costs could just be interpreted as discounted aggregated costs of education during the childhood.

[37] In Burkina Faso, the polygyny rate is relatively high, with 42% of the married women having at least one co-wife according to the DHS 2010 (see also Table 4.1 in Chapter 4, Section 4.2). Therefore, one could think about an extension of the model in which polygyny is possible. In an earlier version of their paper from 2007, Chesnokova and Vaithianathan (2010) find that circumcised women in a polygynous relationship are more likely to have a higher rank within the marriage. This could be another margin along which FGC might improve marriage market prospects. In this version of the model, I abstract from this additional dimension and leave it to future research.

can potentially marry every single of the opposite sex, regardless how old this person is.[38] With a probability of δ_{im}, a single has to marry the partner met in the marriage market, without having the option of rejecting.[39] With probability $(1-\delta_{im})$, a single person has the option of refusing to marry. This feature ensures that everyone who survives eventually marries, which corresponds to the empirical findings (see Table 3.A1 in Appendix 3.A.1). This marriage market is characterized by search frictions, as in Greenwood et al. (2012), since people only randomly meet a person of the opposite sex.[40]

3.3.5. Optimization Problem

The value function of a single with gender g is denoted by V_g^s. While the value function of a just married person in the first period of marriage (young couple) is denoted by $V_g^{m,y}$, the abbreviation for the value function of a married person from the second period of marriage onwards (old couple) is $V_g^{m,o}$. The traits of the spouse are marked by a hat, e.g. the education attainment of the spouse is denoted by $\hat{e}_g$.

3.3.5.1. Singles

For a *single female,* the value function is given by

$$\begin{aligned} V_f^s(e_f, \alpha_f, F) &= \max_{c_f^s} \left\{ \frac{{c_f^s}^{1-\sigma}}{1-\sigma} - \alpha_f F + (1-\delta)\beta \mathbb{E}(V_f^{market}(e_f, \hat{e}_m, \alpha_f, F, a_{f'}, a_{m'})) \right\} \\ s.t.\ c_f^s &\leq \underbrace{\psi_f(w_{min} + \eta e_f)}_{w(e_f, f)} \end{aligned} \tag{3.8}$$

[38]Of course, this is a simplifying assumption, yet is not unreasonable for girls, since the age gap between men and women at marriage is relatively high in Burkina Faso. On average, women are around 11 years younger than their husband (this average gap is 6 years when only considering women and men aged 15 to 39), although there are also some couples for which the woman is older (see Figure 3.A2 in Appendix 3.A.1). The empirical distribution of the age gap is not symmetric around zero, which cannot be accounted for in the model. However, this feature is not crucial for the analysis, since this paper does not focus on the age gap in marriage. Furthermore, the age gap between parents is not economically relevant for the decision on FGC, which can be seen from the logit regression results in Table 3.A12 (Appendix 3.A.1). The estimated coefficient of the age gap on the probability of FGC is hardly significant at the 10% level and very small.

[39]The subscript (im) stands for involuntary marriage.

[40]Alternatively, one could think about a setup with lower search frictions. The marriage market could be separated, i.e. into one market in which only circumcised women search for a husband and every man who prefers circumcised women could search there. The other marriage market would be one in which uncircumcised women are present. Furthermore, one concern of the marriage market in this paper could be that children do not decide on their marriage in reality, but rather their parents. However, the model can easily be reinterpreted in the way that parents decide on the marriage market of their children, under the same search frictions.

The current utility is given by $\frac{{c_f^s}^{1-\sigma}}{1-\sigma} - \alpha_f F$ and $\mathbb{E}(V_f^{market}(e_f, \hat{e}_m, \alpha_f, F, a_{f'}, a_{m'}))$ is the expected continuation value from the next period onwards, which depends on the marriage market outcome. The state variables for a single woman are her education status (e_f), her utility cost of FGC (α_f) and her FGC status (F), which do not change over time.[41] Primes are used to indicate the characteristics of the children. The expected continuation value is defined as:

$$\begin{aligned}
\mathbb{E}(V_f^{market}(e_f, \hat{e}_m, \alpha_f, F, a_{f'}, a_{m'})) &= \int_L \int_{A_f} \int_{A_m} \int_{\hat{S}^{m,new'}} \\
&\Big\{ \mathbb{I}_{e_f,F,\hat{e}_m,l} V_f^{m,y}(e_f, \hat{e}_m, \alpha_f, F, a_{f'}, a_{m'}) \\
&+(1-\mathbb{I}_{e_f,F,\hat{e}_m,l}) \left[(1-\delta_{im}) V_f^s(e_f, \alpha_f, F) \right. \\
&\left. + \ \delta_{im} V_f^{m,y}(e_f, \hat{e}_m, \alpha_f, F, a_{f'}, a_{m'}) \right] \Big\} \\
&d\hat{\mathbf{S}}^{m,new'}(e_m) d\mathbf{A}_m(a_{m'}) d\mathbf{A}_f(a_{f'}) d\mathbf{L}(l) \\
\mathbb{I}_{e_f,\hat{e}_m,F,l} &= \begin{cases} 1 & \text{if mutual agreement to marry} \\ 0 & \text{otherwise.} \end{cases}
\end{aligned} \tag{3.9}$$

The expectation is formed over the normalized distributions of single males in the next period, $\hat{\mathbf{S}}^{m,new'}(\hat{e}_m)$, over the distribution of the love shock, $\mathbf{L}(l)$, and the ability shocks for the daughter and the son, $\mathbf{A}_f(a_{f'})$ and $\mathbf{A}_m(a_{m'})$. If a couple mutually agrees upon marrying ($\mathbb{I}_{e_f,F,\hat{e}_m,l} = 1$), the continuation value for the woman is $V_f^{m,y}(e_f, \hat{e}_m, \alpha_f, F, a_{f'}, a_{m'})$, i.e. the value function of a young married woman, which is explained in further detail in the next section. If they do not mutually agree, there is still a small chance of marriage, with probability δ_{im}. This yields the same continuation value of $V_f^{m,y}(e_f, \hat{e}_m, \alpha_f, F, a_{f'}, a_{m'})$. However, they will not marry with probability $(1-\delta_{im})$, which leads to the continuation value of $V_f^s(e_f, \alpha_f, F)$, i.e. the value function of a single woman. The marriage decision and the single distributions are discussed in further detail in Sections 3.3.5.3 and 3.3.6, respectively.

[41] Hence the notation will stay the same, without primes, in the next period. Furthermore, her ability a_f is not a state variable, since it has only been relevant for her education level, e_f, chosen by her parents. Thus, all crucial information about a_f for the woman's decisions is captured in the education, such that the ability does not need to be included in the value function. This also holds for single men, as well as people living as young couples and old couples.

For a *single male,* the value function is defined analogously:

$$\begin{aligned} V_m^s(e_m) &= \max_{c_m^s} \left\{ \frac{c_m^{s\ 1-\sigma}}{1-\sigma} + (1-\delta)\beta\mathbb{E}(V_m^{market}(\hat{e}_f, e_m, \hat{\alpha}_f, \hat{F}, a_{f'}, a_{m'})) \right\} \\ s.t.\ c_m^s &\leq \underbrace{w_{min} + \eta e_m}_{w(e_m,m)} \end{aligned} \tag{3.10}$$

with

$$\begin{aligned} \mathbb{E}(V_m^{market}(e_m, \hat{e_f}, \hat{\alpha}_f, \hat{F}, a_{f'}, a_{m'})) &= \int_L \int_{A_f} \int_{A_m} \int_{\hat{S}^{f,new'}} \\ & \Big\{ \mathbb{I}_{\hat{e}_f, e_m, \hat{F}, l} V_m^{m,y}(\hat{e}_f, e_m, \hat{\alpha}_f, \hat{F}, a_{f'}, a_{m'}) \\ & + (1 - \mathbb{I}_{\hat{e}_f, e_m, \hat{F}, l}) \left[(1-\delta_{im}) V_m^s(e_m) \right. \\ & \left. + \ \delta_{im} V_m^{m,y}(\hat{e}_f, e_m, \hat{\alpha}_f, \hat{F}, a_{f'}, a_{m'}) \right] \Big\} \\ & d\hat{\mathbf{S}}^{f,new'}(e_f, \alpha_f, F) d\mathbf{A}_m(a_{m'}) d\mathbf{A}_f(a_{f'}) d\mathbf{L}(l) \\ \mathbb{I}_{\hat{e}_f, e_m, \hat{F}, l} &= \begin{cases} 1 & \text{if mutual agreement to marry} \\ 0 & \text{otherwise.} \end{cases} \end{aligned} \tag{3.11}$$

The single man only has his education level as a state variable. Furthermore, he faces the same distributions of the love and ability shocks ($\mathbf{L}(l)$, $\mathbf{A}_f(a_{f'})$ and $\mathbf{A}_m(a_{m'})$) as a single woman, although the normalized distribution of single females in the next period is relevant for him, i.e. $\hat{\mathbf{S}}^{f,new'}(\hat{e}_f, \hat{\alpha}_f, \hat{F})$.

3.3.5.2. Couples

There are two different types of couples, i.e. young and old couples, as briefly mentioned in Section 3.3.3. A couple that just got married in this period is called a young couple, while all others are old couples. For a *woman who just got married*, the value function is:

$$\begin{aligned} V_f^{m,y}(e_f, \hat{e}_m, \alpha_f, F, a_{f'}, a_{m'}) &= \frac{(c_f^{m,y*})^{1-\sigma}}{1-\sigma} - \alpha_f F + l_f + (1-\delta)\beta V_f^{m,o}(e_f, \hat{e}_m, \alpha_f, F) \\ & \underbrace{+ \gamma_1 \mathbb{E}\left(V_f^{market'}(e^*_{f'}, \hat{e}_{m'}, \alpha_{f'}, F'^*, a_{f''}, a_{m''})\right)}_{\text{altruism (daughter)}} \\ & \underbrace{+ \gamma_1 \mathbb{E}\left(V_m^{market'}(\hat{e}_{f'}, e^*_{m'}, \hat{\alpha}_{f'}, \hat{F}', a_{f''}, a_{m''})\right)}_{\text{altruism (son)}}, \end{aligned} \tag{3.12}$$

where $\mathbb{E}(V_f^{market'}(e^*_{f'}, \hat{e}_{m'}, \alpha_{f'}, F'^*, a_{f''}, a_{m''}))$ is the expected lifetime valuation of the daughter and $\mathbb{E}(V_m^{market'}(\hat{e}_{f'}, e^*_{m'}, \hat{\alpha}_{f'}, \hat{F}', a_{f''}, a_{m''}))$ of the son.[42] In addition, her current utility, $\frac{(c_f^{m,y*})^{1-\sigma}}{1-\sigma} - \alpha_f F$, the love from marriage, l_f, and her discounted continuation value of the ongoing marriage, $V_f^{m,o}(e_f, \hat{e}_m, \alpha_f, F)$, are incorporated into the value function of a young married woman. State variables are her education, e_f, her utility cost of circumcision, α_f, her circumcision status, F, the education status of her husband, $\hat{e}_m$, and the ability of her children, $a_{f'}$ and $a_{m'}$.[43] It is important to note that the cost of circumcision is the same for the mother and her daughter, $\alpha_f = \alpha_{f'}$.

The value function of a *man who just got married* reads:

$$\begin{aligned} V_m^{m,y}(\hat{e_f}, e_m, \hat{\alpha}_f, \hat{F}, a_{f'}, a_{m'}) \quad = \quad & \frac{(c_m^{m,y*})^{1-\sigma}}{1-\sigma} + \alpha_m \hat{F} + l_m + (1-\delta)\beta V_m^{m,o}(\hat{e_f}, e_m, \hat{F}) \\ & \underbrace{+\gamma_1 \mathbb{E}\left(V_f^{market'}(e^*_{f'}, \hat{e}_{m'}, \alpha_{f'}, F'^*, a_{f''}, a_{m''})\right)}_{\text{altruism (daughter)}} \\ & \underbrace{+\gamma_1 \mathbb{E}\left(V_m^{market'}(\hat{e}_{f'}, e^*_{m'}, \hat{\alpha}_{f'}, \hat{F}', a_{f''}, a_{m''})\right)}_{\text{altruism (son)}}. \end{aligned} \tag{3.13}$$

His state variables correspond to those of his wife.[44] The wife's cost of circumcision ($\hat{\alpha}_f$) is only relevant for the husband to the extend that this utility cost is transmitted to the daughter ($\hat{\alpha}_f = \alpha_{f'}$) and thus influences the FGC decision.[45] Since the decisions within a household are based upon a cooperative bargaining with fixed weights (θ_f is the bargaining power of the wife), the choice variables are the solutions to the following optimization problem of a *young*

[42] The star (*) indicates that the choice variable is an outcome of the cooperative bargaining process of a couple. The expected lifetime valuations of the children is equivalent to the expected continuation value of a single, as discussed in Section 3.3.5.1.

[43] The love parameter l_f is not a state variable in the sense that it does not influence anything other than the decision whether to marry. Therefore, there is no need to keep track of it.

[44] Note, the utility gain α_m of being married to a circumcised women is the same for all man. Therefore, it is sufficient to only carry the FGC status of the wife as a state variable.

[45] $\hat{\alpha}_f$ denotes the FGC cost of the wife, $\alpha_{f'}$ of the daughter and $\hat{\alpha}_{f'}$ denotes the cost of circumcision of the son's potential wife.

couple:[46]

$$
\begin{aligned}
(c_f^{m,y*}, c_m^{m,y*}, e_{f'}^*, e_{m'}^*, F'^*) &= \underset{c_f, c_m, e_{f'}, e_{m'}, F'}{arg \quad max} \Big\{ \theta_f \frac{(c_f^{m,y})^{1-\sigma}}{1-\sigma} + (1-\theta_f)\frac{(c_m^{m,y})^{1-\sigma}}{1-\sigma} \\
&+\gamma \mathbb{E}\left(V_f^{market'}(e_{f'}, \hat{e}_{m'}, \alpha_{f'}, F', a_{f''}, a_{m''})\right) \\
&+\gamma \mathbb{E}\left(V_m^{market'}(\hat{e}_{f'}, e_{m'}, \hat{\alpha}_{f'}, \hat{F}', a_{f''}, a_{m''})\right)\Big\}
\end{aligned}
$$

$$
\begin{aligned}
s.t \qquad & \phi(c_f + c_m) + \kappa(a_{f'}, e_{f'}) + \kappa(a_{m'}, e_{m'}) \leq w(e_f, f) + w(e_m, m) \\
& e_g \in \{0, .., k\} \text{ with } g = \{m, f\} \text{ and} \\
& F = \hat{F}. \qquad (3.14)
\end{aligned}
$$

The budget constraint includes the cost of education for the children and a gain from marriage, namely that consumption goods are less costly, $\phi(c_f + c_m)$ with $\phi < 1$. The lifetime valuation of the children depends on the marriage market in the next period. The distribution of singles and the traits of the children, which influences their probabilities of marrying or not, are relevant to form this expectation. The expected lifetime valuations $\mathbb{E}(V_f^{market'}(e_{f'}^*, \hat{e}_{m'}, \alpha_{f'}, F'^*, a_{f''}, a_{m''}))$ and $\mathbb{E}(V_m^{market'}(\hat{e}_{f'}, e_{m'}^*, \hat{\alpha}_{f'}, \hat{F}', a_{f''}, a_{m''}))$ correspond to Equations 3.9 and 3.11. The education decision for the daughter and the son can be formulated as policy functions, $e_{f'}^* = e_{f'}(e_f, e_m, \alpha_f, F, a_{f'}, a_{m'})$ and $e_{m'}^* = e_{m'}(e_f, e_m, \alpha_f, F, a_{f'}, a_{m'})$, as can the FGC decision, $F'^* = F'(e_f, e_m, \alpha_f, F, a_{f'}, a_{m'})$ and the consumption decision.[47]

After the first period of marriage in which children were born, an *old couple* only lives together without deriving utility from their children. Therefore, the value function of a woman from the second period of marriage onwards is:

$$
V_f^{m,o}(e_f, \hat{e}_m, \alpha_f, F) = \frac{(c_f^{m,o^*})^{1-\sigma}}{1-\sigma} - \alpha_f F + (1-\delta)\beta V_f^{m,o}(e_f, \hat{e}_m, \alpha_f, F) \qquad (3.15)
$$

and for a man:

$$
V_m^{m,o}(\hat{e}_f, e_m, \hat{F}) = \frac{(c_m^{m,o^*})^{1-\sigma}}{1-\sigma} + \alpha_m \hat{F} + (1-\delta)\beta V_m^{m,o}(\hat{e}_f, e_m, \hat{F}), \qquad (3.16)
$$

[46]Note that neither the love shocks, l_f and l_m, nor the utility loss and gain, $(-\alpha_f F)$ and $\alpha_m \hat{F}$, of the young couple are included in the maximization problem, since they do not influence the decisions of the married couple.

[47]The policy functions for the consumption are $c_f^{m,y*} = c_f^{m,y}(e_f, e_m, \alpha_f, F, a_{f'}, a_{m'})$ and $c_m^{m,y*} = c_m^{m,y}(e_f, e_m, \alpha_f, F, a_{f'}, a_{m'})$.

with the consumption decision being determined by a bargaining process with fixed weights:[48]

$$\begin{aligned}(c_f^{m,o*}, c_m^{m,o*}) &= \underset{c_f, c_m}{arg\,max} \left\{ \theta_f \frac{(c_f^{m,o})^{1-\sigma}}{1-\sigma} + (1-\theta_f)\frac{(c_m^{m,o})^{1-\sigma}}{1-\sigma} \right\} \\ s.t \quad & \phi(c_f + c_m) \leq w(e_f, f) + w(e_m, m) \text{ and} \\ & F = \hat{F}. \end{aligned} \tag{3.17}$$

3.3.5.3. Marriage Decision

A single is willing to marry a person of the opposite gender if the continuation value of marriage, including the love shock, is higher than the continuation value of staying single: $V_g^{m,y} > V_g^s$. People will marry, $\mathbb{I}_{e_f, e_m, F, l} = 1$, if and only if:

$$\begin{aligned} V_f^{m,y}(e_f, \hat{e}_m, \alpha_f, F, a_{f'}, a_{m'}) &\geq V_f^s(e_f, \alpha_f, F) \text{ and} \\ V_m^{m,y}(\hat{e}_f, e_m, \hat{\alpha}_f, \hat{F}, a_{f'}, a_{m'}) &\geq V_m^s(e_m), \end{aligned} \tag{3.18}$$

otherwise $\mathbb{I}_{e_f, e_m, F, l} = 0$. The minimum love shocks to marry a randomly met person are defined by $l_f^*(e_f, \hat{e}_m, \alpha_f, F, a_{f'}, a_{m'})$=$V_f^s - V_f^{m,y}$ and $l_m^*(\hat{e}_f, e_m, \hat{\alpha}_f, \hat{F}, a_{f'}, a_{m'})$= $V_m^s - V_m^{m,y}$, where the underlying distribution function of these random shocks is normal, $l_g \sim N(\mu_l, \sigma_l^2)$, and the same for both genders and denoted by **L**.[49] Alternatively stated, $\mathbb{I}_{e_f, e_m, F, l} = 1$, if and only if:

$$\begin{aligned} l_f &\geq l_f^*(e_f, \hat{e}_m, \alpha_f, F, a_{f'}, a_{m'}) \text{ and} \\ l_m &\geq l_m^*(\hat{e}_f, e_m, \hat{\alpha}_f, \hat{F}, a_{f'}, a_{m'}), \end{aligned} \tag{3.19}$$

otherwise $\mathbb{I}_{e_f, e_m, F, l} = 0$. With probability δ_{im}, people have to marry the randomly met person of the opposite sex, even if Condition (3.18) is not fulfilled.[50] As mentioned in Section 3.3.4, this allows the model, depending on the value of δ_{im}, to match the empirical observation that almost everyone in Burkina Faso has been married after a certain age (around 40 years).

[48] As for the decision problem (3.14), the utility loss and gain, $(-\alpha_f F)$ and $\alpha_m \hat{F}$, of the old couple do not influence the maximization problem and are thus excluded.

[49] Here, the index function $\mathbb{I}_{e_f, e_m, F, l}$ does not include any ^ notation of the subscripts, since the Condition (3.18) is not formulated from the perspective of a particular gender, but rather from a general perspective. In Equations (3.9) and (3.11), the index functions represent the perspective of a woman ($\mathbb{I}_{e_f, \hat{e}_m, F, l}$) and man ($\mathbb{I}_{\hat{e}_f, e_m, \hat{F}, l}$). The subscript l combines both love shocks (l_f and l_m).

[50] An alternative interpretation would be that with probability δ_{im} the love shocks are huge, such that the couple wants to marry.

3.3.6. Steady-State Equilibrium

The marriage decision is made by comparing the continuation values of staying single with that of being married. Therefore, each individual needs to solve both dynamic programming problems, which requires the knowledge of the distributions of the potential mates in the next period. The initial distribution of singles in the next period consists of those people who did not marry in the last period and are still alive, $\mathbf{S}^{g,old}$, as well as those children who are now grown-ups and enter the marriage market as new singles, $\mathbf{S}^{f'}$ and $\mathbf{S}^{m'}$(grown-up daughters and sons). The parents of these grown-up children have been married T_c periods ago. The distribution of singles before the marriage market of the previous period is denoted by $\mathbf{S}^{g,new}$ and $\mathbf{S}^{g,new,T_c}$ represents the distribution of singles before the marriage market T_c periods ago. The *distribution of female singles* $\mathbf{S}^{f,new'}$ just before the marriage market starts is given by:

$$\mathbf{S}^{f,new'}(e_f, \alpha_f, F) = \mathbf{S}^{f,old}(e_f, \alpha_f, F) + \mathbf{S}^{f'}(e_f, \alpha_f, F) \text{ with} \tag{3.20}$$

$$\begin{aligned} \mathbf{S}^{f,old}(e_f, \alpha_f, F) = {} & (1-\delta) \int_L \int_{A_f} \int_{A_m} \int_{\hat{S}^{m,new}} \int_{S^{f,new}} (1 - \mathbb{I}_{e_f,\hat{e}_m,F,l})(1-\delta_{im}) \\ & d\mathbf{S}^{f,new}(e_f, \alpha_f, F) d\hat{\mathbf{S}}^{m,new}(e_m) d\mathbf{A}_m(a_{m'}) d\mathbf{A}_f(a_{f'}) d\mathbf{L}(l) \end{aligned} \tag{3.21}$$

$$\begin{aligned} \mathbf{S}^{f'}(e_f, \alpha_f, F) = {} & \int_L \int_{A_f} \int_{A_m} \int_{\hat{S}^{m,new,T_c}} \int_{S^{f,new,T_c}} [\mathbb{I}_{e_f,\hat{e}_m,F,l} + (1 - \mathbb{I}_{e_f,\hat{e}_m,F,l})\delta_{im}] \\ & \mathbf{G}_f\{e_{f'}(e_f, \hat{e}_m, \alpha_f, F, a_{f'}, a_{m'}), F'(e_f, \hat{e}_m, \alpha_f, F, a_{f'}, a_{m'}), \alpha_f\} \\ & d\mathbf{S}^{f,new,T_c}(e_f, \alpha_f, F) d\hat{\mathbf{S}}^{m,new,T_c}(e_m) d\mathbf{L}(l) d\mathbf{A}_f(a_{f'}) d\mathbf{A}_m(a_{m'}). \end{aligned} \tag{3.22}$$

The distribution of "old" female singles is characterized by those women who did not marry in the previous period $(1-\mathbb{I}_{e_f,\hat{e}_m,F,l})(1-\delta_{im})$ and are still alive in this period $(1-\delta)$. $\hat{\mathbf{S}}^{m,new}(e_m)$ was the normalized distribution of male singles before the marriage market in the last period.[51] The distribution of grown-up daughters in the marriage market of this period depends on the mating outcome T_c periods ago, the people who married $(\mathbb{I}_{e_f,\hat{e}_m,F,l} + (1 - \mathbb{I}_{e_f,\hat{e}_m,F,l})\delta_{im})$ and the respective education and FGC decisions of those couples.[52] The policy rule of the daughter's education is given by $e_{f'}(e_f, \hat{e}_m, \alpha_f, F, a_{f'}, a_{m'})$ and the policy rule for FGC by $F'(e_f, \hat{e}_m, \alpha_f, Fa_{f'}, a_{m'})$. The characteristics of a grown-up daughter entering the marriage

[51] Equations 3.28 and 3.29 display the normalization of the stationary distributions. The same applies to $\hat{\mathbf{S}}^{m,new}(e_m)$ and $\hat{\mathbf{S}}^{f,new}(e_m)$.

[52] $\hat{\mathbf{S}}^{m,new,T_c}$ is the normalized distribution of male singles before the marriage market T_c periods ago.

market are described by $\mathbf{G}_f\{e_{f'}(e_f, \hat{e}_m, \alpha_f, F, a_{f'}, a_{m'}), F'(e_f, \hat{e}_m, \alpha_f, F, a_{f'}, a_{m'}), \alpha_f\}$.

The *distribution of male singles* entering the marriage market $\mathbf{S}^{m,new'}$ evolves as follows:[53]

$$\mathbf{S}^{m,new'}(e_m) \;=\; \mathbf{S}^{m,old}(e_m) + \mathbf{S}^{m'}(e_m) \text{ with} \tag{3.23}$$

$$\begin{aligned}\mathbf{S}^{m,old}(e_m) \;=\; & (1-\delta)\int_L\int_{A_f}\int_{A_m}\int_{S^f}\int_{S^m}(1-\mathbb{I}_{\hat{e}_f,e_m,\hat{F},l}) \\ & d\mathbf{L}(l)d\mathbf{A}_f(a_{f'})d\mathbf{A}_m(a_{m'})d\hat{\mathbf{S}}^{f,new}(e_f,\alpha_f,F)d\mathbf{S}^{m,new}(e_m)\end{aligned} \tag{3.24}$$

$$\begin{aligned}\mathbf{S}^{m'}(e_m) \;=\; & \int_L\int_{A_f}\int_{A_m}\int_{S^f}\int_{S^m}[\mathbb{I}_{\hat{e}_f,e_m,\hat{F},l} + (1-\mathbb{I}_{\hat{e}_f,e_m,\hat{F},l})\delta_{im}] \\ & \mathbf{G}_m\{e_{m'}(\hat{e}_f,\hat{\alpha}_f,\hat{F},e_m,a_{f'},a_{m'})\} \\ & d\mathbf{L}(l)d\mathbf{A}_f(a_{f'})d\mathbf{A}_m(a_{m'})d\hat{\mathbf{S}}^{f,new,T_c}(e_f,\alpha_f,F)d\mathbf{S}^{m,new,T_c}(e_m).\end{aligned} \tag{3.25}$$

In this model, men are characterized by only one trait, their education, which simplifies the expression of the distribution, although the basic structure remains the same. The characteristic of a grown-up son entering the marriage market is specified by $\mathbf{G}_m\{e_{m'}(e_f, \hat{\alpha}_f, \hat{F}, \hat{e}_m, a_{f'}, a_{m'})\}$, with $e_{m'}(e_f, \hat{\alpha}_f, \hat{F}, \hat{e}_m, a_{f'}, a_{m'})$ being the policy function of the sons' education. Again, the parents have been married T_c periods ago. The normalized distribution of female singles before the marriage market in the previous period is given by $\hat{\mathbf{S}}^{f,new}$.[54]

The *steady-state distributions* for female singles, $\mathbf{S}^f(e_f, \alpha_f, F)$, and male singles, $\mathbf{S}^m(e_m)$, satisfy:

$$\mathbf{S}^f(e_f,\alpha_f,F) \;\equiv\; \mathbf{S}^{f,new'}(e_f,\alpha_f,F) = \mathbf{S}^{f,new}(e_f,\alpha_f,F) = \mathbf{S}^{f,new,T_c}(e_f,\alpha_f,F), \tag{3.26}$$

$$\mathbf{S}^m(e_m) \;\equiv\; \mathbf{S}^{m,new'}(e_m) = \mathbf{S}^{m,new}(e_m) = \mathbf{S}^{m,new,T_c}(e_m), \tag{3.27}$$

such that the inflow and outflow of the single pool does not change its size and composition. The normalized stationary distributions are defined as:

$$\hat{\mathbf{S}}^f(e_f,\alpha_f,F) \;=\; \frac{\mathbf{S}^f(e_f,\alpha_f,F)}{\int d\mathbf{S}^f(e_f,\alpha_f,F)} \text{ and} \tag{3.28}$$

$$\hat{\mathbf{S}}^m(e_m) \;=\; \frac{\mathbf{S}^m(e_m)}{\int \mathbf{dS}^m(e_m)}. \tag{3.29}$$

[53] Denoting the distribution of male singles before the marriage market of the previous period by $\mathbf{S}^{m,new}$.

[54] $\hat{\mathbf{S}}^{f,new,T_c}$ was the normalized distribution of female singles before the marriage market T_c periods ago.

Definition 3.1. A Stationary Matching Equilibrium consists of the value functions for singles, $V_f^s(e_f, \alpha_f, F)$ and $V_m^s(e_m)$, for just married people, $V_f^{m,y}(e_f,\hat{e}_m,\alpha_f,F,a_{f'},a_{m'})$ and $V_m^{m,y}(\hat{e}_f,e_m,\hat{\alpha}_f,\hat{F},a_{f'},a_{m'})$, those longer married, $V_f^{m,o}(e_f,\hat{e}_m,\alpha_f,F)$ and $V_m^{m,o}(\hat{e}_f, e_m, \hat{F})$, policy rules on the education of children, the circumcision of the daughter ($e^*_{f'}$, $e^*_{m'}$ and F'^*) and consumption (c_f^{s*}, c_m^{s*}, $c_f^{m,y*}$, $c_m^{m,y*}$, $c_f^{m,o*}$, $c_m^{m,o*}$), a matching rule for singles, $\mathbb{I}_{e_f,e_m,F,l}$, and stationary distributions of singles, $\mathbf{S}^f(e_f, \alpha_f, F)$ and $\mathbf{S}^m(e_m)$, such that:

1. The value functions $V_f^s(e_f, \alpha_f, F)$ and $V_m^s(e_m)$ solve the single's recursions, defined in Equations (3.8) and (3.10), taking as given the value functions of "young" married people, $V_f^{m,y}(e_f,\hat{e}_m,\alpha_f,F,a_{f'},a_{m'})$ and $V_m^{m,y}(\hat{e}_f,e_m,\hat{\alpha}_f,\hat{F},a_{f'},a_{m'})$, the normalized distributions for singles of the opposite sex, $\hat{\mathbf{S}}^f(e_f, \alpha_f, F)$ and $\hat{\mathbf{S}}^m(e_m)$, defined by Equations (3.28) and (3.29), as well as the matching rule $\mathbb{I}_{e_f,e_m,F,l}$.
2. The value functions of young married people $V_f^{m,y}(e_f,\hat{e}_m,\alpha_f,F,a_{f'},a_{m'})$ and $V_m^{m,y}(\hat{e}_f,e_m,$ $\hat{\alpha}_f,\hat{F},a_{f'},a_{m'})$ solve the recursions (3.12) and (3.13), taken as given the policy functions $c_f^{m,y*}$, $c_m^{m,y*}$, $e^*_{f'}$, $e^*_{m'}$ and F'^*, which solve the cooperative bargaining problem (3.14), the own value functions as a old married person $V_f^{m,o}(e_f,\hat{e}_m,\alpha_f,F)$ and $V_m^{m,o}(\hat{e}_f, e_m, \hat{F})$, the value functions of the children being single, $V_f^s(e^*_{f'},\alpha_{f'},F'^*)$ and $V_m^s(e^*_{m'})$, and newly married, $V_f^{m,y}(e^*_{f'},\hat{e}_{m'},\alpha_{f'},F'^*,a_{f''},a_{m''})$ and $V_m^{m,y}(\hat{e}_{f'},e^*_{m'},\hat{\alpha}_{f'},\hat{F}',a_{f''},a_{m''})$, as well as the normalized distributions for singles, $\hat{\mathbf{S}}^f(e_f, \alpha_f, F)$ and $\hat{\mathbf{S}}^m(e_m)$, and the matching rule, $\mathbb{I}_{e_f,e_m,F,l}$.
3. The value functions of old married people $V_f^{m,o}(e_f,\hat{e}_m,\alpha_f,F)$ and $V_m^{m,o}(\hat{e}_f, e_m, \hat{F})$ solve the recursions (3.15) and (3.16), taking as given the policy functions $c_f^{m,o*}$and $c_m^{m,o*}$, which solve the cooperative bargaining problem (3.17).
4. The matching rule $\mathbb{I}_{e_f,e_m,F,l}$ is in accordance with Equation (3.18), taking as given all value functions.
5. The stationary distributions $\mathbf{S}^f(e_f, \alpha_f, F)$ and $\mathbf{S}^m(e_m)$ solve (3.26) and (3.27), taking all policy rules and the matching rule as given and $\delta_{im} = \delta$.[55]

3.4. Numerical Example: Burkina Faso

In this Section, I discuss the model results for a numerical example that is calibrated to fit the data of Burkina Faso in 2010. While the parameter values are explained in Section 3.4.1,

[55]To ensure a stationary distribution of singles over education and FGC status ($\mathbf{S}^f(e_f, \alpha_f, F)$ and $\mathbf{S}^m(e_m)$), the probability of involuntary marriage (δ_{im}) has to equal the dying probability (δ). Otherwise, the fraction of singles (δ) passing away would not be replaced by young adults, because they do not marry and have no children, and thus the single pool would eventually die out.

the results are presented in Section 3.4.2. The model is solved numerically, since an analytical solution does not exist. Broadly speaking, the value functions are solved using value function iteration and the stationary matching equilibrium is found through iteration on the single distributions. The exact numerical solution algorithm is described in Appendix 3.A.2.

3.4.1. Parameters

There are 18 parameters in the model that have to be determined. They can be roughly categorized into five groups: cost and benefit of FGC, marriage, cost of education, income process and further parameters.

I start with a discussion of those parameters that are set either directly from the data or the literature (see Table 3.6). The period length of the model is one year and adulthood starts at the age of 15, since I only have information on women and men older than 14 years. All circumcised women in Burkina Faso have ever been married at the age of 35 and all non-circumcised women at the age of 40 (see Table 3.A1 in the Appendix). This indicates that the relevant period for women's search in the marriage market lies between the ages of 15 and 39.[56] Therefore, the model covers the period length of 25 years, which leads to a dying probability of $\delta = \frac{1}{25}$. Note that the probability of involuntary marriage δ_{im} has to be the same as the dying probability to ensure a stationary matching equilibrium. While this seems to be a critical assumption upon first glance, it ensures that everyone who survives eventually marries, which in turn corresponds to the data. The discount factor β is chosen to be 0.98, which is a common value in the macroeconomic literature, while the number of education categories is set according to the data: no education, primary, secondary and higher education. In line with Chapter 2, I set the bargaining power of women in Burkina Faso to $\theta_f = 0.4$.[57] The altruism parameter is determined to be $\gamma = 0.5$.[58]

[56] This period is a little longer for men, namely until the age of 45, albeit with a negligible low fraction of men never being married between the ages of 40 and 45. Within the model, this period does not differ between men and women and since the emphasis of the paper is placed on the education and FGC of women, I focus on the information on women.

[57] The value is chosen according to the Social Institution and Gender Index 2009 (OECD) for Burkina Faso, see Section 2.5.2 in Chapter 2.

[58] For comparison, the calibrated altruism parameters in Nishiyama (2000)'s dynamic heterogeneous agent OLG model are 0.5 for a CRRA of 2 and 0.7 for relative a risk aversion level of 1.

Table 3.6.: Predefined Parameters

Description	Parameter	Value	Reference/Source
Dying probability	$\delta = \delta_{im}$	$\frac{1}{25}$	Data (relevant age group: 15-39)
Discount factor	β	0.98	Standard value in the literature
Education categories	e_g	$\{0, 1, 2, 3\}$	Data
Bargaining power	θ_f	0.4	Data (see Chapter 2)
Altruism	γ	0.5	Set freely (see also Nishiyama, 2000)

The remaining 13 parameters are calibrated such that the model moments fit the data of Burkina Faso. Since the moments are indirect, nonlinear functions of the parameters and based on numerical results, the explicit functional form is unknown. A one-to-one mapping of these moments to the parameters does not exist. Nevertheless, depending on the targeted moment, certain parameters will be more important than others. Such a rough assignment of moments to parameters is shown in Table 3.7. The utility cost of FGC for women and the utility gain for men are the main driving forces of the FGC rates. Imagine that men did not value female circumcision at all, then FGC would not be prevalent in equilibrium. Thus, the levels of α_m, μ_{α_f} and σ_{α_f} are crucial in determining the FGC rates.[59] Turning to the marriage rates, which are strongly affected by the love shock; namely, the higher the average love shock μ_l, the higher the likelihood that a person will consent to marriage. The variance of the love shock σ_l^2 introduces additional heterogeneity into the marriage decision. Furthermore, since a married person enjoys economies to scale ϕ in the form of lower consumption good costs, the size of this parameter is also relevant for the marriage decision and hence the marriage rates.[60] The education distributions (of singles and married people) are influenced by the education costs, based on κ_f and κ_m, as well as the ability ($ln(a) = N(0, \sigma_a^2)$). The ability distributions for men and women are assumed to be the same.[61] Indirectly, these parameters also determine the annual income of women and men through human capital. A more direct relation exists between the levels of the minimum income, w_{min}, the returns to education, η, and annual income. The difference between women's and men's income is strongly driven by the gender wage gap ψ. As previously mentioned, all those linkages between parameters and moments are not exclusive. Most of the parameters influence further moments, if only through interactions

[59] The distribution of the FGC costs is discretized for the numerical solution method.
[60] Of course, the predefined probability of "involuntary" marriage δ_{im} also influences the marriage rates.
[61] As the distribution of the FGC costs, the ability distribution is discretized within the numerical solution method.

with other parameters. Moreover, this is also true for the CRRA parameter σ.[62] Table 3.7 also shows the resulting parameter values to fit the data and Appendix 3.A.2 presents the details concerning the calculation of the model moments.

Table 3.7.: Targeted Moments and Calibrated Parameters

Group	Description	Parameter	Values	Targeted Moments
Cost/benefit of FGC	Gain of FGC	α_m	2	FGC rates of married
	Cost of FGC	μ_{α_f}, σ_{α_f}	-0.9, 1.5	and single women
Marriage	Love shock	μ_l, σ_l	20, 30	Marriage rates of un-/
	Marriage gain	ϕ	0.58	circumcised women
Cost of education	Educ. costs	κ_f, κ_m	399.5, 336	Education
	Ability shock	σ_a	0.35	distributions
Income process	Min. income	w_{min}	250	Annual
	Educ. returns	η	126	income
	Wage gap	ψ_f	0.63	data
Further	CRRA para.	σ	1.05	All moments

Note: The targets and data moments are assigned to the respective group of parameters and not to one single parameter. Furthermore, it is possible and quite likely that some parameters also influence other moments.

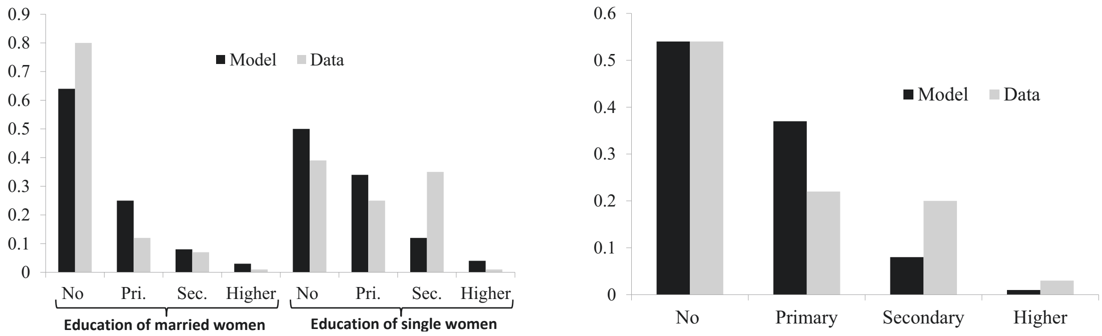
3.4.2. Model vs. Data

The model is able to qualitatively reproduce the empirical facts depicted in Section 3.2. First, uncircumcised and single women are better educated than circumcised and married women. Second, the marriage rate is higher for circumcised than uncircumcised women and a larger fraction of lower than better educated women is married. Finally, better educated parents are less likely to circumcise their daughter. Note that the model moments are calculated in the model steady state after the marriage market has taken place (see Appendix 3.A.2 for details).

In particular, the model fits the FGC and the marriage rates remarkably well (see Table 3.8). The overall FGC rate is 72% in the model vs. 73% in the data. Disaggregation shows that 77% (54%) of the married (single) women are circumcised in the model, compared to 78% (55%) in the data. The marriage rate among all women is perfectly matched with 79%, which is also true for the marriage rates of circumcised (84%) and uncircumcised (65%) women. As

[62] The CRRA parameter influences all moments, e.g. changing the preferences to log-preferences, while keeping the other parameters unchanged, leads to higher FGC rates, higher marriage rates and lower education.

in the data, single women have a higher educational attainment than married women (see also Figure 3.2a). However, for singles, the fraction of non-educated women is 11 percentage points higher in the model compared to the data, while the opposite is true for married women, for whom the fraction of non-educated women is 16 percentage points lower in the model. Hence, the results understate the educational differences between single and married women. The model is better in replicating the data for married women at a higher aggregation level of education, i.e. no or primary education vs. secondary or higher education. The fraction of married women with no or primary education is 89% in the model, only slightly lower than the 92% in the data. While the model perfectly matches the fraction of non-educated men, it somewhat overstates the fraction of primary educated men. This leads to understating the fraction of men with secondary education compared to the data (see Figure 3.2b). Turning to the annual income, the model results are relatively close to the data (831 vs. 861 USD for women and 1326 vs. 1306 USD for men).[63]



(a) Women **(b)** Men

Figure 3.2.: Model Fit – Education Distribution

Changing the emphasis from the targeted moments to some non-targeted moments shows an acceptable fit of the model along these dimensions. Despite absolute values differing, the data patterns are replicated by the model. For example, the model matches the marriage rate within the combined group of non- and primary educated women (80% in the model vs. 84% in the data) fairly well. The fact that the fit of the education distribution needs improvement is reflected in the deviating marriage rates of the secondary and higher educated women (45% in the model vs. 72% in the data). The picture for the FGC rates in the two more

[63] The income data differs to some extent form the one in Chapter 2. Here the estimated earned income is given in PPP USD for the year 2006 provided by OECD Gender, Institutions and Development Database 2009. The numbers in Chapter 2 are calculated based on the GDP (current USD) in 2010 and the population share within the income deciles.

Table 3.8.: Model Fit – Targeted Moments

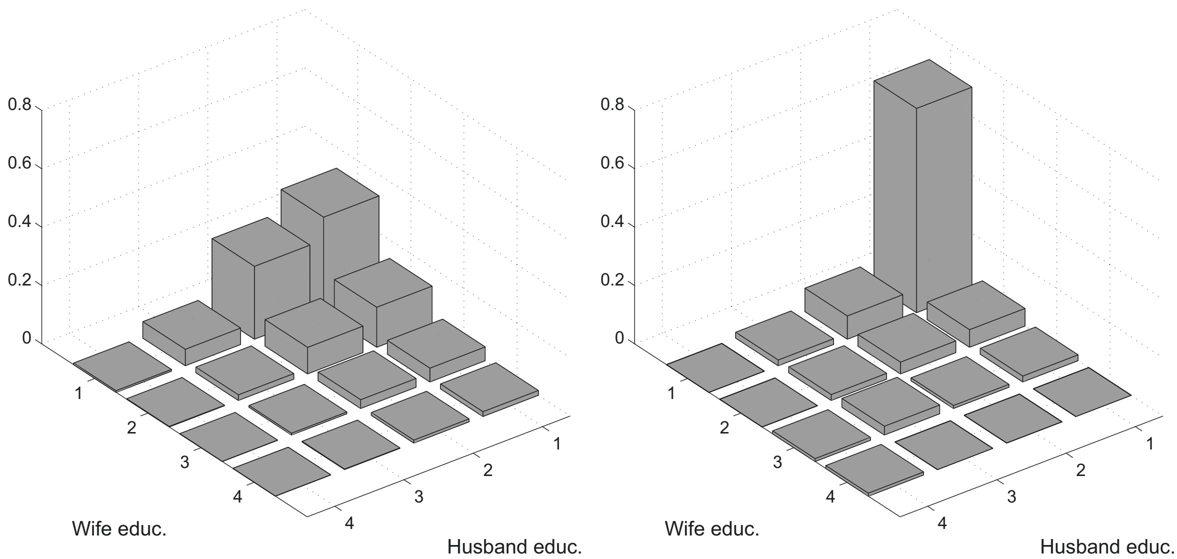
Description	Model Moment	Data Moment
FGC rate:		
Married women	0.77	0.78
Single women	0.54	0.55
Marriage rate:		
Circumcised women	0.84	0.84
Uncircumcised women	0.65	0.65
Education distribution (no, primary, secondary, higher):		
Married women	0.64, 0.25, 0.08, 0.03	0.80, 0.12, 0.07, 0.01
Single women	0.50, 0.34, 0.12, 0.04	0.39, 0.25, 0.35, 0.01
Men	0.54, 0.37, 0.08, 0.01	0.54, 0.22, 0.20, 0.03
Annual income:		
Women	831	861
Men	1326	1306

Source: Income data are taken from the OECD Gender, Institutions and Development Database 2009 and expressed in PPP USD. All other data moments are based on the Burkina Faso DHS 2010. The education distribution shows the fractions of people with no, primary, secondary and higher education.

broadly defined education groups is similar. While the model generates a FGC rate of 78% (31%) for the group of non- or primary (secondary or higher) educated, the corresponding rate in the data is 77% (54%). From a different perspective, 95% (70%) of the circumcised (uncircumcised) women are non- or primary educated in the model compared to 90% (76%) in the data.[64] Furthermore, the model delivers an imperfect assortative mating with respect to the education level, which is in line with the data. Figure 3.3 contrasts the mating outcome in the model with that in the data. In both cases, the wedlocks between women and men with no education comprise the largest part of all marriages. However, this fraction is much smaller in the model, leaving room for quite a few marriages between either a non-educated wife and primary educated husband or the opposite constellation. Last but not least, there is one caveat with respect to the education distribution of the men. Even though the overall education distribution is relatively well matched, the differential education patterns between single and married men do not fit (see Figure 3.A3 in Appendix 3.A.3). In contrast to the data, married men are slightly better educated than singles in the model. This stems from the

[64] Thus, 5% (30%) of the circumcised (uncircumcised) women are secondary or higher educated in the model, compared to 10% (24%) in the data.

fact that in the model the better educated men are more attractive in the marriage market, and thus have a higher likelihood of getting married.



(a) Model **(b)** Data

Notes: The figures show the distribution of couples, where a bar represents the fraction of couples with the respective educational attainments of the wife and the husband.

Figure 3.3.: Mating Outcome

To summarize, the model is able to replicate the qualitative patterns in the data. Specifically, the most important moments, such as FGC rates of married and single women, are quantitatively matched.[65]

Furthermore, education and FGC are two competing investments for the daughter. While the benefit of FGC lies in the better marriage market prospects, the benefit of female education can have two margins. Since women with better education earn more, they first have the opportunity to live on their own and thus can be also more chary about their groom. Put differently, education improves the outside options to marriage and thus educated women are less likely to be married ("independence" margin). Second, higher income makes a woman more attractive for a man, thus increasing her marriage market prospects ("marriage" margin). Which margin dominates remains open and strongly depends on the equilibrium effects. However, the following policy experiment will provide some insights, suggesting that the "marriage" margin seems to be more important.

[65] However, the calibration of the model could be improved, since some of the moments are not quantitatively matched.

3.5. Policy Experiment: Female Education Subsidy

The question of whether the introduction of female education subsidies could reduce FGC rates in an economy arises almost naturally from the empirical and theoretical results. Of course, this is not the only possible policy intervention to reduce FGC rates, as is already evident from the policy discussion in Chapter 2. However, quantifying the effect of an education subsidy for girls on the FGC rate will provide valuable insights for policy makers.

The policy experiment is based on a steady state comparison and is translated into the model as a reduction of the education cost parameter κ_f.[66] This affects the budget constraint of a young married couple, altering Equation (3.6) to:

$$\phi(c_f + c_m) + \frac{(1-s_{e_f})\kappa_f}{a_{f'}} e_{f'} + \frac{\kappa_m}{a_{m'}} e_{m'} \quad \leq \quad w(e_f, f) + w(e_m, m), \tag{3.30}$$

where $s_{e_f} \in (0,1)$ represents the subsidy as a fraction of the education costs. The financing of the policy intervention is not incorporated into the analysis.[67]

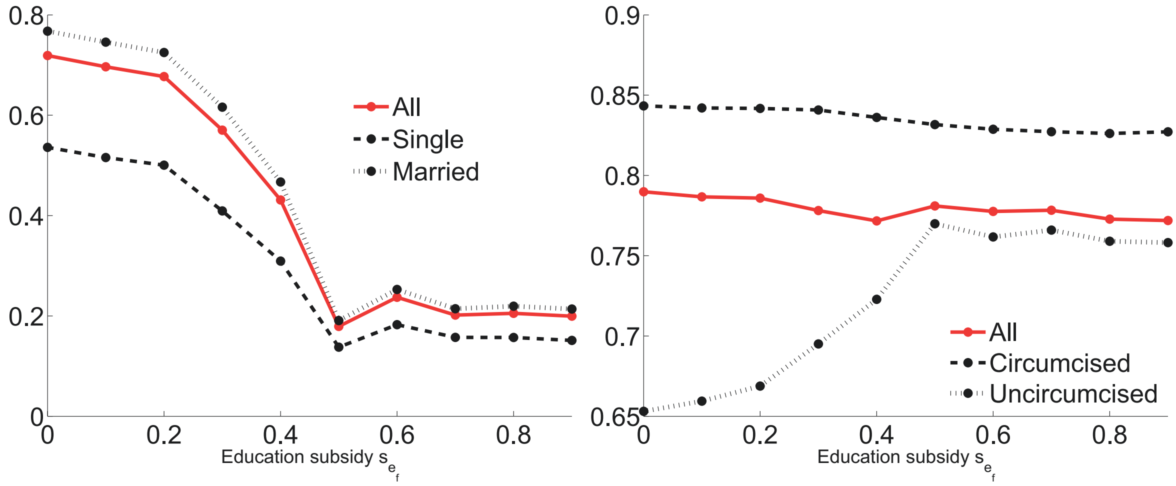
Figure 3.4 shows the steady state FGC and marriage rates for different education subsidies, i.e. $s_{e_f} \in \{0,\ 0.1,\ 0.2,\ ...,\ 0.8,\ 0.9\}$.[68] The starting point is the calibrated version of the model with no subsidy, $s_{e_f} = 0$. Then the education costs for women are gradually reduced. The most important thing to note is that for low subsidy rates the FGC rate decreases with the level of subsidy. However, there seems to be a lower bound of the FGC rate, around 20%, which it does not fall below. Second, while the marriage rate for circumcised women only slightly decreases, for uncircumcised women it first increases and subsequently evens out at higher subsidy rates. The overall marriage rate only registers a very small downtrend. An unsurprising response is observed for the educational attainment (see Figure 3.5). As the education cost for females decreases through higher subsidies, women become better educated. Indeed, the fraction of higher educated women increases at the expense of the fraction of non-educated women, which decreases, while the fraction of primary educated women is also reduced. For lower subsidy rates, the fraction of women with secondary education increases, but since almost everyone can afford higher education for the daughter at high enough subsidy

[66] The transition path between the steady states is not considered here and is left for future research.

[67] One possibility would be to introduce a lump-sum tax to finance the education subsidy, although I presume that this would not significantly alter the results.

[68] Note that the figures are not based on a continuous measure of education subsidies and that only 10 policies with different levels of subsidies are carried out here. The lines only connect the results and do not allow for any statements concerning differentiability or continuity. Numerical inaccuracy could also lead to larger jumps.

rates, this fraction drops again.



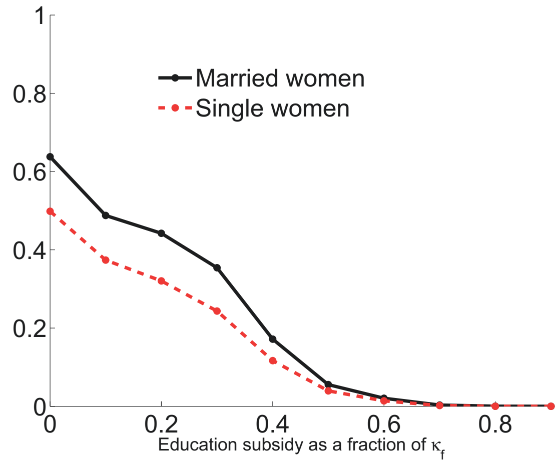
(a) FGC Rates **(b)** Marriage Rates

Figure 3.4.: FGC Rates and Marriage Rates for Different Education Subsidies

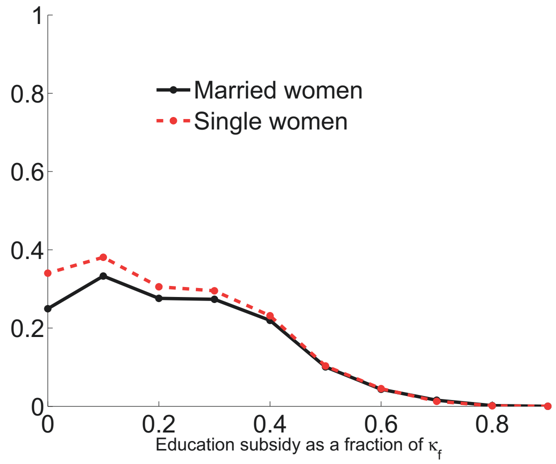
If female education becomes cheaper, some parents refrain from circumcising their daughters and invest more in their education. For subsidy rates below 60%, they invest at the same time less into the education of their sons (see Figure 3.A4 in the Appendix 3.A.3). The negative correlation between female education and FGC further supports the hypothesis of two competing investments. Turning to the two dimensions of the education investment, the fact that the marriage rate for uncircumcised women increases with the education subsidy (for $s_{e_f} \leq 0.5$) points towards the "marriage" margin. The education level of uncircumcised women makes them more attractive for marriage. However, as education levels converge across women, the FGC status is the only characteristic in which women differ. Since men prefer circumcised to uncircumcised women, those daughters with a low cost of FGC are circumcised to improve their marriage market prospects. Therefore, the marriage rate among circumcised women is still slightly higher. The "independence" margin of education investments, i.e. better education offers the opportunity to earn one's own living, seems to play a minor role in equilibrium. This can be seen in the only slightly reduced marriage rate of circumcised women. However, this is partly driven by the positive probability of involuntary marriage, $\delta_{im} = 0.04$, which is the same for all subsidy rates.

The policy's effect on welfare of different groups is displayed in Figure 3.6. The welfare measure is defined as the average over all individual value-functions of the group members, e.g. Figure 3.6a shows the welfare of all women and men for the different subsidy rates.[69] The

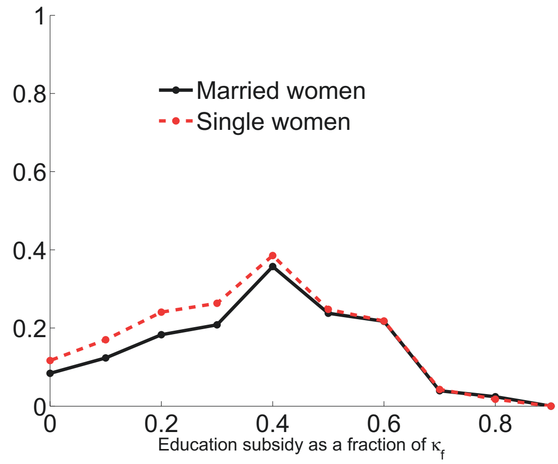
[69]The distributions of single and married people are derived in the model. Thus, I know exactly how many



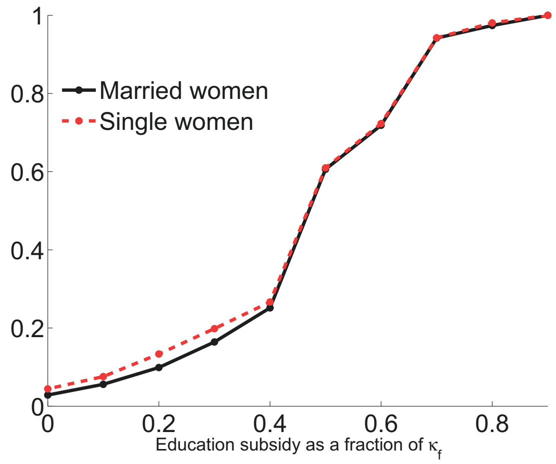
(a) Fraction of Non-Educated Women



(b) Fraction of Women with Primary Education



(c) Fraction of Women with Secondary Education



(d) Fraction of Women with Higher Education

Figure 3.5.: Female Education for Different Education Subsidies

policy leads to a decrease in men's welfare for each subsidy rate compared to the starting point. For subsidy rates up to 50%, this decrease increases with the level of subsidy; however, for higher subsidy rates the welfare of all men flattens with a slight upward trend. For women, the welfare slightly increases for most subsidy rates, but for $s_{e_f} \in \{0.1, 0.3, 0.4\}$ there are small decreases of women's welfare.[70] Looking at the welfare of circumcised and

people and couples have certain characteristics and value functions. Therefore, a certain value function can be weighted by the fraction of people for whom it applies, whereby all value functions of the analyzed group can then be aggregated. Such a group could be "all single and circumcised women", for whom the value functions differ with education level and FGC utility cost. Since the fractions of women who have a certain education level and FGC cost are known, the value functions are weighted by these fractions and then aggregated. This procedure is the same for all other potential groups: value functions from the lowest level of aggregation (for all possible state variables and there combination) are weighted and then added up to the aggregation level of the analyzed group. For example, the weighted sum of the value functions of all women is thus the welfare of all women.

[70] The group of men and women can be further divided into married vs. single men and women, which is done in Figure 3.A5 in Appendix 3.A.3. The patterns are roughly the same.

uncircumcised women separately shows that the subsidy has a strong positive effect on the welfare of uncircumcised women (see Figure 3.6b). In contrast, the effect on the average welfare of circumcised women is relatively small.[71] For such a comparison, it is important to remember that the fraction of uncircumcised women increases with the subsidy rate and thus the average welfare of uncircumcised women represents a larger fraction of women. Such a size effect is also at work for other groups, i.e. the number of people within a certain group might change with the subsidy level, since the composition of the whole population changes. Figures 3.6c and 3.6d present the welfare at an even more disaggregated level, i.e. circumcised vs. uncircumcised single women and circumcised vs. uncircumcised married women. In the group of single women, the welfare increase is steeper for uncircumcised than circumcised women. The opposite is true in the group of married women, among whom the welfare increase is lower for uncircumcised than circumcised women.

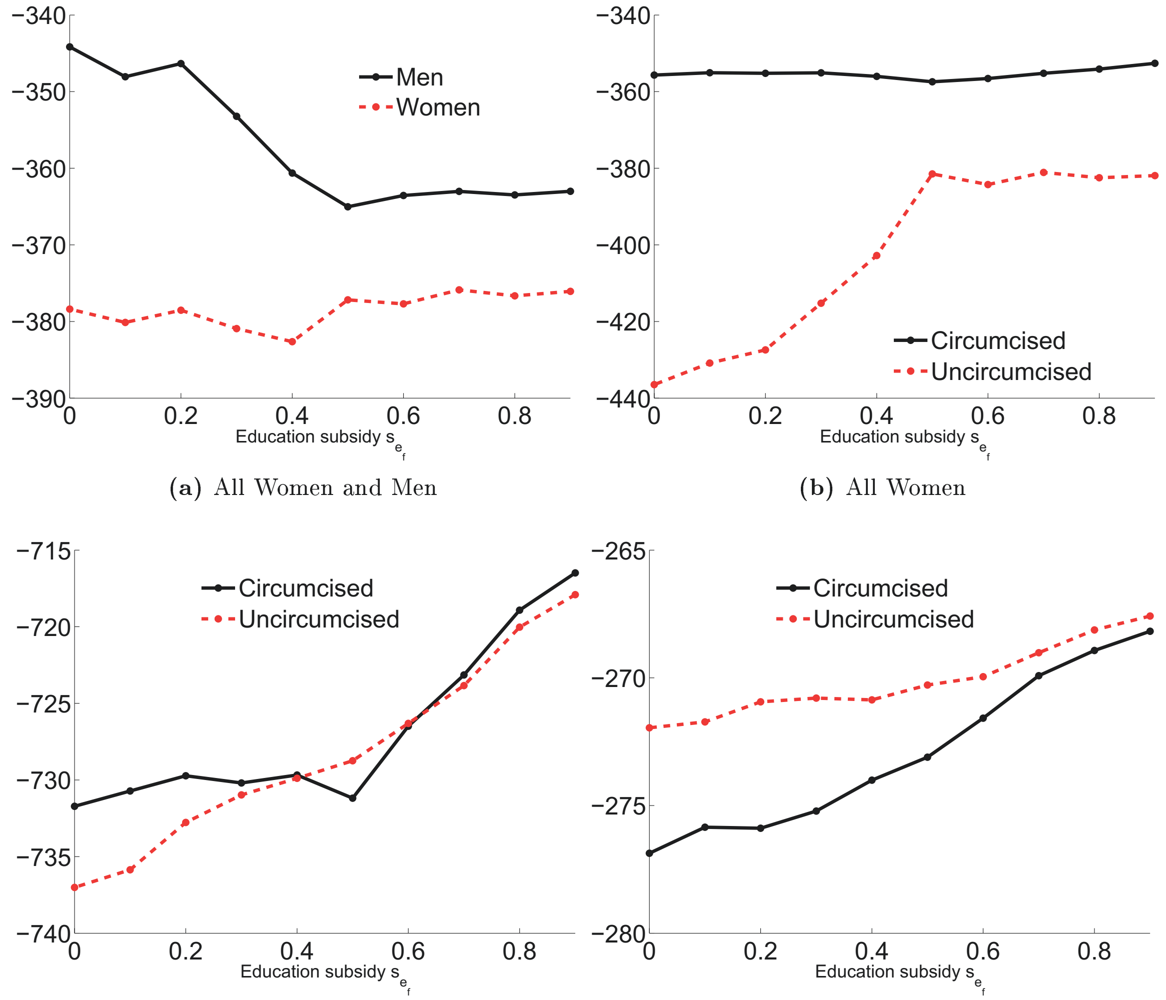
Overall, women are the winners of this policy intervention, partly at the expense of men, while the welfare gain is stronger for uncircumcised than circumcised women. For subsidy rates below 50%, the welfare of men strongly falls, since the FGC rate decreases and the fraction of non-educated men goes up (see Figure 3.A4 in the Appendix 3.A.3). For higher subsidy rates, the FGC level does not further decrease, while the fraction of men with primary and secondary education increases, as does the eduction level of all women (particularly the wives). This trend leads to a slight recovery of men's welfare, even though the levels remain below the welfare of the starting point.

To analyze the policy effects in greater detail, I focus on one level of the education subsidy, e.g. $s_{e_f} = 0.5$. A 50% reduction of the education costs for women results in a lower FGC rate of 18%, which is a decrease of 54 percentage points (or a decrease of 75%).[72] However, I wish to stress the pattern and direction of the changes rather than the exact numbers. Table 3.9 shows the results of a decomposition exercise for this subsidy rate. In a first step, I introduce the subsidy and let people re-optimize, but under the constraint that the FGC decision rule remains unchanged, i.e. the FGC policy function is fixed. In a second step, people can also adjust their FGC decision, although the marriage probabilities are the same, i.e. the minimum love shock for a certain couple is fixed. Again, I only consider the steady state of the economy for both steps.

A small decrease in FGC rates can already be observed for the setup in which the FGC policy

[71] While the axis scale makes it hard see, the welfare of circumcised women is higher than in the initial situation for almost all subsidy rates, except for 0.4, 0.5 and 0.6.

[72] Further decomposition for the subsidy rates 0.3 and 0.4 are shown in Table 3.A14 in Appendix 3.A.3.



(a) All Women and Men

(b) All Women

(c) All Single Women

(d) All Married Women

Notes: These plots display the average welfare of the respective groups.

Figure 3.6.: Average Welfare

function is fixed. The education subsidy reduces the education costs for daughters; therefore, parents re-optimize and invest more into their daughter's education, which leads to a better overall education of women. The altered education distribution leads to a small reduction of FGC rates, since better educated, and thus better earning, mothers tend to circumcise their daughters less (according to the initial FGC policy rule). In this steady state, the FGC rate is only indirectly influenced, namely through the better education of the mothers. The marriage rate for uncircumcised women is slightly higher than at the starting point (no policy), since uncircumcised women are now better educated and thus more attractive for men.

The reduction of the FGC rate is higher for the second step, where the minimum love shock and thus the marriage probability are kept at their initial levels. Here, parents can not only re-optimize with respect to the education of their children, but also with respect to the FGC of their daughter. As in the first step, women are better educated, but parents also circumcise their daughters less since FGC is now relatively more expensive in terms of utility costs compared to the costs of education.

The strongest effect on the FGC rate is observed under the full policy, when parents can re-optimize freely and marriages can adjust. Thus, general equilibrium (GE) effects in the marriage market are the driving forces, highlighting the importance of accounting for them when conducting policy analysis. Furthermore, these results support the story of competing investments. Parents invest more in the education of the daughter and less in FGC. Higher education also makes uncircumcised women more attractive for men, which is reflected in the higher marriage rate of uncircumcised women.

Table 3.9.: Decomposition of the Effects of the Female Education Subsidy Policy

		Subsidy ($s_{e_f} = 0.5$)		
	No Policy	Fix FGC decision rule	Fix marriage probability	Full Policy
FGC rate:				
All	0.72	0.68	0.57	0.18
Married	0.77	0.72	0.62	0.19
Single	0.54	0.52	0.42	0.14
Marriage rate of women:				
All	0.79	0.79	0.77	0.78
Circumcised	0.84	0.84	0.83	0.83
Uncircumcised	0.65	0.68	0.69	0.77
Education of married women:				
No	0.64	0.13	0.11	0.05
Primary	0.25	0.11	0.11	0.10
Secondary	0.08	0.24	0.23	0.24
Higher	0.03	0.52	0.55	0.61
Education of single women:				
No	0.50	0.08	0.07	0.04
Primary	0.34	0.10	0.10	0.10
Secondary	0.12	0.22	0.22	0.25
Higher	0.04	0.60	0.61	0.61

In summary, it can be stated that subsidies to female education in the numerical example of Burkina Faso can reduce FGC rates, but only down to a certain rate. The winners of this policy are women. Additional policy interventions would be needed to completely eradicate FGC. Furthermore, the "marriage" margin of education investments, i.e. higher education makes women more attractive to men, seems to dominate in equilibrium. However, what remains open is the trade-off between the cost and benefit of this policy, since I abstracted from making any financing considerations.

3.6. Conclusion

In this chapter, I have provided within country-evidence concerning the interaction of education, FGC and marriage for Burkina Faso. First of all, I find that uncircumcised women as well as single women are better educated than circumcised and married women. Second, circumcised and non-educated women are more likely to be married than their counterparts. Furthermore, better educated parents are less likely to circumcise their daughters.

To replicate these empirical patterns and answer the question of whether an education subsidy to women could reduce FGC rates, I present a dynamic model with an equilibrium search on the marriage market. Parents decide upon the circumcision of their daughter and the level of education of their children. While FGC improves the marriage market prospects of the daughter, education increases the children's income later in life. For women, higher income through better education provides them with the opportunity to live on their own (better outside option to the marriage, "investment" margin), as well as making them more attractive for marriage ("marriage" margin).

The calibrated version of the model is able to qualitatively replicate the observed empirical patterns between women's education, marriage and FGC. It quantitatively matches the FGC and marriage rates of Burkina Faso in 2010.

The policy experiment shows novel results, namely that a decrease in the education cost of girls leads to higher educational attainment, as well as a decrease in the overall FGC rate. However, the FGC does not fall below a certain lower bound (here 20%). At high enough subsidy rates, everyone can afford high education of the daughter. Thus, almost all women are highly educated and FGC status reflects the only dimension in which women may differ. Since men prefer circumcised to uncircumcised women, FGC increases the marriage market prospects and parents will still circumcise their daughter if the cost of FGC is low enough. Furthermore, the policy experiment sheds light on the two dimensions of the education investment, suggesting that the "marriage" margin seems to play a more important role in equilibrium than the "investment" margin. The welfare analysis of different subsidy levels shows that women benefit from this policy. For subsidy rates below 50%, the welfare of men decreases with the level of female education subsidy rates. However, it slightly increases again for higher subsidy rates, while remaining below the welfare level of the starting point.

The limited number of economic papers on female genital cutting highlights that there are many different directions to explore in future research. This paper aims to provide a tractable framework to analyze policy interventions and discuss the tradition and its interplay with other economic variables/outcomes. Nonetheless, given the vast number of open questions, I only focus on possible research avenues resulting directly from this paper. First of all, the financing part of the education subsidy should be incorporated into the analysis. It could be financed through (lump-sum) taxes on the population, which might affect the welfare analysis. Second, including the transition paths between two steady states in the analysis would be very interesting and important. During the transition, the welfare impact could be very different from the current findings. Third, since an education subsidy is unable to completely eradicate FGC, additional policies, e.g. penalty fees, should be considered and analyzed, which can be achieved within this model. One can even analyze the effects and the interactions of policy packages, i.e. a combination of different policies at the same time. The proposed framework can also be employed to analyze the effect of differing FGC valuation by education. For example, Sakeah et al. (2006) find evidence from Ghana suggesting that illiterate men and those with only primary schooling have stronger preferences for circumcised women. In such an environment, an interesting question would be whether education subsidies to men could also reduce FGC rates.

3.A. Appendix

3.A.1. Further Evidence from Burkina Faso

This section presents further evidence from Burkina Faso, including summary statistics, the estimates for the controls of the regressions in Section 3.2.2 and robustness checks.

Table 3.A1.: Fraction of Ever Married People

	Women				**Men**	
Age	**FGC**		**no FGC**			
group	**Fract.**	**Total**	**Fract.**	**Total**	**Fract.**	**Total**
15-19	0.37	1866	0.26	1459	0.02	1499
20-24	0.87	2260	0.74	971	0.31	1018
25-29	0.97	2288	0.93	647	0.73	918
30-34	0.98	2135	0.99	444	0.92	939
35-39	1.00	1696	0.99	286	0.96	804
40-44	1.00	1466	1.00	191	0.99	712
45-49	1.00	1186	1.00	136	1.00	610
50-54	.	0	.	0	1.00	463
55-59	.	0	.	0	1.00	344
All ages	0.87	12897	0.68	4134	0.66	7307

Source: DHS 2010 Burkina Faso, own calculations. Observations are weighted by individual sampling weights. The fractions of ever married women are significantly different at the 1% significance level for circumcised and uncircumcised women in the age groups 15-19, 20-24 and 25-29. The fractions are tested on equality based on a two-sample t-test with sampling weights.

Table 3.A2.: Summary Statistics - FGC Rates (1)

	FGC rates of women (15-39 years)		Women with circumcised daughters	
	Mean	Total	Mean	Total
Total	0.7344	14052	0.1632	10716
Wealth				
poorest quintile	0.7436	2181	0.2072	2003
poorer quintile	0.7603	2495	0.1905	2130
middle quintile	0.7597	2697	0.1660	2208
richer quintile	0.7763	2941	0.1569	2343
richest quintile	0.6598	3738	0.0893	2032
Education (wife)				
no education	0.7841	9784	0.1813	8915
primary	0.6808	2175	0.0972	1166
secondary	0.5435	1986	0.0221	597
higher	0.4886	100	0.0000	36
Education (husband)				
no education	0.8055	8321	0.1826	8583
primary	0.7399	1456	0.1165	1198
secondary	0.6831	1001	0.0297	694
higher	0.5880	117	0.0106	76
Marital status				
never married	0.5535	3090	0.0314	109
ever married	0.7824	10962	0.1643	10607

Source: DHS 2010 Burkina Faso, own calculations. Observations are weighted by individual sampling weights. The FGC rates for different marital status and educational attainment of women are tested on equality based on a two-sample t-test with sampling weights. FGC rates between ever and never married women are significantly different at the 1% level. This is also the case for all differences in FGC rates between education groups. Only the difference in FGC rates between secondary and higher educated women is not significant.

Table 3.A3.: Summary Statistics - FGC Rates (2)

	FGC rates of women (15-39 years)		**Women with circumcised daughters**	
	Mean	Total	Mean	Total
Religion				
no religion	0.5974	110	0.2006	78
muslim	0.7967	8509	0.1892	6515
catholic	0.6265	3434	0.0995	2425
protestant	0.5774	914	0.0856	615
traditionnal/animist	0.7126	1056	0.1857	1044
Ethnicity				
bobo	0.6488	534	0.1633	395
dioula	0.6659	122	0.1589	102
fulfuldé/peul	0.8299	1112	0.2842	909
gourmatché	0.6178	909	0.1054	701
gourounsi	0.5791	666	0.1175	476
lobi	0.7970	484	0.1833	411
mossi	0.7636	7359	0.1437	5537
sénoufo	0.8540	750	0.2340	595
touareg / bella	0.2090	211	0.0464	154
dagara	0.6213	429	0.1893	342
bissa	0.8072	567	0.1898	401
others	0.7226	885	0.1994	671
Region				
boucle de mouhoun	0.6677	1073	0.1775	940
cascades	0.7971	909	0.1121	712
centre	0.6337	1436	0.0522	801
centre-est	0.8827	1064	0.1954	796
centre-nord	0.8468	951	0.1381	779
centre-ouest	0.5219	1232	0.1146	949
centre-sud	0.6335	943	0.1009	753
est	0.6726	1156	0.1091	926
hauts basins	0.8099	1287	0.2388	922
nord	0.8653	1081	0.2302	825
plateau central	0.8537	1019	0.1367	777
sahel	0.7756	944	0.2901	755
sud-ouest	0.7425	957	0.1926	781
urban	0.6603	4593	0.0838	2689
rural	0.7635	9459	0.1835	8027

Source: DHS 2010 Burkina Faso, own calculations. Observations are weighted by individual sampling weights.

Table 3.A4.: Summary Statistics - Circumcised vs. Uncircumcised Women

	Circumcised (15-39 years)		**Uncircumcised (15-39 years)**	
	Mean	Total	Mean	Total
Current age	26.59	10245	23.17	3807
Ever married	0.84	10245	0.65	3807
Age at first cohabitation	17.32	8601	17.51	2361
Circumcised daughters	0.18	6392	0.01	1555
Age of circumcision	3.49	12842		
Education				
no education	0.76		0.58	
primary	0.14		0.18	
secondary	0.10		0.22	
higher	0.01		0.02	
		10240		3805
Wealth				
poorest quintile	0.17		0.16	
poorer quintile	0.19		0.17	
middle quintile	0.20		0.17	
richer quintile	0.21		0.17	
richest quintile	0.23		0.33	
		10245		3807
Form of circumcision				
cut, no flesh removed	0.16			
cut, flesh removed	0.77			
sewn closed	0.01			
don't know/missing	0.06			
		10245		
Circumcision performed by				
health professional	0.00			
traditional circumciser	0.97			
don't know	0.03			
		10245		

Source: DHS 2010 Burkina Faso, own calculations. Observations are weighted by individual sampling weights. The differences between circumcised and uncircumcised women are signficant at the 1% level. Only the difference in the ages at first cohabitation is significant at the 5% level. The means are tested on equality based on a two-sample t-test with sampling weights.

Table 3.A5.: Education Distributions of Women - Different Age Groups

	Ever Married			Singles				no
Education	FGC	no FGC	both	FGC	no FGC	both	**FGC**	**FGC**
no education	0.83	0.74	0.81	0.46	0.29	0.38	0.78	0.60
primary	0.11	0.13	0.11	0.24	0.25	0.25	0.12	0.17
secondary	0.06	0.10	0.06	0.29	0.44	0.35	0.08	0.21
higher	0.01	0.02	0.01	0.01	0.02	0.02	0.01	0.02
Total	11244	2688	13932	1648	1444	3092	12892	4132

Source: DHS 2010 Burkina Faso, own calculations. Observations are weighted by individual sampling weights. All women aged 15-49 years are considered.

(a) All Women

	Ever Married			Singles				no
Education	FGC	no FGC	both	FGC	no FGC	both	**FGC**	**FGC**
no education	0.80	0.73	0.78	0.47	0.29	0.39	0.72	0.55
primary	0.13	0.15	0.14	0.24	0.25	0.25	0.16	0.19
secondary	0.06	0.11	0.07	0.28	0.43	0.35	0.11	0.24
higher	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.02
Total	5444	1799	7243	1606	1439	3045	7050	3238

Source: DHS 2010 Burkina Faso, own calculations. Observations are weighted by individual sampling weights. Only women of ages 15 to 30 years.

(b) Women aged 15-30 years

	Ever Married			Singles				no
Education	FGC	no FGC	both	FGC	no FGC	both	**FGC**	**FGC**
no education	0.80	0.71	0.77	0.48	0.30	0.40	0.70	0.50
primary	0.13	0.16	0.14	0.24	0.25	0.25	0.17	0.20
secondary	0.06	0.12	0.08	0.27	0.44	0.35	0.13	0.28
higher	0.00	0.01	0.01	0.00	0.02	0.01	0.00	0.01
Total	3129	1226	4355	1548	1397	2945	4677	2623

Source: DHS 2010 Burkina Faso, own calculations. Observations are weighted by individual sampling weights. Only women of ages 15 to 25 years.

(c) Women aged 15-25 years

Note: The differences within the aggregated groups of circumcised (FGC) vs. uncircumcised (no FGC) as well as ever married vs. single women are significant at the 1% level. Only the differences in higher education between ever married and single women are significant at the 5% (in Table (a)), 10% (in Table (b)) level or even insignificant (in Table (c)). The fractions are tested on equality based on a two-sample t-test with sampling weights.

Table 3.A6.: Joint Distribution of Education and FGC of Women - Different Age Groups

	Ever Married		**Singles**	
Education	FGC	no FGC	FGC	no FGC
no education	0.67	0.15	0.25	0.13
primary	0.09	0.03	0.13	0.11
secondary	0.04	0.02	0.16	0.19
higher	0.00	0.00	0.01	0.01
Total	13932		3092	
	11244	2688	1648	1444

Source: DHS 2010 Burkina Faso, own calculations. Observations are weighted by individual sampling weights.

(a) All Women

	Ever Married		**Singles**	
Education	FGC	no FGC	FGC	no FGC
no education	0.60	0.18	0.26	0.13
primary	0.10	0.04	0.13	0.11
secondary	0.05	0.03	0.15	0.20
higher	0.00	0.00	0.01	0.01
Total	7243		3045	
	5444	1799	1606	1439

Source: DHS 2010 Burkina Faso, own calculations. Observations are weighted by individual sampling weights. Only women of ages 15 to 30 years.

(b) Women aged 15-30 years

	Ever Married		**Singles**	
Education	FGC	no FGC	FGC	no FGC
no education	0.57	0.20	0.26	0.13
primary	0.10	0.04	0.13	0.11
secondary	0.05	0.03	0.15	0.20
higher	0.00	0.00	0.00	0.01
Total	4355		2945	
	3129	1226	1548	1397

Source: DHS 2010 Burkina Faso, own calculations. Observations are weighted by individual sampling weights. Only women of ages 15 to 25 years.

(c) Women aged 15-25 years

Note: The differences between ever married and single women are signficant at the 1% level. For the groups of higher educated uncircumcised women (and non-educated uncircumcised women in Table (a)) the differences are only significant at the 5% level. For higher educated circumcised women there are no significant differences. The fractions are tested on equality based on a two-sample t-test with sampling weights.

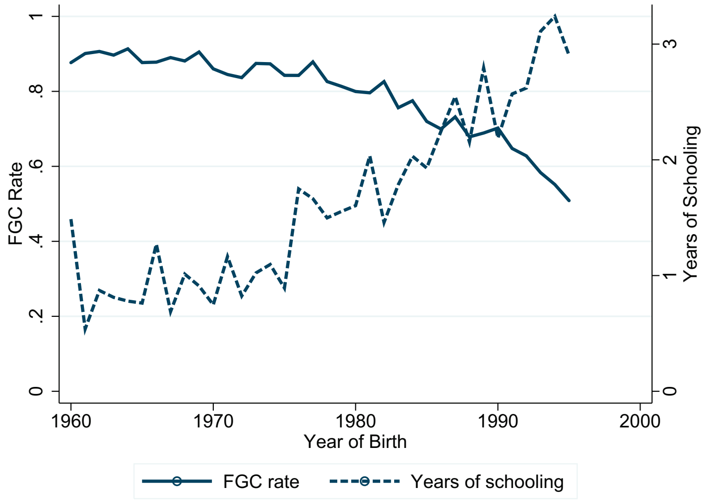


Figure 3.A1.: Education and FGC Rates by Cohorts

Table 3.A7.: Education Distribution of Men

	Ever Married	**Singles**	**All**
no education	0.65	0.43	0.54
primary	0.20	0.25	0.22
secondary	0.13	0.29	0.20
higher	0.03	0.03	0.03
Total	2580	2597	5177

Source: DHS 2010 Burkina Faso, own calculations. Observations are weighted by individual smaple weights. Men aged 15 to 39 years. The differences between ever married and single men are significant at the 1% level, except for the higher educated group with no significant difference. The fractions are tested on equality based on a two-sample t-test with sampling weights.

Table 3.A8.: Education of Women (All Controls)

	Daughters		All	
Circumcised before age 7	-0.668***	(0.110)	-0.586***	(0.0488)
Number of older siblings	0.00266	(0.0222)	-0.00430	(0.00778)
Age	0.0486**	(0.0193)	-0.0660***	(0.00256)
Bobo	0.0113	(0.291)	-0.142	(0.119)
Dioula	-1.744***	(0.593)	0.0791	(0.217)
Fulani	-1.021***	(0.388)	-1.548***	(0.130)
Gurmanche	-0.973**	(0.429)	-1.290***	(0.150)
Gurunsi	-0.406	(0.350)	-0.397***	(0.114)
Lobi	-0.280	(0.490)	-0.144	(0.155)
Mossi	-0.546**	(0.243)	-0.693***	(0.0799)
Senufo	0.104	(0.322)	0.0129	(0.119)
Touareg	-1.398***	(0.535)	-2.440***	(0.261)
Dagara	-0.400	(0.422)	-0.816***	(0.146)
Bissa	-0.525	(0.328)	-0.240*	(0.134)
Muslim	0.486	(0.566)	1.327***	(0.296)
Catholic	1.100*	(0.565)	2.184***	(0.295)
Protestant	1.315**	(0.575)	2.152***	(0.302)
Animist	0.245	(0.601)	-0.0265	(0.317)
Poorer	0.151	(0.193)		
Middle	0.405**	(0.186)		
Richer	1.042***	(0.184)		
Richest	1.935***	(0.219)		
Urban	0.952***	(0.146)		
Cascades	-0.0802	(0.327)		
Centre	0.825***	(0.273)		
Centre-Est	0.749***	(0.290)		
Centre-Nord	0.328	(0.304)		
Centre-Ouest	0.216	(0.271)		
Centre-Sud	1.077***	(0.313)		
Est	0.426	(0.401)		
Hauts-Bassins	0.0250	(0.242)		
Nord	0.505*	(0.276)		
Plateau-Central	0.387	(0.292)		
Sahel	0.670*	(0.397)		
Sud-Ouest	0.0660	(0.359)		
Constant (cut 1)	1.800**	(0.701)	-0.349	(0.310)
Constant (cut 2)	3.239***	(0.701)	0.717**	(0.310)
Constant (cut 3)	8.005***	(0.716)	3.974***	(0.324)
Observations	2008		13376	
Pseudo R^2	0.201		0.116	

Source: DHS, own calculations. Notes: Ordered logit model with estimated coefficients. Standard errors are in parentheses and clustered at the household level. * (p<0.10), ** (p<0.05), *** (p<0.01). The education categories are no education, primary education, secondary education and higher education. The dummy "circumcised before age 7)" is equal to one if the woman was circumcised before age 7 and zero if she never has been circumcised. Column 1 only considers unmarried daughters, above 14 years, who are still living at their parental home. Column 2 considers all women. The reference groups for ethnicity, religion, wealth and region are "others", "no religion", "poorest" and "boucle de mouhoun". The urban dummy is equal to one if the person lives in an urban area, otherwise it is zero.

Table 3.A9.: Education of Women (Different Classification)

	Daughters		All	
Circumcised before age 7	-0.645***	(0.122)	-0.678***	(0.0562)
Number of older siblings	0.00875	(0.0247)	0.00291	(0.00906)
Age	0.0946***	(0.0222)	-0.0620***	(0.00315)
Ethnicity:				
Bobo	0.252	(0.311)	-0.130	(0.139)
Dioula	-1.613**	(0.700)	0.159	(0.254)
Fulani	-0.908**	(0.434)	-1.484***	(0.170)
Gurmanche	-1.036**	(0.462)	-1.184***	(0.171)
Gurunsi	-0.362	(0.404)	-0.312**	(0.140)
Lobi	-0.150	(0.570)	-0.111	(0.194)
Mossi	-0.239	(0.268)	-0.573***	(0.0950)
Senufo	-0.0310	(0.343)	0.0516	(0.139)
Touareg	-1.615***	(0.622)	-3.054***	(0.462)
Dagara	-0.0943	(0.433)	-0.839***	(0.178)
Bissa	-0.420	(0.375)	-0.263	(0.165)
Religion:				
Muslim	1.676	(1.391)	1.698***	(0.514)
Catholic	2.081	(1.390)	2.450***	(0.512)
Protestant	2.334*	(1.392)	2.515***	(0.516)
Animist	1.228	(1.432)	-0.206	(0.553)
Wealth	✓		✗	
Urban	✓		✗	
Region	✓		✗	
Constant (cut 1)	4.775***	(1.495)	0.848	(0.524)
Constant (cut 2)	9.244***	(1.504)	3.882***	(0.527)
Constant (cut 3)	10.02***	(1.515)	4.433***	(0.531)
Observations	2008		13376	
Pseudo R^2	0.236		0.129	

Source: DHS, own calculations. Notes: Ordered logit model with estimated coefficients. Standard errors are in parentheses and clustered at the household level. * ($p<0.10$), ** ($p<0.05$), *** ($p<0.01$). The education categories: no education, primary education, secondary education and higher education are defined in a more pessimistic way. Incomplete primary education is defined as no education and incomplete secondary education is defined as primary education. The dummy "circumcised (age<7)" is equal to one if the woman was circumcised before age 7 and zero if she never has been circumcised. Column 1 only considers unmarried daughters, above 14 years, who are still living at their parental home. Column 2 considers all women. ✓ controlling for, ✗ not controlling for. The reference groups for ethnicity and religion are "others" and "no religion".

Table 3.A10.: Education of Women (All Women)

	Daughters		All	
FGC	-0.669***	(0.101)	-0.622***	(0.0464)
Number of older siblings	0.0172	(0.0206)	-0.00217	(0.00741)
Age	0.0344**	(0.0173)	-0.0660***	(0.00231)
Ethnicity:				
Bobo	-0.0869	(0.293)	-0.191*	(0.115)
Dioula	-1.743***	(0.575)	0.106	(0.203)
Fulani	-1.140***	(0.369)	-1.573***	(0.125)
Gurmanche	-1.108***	(0.403)	-1.391***	(0.137)
Gurunsi	-0.659*	(0.336)	-0.453***	(0.108)
Lobi	-0.361	(0.473)	-0.290**	(0.147)
Mossi	-0.747***	(0.238)	-0.716***	(0.0747)
Senufo	0.0316	(0.314)	-0.112	(0.111)
Touareg	-1.535***	(0.525)	-2.496***	(0.260)
Dagara	-0.388	(0.427)	-0.824***	(0.140)
Bissa	-0.823**	(0.323)	-0.472***	(0.122)
Religion:				
Muslim	0.548	(0.554)	1.326***	(0.287)
Catholic	1.166**	(0.553)	2.152***	(0.286)
Protestant	1.383**	(0.562)	2.127***	(0.292)
Animist	0.152	(0.584)	-0.0875	(0.308)
Wealth	✓		✗	
Urban	✓		✗	
Region	✓		✗	
Constant (cut 1)	1.527**	(0.673)	-0.406	(0.299)
Constant (cut 2)	2.920***	(0.673)	0.663**	(0.299)
Constant (cut 3)	7.644***	(0.685)	3.890***	(0.312)
Observations	2288		16688	
Pseudo R^2	0.201		0.113	

Source: DHS, own calculations. Notes: Ordered logit model with estimated coefficients. Standard errors are in parentheses and clustered at the household level. * (p<0.10), ** (p<0.05), *** (p<0.01). The dummy "circumcised" is equal to one if the woman is circumcised and zero if not. Column 1 only considers unmarried daughters, above 14 years, who are still living at their parental home. Column 2 considers all women. ✓ controlling for, ✗ not controlling for. The reference groups for ethnicity and religion are "others" and "no religion".

Table 3.A11.: Probability of Marriage (All Controls)

	Marriage	
FGC	0.159**	(0.0721)
Age	0.498***	(0.0110)
Primary education	-0.704***	(0.0838)
Secondary education	-2.022***	(0.0953)
Higher eduation.	-2.616***	(0.311)
Number of siblings	-0.0366**	(0.0167)
Number of older siblings	-0.00330	(0.0124)
Urban	-0.924***	(0.0796)
Region:		
Cascades	-0.0664	(0.204)
Centre	-0.454***	(0.168)
Centre-Est	-0.196	(0.193)
Centre-Nord	-0.0692	(0.189)
Centre-Ouest	-0.463***	(0.176)
Centre-Sud	-0.153	(0.188)
Est	0.142	(0.231)
Hauts-Bassins	-0.537***	(0.164)
Nord	-0.598***	(0.181)
Plateau-Central	-0.681***	(0.182)
Sahel	0.0894	(0.216)
Sud-Ouest	0.373	(0.231)
Ethnicity:		
Bobo	0.401*	(0.209)
Dioula	-0.628*	(0.365)
Fulani	0.651***	(0.202)
Gurmanche	0.943***	(0.253)
Gurunsi	0.450**	(0.208)
Lobi	-0.183	(0.268)
Mossi	0.330**	(0.147)
Senufo	0.207	(0.212)
Touareg	0.843**	(0.352)
Dagara	0.513**	(0.261)
Bissa	0.0114	(0.224)
Religion:		
Muslim	0.377**	(0.156)
Catholic	-0.391**	(0.159)
Protestant	-0.732***	(0.188)
Constant	-8.561***	(0.304)
Observations	16688	
Pseudo R^2	0.599	

Source: DHS, own calculations. Notes: Logistic regression model with estimated coefficients. Standard errors are in parentheses and clustered at household level. * (p<0.10), ** (p<0.05), *** (p<0.01). The reference groups for education, region, religion and ethnicity are "no education", "boucle de mouhan", "traditionlist/animist and others", and "others".

Table 3.A12.: Probability of Circumcising Daughters (All Controls)

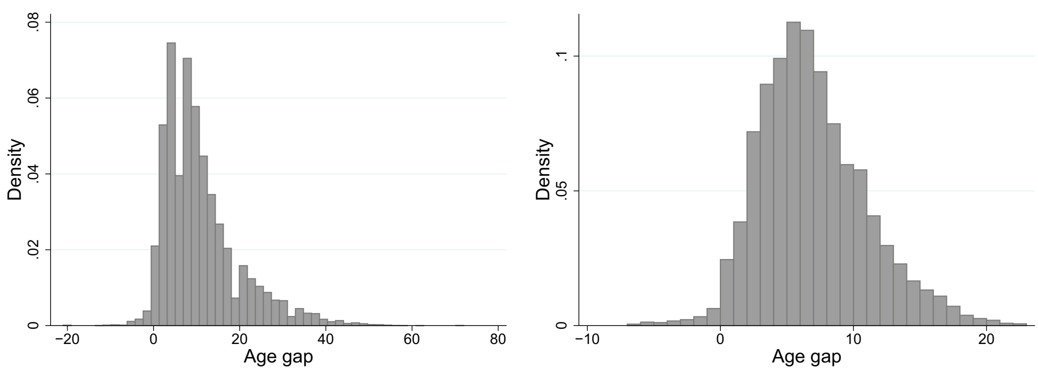
	FGC Daughter (1)		FGC Daughter (2)	
Mother:				
Primary education	-0.186	(0.121)	-0.174	(0.123)
Secondary education	-0.786***	(0.299)	-0.789***	(0.303)
FGC	2.694***	(0.235)	2.705***	(0.241)
Age	0.00679	(0.00583)	0.00889	(0.00601)
Age at first cohabition	-0.00432	(0.0117)	-0.0111	(0.0122)
Father:				
Primary education	-0.142	(0.112)	-0.170	(0.114)
Secondary education	-0.952***	(0.271)	-1.029***	(0.285)
Higher education	-0.926	(1.001)	-0.891	(0.998)
Family:				
Children ever born	0.0556***	(0.0211)	0.0526**	(0.0218)
Daughters living	0.240***	(0.0265)	0.237***	(0.0272)
Household members	0.0210***	(0.00769)	0.0240***	(0.00806)
Sex of household head	0.0544	(0.119)	-0.0748	(0.138)
Urban area	-0.349***	(0.105)	-0.335***	(0.108)
Age difference (couple)			-0.00608*	(0.00368)
Wealth of family:				
Poorer	-0.121	(0.0904)	-0.126	(0.0923)
Middle	-0.205**	(0.0949)	-0.215**	(0.0973)
Richer	-0.225**	(0.0992)	-0.211**	(0.101)
Richest	-0.279*	(0.143)	-0.308**	(0.148)
Observations	10491		10018	
Pseudo R^2	0.147		0.147	

Source: DHS, own calculations. Notes: Logistic regression model with estimated coefficients. Standard errors are in parentheses and clustered at household level. * ($p<0.10$), ** ($p<0.05$), *** ($p<0.01$). Controlling for region, religion and ethnicity in all columns. The reference groups for wealth and edcuation are "poorest" and "no education". For the mother's education "highest educ" is omitted. Column (2) has an additional control, i.e age difference between the couple, which is father's age minus mother's age.

Table 3.A13.: Probability of Circumcising Daughters (Separate)

	Uncircumcised Mothers		Circumcised Mothers	
Mother:				
Primary education	(.)	(.)	-0.152	(0.124)
Secondary education	(.)	(.)	-0.788***	(0.301)
Age	-0.0945	(0.0825)	0.00988	(0.00602)
Age at first cohabition	0.0655	(0.130)	-0.0123	(0.0122)
Father:				
Primary education	-1.204	(1.220)	-0.153	(0.115)
Secondary education	(.)	(.)	-0.994***	(0.283)
Family:				
Age difference (couple)	-0.0240	(0.0282)	-0.00571	(0.00372)
Children ever born	0.341*	(0.177)	0.0508**	(0.0220)
Daughters living	0.0112	(0.220)	0.242***	(0.0276)
Household members	0.0959**	(0.0401)	0.0229***	(0.00821)
Sex of household head	-1.164	(0.885)	-0.0567	(0.139)
Urban area	0.0506	(0.784)	-0.345***	(0.109)
Wealth of family:				
Poorer	1.133	(0.771)	-0.139	(0.0934)
Middle	0.736	(0.877)	-0.221**	(0.0986)
Richer	1.135	(0.815)	-0.223**	(0.102)
Richest	0.966	(1.015)	-0.335**	(0.149)
Observations	1051		8323	
Pseudo R^2	0.153		0.098	

Source: DHS, own calculations. Notes: Logistic regression model with estimated coefficients. Standard errors are in parentheses and are clustered at household level. * (p<0.10),** (p<0.05), *** (p<0.01). Controlling for region, religion and ethnicity in all columns. The reference groups are "poorest" and "no education". (.) stands for omitted.



(a) All Ages **(b)** Women and Men aged 15-39

Figure 3.A2.: Age Gap for Couples

3.A.2. Numerical Solution Algorithm and Moments of the Model

The model is solved numerically using the software MATLAB R2013b. The solution algorithm works in the following iteration steps:

1. Start with an initial guess of the distribution of single females and males, ($\mathbf{S^f}(e_f, \alpha_f, F)_{i=0}$ and $\mathbf{S}^m(e_m)_{i=0}$), the value functions of singles, ($V_f^s(e_f, \alpha_f, F)_{i=0}$ and $V_m^s(e_m)_{i=0}$), the expected continuation values of the marriage market for women and men, ($E(V_f^{market}(e_f, \hat{e}_m, \alpha_f, F, a_{f'}, a_{m'}))_{i=0}$ and $E(V_m^{market}(\hat{e}_f, e_m, \hat{\alpha}_f, \hat{F}, a_{f'}, a_{m'}))_{i=0}$), and the value functions of young married women and men, ($V_f^{m,y}(e_f, \hat{e}_m, \alpha_f, F, a_{f'}, a_{m'})_{i=0}$ and $V_m^{m,y}(\hat{e_f}, e_m, \hat{\alpha}_f, \hat{F}, a_{f'}, a_{m'})_{i=0}$).[73]
2. Solve for the value function of old married women and men ($V_f^{m,o}(e_f, \hat{e}_m, \alpha_f, F)$ and $V_m^{m,o}(\hat{e}_f, e_m, \hat{F})$, which are defined in Equations (3.15) and (3.16)) based on the decision problem of an old married couple (see Equation (3.17)).[74] The decision problem of such a couple is independent of the single distribution, since old married people no longer have any connection to the marriage market.[75] The old married couple only makes intratemporal choices, which enables a closed form solution of the consumption policy rule, yielding:

$$
\begin{aligned}
c_f^*(e_f, e_m) &= \frac{\theta_f^{\frac{1}{\sigma}}}{\theta_f^{\frac{1}{\sigma}} + (1-\theta_f)^{\frac{1}{\sigma}}} \frac{w(e_f, f) + w(e_m, m)}{\phi} \\
c_m^*(e_f, e_m) &= \frac{(1-\theta_f)^{\frac{1}{\sigma}}}{\theta_f^{\frac{1}{\sigma}} + (1-\theta_f)^{\frac{1}{\sigma}}} \frac{w(e_f, f) + w(e_m, m)}{\phi}.
\end{aligned}
$$

3. Based on the single distributions, calculate the normalized single distributions ($\hat{\mathbf{S}}^\mathbf{f}(e_f, \alpha_f, F)_i$ and $\hat{\mathbf{S}}^m(e_m)_i$) according to Equations (3.28) and (3.29).[76]
4. Taking these normalized single distributions ($\hat{\mathbf{S}}^\mathbf{f}(e_f, \alpha_f, F)_i$ and $\hat{\mathbf{S}}^m(e_m)_i$) into account, solve the optimization problem of a young married couple (see Equation (3.14)) and

[73] The subscript indicates the iteration step. The initial step is only undertaken once at the beginning of the algorithm. Therefore, I denote it by $i = 0$. Since the following steps (starting with step 3) will be repeated until convergence occurs, the index is given in a general form: $i + 1$. For the first iteration, it is equal to 1, for the second iteration it is equal to 2, and so on. Consequently, i refers to the values of the previous iteration.

[74] I refrain from indexing the value functions, since these are already the final solutions and do not change throughout the iteration process.

[75] People who are married stay together until they die. Furthermore, from the second period of their marriage (old married couple) onwards, they no longer derive any utility from having children. Therefore, the marriage market is irrelevant for them and their decisions.

[76] These are the normalized single distributions based on the previous single distributions (or based on the initial distributions for the very first iteration). Therefore, the index is i.

with that the value functions of a young married women and men, $(V_f^{m,y}(e_f, \hat{e}_m, \alpha_f, F, a_{f'}, a_{m'})_{i+1}$ and $V_m^{m,y}(\hat{e}_f, e_m, \hat{\alpha}_f, \hat{F}, a_{f'}, a_{m'})_{i+1})$, which are given by Equations (3.12) and (3.13). Save the policy functions for the education of the children and the female circumcision of the daughter. The underlying solution procedure is based on value function iteration. To improve the speed of the algorithm, the value function iteration is conducted in parallel with the updating of the single distributions (see Step (9)).[77]

5. For every possible mating outcome, calculate the probability that this couple will meet and marry ("meet-and-marry" probabilities).[78] This depends on the normalized single distributions, $(\hat{\mathbf{S}}^{\mathbf{f}}(e_f, \alpha_f, F)_i$ and $\hat{\mathbf{S}}^m(e_m)_i)$, the drawn love shock, the value functions of singles, $(V_f^s(e_f, \alpha_f, F)_i$ and $V_m^s(e_m)_i)$, and the value functions of young married people, $(V_f^{m,y}(e_f, \hat{e}_m, \alpha_f, F, a_{f'}, a_{m'})_i$ and $V_m^{m,y}(\hat{e}_f, e_m, \hat{\alpha}_f, \hat{F}, a_{f'}, a_{m'})_i)$. The underlying decision is explained in Section 3.3.5.3.
6. Based on these "meet-and-marry" probabilities, the expected continuation values of the marriage market for women and men can be updated according to the Equations (3.9) and (3.11), which are then denoted by $E(V_f^{market}(e_f, \hat{e}_m, \alpha_f, F, a_{f'}, a_{m'}))_{i+1}$ and $E(V_m^{market}(\hat{e}_f, e_m, \hat{\alpha}_f, \hat{F}, a_{f'}, a_{m'}))_{i+1}$, respectively.
7. Using these updated continuation values of the marriage market, the value functions of the singles can be recalculated based on Equations (3.8) and (3.10). The consumption decision of a single person is straight-forward, since consumption equals income. The updated single value functions are $V_f^s(e_f, \alpha_f, F)_{i+1}$ and $V_m^s(e_m)_{i+1}$.
8. The "meet-and-marry" probabilities from Step 6 and the investment decisions of the parents concerning their children, who enter the marriage market from Step 4, are used to calculate the new single distributions.[79] The new single distributions are denoted by $\mathbf{S}^{\mathbf{f}}(e_f, \alpha_f, F)_{i+1}$ and $\mathbf{S}^m(e_m)_{i+1}$ and calculated as explained in Section 3.3.6.
9. Compare the old single value functions, $V_f^s(e_f, \alpha_f, F)_i$ and $V_m^s(e_m)_i$, with the new calculated ones, $V_f^s(e_f, \alpha_f, F)_{i+1}$ and $V_m^s(e_m)_{i+1}$. If the difference is lower than the acceptable error, keep the old ones; otherwise, update the value functions for singles and replace $V_f^s(e_f, \alpha_f, F)_{i+1}$ and $V_m^s(e_m)_{i+1}$ by them.[80] This is indirectly also an updating of the

[77] The choices for the children depend on the expected continuation values of the marriage market for them. The iteration is undertaken on these objects, which is indirectly an iteration on the value functions of young married people.

[78] Since each man can potentially meet every woman, the "meet-and-marry" probability has to be calculated for every single possibility.

[79] The investment decisions are the policy rules for education of the children and the female circumcision decision for the daughter.

[80] The updating is conservative, e.g. $V_m^s(e_m)_{i+1}^{update} = \lambda V_m^s(e_m)_i + (1-\lambda)V_m^s(e_m)_{i+1}$ and changes with the

continuation values of the marriage market and the value functions of young married people. Furthermore, compare the old single distributions, $\mathbf{S^f}(e_f, \alpha_f, F)_i$ and $\mathbf{S}^m(e_m)_i$, with the new calculated ones, $\mathbf{S^f}(e_f, \alpha_f, F)_{i+1}$ and $\mathbf{S}^m(e_m)_{i+1}$, and apply the same updating procedure as for the single value functions. In addition, update $E(V_f^{market}(e_f, \hat{e}_m, \alpha_f, F, a_{f'}, a_{m'}))_i$ and $E(V_m^{market}(\hat{e}_f, e_m, \hat{\alpha}_f, \hat{F}, a_{f'}, a_{m'}))_i$ with the new values from Step 6.

10. If one of the differences in Step 9 is larger than the predefined errors, continue with Step 3; otherwise, stop the iteration and the stationary matching equilibrium is found.

Given that I am interested in the outcomes of the marriage market, the *model moments* are calculated after the marriage market has taken place. Note that the moments are only derived for the steady state of the model. Therefore, the following notation always refers to the steady state. After the marriage market, the population of adults consists of those people who are still singles ($S^{f,old}$ and $S^{m,old}$), those who have just been married ($M^{f,y}$ and $M^{m,y}$) and those who have been married for more than one period and are still living ($M^{f,old}$ and $M^{m,old}$). The "old married" population not only includes the surviving couples who got married the last period, but also those who married two periods ago and so forth. Therefore, $M^{f,old}$ and $M^{m,old}$ are defined as follows: $M^{f,old} = \sum_{i=1}^{\infty}(1-\delta)^i M^{f,y}$ and $M^{m,old} = \sum_{i=1}^{\infty}(1-\delta)^i M^{m,y}$. I do not consider children here (adulthood starts at 15 in the calibrated model), since the data is restricted to people aged 15 and older. Thus, the relevant female, P^f, and male populations, P^m, are:

$$
\begin{aligned}
P^f &= S^{f,old} + M^{f,y} + \sum_{i=1}^{\infty}(1-\delta)^i M^{f,y} \\
&= S^{f,old} + \frac{1}{\delta} M^{f,y} \text{ and} \\
P^m &= S^{m,old} + \frac{1}{\delta} M^{m,y}.
\end{aligned}
\tag{3.31}
$$

All moments are based on these definitions. For example, the overall marriage rate of women equals $\frac{1}{\delta}M^{f,y}/(S^{f,old} + \frac{1}{\delta}M^{f,y})$, while the overall FGC rate is given by $(S^{f,old}_{F=1} + \frac{1}{\delta}M^{f,y}_{F=1})/(S^{f,old} + \frac{1}{\delta}M^{f,y})$, where the index $F = 1$ indicates that only the circumcised women are considered. The FGC rate of single women is defined as $S^{f,old}_{F=1}/S^{f,old}$ and married women as $M^{f,y}_{F=1}/M^{f,old}$. The other moments are calculated along these lines.

number of iterations. The updating coefficient λ is larger than 0.5 and increases with the number of iterations to ensure convergence.

3.A.3. Further Calibration and Policy Results

Figure 3.A3 shows the fit of the calibrated model for the education distribution of married and single men. It shows the fraction of married and single men in each education category: no education, primary, secondary and higher education. Figure 3.A4 shows the education

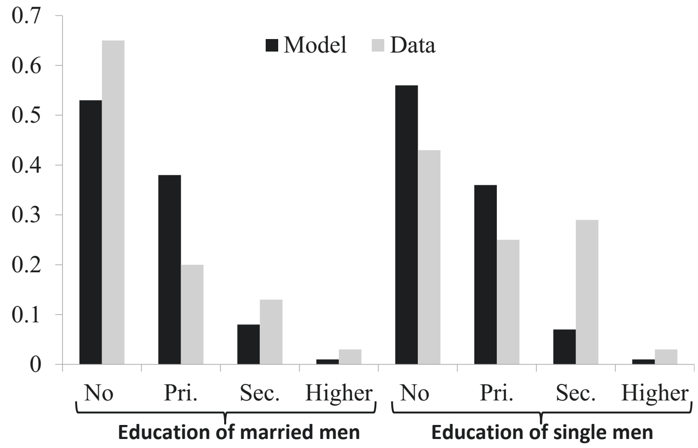
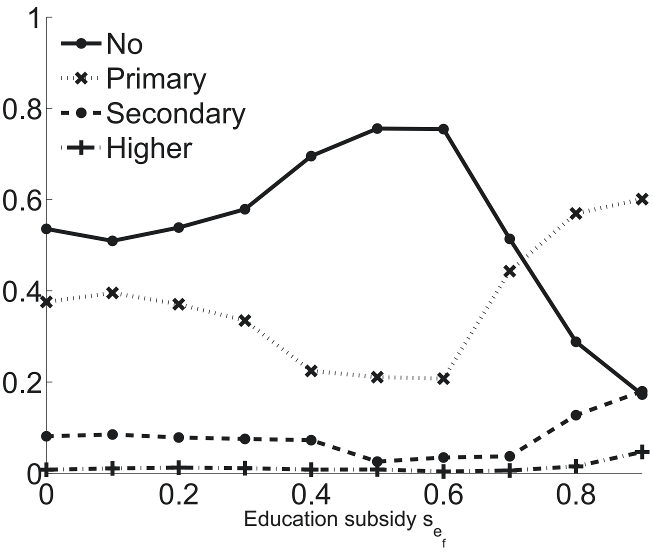


Figure 3.A3.: Model Fit – Education Distribution of Married and Single Men

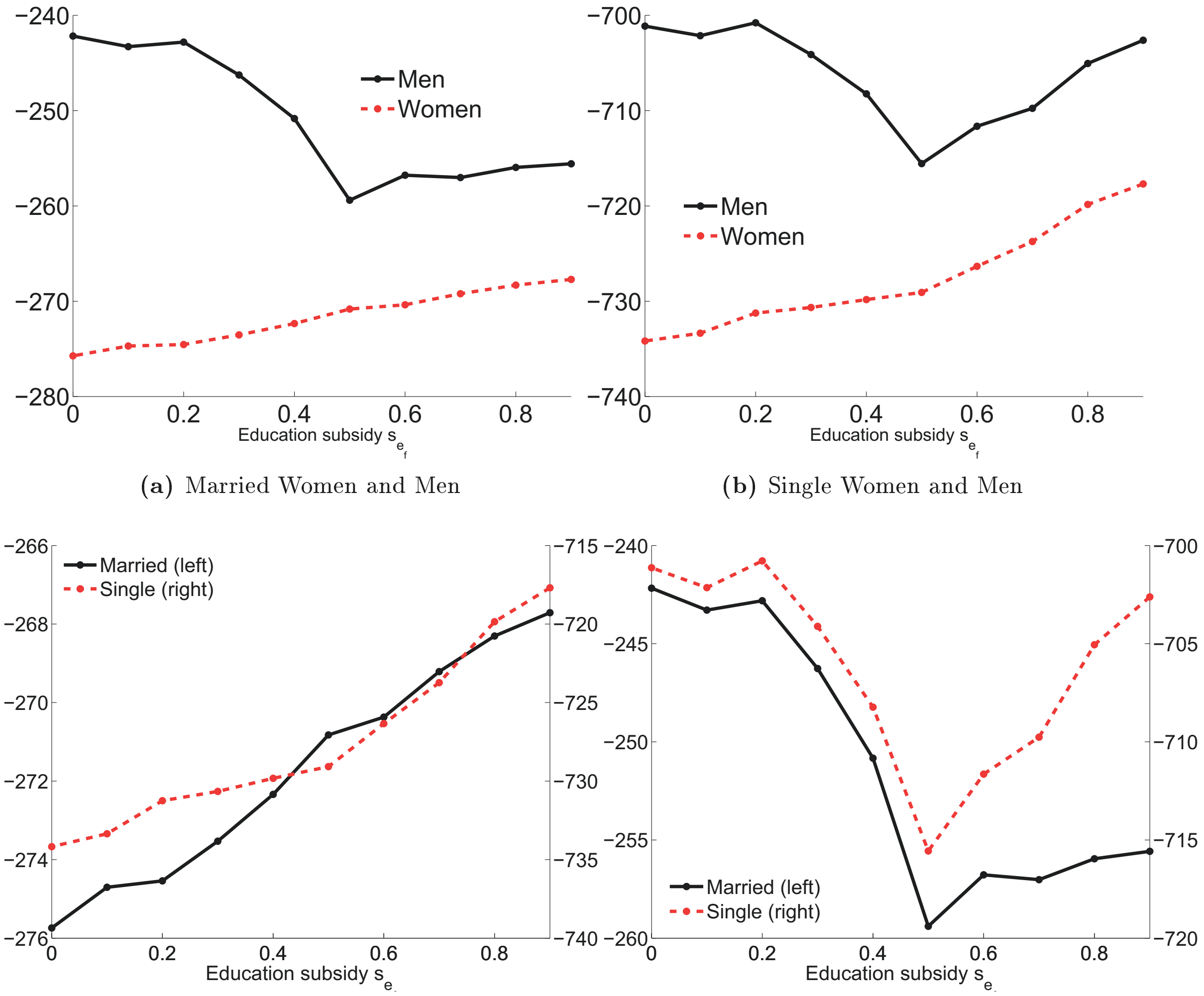
distribution of all men for different female education subsidies s_{e_f}, depicting the fraction of non-educated, primary, secondary and higher educated men.



Notes: This figure displays the fraction of non-, primary, secondary and higher educated men.

Figure 3.A4.: Male Education for Different Education Subsidies

Figure 3.A5 displays the average welfare for married and single women and men for different female education subsidies. Table 3.A14 presents the decomposition results for two subsidy



(a) Married Women and Men

(b) Single Women and Men

(c) Married and Single Women

(d) Married and Single Men

Notes: These plots display the average welfare of the respective groups.

Figure 3.A5.: Average Welfare - Married and Single People

rates, i.e. 0.3 and 0.4. The first column of each policy experiment shows the steady state outcomes of an subsidy introduction, whereby people can re-optimize but the FGC policy rule is fixed at its initial (no policy). In the second column, the minimum love shocks and thus the marriage probabilities for each couple are kept fixed at their initial levels, while everything else can adjust.

Table 3.A14.: Further Decompositions of the Effects of the Female Education Subsidy Policy

		Subsidy ($s_{e_f} = 0.3$)			Subsidy ($s_{e_f} = 0.4$)		
		Fix			Fix		
	No Policy	FGC rule	marriage prob.	Full Policy	FGC rule	marriage prob.	Full Policy
FGC rate:							
All	0.72	0.70	0.67	0.57	0.69	0.60	0.43
Married	0.77	0.75	0.72	0.62	0.73	0.65	0.47
Single	0.54	0.53	0.49	0.41	0.53	0.44	0.31
Marriage rate of women:							
All	0.79	0.79	0.78	0.78	0.79	0.77	0.77
Circumcised	0.84	0.84	0.84	0.84	0.84	0.83	0.84
Uncircumcised	0.65	0.67	0.66	0.70	0.67	0.68	0.72
Education of married women:							
No	0.64	0.41	0.40	0.35	0.21	0.20	0.17
Primary	0.25	0.27	0.28	0.27	0.21	0.20	0.22
Secondary	0.08	0.16	0.16	0.21	0.30	0.28	0.36
Higher	0.03	0.16	0.16	0.16	0.28	0.32	0.25
Education of single women:							
No	0.50	0.29	0.27	0.24	0.14	0.13	0.12
Primary	0.34	0.29	0.31	0.30	0.19	0.19	0.23
Secondary	0.12	0.22	0.22	0.26	0.29	0.28	0.39
Higher	0.04	0.20	0.20	0.20	0.37	0.40	0.27

Part II.

Completed Fertility

Chapter 4

Gender Gaps in Completed Fertility[1]

4.1. Introduction

There is a large literature within demography and population science analyzing fertility patterns and trends. Within economics, the emphasis is placed on understanding fertility choices, whereby fertility data is a fundamental ingredient to achieve this goal. Essentially all of the known "fertility facts" are based on surveys about the reproductive behavior of women, whereas male fertility is typically ignored. The reason is that most surveys only ask women about their child-bearing behavior. Greene and Biddlecom (2000) already emphasized this lack of research of male fertility as a problem more than a decade ago, pointing to several specific directions of future research on male reproductive behavior. While this call has stimulated research on men's role in reproductive behavior (i.e. it is now more common to model reproductive behavior as a bargaining outcome between two partners), the measurement itself has not changed. Because women may remember pregnancies and births better than men, it is often believed that measuring fertility purely based on women's reproductive behavior is sufficient, also to avoid double-counting. In this paper, we want to question this view.

Even though each child has two parents, for any given couple, the fertility of the husband and wife do not need to coincide. Each spouse could in principle also have children with other partners, either sequentially, or even simultaneously in the case of men. Especially in societies with a high degree of polygyny, the discrepancy could be large. Even if polygyny is banned (as in many countries today), having children with multiple partners (one could call this informal polygyny) is still legal and indeed happens. Another possibility is remarriage (after divorce, separation, or death) and having additional children with the new partner,

[1]This chapter is joint work with Erica Field and Michèle Tertilt.

which have largely been ignored in the empirical fertility literature. A traditional household survey only asks women about their reproductive histories and children are rarely assigned to a particular birth father.

There are a few recent notable exceptions of surveys in which men are asked about their reproductive histories. The Survey of Family Growth in the U.S. started interviewing men about their reproductive behavior in 2002. Based on this data, Guzzo and Furstenberg (2007) find that 8% of American men had children with more than one partner. The number among poor African American men is as high as one third, and 16% of them report children with three or more women. Recent waves of the World Value Surveys and the Population Acceptance Study also include questions on male fertility, specifically in European countries.[2] Moreover, the analysis of administrative register data has become more common in recent years, particularly in Scandinavian countries. Such data typically include information on fathers and mothers. From population registers, it is possible to construct fertility measures for fathers separate from mothers. However, this possibility has not been exploited much in the literature to date. Two notable exceptions are Lappegård and Rønsen (2011) and Kunze (2014), who both use Norwegian register data. Lappegård and Rønsen (2011) study the importance of multi-partner fertility, finding that disadvantaged and advantaged men are more likely to father children with multiple women. Kunze (2014) studies how births affect the earning dynamics of fathers. Boschini et al. (2011) use Swedish register data to analyze the connection between career and fertility for men and women separately. In this context, they find that childlessness is more common among men than women. Interestingly, they also find that male fertility does not differ much by education levels, while female fertility does.

In sum, while very recent surveys sometimes include information on male fertility, so far these data have been mostly used to analyze the importance of multi-partner fertility. What is lacking are attempts to explore systematically the extent to which conventional "fertility facts" would be different if measured based on data from men rather than women. In particular, the extent to which average fertility is any different has not been explored.

To answer these questions, we look at recent waves of the Demographic and Health Surveys (DHS) in six different, mostly African, countries. The recent waves include a sample of men who are asked about their reproductive behavior.[3] To analyze whether there are any

[2] Puur et al. (2008) and Westoff and Higgins (2009) use these data. However, the main research question is quite different from ours, as these papers focus on the relationship between men's role orientation and fertility aspirations.

[3] A few other studies have used the same data. Agajanian (2002) uses DHS data from Mozambique, in addition to qualitative field work in the Greater Maputo area, to study how men communicate about reproductive behavior and contraception.

robust patterns across countries, we conduct the same analysis for six different countries. Our starting point is that the discrepancy in male vs. female fertility, if it exists, would be largest in highly polygynous countries. To investigate this hypothesis, we analyze three pairs of countries: two highly polygynous countries (Senegal and Burkina Faso), two countries with a low level of polygyny (Malawi and Ethiopia) and two countries where polygyny is almost non-existent (Madagascar and India). For each country, we piece information together from different waves of the DHS to compare the completed fertility of men and women of the same birth cohort.

We document some striking facts. First, we find that men have on average more children than women in four out of the six countries considered. The gaps are large, ranging from 1.3 children in Ethiopia, 2.1 children in Malawi, 3.1 children in Senegal to 4.6 children in Burkina Faso, but appear to be decreasing over time. For example, in Burkina Faso, we find a gap of 4.6 for the 1944-48 birth cohort and a smaller gap of only 2.8 for the 1951-55 birth cohort. Similarly, the gap in Malawi is 2.1 for the 1946-50 cohort, falls to 1.7 for the 1950-54 cohort and further decreases to 1.1 for the 1956-60 cohort. Positive gaps mean that men must be having children with more than one woman. Indeed, we find that the size of the gap is positively related to the degree of polygyny. Second, we document a larger heterogeneity in fertility outcomes among men than women. The coefficient of variation of fertility for women is lower than that for men in all countries, except India. In other words, with the exception of India, women are more equal to each other in their reproductive behavior than men are. The gap is largest in the high polygyny countries Burkina Faso and Senegal. Third, we find that differences in the desire to have children can be explained to a large extent by differences in realized fertility. Fourth, we document that the demographic transition started earlier and was steeper when considered from a male perspective.

We believe that these findings are important for a number of reasons. First, investments in children heavily depend on the resources of fathers. There is a large body of literature investigating how inequality becomes amplified through endogenous fertility and child investments.[4] The literature shows that it matters how children are spread across families. Given that a large fraction of wealth worldwide is owned by men; in fact, it matters how children are spread across *men* specifically. In other words, since men control a large part of resources, the number of siblings who share the same father seems more informative than the number of those who share the same mother. Second, it is often emphasized that men desire more

[4] See, for example, Kremer and Chen (2002) and De la Croix and Doepke (2003).

children than women (Bankole and Singh, 1998). Such discordant preferences are thought to lead to conflict and are sometimes modeled as a bargaining game between spouses (Rasul (2008) and Doepke and Kindermann (2013)).[5] However, our results show that differences in demand are often mirrored in differences in actual achieved fertility, such that there is no innate source of conflict surrounding fertility choices. Third, much polygyny today is informal. One might be able to recover some information about the organization of the family by looking at children. A final problem with ignoring children of men outside the household is the assumption that transfers sent outside of or received into the household do not go towards supporting parents' offspring. This can lead to systematic mis-measurement in the amount that parents invest in their children when living in multiple partnership settings, and fathers' investment in children will be systematically underestimated when their offspring live in multiple households. In sum, we believe that these new facts will be useful when building theories of fertility choice.

In the next section, we describe the data we use. In Section 4.3, we document the extent to which average complete fertility differs by gender. Section 4.4 analyzes differences in fertility inequality for men vs. women. In Section 4.5, we analyze differences in desired fertility and how it relates to actual fertility. Section 4.6 reconsiders the demographic transition from a male perspective, before Section 4.7 concludes.

4.2. The Data

4.2.1. Some Preliminaries

How should one compare the fertility of men and women? There are multiple possibilities. For example, one could compute the number of births in a given year relative to the number of women and men of child-bearing age. Alternatively, one could try to construct measures of the total fertility rate also for men and compare it to standard female total fertility rates. The measure that most closely captures actual fertility choices is the "completed fertility rate" (or "children ever born") based on self-reported fertility histories.[6] When using this measure to compare fertility rates over time, one usually compares children ever born by birth cohorts of mothers. We follow the same approach here, i.e. we compute completed fertility rates for men by birth cohorts and compare them to women of the same birth cohort.[7] Of course,

[5]See also Voas (2004) on this.

[6]This is a commonly used measure, see for example Jones and Tertilt (2008).

[7]In line with the literature, completed fertility rates are computed based on all men and women, including those with zero children.

men and women of the same birth cohort do not necessarily have children with each other (i.e. if there is an age gap in marriage), although we do not view this as a problem. On the contrary, the purpose of the paper is to investigate the extent to which cohorts of men and women born at the same time and living during the same years (and hence facing the same economic conditions over their lifetime) make different fertility choices.

Naturally, there are some data issues. To assure that people have truly completed their fertility, one should use data from relatively old people. On the other hand, only living people can be asked about their completed fertility; thus, waiting until people are 70 in countries where the average life expectancy is around 50 is not very practical. Even more importantly, the oldest men included in the Demographic and Health Surveys, of which we make use, are 59. Wherever possible, we measure completed fertility based on men aged between 55 and 59. Women are only included in the surveys up to age 49. To compare men and women of the same birth cohort, we thus have to piece together information from different survey years. For example, we can construct male fertility for the 1941-45 cohort of men by using 55-59 year old men from a 2010 survey. If we used the oldest (i.e. 45-49 year old) women from the same survey, they would correspond to a different birth cohort. However, we can use data from a second survey (ideally 2000) to compute the fertility rate for the 1941-45 female cohort by analyzing 45-49 year old women from the earlier survey. Unfortunately, the DHS surveys are not always spaced exactly 10 years apart. Therefore, we sometimes have to use slightly different ages in our comparisons. Exactly which combination of data sets, ages and cohorts are used in our analysis will be detailed further below.

One important question one might ask is whether men in their late-50s and women in their late-40s truly have completed their reproduction. There is a large literature on this topic within biology and medicine. McKinlay et al. (1992) find that the median age for the onset of menopause in the U.S. is 51 years. However, note that female fecundity is already severely reduced in the pre-menopausal phase, which is supported by the findings of Eijkemans et al. (2014). They show that the biological hazard of sterility dramatically increases after the age of 38 for European and North American women, reaching almost 90% at the age of 45. Moreover, the onset of menopause increases with development (because of better nutrition), so that it likely occurs earlier in our samples of African and Indian women (see e.g. Sidibe, 2005). We thus believe that we are not missing many children when computing completed fertility based on our samples of women older than 40. Male fecundity also decreases with age, but more slowly than for women and there is no equivalent to menopause beyond which complete sterility occurs (see for example Kidd et al. (2001) and Harris et al. (2011)). Thus, to measure completed male fertility, men should be surveyed at later ages than women, which we do. To the extent that men have children beyond their mid-50s, note that this will downward bias our measures of male fertility. In other words, we might even be understating gender gaps in fertility.

4.2.2. The DHS Samples

We use data from six different developing countries. For convenience, we classify them by their degree of polygyny: Burkina Faso and Senegal both have high rates of polygyny, Malawi and Ethiopia have lower rates of polygyny, and in Madagascar and India polygyny essentially does not exist. We use recent waves of the Demographic and Health Surveys (DHS) for our analysis (ICF-International, 1994-2012). The spacing between consecutive waves in the same country is typically five years, although there are exceptions. Each survey is a representative sample of households.[8] To assure representativeness on national, regional and residence levels, individual sample weights are included, which we use in our calculations unless otherwise noted.

Even though the DHS is a household survey, note that not all household members are interviewed. The main target group is women of reproductive age (15-49 years). However, recent waves also include interviews with a sub-sample of men (aged 15-54/59). The fraction of men interviewed varies by country and year, with the fraction of households eligible for male interviews varying from around every 1.6th to every 4th household. The final ratio of interviewed women and men also differs due to (small) differences in non-response rates by gender.[9] The sex ratio of interviewed people for the surveys used are given in Table 4.A2 in the Appendix.

In each of the six countries, we use all DHS waves that include a male sample. Depending on the country, there are between one (India) and four (Burkina Faso, Senegal and Malawi) waves that include a male sample. When available, we incorporate an additional earlier wave with only female interviewees, since, as explained above, we use women from earlier surveys to construct the fertility rates of the same birth cohorts of men and women. Based on these

[8] In most instances, the sample is based on a stratified two-stage cluster design. The enumeration areas are drawn from Census files in the first stage and the households in each enumeration area are drawn from an updated list of households. More detailed information on the sample design can be found on the DHS website http://www.measuredhs.com/What-We-Do/Survey-Types/DHS-Methodology.cfm.

[9] Overall response rates were high, with household response rates of over 97%. However, not all eligible individuals were interviewed. Depending on the country and year, female response rates are over 92%, while males rates may be as low as 85%.

criteria, we end up with four different DHS surveys for Burkina Faso, Senegal, Malawi and Madagascar, and only two for Ethiopia and India. In Table 4.1, we provide an overview of the surveys used.[10] The table includes sample sizes by gender and the age ranges of the interviewed people. For the majority of countries, the most recent waves of the DHS were conducted in 2010 or 2011. Only for Madagascar and India was the latest data collected in 2008/09 and 2005/06, respectively. Overall sample sizes significantly differ, largely due to the sizes of the countries. For example, the Indian DHS is the largest, followed by the 2010 wave from Malawi. The sample sizes have been growing over time.

Table 4.1 also includes the polygyny rate – measured as the fraction of all married women with at least one co-wife – and the total fertility rates (TFR).[11] The highest polygyny rates can be found in Burkina Faso (42% in 2010) and the lowest in India (2% in 2005/06). The same pattern holds true for the total fertility rates, with Burkina Faso having the highest TFR of 6.0 in 2010 and India the lowest, with 2.7 in 2005/06. This means that the TFRs and polygyny rates in our sample are positively correlated, i.e. the higher the fraction of women with a co-wife in a country, the higher the total fertility rates.

As explained in Section 4.2.1, the goal is to compare the number of children ever born by birth cohorts of the parents. Combining men born within a given period of 5 years into one birth cohort ensures sufficiently large sample sizes. For the reasons discussed above, whenever possible we use men between the ages of 55 and 59 and compare them to women aged 45 to 49 from a survey conducted 10 years earlier. However, we sometimes have to deviate from this rule for two reasons: first, in some cases, the oldest men interviewed are only 54 (Malawi and India); and second, the surveys are not always conducted exactly 10 years apart. Table 4.2 provides an overview of which birth cohorts we actually use, from which DHS the information is taken and the ages at the time of the interview. The table also includes the sample sizes of the relevant birth cohorts. Note that we used surveys only around 5 years apart to construct data for the same birth cohorts of men and women in the cases of India and Malawi, given that men were included only up to the age of 54 in these countries, while the oldest women in the survey are 49. Comparing surveys 5 years apart leads to the oldest men and women respectively being from the same birth cohort. The second reason why we cannot always compare exactly 45-49 year old women to 55-59 year old men is that the spacing between

[10]Note that the Ethiopian calender is different to the Gregorian one, generally being 92 months behind. For example, the DHS 2011 is conducted in the Ethiopian year 2003 and the year of birth of the interviewed people is provided in the Ethiopian system. For an easy comparison with the other countries, we state the approximated Gregorian years in the table and throughout the paper (Ethiopian year +8 years).

[11]Women who live together with their partner but are not married are included.

Table 4.1.: DHS Information

Polygyny preval.	Country	Year DHS	Sample size women	Sample size men	Ages women	Ages men	Polyg.[a] (in %)	TFR[b]
High	Burkina Faso	2010	17,087	7,307	15-49	15-59	42	6.0
		2003	12,477	3,605	15-49	15-59	48	5.9
		1998-99	6,445	2,641	15-49	15-59	55	6.4
		1993	6,354	1,845	15-49	18-97	51	6.5
	Senegal	2010-11	15,688	4,929	15-49	15-59	35	5.0
		2005	14,602	3,761	15-49	15-59	39	5.3
		1997	8,593	4,306	15-49	15-59	47	5.7
		1992-93	6,310	1,436	15-49	20-92	48	6.0
Low	Malawi	2010	23,020	7,175	15-49	15-54	14	5.7
		2004-05	11,698	3,261	15-49	15-54	16	6.0
		2000	13,220	3,092	15-49	15-54	17	6.3
		1992	4,849	1,151	15-49	20-54	20	6.7
	Ethiopia	2011	16,515	14,110	15-49	15-59	11	4.8
		2000	15,367	2,607	15-49	15-59	14	5.5
Almost no	Madagascar	2008-09	17,375	8,586	15-49	15-59	3	4.8
		2003-04	7,949	2,432	15-49	15-59	3	5.2
		1997	7,060	.	15-49	.	3	6.1
		1992	6260	.	15-49	.		6.1
	India	2005-06	124,385	74,369	15-49	15-54	2	2.7
		1998-99[c]	89,199	.	15-49	.	.	2.8

Notes: Individual sample weights are used for the calculations. Polygyny preval. stands for polygyny prevalence. (a) Fraction of all women, who are married or live together with their partner, with at least one cowife, taking out the missing values. (b) Total fertility rates are taken from the statcompiler which is based on the corresponding DHS data. (c) Only ever married women are interviewed.

the surveys is rarely exactly 5 or 10 years. Our procedure here was to use the oldest men for which data is available and adjust the ages of the women so that they are from the exact same birth cohort. This logic explains why the women of the 1951-55 cohort in Burkina Faso are aged 42-48, for example, given that the DHS are 11-12 years apart. This example shows a further complication, since several DHS waves include interviews from two consecutive years.[12] Fortunately, the surveys include a question of the year of birth, upon which we base our selection of men and women. However, depending on the exact birth date and the month of the survey, 5 years of birth cohort can include people of more than 5 different ages, as the example of Burkina Faso shows. The final sample sizes are obviously much smaller than the size of the surveys given in Table 4.1. They range from 394 (Burkina Faso DHS 1993)

[12]Interviews were typically spread out over several months, which in some cases included December of one year and January of the following year.

to 9,312 (India DHS 1998/99) for women and from 93 (Madagascar DHS 2003/04) to 3,997 (India DHS 2005/06) for men. The small samples size for Madagascar makes inference for the cohort born in 1945-49 difficult.

The polygyny rates reported in Table 4.2 are higher for the older cohorts than for the whole sample (compare with Table 4.1) for all countries, except for the countries with a low level of polygyny. This is unsurprising since polygyny rates have been falling over time and the rates in Table 4.1 also include younger couples. Men are also asked whether they currently have more than one wife or partner, which is shown in the last column of Table 4.2. These rates are in line with our categorization of the six countries into high, low and almost no polygyny.

Table 4.2.: Summary Statistics

Country	Cohorts	Women[a]				Men[b]			
		DHS	Total	Age	Poly.[c]	DHS	Total	Age	Poly.[d]
Burkina	1951-55	1998/99	478	42-48	0.69	2010	350	54-59	0.45
Faso	1944-48	1993	394	44-49	0.63	2003	188	54-59	0.55
Senegal	1951-55	1997	693	41-46	0.65	2010/11	233	54-59	0.38
	1946-50	1992/93	495	42-47	0.67	2005	150	54-59	0.49
Malawi	1956-60	2004/05	803	43-49	0.22	2010	401	49-54	0.12
	1950-54	2000	766	45-49	0.14	2004/05	175	50-54	0.16
	1946-50	1992	412	41-46	0.28	2000	186	49-54	0.22
Ethiopia	1952-56	2000	1194	43-48	0.19	2011	541	54-59	0.08
Mada-	1949-53	1997	500	43-48	0.01	2008/09	387	55-59	0.02
gascar	1945-49	1992	427	42-47	0.02	2003/04	93	54-59	0.00
India	1951-55	1998/99	9312	42-49	.	2005/06	3997	50-54	0.02

Notes: Individual sample weights are used to calculate the statistics. (a) Information is based on the sample of women who provide information on the number of born children. (b) Information is based on the sample of men who provide information on the number of born children. (c) Polygyny is measured as the fraction of women, who are married or live together with their partner, with at least one cowife. (d) Polygyny is measured as the fraction of men with more than one wife/partner.

4.3. Gender Gaps in Fertility

We now compare the average completed fertility for men and women of the same birth cohort. As Table 4.3 shows, men have many more children than women in almost all countries that we consider. The gap is particularly pronounced in countries with high levels of polygyny. In Burkina Faso, men born in 1944-48 have on average 12.18 children, compared to only 7.55

for women. Of course, men often marry younger women; in fact, the average age gap at first birth is 8.6 years, as shown in Table 4.4. However, this cannot explain the gap by itself, since women of the 1951-55 cohort, i.e. those on average 7 years younger, also have only 7.48 children each. Clearly, men are having children with more than one woman. Moreover, this is true for the average man, i.e. it is not only the case that some rich men have children with multiple women while other men do not. It should be emphasized again that the data includes all men and women, including those who remain childless. Thus, the data shows that *on average* men must have children with more than one woman. The data looks similar for Senegal, another high polygyny country. Men born in 1946-50 have on average 10.26 children, while women of the same cohort have only 7.21, i.e. men have on average 3.06 more children than women of the same cohort. Five years later, the gap has shrunk, yet is still a sizeable 1.92 children.

We see a similar pattern in Ethiopia and Malawi. Men born between 1950 and 1954 have 8.69 children while women have only 7.02, i.e. a gap of around two children. In Ethiopia, the gap for the 1952-56 cohort is only 1.32, which is nonetheless still a high number – larger than total fertility rates in some European countries.

Finally, the table shows that women in Madagascar and India have more children than men do. However, recall that the sample size for Madagascarian men is extremely small; in fact, the differences across gender are barely significant.

We can also use the data to check how reasonable our assumption of completed fertility is at ages (depending on the country/year) 50-54/59 for men and 41-49 for women. The survey includes a question on the age of the youngest child. We calculate the fraction of men and women of various ages who have a child below one, based on the most recent DHS for each country. The numbers are given in Table 4.A1 in the Appendix, which shows a hump-shaped pattern in all countries and for both sexes. The peak fertility occurs for women between the ages of 20 and 29 in all countries, before falling rapidly after age 34. For example, while a quarter to a third of all 25-34 year olds have a child that was born in the last year, this has declined to 11% or less by 40-44. Very few women aged 45 or older have young children. The highest percentage is in Malawi, with 3% of 45-49 year old women having a child born during the previous year. Therefore, we think that it is fairly innocuous to use completed fertility rates of women aged 42 and older as a proxy for completed life-time fertility rates.

The corresponding figures for men look somewhat different, particularly in the highly polygynous countries. For men, peak fertility occurs at later ages, between 25 and 49 depending

Table 4.3.: Average Fertility by Gender

Country	Cohort	Fertility		Gap
		Women	Men	
Burkina Faso	1951-55	7.48	10.24	2.76 ***
	1944-48	7.55	12.18	4.63 ***
Senegal	1951-55	7.00	8.92	1.92 ***
	1946-50	7.21	10.26	3.06 ***
Malawi	1956-60	6.76	7.81	1.06 ***
	1950-54	7.02	8.69	1.67 ***
	1946-50	7.15	9.20	2.05 ***
Ethiopia	1952-56	7.07	8.39	1.32 ***
Madagascar	1949-53	6.99	6.78	-0.21
	1945-49	7.12	6.37	-0.75 *
India	1951-55	4.61	3.98	-0.63 ***

Notes: Fertility is measured by the average number of children born to the cohort, also considering men and women with no children. The significance levels are denoted by *** 1%, ** 5% and * 10%. The means are tested on equality based on a two-sample t-test with sampling weights.

on the country. In some countries, there is still a large fraction of men in the oldest age group who have a child aged one or younger, which is as high as 22% for 55-59 year old men in Senegal. Therefore, it is difficult to argue that men have truly completed their fertility by this age. However, note that this finding biases our results concerning the average fertility of men downwards. In other words, adjusting for children that men have at even older ages would further increase the male fertility rates and thereby increase the gender gaps in fertility reported in Table 4.3. Note also that for countries with low levels of polygyny, the fraction of men with a child born in the previous year peaks at an earlier age and is considerably lower for the older ages and thus even less problematic for our assumption that fertility is completed for men in their mid-50s.

4.3.1. Polygyny as Driving Force of the Gender Gap

The main channel through which men achieve higher fertility than women is by continuing to have children beyond their mid-40s, at ages when women are essentially no longer fertile. To observe this, we depict the number of children born over the life cycle. Since the Demographic and Health Surveys are not panels, but rather consist of repeated cross sections, we cannot compute fertility rates for the same cohorts over their life cycle. Instead, we construct an artificial life cycle by piecing together different cohorts. Figure 4.1 depicts one life-cycle profile for each country, based on the most recent DHS wave in each of our six countries. To make it more transparent how these graphs were constructed, we have labeled them with the birth cohort of the mothers and fathers, respectively. To convert this into ages, note that these profiles start at the age 15 and continue to 59 for all countries apart from India and Madagascar, where the highest age is 54. Furthermore, for women, we have data only until the age of 49. However, female fecundity after the age 49 is essentially zero.[13] Thus, to make the increasing gap between men and women at older ages more visible, we have added figures for the older cohorts of women to the graphs by assuming that fertility does not grow after the age of 49.[14]

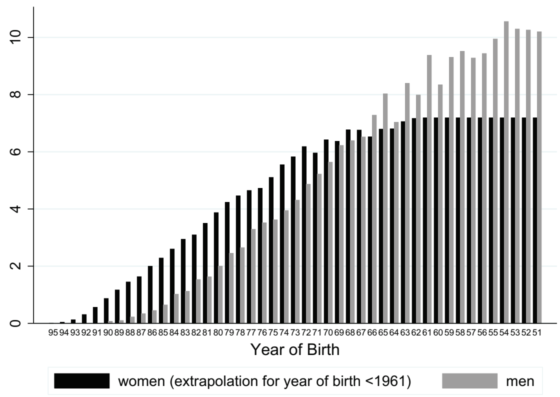
The first thing to note from Figure 4.1 is that men start having children later in life than women. Accordingly, young women have more children than young men, which is true in all countries that we consider. For example, in Burkina Faso, women in the 1986 cohort, i.e. those aged 24 when asked about their children, already have 2 children, whereas men of the same age have less than one child on average. However, the gap closes as age increases, which is of course unsurprising given the age gap in marriage. What is more interesting is that the gap eventually reverses sign. In other words, men continue to increase their fertility well into their 50s, while women stop in their mid-40s. This pattern is most pronounced in Burkina Faso and Senegal, the most polygynous countries. However, we even see the same pattern in Ethiopia, Malawi and Madagascar, albeit to a lesser degree. Such a reverse cannot be explained through an age gap alone. An age gap in a monogamous marriage without remarriage would mean that the fertility of men and women converges with age. While each individual man can deviate from this pattern by mating more than one woman (and in particular having children with younger women as he ages), it seems that the same cannot be possible at the aggregate level. With a balanced sex ratio, one may think that on average men cannot have children with more than one woman. However, that is a fallacy. With a growing population, it is indeed possible for a large fraction of men to have more than one wife.[15]

To see that this is possible even in a steady state, let f_m be the fertility of the average male and f_f the fertility of the average female. Let n be the number of wives per man and η the population growth rate. Assuming an age gap of g years between husband and wife, it

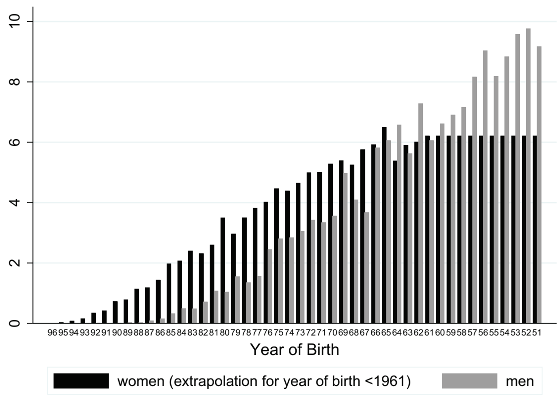
[13] As previously discussed, assuming it is zero thereafter seems a relatively innocuous assumption.

[14] In the graphs, this corresponds to the 1960 cohorts and older for Burkina Faso, Senegal and Malawi, the 1958 cohorts and older for Madagascar, 1961 for Ethiopia and 1955 for India.

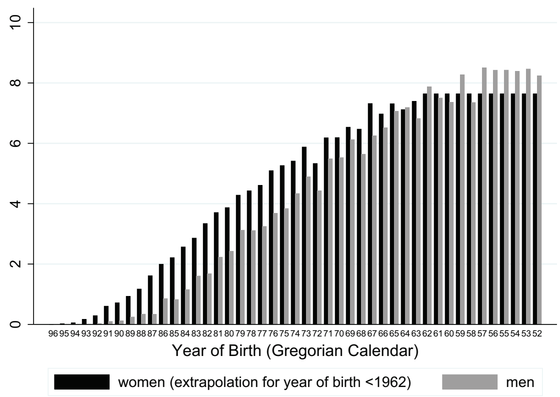
[15] This paper is not concerned with formal marriage; rather, we are interested in those "women a man has fathered children with." Since this is a cumbersome expression, we often write "wife" instead. However, this does not mean that she is an official wife or even a cohabiting partner.



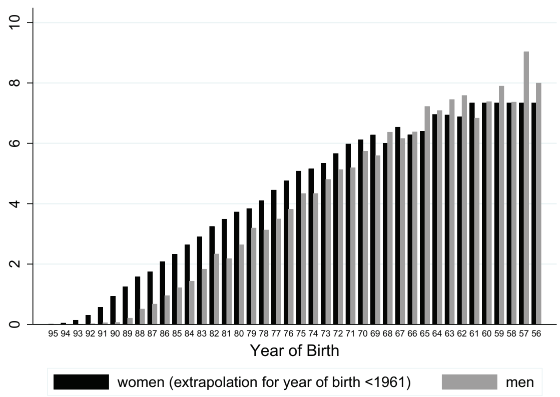
(a) Burkina Faso



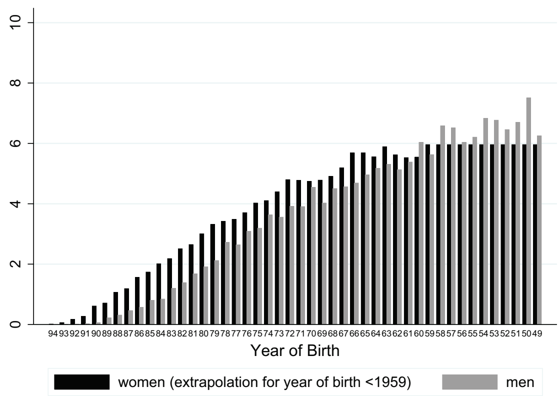
(b) Senegal



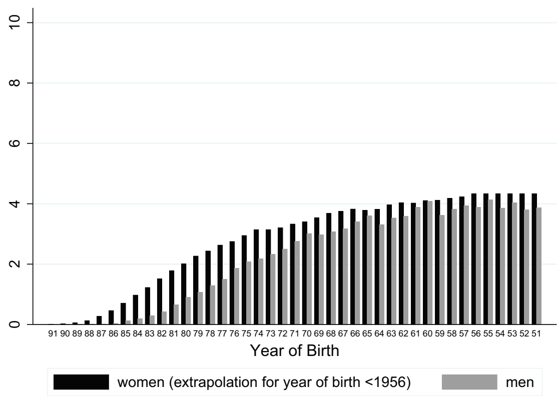
(c) Ethiopia



(d) Malawi



(e) Madagascar



(f) India

Figure 4.1.: Number of Children Born by Birth Cohorts

Table 4.4.: Age at First Birth by Gender

Country	Cohort	Age at first birth		Gap
		Women	Men	
Burkina Faso	1951-55	19.8	28.4	8.6 ***
	1944-48	19.8	.	.
Senegal	1951-55	19.6	30.2	10.6 ***
	1946-50	19.4	28.1	8.7 ***
Malawi	1956-60	19.5	24.7	5.2 ***
	1950-54	19.6	24.6	5.0 ***
	1946-50	19.9	.	.
Ethiopia	1952-56	18.8	26.2	7.4 ***
Madagascar	1949-53	19.7	25.5	5.9 ***
	1945-49	18.6	28.4	9.8 ***
India	1951-55	19.4	26.2	6.8 ***

Notes: *** 1%, ** 5% and * 10% significance level. The means are tested on equality based on a two-sample t-test with sampling weights.

is possible for the average man to have children with $n = (1+\eta)^g$ women. The number of children per man then relates to the number of children per woman as follows:

$$f_m = (1+\eta)^g f_f.$$

For example, if the age gap was 10 years and annual population growth was 3%, then $\frac{f_m}{f_f} = 1.34$, i.e. men have on average 34% more children than women.[16] Table 4.4 shows the average age at first birth by gender and the resulting age gap for all six countries. The age gap is highest in the high polygynous countries, which suggests the importance of this channel.[17]

Finally, what does all of this mean for the essentially monogamous countries India and Madagascar? Do the negative gaps, i.e. the finding that women have more children than men, imply that women in these countries have children with multiple men? Even if polyandry is not legal in these countries, sequential polyandry is of course possible in the sense that women first have children with one man and then additional children with a second husband after the death of the first husband or divorce/separation. However, divorce is relatively rare in these countries. A more likely explanation is again offered by the large age gaps reported in

[16]This point is also made in Tertilt (2005).

[17]For the low and almost no polygynous countries, only Madagascar's age gap for the cohorts born in 1945-49 is at a comparatively high level. However, since the underlying sample size for men is below 93, this age gap should be interpreted with caution.

Table 4.4, whereby the negative fertility gaps could result from the age gap in combination with the demographic transition. If men have children with women of a later cohort (due to the age gap) and fertility is falling over time, then it is necessary for any given cohort that the fertility of women is higher than that of men.

4.3.2. Alternative Explanations Based on Measurement Issues

In this section, we explore whether the large gender gaps in fertility could be an artifact of measurement. First, it could be the case that differential mortality biases our estimates of average fertility. Naturally, by using retrospective fertility outcomes of men and women aged between 41 and 59, we focus on those people who survive to that age. If high fertility increased mortality for women, then we could be systematically missing the high fertility women, which would downward bias the female fertility estimates. We find this an unlikely explanation, because if women die for pregnancy-related reasons, then they often die when pregnant with the first child. This would bias results in the opposite direction and could clearly not explain why the fertility of men is higher than women. Furthermore, the fact that the fertility gap is very different across countries, and in fact negative for India and Madagascar, makes differential mortality unlikely to be the main explanation, unless one considered that such differential mortality only existed in some of the countries.

Second, it could be the case that the DHS is not representative of men and we are systematically missing those men who remain childless. As one indicator, we compare the sex ratios (number of men per woman) based on national census data published by the UN with those in the DHS. We calculate the ratio of interviewed men and women, adjusting for the fraction of sampled households in which men are supposed to be interviewed. These sex ratios are presented in Table 4.5, with the left two columns presenting the ratios for the age group of 15 to 49 years and the right two columns only for those aged 45-49. Such a comparison is not possible for older cohorts (50-59), namely those of relevance for our analysis, since women are only interviewed until age 49. Even though the DHS sex ratios are systematically lower for the whole age group 15-49 in all countries, which indicates that the DHS covers fewer men than would be representative, this is mainly driven by the younger cohorts. For the cohort aged 45-49, being closest to the relevant group of people, the discrepancies between the sex ratios is less pronounced and even negative for the surveys in Burkina Faso in 2010 and Senegal in 2010/11. Thus, we do not believe that the large gender gaps could only be explained by missing men in our analysis.

Table 4.5.: Sex Ratios

		Number of Men per Women			
		Aged 15-49		Aged 45-49	
Country	Year	Census	DHS	Census	DHS
Burkina Faso	2010	0.99	0.76	0.86	0.92
	2003	0.97	0.73	0.80	0.66
Senegal	2010/11	0.94	0.74	0.82	0.87
	2005	0.94	0.70	0.84	0.84
Malawi	2010	1.02	0.86	0.92	0.88
	2004/05	0.99	0.79	0.87	0.70
	2000	0.97	0.88	0.91	0.91
Ethiopia	2011	1.0	0.78	0.94	0.87
Madagascar	2008/09	0.99	0.88	0.96	0.95
	2003/04	0.99	0.83	0.97	0.94
India	2005/06	1.08	0.89	1.08	1.05

Source: The Census sex ratios are published by the United Nations, Department of Economic and Social Affairs, Population Division (2013), World Population Prospects: The 2012 Revision and based on national census data.

Third, could there by some systematic over-/underreporting of fertility, which differs for men vs. women? Given that women spend nine months in pregnancy and typically another year or more nursing, and since giving birth itself can be a long and painful process, it seems unlikely that a woman would not remember all her children. These arguments do not apply to men. Moreover, a man can never be absolutely sure that a child is truly his own. Thus, there could be double-counting of children if several men claimed the same child. Alternatively, there could be underreporting of male fertility if some children were not attributed to any father. A small body of literature exists concerning the issue of reporting bias in male fertility. There seems to be some evidence of male underreporting of fertility (for example, Rendall et al. (1999) find that men tend to severely underreport their non-marital births in data from the US and the UK), although other papers find no difference in reporting bias between men and women (e.g. Fikree et al. (1993), based on a small sample of men and women in Vermont). Probably more relevant for our study is evidence based on other African countries. Ratcliffe et al. (2002) analyze data from the Gambia, a highly polygynous country, finding no difference in the reliability of male vs. female fertility reports. Similarly, Hertrich (1998) finds no difference in the reliability of reporting live births between men and women in Mali. Given that none of the studies find that men overreport fertility, it seems highly unlikely that the gender gaps we find in fertility are an artifact of male reporting biases.

4.4. Higher Fertility Inequality for Men

Thus far, we have established that on average men have more children than women in all countries that we analyze, apart from Madagascar and India. Furthermore, we have argued that it is indeed possible that *all* men have more children than women in polygynous countries with high population growth. In reality, of course, there is important heterogeneity, whereby some people have many children, while others have very few or even none. We now turn to analyzing the heterogeneity in fertility decisions separately for men and women. Specifically, Table 4.6 displays two measures of fertility inequality for the six countries: the standard deviation and the coefficient of variation (CV). The first thing to note is that the standard deviation of fertility of men is much higher than for women. For example, the standard deviation of the 1951-55 cohort in Burkina Faso is 5.25 for men, compared to only 2.63 for women.

To better compare fertility inequality across gender and countries with very different means, the table also includes the coefficient of variation. Even controlling for the fact that mean fertility is lower for women, we find a larger degree of inequality for men than women in all countries.[18] Accordingly, women are more similar to each other in their fertility behavior than men are to each other in almost all countries that we consider. Again considering the example of the 1951-55 cohort in Burkina Faso, we find a CV for men of 0.51 compared to only 0.35 for women. Interestingly, the coefficient of variation for men is very similar across countries, at around 0.5. The finding that male fertility inequality is larger than female inequality is strongest in the high polygyny countries. In Burkina Faso and Senegal, the difference between the male and female CV is 0.10 or higher, depending on the cohort considered. In the low polygyny countries (Ethiopia and Malawi), it is only between 0.02 and 0.06.[19] Finally, the almost no polygyny countries (Madagascar and India) only display a gap of 0.02 to 0.04.[20] Put differently, high male heterogeneity in fertility directly translates into high female heterogeneity in monogamous countries. This is not the case in countries with a high degree of polygyny where men have another margin of adjustment. Those men who want many children do not necessarily need a woman who agrees, but rather they can have

[18] There are two exceptions, namely the 1950-54 cohort in Malawi and the 1945-49 cohort in Madagascar.

[19] Again, the 1950-54 cohort in Malawi does not follow this pattern, as female fertility inequality is higher than male.

[20] The 1945-49 cohort in Madagascar shows a higher inequality for women than for men. However, this result needs to be regarded with caution due to the small male sample size.

Table 4.6.: Fertility Inequality by Gender

Country	Cohort	SD		CV	
		Women	Men	Women	Men
Burkina Faso	1951-55	2.63	5.25	0.35	0.51
	1944-48	2.83	6.23	0.37	0.51
Senegal	1951-55	2.91	4.94	0.42	0.55
	1946-50	3.01	5.36	0.42	0.52
Malawi	1956-60	2.87	3.75	0.42	0.48
	1950-54	3.17	3.66	0.45	0.42
	1946-50	3.08	4.20	0.43	0.46
Ethiopia	1952-56	2.81	3.50	0.40	0.42
Madagascar	1949-53	3.77	3.82	0.54	0.56
	1945-49	4.04	2.61	0.57	0.41
India	1951-55	2.42	2.23	0.52	0.56

Notes: SD represents the standard deviation. CV is the coefficient of variation, which is the standard deviation divided by the mean.

children with multiple women.

To gain a better sense of how male and female fertility behaviors differ, Figure 4.2 displays the distribution of fertility outcomes. For each country, we have plotted only one distribution, based on the most recent cohort for which we have data. Each panel includes separate distributions for men and women. The first thing to note is that the distribution for men is flatter than the female distribution and shifted to the right. Again, the differences between men and women are most striking for Burkina Faso and Senegal. While there are no women with more than 14 (16) children in Burkina Faso (Senegal), many men have higher fertility rates, with some having up to 27 children. The percentage of men with more children than the highest fertility of women is quite large, at 19% in Burkina Faso and 10% in Senegal. Figure 4.A1 in the Appendix shows the fertility distribution, which is censored for the gender with the higher maximum number of born children at the highest fertility reported by the opposite gender. While 24% (12%) of the men in Burkina Faso (Senegal) have more than 13 (15) children, only 0.7% (0.2%) of the women do so.

The pattern in Ethiopia and Malawi are less pronounced but qualitatively similar. In each case, there is a sizeable fraction of men having more children than the highest fertility women, at 2% in Ethiopia and 3% in Malawi. What is also interesting is that no large fraction of childless men is observed in any of the four polygynous countries. One might have thought that high male fertility inequality means many men with high numbers of wives and children and equally many with no wives and children, although this is clearly not the case. On the contrary, the fraction of men without any children is lower than the fraction of women with no children in both Burkina Faso and Ethiopia. In Malawi, the fractions are essentially the same. Only in Senegal and India do we have a higher fraction of childless men than women, although the numbers are still small in absolute terms, with around 4% of men having no children.

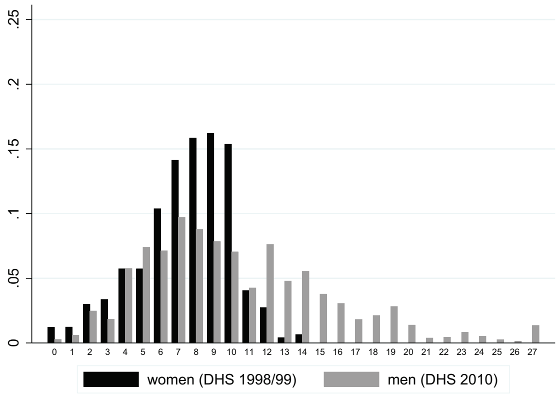
Finally, turning to our no polygyny countries, Madagascar and India, it is striking how similar the distributions are for men and women.

As a side note, it is interesting to compare the distribution of children across women against other countries. Jones and Tertilt (2008) provide fertility distributions for a series of cohorts of U.S. women, from 1826-1830 to 1956-1960. The shape of the distribution substantially changes over the century, in parallel with the declining average fertility rate. The first cohort (1826-1830) has the highest completed fertility rate, namely 5.6 children per woman, and thus is closest (in mean) to the rates of the countries considered in this paper. Nonetheless, the distribution looks surprisingly different (see Figure 4.3). First, the fraction of childless women is much higher in the US. The data analyzed in Jones and Tertilt (2008) shows that this is not an anomaly of this particular cohort, as the rate of childlessness is above 10% for almost all cohorts, which is much larger than for the six developing countries analyzed in this paper. Furthermore, the US distribution is much more concentrated to the left. The fertility distributions are almost flat at low parities and falling thereafter. In contrast, Figure 4.2 suggests that the distributions are much closer to a normal distribution in the six developing countries analyzed here.

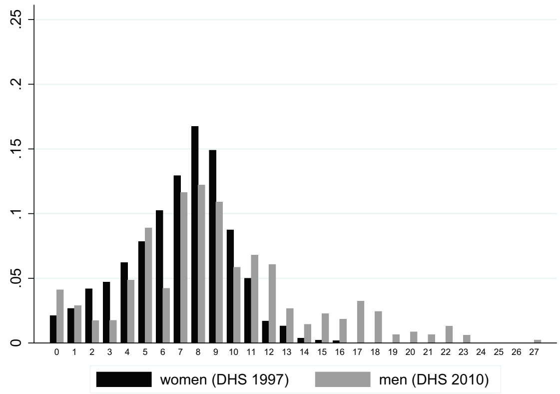
4.5. Gender Gaps in Desired vs. Actual Fertility

It is well-known that the desired fertility of men and women often does not coincide in survey data. Especially in developing countries, men tend to say that they desire more children than women (Bankole and Singh, 1998).[21] The typical interpretation is that women bear a higher share of the cost of child-rearing, which makes children relatively more expensive for women. For example, one cost is the risk of dying in child birth, which is obviously born by women only. But, how is this discrepancy in preferences resolved? One could view the actual

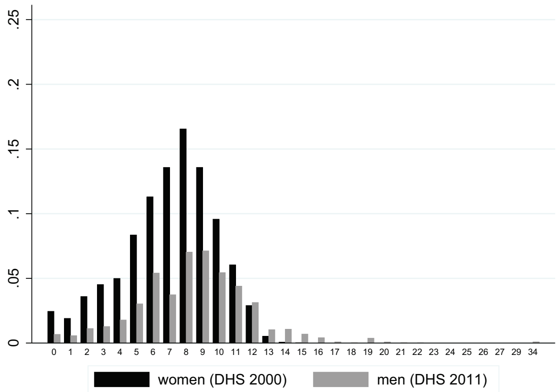
[21] Although Mason and Taj (1987) find little differences in desired fertility in an older meta-analysis. However, this finding might be due to the paucity of data at the time of this study, almost two decades ago.



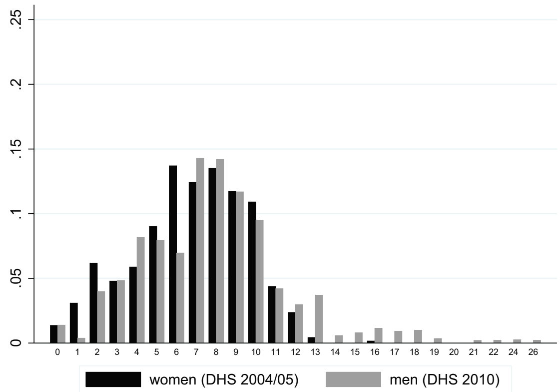
(a) Burkina Faso (Cohort 1951-55)



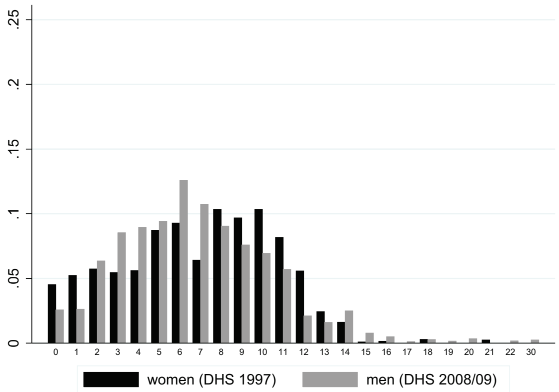
(b) Senegal (Cohort 1951-55)



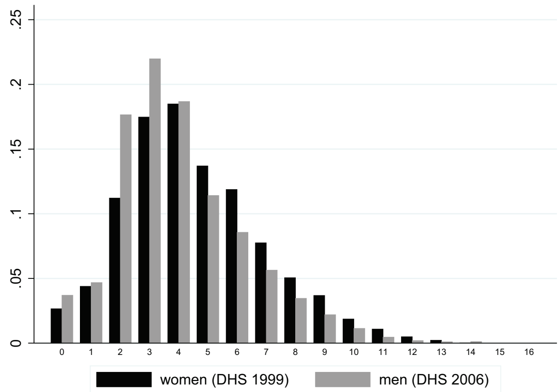
(c) Ethiopia (Cohort 1952-56)



(d) Malawi (Cohort 1956-60)

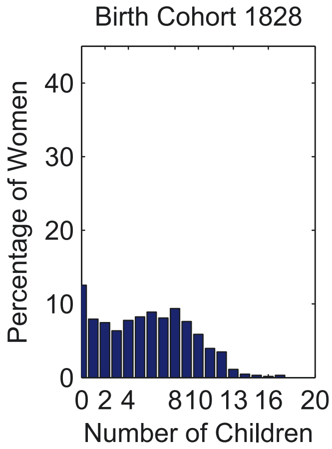


(e) Madagascar (Cohort 1949-53)



(f) India (Cohort 1951-55)

Figure 4.2.: Fertility Distribution



Source: Jones and Tertilt (2008), Figure A3

Figure 4.3.: Fertility Distribution of U.S. Women, born 1826-1830

fertility outcome as the result of a bargaining game between husband and wife, possibly with asymmetric information. This is the approach of Doepke and Kindermann (2013), who built a model of spousal bargaining over fertility outcomes to analyze fertility in Europe, as well as Rasul (2008), who analyzes discordant fertility preferences in Malaysia.[22] The importance of asymmetric information is emphasized in Ashraf et al. (2013), who provide evidence from a field experiment that women conceal contraceptive use from their husbands if given a chance, thereby reduce child-bearing.

Our finding of a gender gap in realized fertility allows a novel interpretation of the gender gap in desired fertility. In particular, it shows that spouses do not need to agree on fertility outcomes. If men want more children than women, they can do so by having children with multiple women.[23] Thus, the question that we analyze in this section is to what extent is the gap in desired fertility explained by the gap in actual fertility. If the two gaps coincided, then no bargaining about babies would be necessary, given that each spouse can realize their desire individually.

To calculate desired fertility, note that the DHS asks two questions on the issue. If a person has living children, she/he is asked: "If you could go back to the time you did not have any children and could choose exactly the number of children to have in your whole life, how many would that be?" For people without living children, the question is rephrased as: "If you could choose exactly the number of children to have in your whole life, how many would that be?" Naturally, these questions are somewhat problematic as they are asked retrospectively. For

[22]See also Voas (2004) for an analysis in the demography literature.
[23]Mott and Mott (1985) make a similar point, specifically for the Yoruba village, Nigeria.

Table 4.7.: Desired Number of Children by Gender

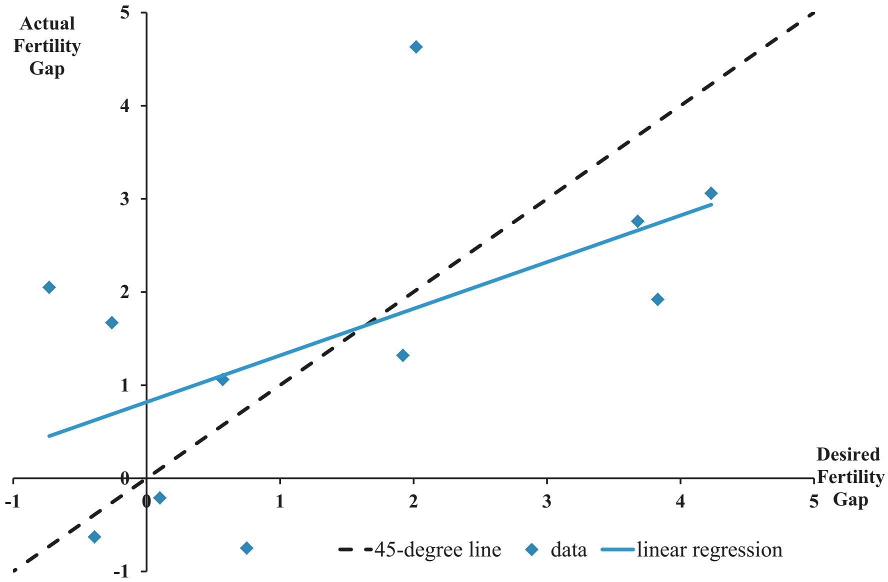
Country	Cohort	Desired Number		Desired	Actual
		Women	Men	Gap	Gap
Burkina Faso	1951-55	6.48	10.16	3.68 ***	2.76 ***
	1944-48	6.73	8.75	2.02 **	4.63 ***
Senegal	1951-55	5.77	9.60	3.83 ***	1.92 ***
	1946-50	6.48	10.72	4.23 ***	3.06 ***
Malawi	1956-60	5.33	5.90	0.57 ***	1.06 ***
	1950-54	5.63	5.37	-0.26	1.67 ***
	1946-50	6.35	5.62	-0.73 **	2.05 ***
Ethiopia	1952-56	6.64	8.56	1.92 ***	1.32 ***
Madagascar	1949-53	6.54	6.64	0.10	-0.21
	1945-49	6.78	7.53	0.75	-0.75 *
India	1951-55	2.92	2.53	-0.39 ***	-0.63 ***

Notes: People are asked how many children they would like to have in life. Those who answer 'whatever god wants' or ' don't know' are not considered here. The significance levels are *** 1%, ** 5% and * 10%. The means are tested on equality based on a two-sample t-test with sampling weights.

example, a person who has many children might be quite reluctant to report having wanted fewer, although this caveat should apply equally to men and women. Since we are interested in the difference between men and women, we do not see the reporting bias as a major concern. As in our previous analysis, we report averages by birth cohorts. In other words, we are not comparing gaps within couples, but rather analyze average gaps within cohorts of men and women.

Table 4.7 shows the mean desired number of children for men and women for all countries and cohorts under consideration. The first thing to note is that we indeed find a large positive and significant gap in the desired number of children in six of the cohorts that we consider. However, we also observe no significant gap or even a negative one (women wanting more children) in some countries. In India, we find that women want more children, while this difference is not significant in Madagascar.[24] In Malawi, the results differ by cohort: for the youngest cohort, we find a significant positive (though relatively small) gap of half a child, while the gap for the older cohorts is negative or insignificant. Note that the size of the gap again seems quite systematically related to polygyny. The two high polygyny countries have extremely large gaps. In Burkina Faso, men of the 1951-55 cohort want on average 3.68 more children than women. Similarly, in Senegal, men want between 3.8 and 4.2 more children

[24]Recall that the male sample size of the cohort born in 1945-49 is very small.



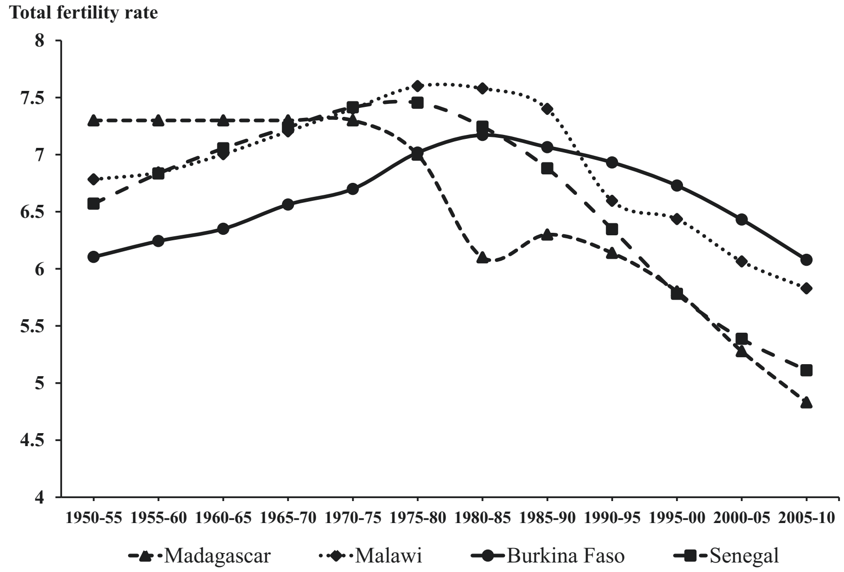
Source: DHS and own calcuations, based on Table 4.7. Notes: all gaps are included, even those that are not significantly different from zero.

Figure 4.4.: Desired vs. Actual Fertility Gaps Across Countries

than women, depending on the cohort considered. We see more mixed results in Malawi and Ethiopia, the two countries with low levels of polygyny. Here, the gap is never larger than two children, and is either negative or insignificant for several cohorts. Finally, in Madagascar and India, the countries with almost no polygyny, we do not see men wanting more children at all. None of the three cohorts considered displays a significant positive gap.

As argued before, if men have children with multiple women, they can potentially realize their differential desires. To observe the extent to which this is actually happening, we also included the gap in realized fertility in the table. Comparing the desired gap with the actual gap, it becomes clear that a large fraction of the desired gap is actually realized in these countries. Figure 4.4 illustrates this visually.[25] The desired gap is on the horizontal axis and the actual gap on the vertical axis. We included the 45-degree line as a benchmark on which all of the desire gap would be realized. Clearly, there is a strong positive relationship between the desired gap and the realized gap. Thus, a large part of the disagreement in fertility seems to translate into men having children with multiple women, although not quite all of it. The relationship is somewhat flatter than the 45-degree line, which is largely driven by the curious

[25]The figure includes all gaps, even those that are not significantly different from zero.



Sources: United Nations, Department of Economic and Social Affairs, Population Division (2013). World Population Prospects: The 2012 Revision.

Figure 4.5.: Demographic Transition based on Total Fertility Rates

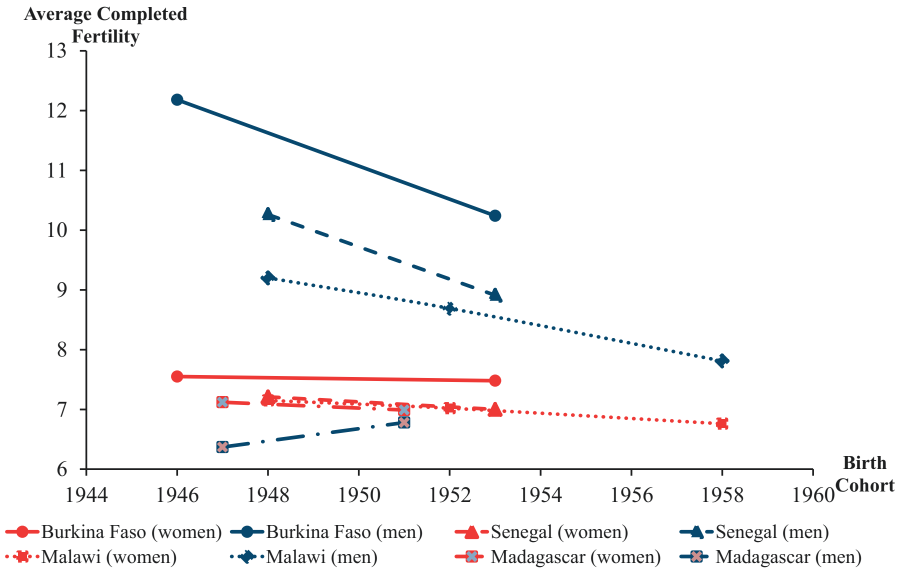
case of Malawi, where women want more children than men in two cohorts, yet men have more children than women.

4.6. Demographic Transition

Conventional wisdom is that the demographic transition in most African countries started relatively late and its pace has been slower than in other regions (see Casterline (2001) and Bongaarts (2008)).[26] Such statements are usually based on total fertility rates, i.e. on measures of female fertility. Figure 4.5 plots total fertility rates for Madagascar, Malawi, Burkina Faso and Senegal over the second half of the 20th century. With the exception of Madagascar, fertility rates did not start falling until the late-1980s, and even then, it fell relatively slowly. For example, in Burkina Faso, total fertility at its peak in the mid-1980s was about 7.2 children per women, before falling within the next two decades to only 6.1, i.e. a little more than a one child decline over a period of twenty years.

We believe that it is not only relevant when choices are made (i.e. when children are born),

[26]See also Cohen (1998) for a relatively comprehensive overview of the demographic transition on the African continent.



Source: DHS and own calculations. Notes: Only the middle year of the birth cohort is displayed, e.g. 1946 represents the cohort born in 1944-48.

Figure 4.6.: Demographic Transition based on Children Ever Born by Gender

but also who makes those choices (i.e. for which parents fertility declines). In other words, one would like to know which cohorts of parents started choosing to have smaller families. Figure 4.6 plots children ever born by birth cohorts from the DHS data. The average numbers of children are depicted in red for women and blue for men. Naturally, due to the limited number of cohorts in our data, the figure does not give a complete picture of the entire demographic transition.[27] Nonetheless, we observe a striking pattern, even for the short time span that we consider. While there is essentially no visible decline in fertility in all four countries for women born between 1944 and 1960, we see a sharp decline for men of the same cohorts in all countries but Madagascar. While men of the 1944-48 cohort in Burkina Faso had 12.2 children on average, less than ten years later, this had declined to 10.2. Similarly in Senegal we see a decline, from 10.3 to 8.9 within only five years. Finally, in Malawi, the number of children per men fell from 9.2 to 7.8 within ten years. The only exception to this pattern is Madagascar, a country with almost no polygyny, which has a lower average fertility for men than women of the same cohorts, as well as no decline in male fertility.

[27]For Ethiopia and India, the DHS data do not allow for a comparison over time, since we only have fertility data for one cohort.

Overall, the idea of a slow demographic transition, or even a stalling fertility decline, which has been much emphasized by demographers, might be an artifact of focusing exclusively on female fertility. From men's perspective, fertility has been falling quite sharply earlier. We believe this distinction is quite important, since it is men who own most resources in those countries. Lower fertility typically goes hand-in-hand with higher child quality, i.e. with higher investments into each child or higher bequests to each child. If this quantity-quality trade-off is at work and if men have more resources than women, then the fact that fertility is falling steeply for men should be more relevant than that it is stalling for women.

4.7. Conclusion

We use novel data provided by the DHS male questionnaires to analyze differences in completed fertility by gender. For Burkina Faso, Senegal, Malawi and Ethiopia, we observe on average higher completed fertility for men than women of the same birth cohorts. The empirical analysis shows that this discrepancy is largest in high polygynous countries. While the fertility gap is large in countries with high polygyny rates (Burkina Faso and Senegal), it is non-existent or even negative in countries with almost no polygyny (Madagascar and India). We document that an important factor for the large gender gaps is that men have children beyond their mid-40s, i.e. beyond the onset of menopause for the majority of women. We show that in countries with a balanced sex ratio yet growing population, a large fraction of men can potentially have multiple and younger wives, which renders a higher average male than female fertility possible.

Second, for high polygynous countries, we document a notably higher inequality in male than female fertility, measured as the variance of fertility. This is less pronounced in countries with low and almost no polygyny. This means that for (almost) monogamous countries, a high heterogeneity of male fertility is translated one to one into female heterogeneity, while men in high polygynous countries have an additional margin of adjustment that breaks the link between male and female heterogeneity.

Third, the difference in average fertility provides a novel explanation for the gender gap in desired fertility. Existing explanations are based on the assumption that the realized fertility does not differ between spouses. We show that average realized fertility between men and women of the same cohort can differ and that there is a positive relationship between the average desired and realized fertility gaps. In line with the literature, we find that men want more children than women in most of the countries. However, a disagreement in these desires can be resolved by men having children with more than one woman.

Fourth, we find that the size and speed of demographic transition depends on the gender considered. In Burkina Faso, Senegal and Malawi, the size and speed of the fertility decline have been much more pronounced for men than women of the same cohort.

We believe that these results may be important for researchers building theories of fertility choice, which are necessarily informed by the facts. Indeed, this paper shows that the facts may look somewhat different depending on whether they are derived based on men or women. Take the facts relating to fertility inequality as an example. Our results show that heterogeneity in fertility outcomes is much larger for men than for women. How does this affect the resource distribution in the next generation? Historically, the relationship between income and fertility is negative in most societies – see Jones and Tertilt (2008). Thus, endogenous fertility leads to an amplification of income inequality over time. Taking the distribution of children across men into account, this amplification could be even more severe than estimates based on women would suggest. However, if it is precisely the rich men who have most children in those societies where men have children with multiple women, then this would mitigate the endogenous inequality propagation across generations.

In this paper, we have analyzed fertility gaps across gender in six countries. Conducting a similar analysis for other countries would be very interesting and is left for future research. Finally, while we speculate that polygyny is the most important factor in explaining gender gaps in fertility, we have not formally investigated this hypothesis. Other possibilities are non-marital child-bearing, divorce followed by remarriage and death with subsequent remarriage. Decomposing the observed gender fertility gaps according to these various possibilities would be an interesting avenue to pursue, although data constraints will not make this an easy task.

4.A. Appendix

Table 4.A1.: Indicator for Completed Fertility

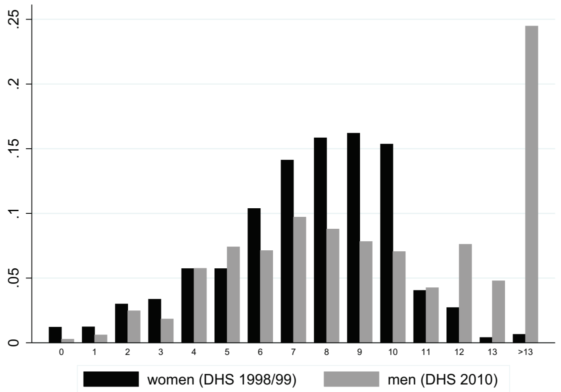
Country	DHS		Fraction with a child aged one or younger								
			15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59
BFA	2010	f	0.10	0.26	0.30	0.24	0.20	0.11	0.01		
		m	0.00	0.13	0.36	0.51	0.48	0.46	0.46	0.31	0.21
SEN	2010/11	f	0.08	0.21	0.25	0.23	0.16	0.07	0.02		
		m	0.00	0.03	0.17	0.35	0.41	0.42	0.41	0.25	0.22
MWI	2010	f	0.11	0.29	0.24	0.20	0.16	0.10	0.03		
		m	0.01	0.22	0.46	0.40	0.42	0.35	0.29	0.12	
ETH	2011	f	0.06	0.23	0.27	0.23	0.20	0.11	0.02		
		m	0.00	0.10	0.32	0.42	0.40	0.38	0.31	0.17	0.09
MDG	2008/09	f	0.13	0.24	0.23	0.19	0.14	0.07	0.01		
		m	0.02	0.22	0.37	0.35	0.30	0.26	0.16	0.06	0.02
IND	2005/06	f	0.07	0.22	0.15	0.07	0.03	0.01	0.00		
		m	0.01	0.14	0.31	0.29	0.16	0.07	0.03	0.01	

Source: Own calculation based on DHS. Notes: The fraction is an unconditional measure, meaning people with no children are also included. BFA: Burkina Faso, SEN: Senegal, MWI: Malawi, ETH: Ethiopia, MDG: Madagascar, IND: India.

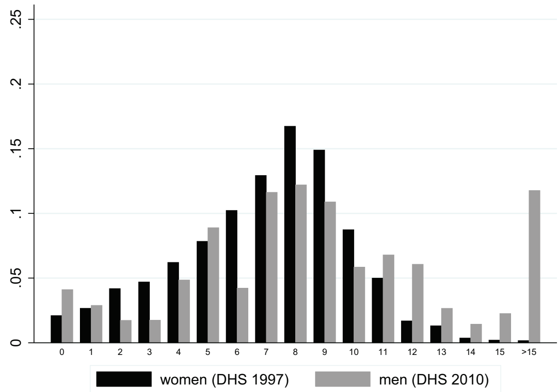
Table 4.A2.: Sample Implementation

		Sampled Households			Interviewed People		
Country	DHS	Female Sample	Male Sample	Ratio	Women	Men	Ratio
Burkina Faso	2010	14,947	7,475	2.00	17,087	7,307	2.34
	2003	9,470	3,297	2.87	12,477	3,605	3.46
Senegal	2010/11	8,212	3,129	2.62	15,688	4,929	3.18
	2005	7,859	2,614	3.01	14,602	3,761	3.88
Malawi	2010	27,307	9,387	2.91	23,020	7,175	3.21
	2004/05	15,041	5,029	2.99	11,698	3,261	3.59
	2000	15,421	3,872	3.98	13,220	3,092	4.28
Ethiopia	2011	17,817	17,817	1.00	16,515	14,110	1.17
Madagascar	2008/09	18,985	9,494	2.00	17,375	8,586	2.02
	2003/04	9,295	3,102	3.00	7,949	2,432	3.27
India	2005/06	116,652	73,974	1.58	124,385	74,369	1.67

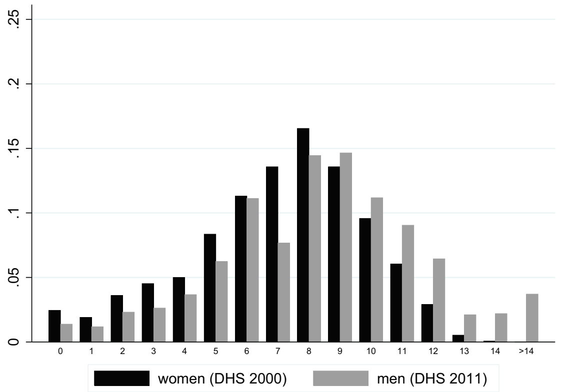
Source: DHS. Notes: The sampled households include the number of households that have been sampled for the women's and men's questionnaires, respectively. This might differ from the acutal responding households. Only the DHSs that we use for the information on men are considered. The very right 3 columns represent the people who were finally interviewed.



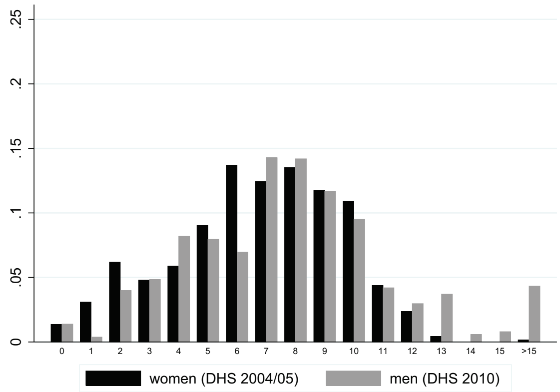
(a) Burkina Faso (Cohort 1951-55)



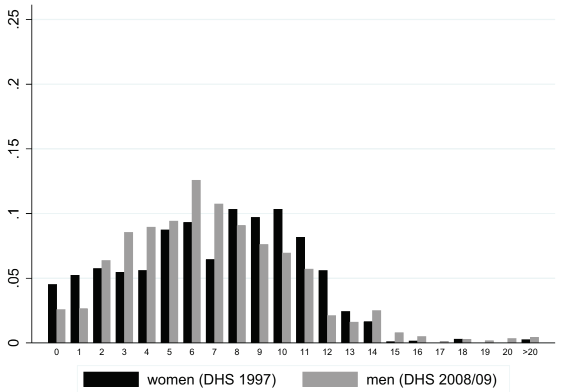
(b) Senegal (Cohort 1951-55)



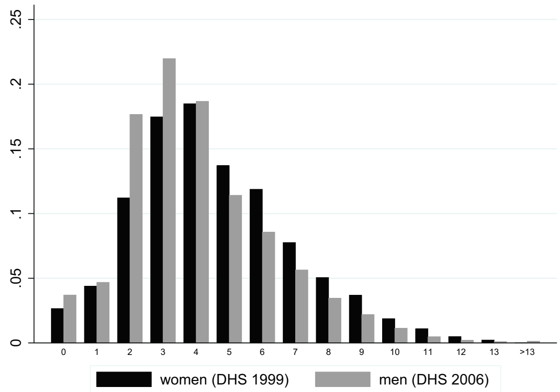
(c) Ethiopia (Cohort 1952-56)



(d) Malawi (Cohort 1956-60)



(e) Madagascar (Cohort 1949-53)



(f) India (Cohort 1951-55)

Notes: For the gender with the higher maximum number of children, the distribution is censored at the highest number of children reported by the opposite gender. In all countries apart from India, the highest fertility is reported by men. In those cases, the maximum number of children born to women is taken as a censoring point for the male fertility. In India, the reverse is true.

Figure 4.A1.: Fertility Distribution (censored)

Part III.

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Curriculum Vitae

2011-2014	PhD in Economics University of Mannheim, Center for Doctoral Studies in Economics, Germany
2009-2011	Master of Science in Economic Research University of Mannheim, Germany
2010-2011	Visiting Scholar University of California, Berkeley, USA
2006-2009	Bachelor of Science in Economics University of Mannheim, Germany
Fall 2008	Erasmus Exchange Student University of Copenhagen, Denmark
2003-2006	Diploma/Bachelor of Arts with First Honours in Banking and Business Administration Baden-Wuerrtemberg Cooperative State University, Germany