# Polygyny and the Economic Determinants of Family Formation in Sub-Saharan Africa*

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**Abstract**

Young bachelors and older married men compete for brides in many areas of Sub-Saharan Africa where polygyny is still practiced. This paper studies how local economic conditions affect the demand for first/unique wives compared to the demand for junior (second or higher order) wives and their consequences for family formation. It shows that the latter is more sensitive to aggregate income shocks (rainfall and crop price shocks) in areas where the shadow price of marrying a junior wife is low. As a result, girls exposed to negative shocks during their prime marriageable years are more likely to marry as first/unique wives of young men. Additionally, the higher elasticity of the demand for junior wives substantially attenuates the extent to which girls' age of marriage and first birth respond to aggregate income shocks.

**JEL Codes.** J1, O15.

**Keywords.** Marriage market, polygyny, bride price, income shocks, informal insurance.

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# 1 Introduction

Polygyny and bride price customs are still practiced extensively in many areas of Sub-Saharan Africa (SSA) with important socioeconomic consequences (Jacoby, 1995; Tertilt, 2005; Rossi, 2019; Ashraf et al., 2020).[1] In these areas, young bachelors are competing for brides with older married men who are seeking to remarry. Changes in economic conditions affect men's willingness to pay for a bride (Jacoby, 1995; Corno et al., 2020). Whether this effect is different for those who are looking for a first/unique wife and those who want to remarry a junior wife (second or higher order wife) is a crucial question that we know little about.

A difference in income elasticity between the demand for first/unique wives and the demand for junior wives will have drastic consequences on family formation and welfare for two main reasons. First, it will induce a shift in the market shares of these two components of the demand when there is an aggregate income shock. This will impact the marital outcomes of many of the women whose marriages are arranged during these harsh times and potentially lead to long-term consequences on their welfare.[2] This shift in market shares could also affect aggregate welfare if young bachelors become more productive after marriage (Becker, 1981; Korenman and Neumark, 1991) or respond to it by reallocating time away from non-productive activities such as leisure, crime, and violence (Akerlof, 1998).[3] Second, marriage markets in SSA are characterized by a widespread practice of child marriage (defined as marriage before the age of 18) for girls. This practice has been linked to poor health, educational, and socioeconomic outcomes for both women and their offspring. A difference in sensitivity between the two types of demand for wives may influence how the equilibrium quantity of child marriages (and marriage timing in general) responds to aggregate shocks in presence of polygyny.

This paper studies how local economic conditions affect the demand for first/unique wives compared to the demand for junior wives and its consequences for family formation in SSA. I focus on short-term aggregate shocks and seek to investigate how they impact a large spectrum of marital outcomes that are tightly linked to any potential difference in elasticity between these

[1] Polygyny is a marital system that allows men to have multiple wives. Bride price is a payment from the groom's family to the bride's family at the time of marriage.

[2] There is evidence that first wives have better bargaining power than junior wives in polygynous households (Matz, 2016; Munro et al., 2019; Reynoso, 2019). The remarrying men are older so junior wives tend to have larger husband-wife age gaps, which can also deteriorate their bargaining power (Browning et al., 1994; Carmichael, 2011; Oreffice, 2011) and lead to a higher likelihood of early widowhood (Lambert et al., 2018).

[3] In polygynous societies and those with a strong gender imbalance (e.g., China), the excess of unmarried young men increases crime and other violent activities (Edlund et al., 2013; Cameron et al., 2019; Koos and Neupert-Wentz, 2020; Rexer, 2022). Edlund and Lagerlöf (2012) extends the idea of time reallocation toward productive activities to illustrate the impact of a polygyny ban on investment in children.

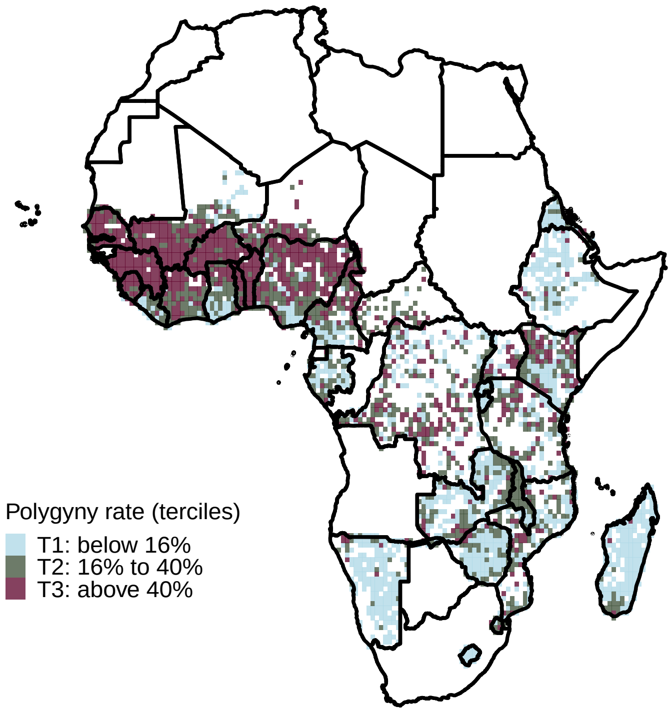
two types of demand for wives.

To guide the empirical analysis, I model the relationship between polygyny, child marriage, and household income in an equilibrium supply and demand framework. I argue that poorer men find it optimal to remarry at baseline in areas where the shadow price of marrying a junior wife is lower. These marginal men will therefore be more sensitive to income shocks in their decision to remarry or not. However, the shadow price of junior wives does not influence the marital decisions of families who are looking for a first/unique wife for their marriageable sons. If this shadow price is low enough, the extra sensitivity of the demand for junior wives can make it even more responsive to aggregate shocks than the demand for first/unique wives. In this case, adverse economic shocks will decrease the market share of older men who are looking for a junior wife to the benefit of younger bachelors.

Lower aggregate income increases child marriage in monogamous marriage markets as argued in (Corno et al., 2020). This happens because patrilocality (the fact that women move to the groom's family upon marriage) makes the demand of child brides less sensitive to an aggregate income drop than the supply. A higher elasticity of the demand for junior wives compared to the demand for first/unique wives also means that the overall demand for child brides will be more sensitive in polygynous areas compared to monogamous ones. This should lead to a weaker impact of these shocks in the latter compared to the former if the supply of child brides is not more elastic in presence of polygyny.

I test these claims and the mechanisms behind them empirically by examining the effects on marital outcomes of the two main sources of fluctuation in agricultural income in SSA: rainfall and global food price shocks. For that, I use Demographic and Health Survey (DHS) data for more than 300,000 women spread across 30 countries in SSA. Polygyny is still widespread in many areas, while other areas are predominantly monogamous. Figure 1 shows the spatial distribution of $0.5 \times 0.5$ decimal degree grid cell level polygyny rates, defined as the share of women who are in union with a polygynous husband. In high polygyny areas (top tercile), over 40% of married women are in polygynous unions. They mostly cover the western part of the so-called "polygyny belt" that stretches from Senegal in the west to Tanzania in the east (Jacoby, 1995). This proportion drops below 15% for markets in low polygyny areas (bottom tercile), with half of them exhibiting a polygyny rate lower than 5%. Medium polygyny areas (middle tercile) are in between. This spatial variation is relatively stable over time and consistent with other proxies of polygyny norms (see Section 3.2). I rely on this persistent spatial variation to test the predictions of my model.

Figure 1: Practice of Polygyny across Space in SSA




**Note.** The polygyny rate is the average share of married women (aged 25 and older) who are in union with a polygynous male in each 0.5 $\times$ 0.5 decimal degree ($\sim$ 50$\times$50 km at the equator) grid cell. It is computed from Demographic and Health Survey (DHS) data collected between 1994 and 2013.

My main results show that droughts increase the market shares of young men looking for a first wife at the expense of older men looking for a junior wife. To establish this result, I leverage the random timing of rainfall shocks to identify cohorts of girls that have been exogenously exposed to them or not during their prime marriageable age (between age 12 and 24). I follow the literature and define a drought as as an annual rainfall realization below the 15th percentile of the local rainfall distribution (Burke et al., 2015; Corno et al., 2020). Girls exposed to droughts between age 12 and 24 are 3.8 percentage points (pp) less likely to marry as a junior wife in high polygyny areas (defined above), which represents 17% of the average share of junior brides. They are also more likely to marry a younger husband with an age gap that is 0.8 years lower ( 7% of the average husband-wife gap). There is no link between exposure to droughts and these two outcomes in low and medium polygyny areas. These findings are robust to a wide set of alternative proxies for polygyny norms, including religion-based proxies.[4] They are also robust to alternative definitions of rainfall shocks and various sample restrictions.

[4]Religion-based proxies rely on the fact that Christian religions often forbid polygyny while Islam and traditional religions in SSA allow/encourage it.

To document the mechanism behind this effect, I conduct some heterogeneity analysis across space. I focus on two key factors that influence the shadow price of junior wives: rural versus urban living and communal versus private land rights systems. The cost of marrying a junior wife is lower in rural areas due to their involvement in farming and home production, as well as the lower living expenses. Within rural areas, those with communal land rights provide easier access to additional land, which further decreases the cost of marrying a junior wife.[5] The empirical analysis demonstrates that my findings are driven by these areas. In urban areas and in rural areas with predominantly privately owned land, there is no detectable link between droughts and the market shares of the demand for wives.

The empirical evidence also confirms that droughts have a weaker impact on marriage timing and on child marriage in areas with more polygyny. In low polygyny areas, a drought raises the average annual hazard of marriage by 0.7 pp (5% of the annual average hazard). This effect is smaller but remains sizable in medium polygyny areas and becomes undetectable in high polygyny areas. This attenuation pattern is driven by women from ethnic groups who traditionally practiced the bride price custom. There is no link between droughts and marriage timing for women from ethnic groups that do not practice bride price, irrespective of the extent to which polygyny is practiced in their area of residence.

The differences in the equilibrium response of marital outcomes to short-term shocks translate into differences in their effect on female fertility onset and levels by age 25. Adverse shocks increase the likelihood of early fertility onset (before age 18) in low polygyny areas but have no detectable effect in high polygyny areas.

The second source of variation in aggregate income also confirms this weaker link between income shocks and marriage timing in the presence of polygyny. To do that, I follow McGuirk and Burke (2020) and define a producer price index (PPI) by combining data on where specific crops are grown with international crop price data to form a cell-year measure. I find that a standard deviation rise in PPI decreases the hazard of marriage in the same year by 0.8 pp for women living in rural low polygyny areas. This effect vanishes in high polygyny areas.

Sensitivity and robustness checks show that the documented results are not driven by other geographic and sociocultural factors that are correlated with polygyny, such as religion, patrilineality (kinship system based on father's lineage), women's traditional role in agriculture,

[5] There is less income inequality and virtually no landless class in societies where property rights are governed by communal land rights (Goldstein and Udry, 2008; Le Rossignol et al., 2024). Le Rossignol et al. (2024) show that communal land rights arose as the optimal land tenure system in areas with long fallow requirements (the time needed to leave land uncultivated to restore fertility).

or local wealth levels. They are also not driven by differences in the reaction of the market's supply side to the shocks, differential migration behavior, differential sizes of the local marriage markets, or differential effects of the shocks on household income.

**Related Literature and Contributions.** This paper contributes to three main strands of the literature. First, it relates to the literature on the economics of polygyny. It provides novel evidence that the demand for junior wives is more sensitive to aggregate income changes than the demand for first/unique wives in many parts of SSA. Existing theories of polygyny portray it as a competition between a rich elite and poorer men for a limited supply of brides (Becker, 1974; Tertilt, 2005; Gould et al., 2008; De La Croix and Mariani, 2015). This leads to some inequality in the number of wives and potentially many poor men who cannot marry. A tacit implication of these theories is that short-term income shocks will have a smaller effect on the rich elite's marital decisions. They will therefore affect less the demand for junior wives compared to the demand for first/unique wives that comes from poorer bachelors. This has, however, never been sustained by any empirical evidence, to the best of my knowledge. My paper argues that, in theory, this is not necessarily the case. It shows that in fact, the opposite is true in many areas of SSA where the shadow price of junior wives is relatively low.

Jacoby (1995) is the only other paper in the literature that tests with micro data how economic conditions affect the demand for wives. He compares the income and shadow price effect of the agricultural development that occurred in the 1960s and 1970s in Côte d'Ivoire. He shows that the latter dominates the former, leading to a decline in polygyny over the period. I focus instead on transitory income shocks that do not affect the shadow price of brides and are very common across SSA. Taking into consideration the fact that polygyny is a sequential one-to-one matching allows me to study the differences in sensitivity of the demand for first/unique wives and the demand for junior wives to such shocks.

Second, this paper fits within the literature that studies how marriage markets work (Abramitzky et al., 2011; Banerjee et al., 2013), and the role of economic factors in marital decisions (Tertilt, 2005; Greenwood et al., 2017; Autor et al., 2019). Many papers have examined the effect of income shocks on marital outcomes for girls (Hoogeveen et al., 2011; Corno et al., 2020; Chort et al., 2021; Corno and Voena, 2023). However, all these papers focus their analysis on monogamous markets. In particular, Corno et al. (2020) introduced an equilibrium framework that explains why droughts increase child marriage in the presence of a bride price, but they decrease it in the presence of a dowry. My paper contributes to this literature by extending the one-to-one matching framework in (Corno et al., 2020) to analyze how local economic conditions affect the timing of marriage and other marital outcomes when polygyny is allowed.

Rexer (2022) is the only other paper that studies how income shocks affect girls' marriage timing in both polygynous and monogamous areas. He establishes a link between rainfall shocks, marriage inequality among men, and the Boko Haram Islamist insurgency in Nigeria. For that, he argues that when women experience good rainfall during their premarital adolescence (supply-side shock), their families raise the reservation bride price, and women delay marriage. This effect is more pronounced in polygynous areas, where women can still match later with the wealthier men (as junior wives). In contrast, my paper treats rainfall fluctuations as aggregate yearly shocks (affecting both sides of the market) that are directly linked to the marriage timing of girls, following Corno et al. (2020). I also abstract from the complex interaction between violence and marital decisions by focusing on cohorts that have not been exposed to any civil war. My results show that, on the contrary, these shocks have a stronger effect on the timing of marriage in monogamous areas. The supply-side mechanism suggested in Rexer (2022) plays therefore a minor role in how the marriage market clears with changing economic conditions.

Third, this paper adds to the literature on the economic effects of culture and local norms. A series of papers document the role of various cultural values and beliefs on economic development and household decision-making (Fernández, 2011; Anderson and Bidner, 2015; La Ferrara and Milazzo, 2017; Ashraf et al., 2020). I contribute to this literature by showing that local norms regarding the practice of polygyny significantly influence the equilibrium reaction of the marriage market to income shocks in a non-trivial way.

**Outline.** The paper is structured as follows. Section 2 provides background information on polygyny and describes the conceptual framework of my analysis. Section 3 describes the data and provides measurement information on key variables of the analysis. Section 4 presents the empirical results and Section 5 concludes.

# 2 Background and Conceptual Framework

## 2.1 Background

### 2.1.1 Practice of Polygyny across Space and Time

The extent to which polygyny is practiced in different parts of SSA is relatively stable over time. Figure A2 shows the temporal evolution of the share of polygynous unions within the 10 years preceding each DHS wave by country.[6] The proportion of polygynous unions remains consistently low in countries such as Madagascar (below 5%) and, to a lesser extent, in Rwanda, Zambia, Zimbabwe, and Namibia (below 10%). Monogamy overwhelmingly prevails in these countries, with polygyny being marginal or practiced in very few areas within each country. Polygyny rates are also relatively stable (or show a slight decline) in countries with intermediate levels of polygyny (between 10 and 25%), such as Cameroon, Ghana, and Uganda. There is, at best, a gradual decline in the proportion of polygynous unions for countries with high levels of polygyny, such as Benin, Burkina Faso, Mali, and Guinea. Even with this decline, these countries still recorded higher shares of polygynous unions within the 10 years preceding the most recent survey waves (around 2015) than what those with a medium level of polygyny experienced within the decade preceding the oldest survey waves (around 1995).

**Fine-grained Spatial Variation.** The average polygyny rate at the cell level captures local variations in the extent to which polygyny is practiced, as depicted in Figure 1 above. The 50$\times$50 km cell grids are large enough to encompass local marriage markets (Mbaye and Wagner, 2017; Corno et al., 2020). Figure A2 displays the kernel density of the distributions of all grid cells based on polygyny rates. More than 15% of the grid cells have a zero polygyny rate, and 50% of the cells in the bottom tercile (low polygyny areas) have a polygyny rate below 5%. On the other end of the spectrum, approximately 18% of all cells have a polygyny rate exceeding 50%. This represents more than half of the cells in high polygyny areas.

[6] This ratio only considers women who marry as junior wives in the numerator and excludes young lone wives who may later become polygamist senior wives. It presents the advantage of being comparable across different surveys, given that the DHS sample represents a repeated cross-sectional dataset of women belonging to a fixed age group. Alternatively, to examine changes in polygyny over time by exploring the link between the year of birth and polygyny, one must eliminate age effects in a regression framework, as argued in Fenske (2015).

#### 2.1.2 The Determinants and Correlates of Polygyny Norms

**Determinants.** In the economics and the anthropology literature, two main theories are put forward to explain the incidence of polygyny in SSA. The first is that polygyny is rooted in the large contribution of women in agriculture (Boserup, 1970). In the absence of markets for female labor, marriage to multiple wives is the primary way to augment the household female workforce, which leads to polygyny. Jacoby (1995) provides evidence from micro data that supports this argument in the case of Côte d'Ivoire.

The second theory is proposed by Becker (1974). He suggests that the demand for wives comes mostly from the demand for children and the perceived advantages associated to it includes prestige, old-age security, and heirs. His theory relies on inequality across men in the marriage market to explain polygyny. This is also the case for theories developed in Gould et al. (2008) and De La Croix and Mariani (2015) to explain the dynamics of marital institutions across different stages of development.

**Correlates.** These two main theories are sustained by strong empirical patterns that have been widely documented in the literature. I replicate the evidence on the main correlates of polygyny using my sample in Table A3. Polygyny is more frequent in patrilineal societies where kinship runs through the man's family compared to matrilineal ones (column 1). It is also more frequent among ethnic groups that practice bride price customs (column 2). This comes from the fact that these bride price customs are more frequent in patrilineal societies where the bride's family needs to be compensated for the loss of a productive asset after marriage. The link between historical female importance in agriculture and polygyny is negative in my data (column 3). Fenske (2012) argues that a plausible explanation for this negative correlation is that women have better bargaining power in societies where they historically contribute more to agricultural production. Areas that received more Catholic and Protestant missions have less polygyny (columns 4-5) because Christian religions forbid this practice. Women who report being Christians in my sample are also less likely to be in a polygynous union (column 6). Polygyny is more frequent in rural areas where female contribution to household income is high (column 7). It is also more frequent among women with no education (column 8) who are typically valued for their reproductive and farming capacity. Grid cell level average wealth is negatively correlated with polygyny but there is no detectable link between wealth inequality within cells (measured by the standard deviation) and polygyny (column 9).[7]

Some studies have suggested a link between exposure to the slave trade and the practice of polygyny today (Edlund and Ku, 2011; Dalton and Leung, 2014). However, this result hinges mostly on a broad comparison of West Africa to the rest of the continent. For instance, Fenske (2012) and Teso (2019) show that the positive correlation between the slave trade and polygyny that is found in micro-level data disappears once country fixed effects are included.

### 2.1.3 Polygyny as a Sequential one-to-one Matching with a Shifting Role for Parents

Bigamy is by far the most common form of polygyny in SSA. Figure A5 shows that even in high polygyny areas, 73% of women in polygynous unions have only one co-wive and 20% have two co-spouses.[8]

Polygyny works in practice as a sequential one-to-one matching in SSA for two reasons. First, there is, on average, more than 10 years between the arrival of the first and the second wife. In Senegal, this time gap is below 6 years in 25 % of polygynous unions, below 12 years for half, and below 16 years for 75% of cases (see Rossi (2019), page 10). In my data (see Panel B of Table A2), the distributions of the age at first marriage for unique, first, or second wives are similar in high polygyny areas ( average age is 17). However, the average husband-wife age gap is of 10 years for first wives and unique wives but 16 years for second wives. This confirms the sequentiality of polygynous unions. The large husband-wife age gap, even for first/unique wives, also means that there is a substantial share of cross-cohort unions that occurs in equilibrium.

Second, the sequentiality of polygynous unions is also reflected by the fact that a man's family (often his father) plays a key role when he is searching for a first/unique wife but not when he is looking for a second one. There is indeed ample survey evidence that parents are very involved in the first union of their sons (especially the young ones). They provide start-up capital (e.g., land) for the new household, arrange and host the marriage ceremony, and often cover most expenses, including bride price payment.[9] However, the decision to marry a second wife and the costs involved are paid for by the groom himself with little involvement from his

[7]The wealth measure recorded in the DHS data relies only on physical assets. Tertilt (2005) argues that polygyny leads to more people buying wives and selling daughters instead of investing in human or physical capital. This could explain the absence of correlation between asset-based wealth inequality and polygyny.

[8]The information on the number of co-wives and spousal ranking takes into account wives that do not co-reside in the same dwelling but these women are not directly surveyed. Rossi (2019) use a more detailed survey in Senegal that collects information on all the wives of a given household head, even if they do not co-reside. She also finds that 80% of polygynous unions are bigamous.

[9]Even successful young men who have high earnings often need to share enough of these earnings with their family before getting the approval for their first marriage (Boutillier et al., 1977; Dupas et al., 2023).

family.[10] Goldschmidt (1974) collected detailed data on how marriages are arranged in East Africa and documents that *"It is incumbent upon a man to supply the bride price for the first marriage of his son but he does not need to help in the payment of subsequent wives and rarely does so"*. Guirkinger and Platteau (2015) collected more recent data on farm households in rural Mali and found that *"most household heads consider that, when individual plots are awarded, they are no more responsible for the financing of marriage-related expenditures including bride price payments. Such expenses now befall the holders of individual plots."*

**Relative Importance of "Selling" Daughters to "Buy" Wives Theory.** Tertilt (2005) argues that *"fathers frequently do not help their sons pay a bride price for their own brides"*. Edlund and Lagerlöf (2012) also stress that parents often use their authority to mobilize household resource to pay a bride price for themselves at the expense of their sons. In light of the arguments mentioned above, this should be taken with caution for the first brides of the sons in many areas of SSA. Moreover, this does not prevent parents from playing a crucial role in the organization of their sons first unions through their control over other necessary inputs, as argued in the first part of the previous paragraph.

Tertilt (2005) also adds that *"Instead, men often use the revenue from a daughter's marriage to buy additional wives for themselves, and sons marry late to give them time to accumulate enough wealth to afford a wife (see Goody and Tambiah 1973, 8; Quale 1988, 91)."* While this "selling" daughters to "buy" wives may be happening in many instances, this is unlikely to be the main driving force of polygynous unions in contemporary SSA. In practice, the majority of polygynous men marry their second wife within less than 12 years after marrying the first one (see second paragraph of this section). The demand for second wives is therefore predominantly coming from married men who do not have daughters of marriageable age (which starts at 12 in the data). The decision to remarry for these men is therefore not tied to the possibility of marrying off their own daughters. For the case of Senegal discussed above, only up to 25% of men could have had a child older than 15 when they were marrying a second wife (Rossi, 2019).[11] Around half of these men had a son as their first child, given the gender ratio at birth.

[10]This is typically true when the first union is successful match. In situations where this is not the case (e.g., because the woman is infertile) the family of sons can be more involved in finding them a second wife relatively fast given that most women get pregnant within the first year of marriage in SSA. This type of second unions is rare in the data. The majority of remarriages happen more than 10 years after the first union as argued above.

[11]85% of women marry at age 15 or above in the data.

#### 2.1.4 Polygyny and Income

Polygyny is not just practiced by the rich elite in SSA. Figure A4 shows that there is a stable proportion of polygynous households across all the asset-based wealth quintiles in my DHS sample. There is also evidence that in many areas across SSA, a substantial share of polygynous men are relatively poor (in terms of income) and tend to face higher levels of economic stress than monogamous men (Antoine et al., 2002; Heath et al., 2020).

The fact that polygyny is common even among relatively poor men is also consistent with the idea that many of these men remarry primarily due to social pressure and because they value substantially the extra services provided by a second wife in the household (sexual, reproductive, and other domestic services).[12]

#### 2.1.5 Polygyny, Child Marriage, and Bride Price in SSA

**Child Marriage.** Child marriage for girls plays a crucial role in how marriage markets clear in SSA. In the data, 45% of girls are married before age 18 versus less than 1% for men. The higher demand for brides in polygynous areas translates into a higher equilibrium quantity of child marriages. The proportion of child marriage is 30% in low polygyny areas, 43% in medium polygyny areas, and 63% in high polygyny areas (see Panel C of Table A2).

**Marriage and Bride Price.** Bride price is typically considered to be a payment to the bride's family in exchange for her labor and reproductive capabilities. Bride price amounts fluctuate over space and time in accord with standard supply and demand theory (Becker, 1973; Goldschmidt, 1974). Within a given year and location, they are relatively constant across grooms' families with different characteristics, including income levels (Borgerhoff-Mulder, 1995; Zhang, 2000; Anderson, 2007). These amounts also do not vary in any systematic way with the wife's ranking in polygynous areas within a given year (Goldschmidt, 1974; Borgerhoff-Mulder, 1995; Anderson, 2007). The main source of heterogeneity in bride price amounts comes from brides' characteristics that affect their reproductive and labor capabilities. Educated women, those who are young or reached puberty early, and those who were never married before command higher

[12] Goldschmidt (1974) documents some strong peer pressure in favor of polygyny in many ethnic groups of East Africa, and this often takes the form of mockery and derision. This is well captured in popular sayings such as this one from the Sebei ethnic group (present in Uganda): *"A man with one wife is a neighbor to a bachelor,"* which means that if the wife is unavailable (e.g., sickness), he must do the household chores himself. Having a second wife provides some continuity in the services that women provide. Doing so still requires resources, and the poorest men cannot afford it throughout their lives.

bride price payments than the others (Anderson, 2007; Lowes and Nunn, 2018; Ashraf et al., 2020).

### 2.1.6 Polygyny, Divorce and Remarriages

In SSA, most women marry only once in their lifetime, and the extent to which some of them re-marry is similar across monogamous and polygynous areas. In my sample, 77% of ever-married women have been married only once in low polygyny areas, versus 76% in medium and 78% in high polygyny areas. The women who remarry are those who divorced or lost their previous husbands by death. In the latter case, they remarry within their late husband's family (levirate) or into a different family. The percentage of widows is low in my sample. It is lower in high polygynous areas (3%) compared to low polygyny areas (6%), partly due to the practice of levirate. The proportion of divorced or separated women is also lower in high polygyny areas (3%) than in low polygyny areas (11%). The presence of polygyny does not lead to higher divorce rates due to the strong patriarchal norms that impose a high cost of divorce on women. Most divorces in SSA occur within the first years of a union (Lambert et al., 2018), while men tend to marry a second wife on average 10 years after their first union.[13] In the model below, I will abstract from divorce and remarriages (including levirate) for simplicity, given their limited aggregate importance even in polygynous areas.

## 2.2 Conceptual Framework

I propose a conceptual framework to better understand the link between polygyny, economic conditions, and marital outcomes. The model detailed in Appendix Section A.1 merely formalizes the intuitions behind this framework. It relies on the stylized facts discussed above. The framework builds on and extends the one in Corno et al. (2020) to allow for polygyny. This is done by combining insights from Becker (1981), Jacoby (1995), and Tertilt (2005).

### 2.2.1 Overview

I model polygyny in an equilibrium supply and demand framework following Becker (1973, 1981) and Grossbard (2015). To focus on the key mechanism of my analysis and keep the model tractable, I follow Tertilt (2005) and assume that brides and grooms are homogeneous except

[13] The majority of divorces in SSA are explained by factors such as urbanization, education, female employment, and kinship systems (Reniers, 2003; Takyi and Broughton, 2006; Clark and Brauner-Otto, 2015).

for their age and gender.[14] The model features agents that are active for two periods and can only marry once per period. Two overlapping cohorts are active each period on each side of the market. On the supply side, potential child brides are active on the market for the first time and unmarried adult women return to the market for a second time. On the demand side, there are young adult men and older married/unmarried men in their first and second participation, respectively. Polygyny is modeled as a sequential one-to-one matching (see Section 2.1.3). The share of men for whom polygyny is not forbidden (e.g., by cultural or religious norms) in the market will determine the relative importance of the potential demand for second wives. This is exogenous in the model.

Brides are rationed according to a matching process in which there is an excess quantity of unmarried old men on the market and a substantial share of cross-cohort unions in equilibrium (see Section 2.1.3). These men (and their families) have the highest willingness to pay a given bride price because this is their last chance to get married without incurring the cost/disutility of being too old to be single (e.g., stigma). They marry all women of the oldest generation and some of them will marry child brides.[15] Parents of young men who are active in the market for the first time can wait to marry them in the next period. They compete for child brides with married men who return to the market looking for a second spouse. On the supply side, women from the oldest cohort also have a higher willingness to accept a bride price in order to avoid the cost and stigma of being unmarried by the end of their prime marriageable age.[16] The equilibrium bride price is therefore determined by the demand and supply of child brides.

The model assumptions on income and preferences follow closely Corno et al. (2020). Preferences are given by a concave utility function over consumption. This concavity implies that a unitary drop in income will have a bigger effect on the utility of poorer households. Income is formed by an aggregate component and a household specific idiosyncratic component. Agents compare their lifetime utility across different choice scenarios to make marital decisions each period. On the demand side, the decisions to marry a second wife or a first/unique wife are

[14]As argued in Jacoby (1995), assuming that brides are homogeneous is not a bad approximation in traditional societies with little investment in human capital and prescribed female roles within the household. In my sample, the proportion of women with no education is 58% in rural areas and 28% in urban areas. 40% of educated urban women only attended primary school. On the demand side, richer or highly productive men are more likely to be polygynous but there is still a substantial share of polygynous men among relatively poor men as argued in Section 2.1.4. One way to easily accommodate such heterogeneity in my model is to consider that rich men's marital decisions are not significantly affected by aggregate income shocks.

[15]This is consistent with the model in Tertilt (2005) in which *"A man can choose to marry either a wife of his own age or a wife who is a generation younger than he is."* Her paper also argues that all men are able to find a wife despite the fact that there is polygyny because of the large spousal age gap and high population growth.

[16]Women's fertility prospect start dropping substantially after their prime marriageable age.

given by threshold rules such that every agent with an idiosyncratic income draw higher than the threshold find it optimal to marry. On the supply side, parents with an idiosyncratic income draw lower than the equilibrium supply threshold will find it optimal to marry off their daughter as a child bride.

The demand for child brides has two components that are sensitive to income and bride price fluctuations: the demand for first/unique wives from young men and the demand for second wives from older men. The relative sensitivity of these two components to income shocks will determine how their market shares respond to such shocks. This also has implications on how the equilibrium quantity of child marriages responds to such shocks.

#### 2.2.2 Main Testable Predictions: Intuitions

**Prediction 1.** Families of young bachelors are competing with already married men for brides. All families find it optimal to marry their sons but the timing of such unions is controlled by elders and depends on many factors that are independent of short-term economic conditions (e.g., family composition and land endowment, perceived readiness for marriage). When deciding on the timing of the marriage of their son, these families do not factor in the potential value of a future junior bride. They have no social obligation to secure a second wife for their son and do not necessarily benefit from it, as argued in Section 2.1.3. Therefore, the sensitivity of the demand for first/unique wives to aggregate shocks does not depend on the shadow price of junior wives. However, a higher lifetime net value of a junior wife's labor and services leads to a lower shadow price so that poorer married men find it optimal to marry one at baseline. These marginal men will, therefore, be more sensitive to income shocks. If the shadow price of a junior wife is low enough, this extra sensitivity can lead to a demand for second wives that is even more responsive to aggregate shocks than the demand for first/unique wives.

**Prediction 2.** The equilibrium quantity of child marriages will vary depending on which side of the market is more sensitive to the aggregate income shock. Negative shocks increase the number of child marriages in monogamous societies because of the greater sensitivity of the supply of child brides relative to the demand for unique wives (due to patrilocality), as argued in Corno et al. (2020). However, in polygynous markets, if the demand for second brides is more sensitive than that for first/unique brides this will result in a smaller increase (if any) in the equilibrium quantity of child marriage.[17]

### 2.2.3 Testable Predictions on Mechanisms: The Shadow Price of Junior wives

The shadow price of a bride is the difference (in absolute term) between her marriage lifetime maintenance cost and the economic value of the benefits that she provides: marital services (e.g., companionship, sex, fertility), home production (e.g., farming, housekeeping), and labor market activities (paid labor). The main hypothesis of this paper is that the demand for junior wives is more sensitive than the demand for first/unique wives to aggregate shocks if the shadow price of marrying a junior bride is sufficiently low and relatively poor men find it optimal to remarry at baseline. This is obviously not necessarily the case everywhere in SSA. There are two margins of variation in the shadow price of marrying a wife that can be exploited to illustrate and test the mechanism behind this prediction: (i) rural versus urban residence, and (ii) communal versus private land rights systems.

**Rural-Urban Residence.** The shadow price of marrying a second wife is higher in urban areas, compared to rural areas, everything else equal. This is due to the higher cost of living in urban areas combined with the fact that the value of a second wife is lower in these areas. Cities in SSA are plagued with high unemployment rates and lower labor force participation for women compared to men. Moreover, a junior wife's home production value is less important in urban areas. In contrast, women in rural areas are substantially involved in the main economic activity: farm production. This activity is labor intensive, especially in female and child labor, so the marginal value of a second wife remains high (Jacoby, 1995; Tertilt, 2005). This means that, everything else equal, men need to be richer in order to find it optimal to marry a second wife in urban areas compared to rural ones. This is less the case for the demand for first/unique wives because the first bride provides highly valuable services in both areas that will not exist otherwise. The difference between the elasticity of the demand for first/unique wives and the demand for junior wives should therefore be larger in rural areas compared to urban ones.

[17] This result requires that the supply of child brides is not more elastic in presence of polygyny. My formal model assumes that this supply is equally sensitive to income shocks with or without polygyny. The supply of child brides is actually likely to be less elastic in polygynous areas, which strengthens Prediction 2. As argued in Rexer (2022), girls have a greater option value of waiting in the presence of polygyny. This is because wealthier men return to the market after their first marriage which increases both the likelihood of meeting a match next period and the expected value of this match. Young women can even still marry some of the high-ability young bachelors who are induced to marry later because of the high competition for wives in polygynous markets.

**Communal versus Private Land Rights.** There is a substantial variation in the structure of property rights over land across SSA. There is virtually no landless class in societies where property rights are governed by communal land rights (Goldstein and Udry, 2008). This system is associated with less income inequality, less conflict, more flexibility in redistributing resources in hard years, and greater peace resilience in the wake of negative shocks (Goldstein and Udry, 2008; Le Rossignol et al., 2024). Easier access to land in these rural areas should reduce substantially the shadow price of marrying a junior wife, making it optimal for poorer men at baseline. This can also lead to higher sensitivity of the demand for junior wives compared to the demand for first/unique wives, following the same line of argument developed in the previous paragraph. This effect is also reinforced by the fact that any redistribution of resources when there is a negative shock will favor young men who are deemed ready to get married in these communities. They often consider a first bride as a necessary good for mature young bachelors but marrying a second wife is perceived as a luxury good.

The higher redistribution of resources in areas governed by communal land rights could also influence in different ways the extent to which income shocks affect the overall supply of child brides. This leads to unclear predictions regarding the heterogeneity of the effects of aggregate shocks on the equilibrium quantity of child marriage.

# 3 Data and Measurement

## 3.1 Household Data and Sample for Analysis

Household data comes from the DHS. These are nationally representative household surveys carried out regularly in several developing countries worldwide. The final dataset assembles all the publicly available DHS surveys in SSA between 1994 and 2013, where geocoded data are available, resulting in a total of 71 surveys across 30 countries (see Figure A2). The GPS coordinates of each DHS household cluster are used to match them to their corresponding $0.5 \times 0.5$ decimal degree PRIO-GRID cell. This is then used to measure each survey respondent's exposure to droughts and crop price shocks over time.

**Sample Restrictions.** The analysis is restricted to the sample of women who are at least 25 years old at the time of the interview. Women exposed to civil conflicts by age 25 are also dropped in the main analysis to abstract from the complex interactions between violence and marital decisions, following Corno et al. (2020). The UCDP/PRIO Armed Conflict Dataset is used to identify the onset and the end of the main armed conflicts. I also show robustness to including war-affected cohorts in the analysis.

## 3.2 Proxies for Local Polygyny Norms

I use several proxies to capture local norms regarding polygyny (the extent to which polygyny is allowed/accepted). These proxies can be grouped into two categories: prevalence-based proxies and religion-based proxies.

### 3.2.1 Polygyny Prevalence-Based Proxies

This category of proxies captures polygyny norms through the long-term average prevalence of polygyny in each cell.

**Stock Prevalence Proxy.** The first proxy within this category is the long-term average share of married women who live in a polygynous household, as defined in Figure 1. This captures the stock of polygynous women relative to the stock of married women between age 25 and 49 in each survey year. This ratio is averaged over all available survey waves in each country. This is my main proxy for polygyny norms at the grid cell level. I show below that this proxy is suitable for testing my theoretical predictions and consistent with other alternative proxies of the extent to which polygyny is allowed/accepted in different areas.

**Flow Prevalence Proxies.** This is the share of junior wife marriages during a given time window: women marrying an already married husband as second or higher order wives. Figure A6 shows for each marriage decade from the 1970s to the 2000s, the proportion of junior wife unions in each tercile of the polygyny rate defined above. This proportion is relatively stable within each group, despite a slight declining trend in high and medium polygyny areas. Less than 5.3% of unions are junior wife marriages in each of these decades in low polygyny cells. Between 12 and 18% of women marry into a polygynous union in medium polygyny areas. This proportion varies between 27 and 30% in high polygyny areas.

This confirms first the fact that spatial differences in the extent to which polygyny is practiced across the three areas defined above (Figure 1) are relatively stable over time. High polygyny areas consistently have proportions of junior wife unions that are six times (twice) higher than those in low (medium) polygyny areas in each decade. It also shows that the market shares of the demand for junior wives is sizable in high polygyny areas, but it remains limited (30% on average). Young bachelors who are looking for their first/unique wife still dominate these markets.

### 3.2.2 Religion-Based Proxies

The second category of proxy is based on religion. Islam and traditional religions in SSA approve and often encourage polygyny while most Christian religions explicitly forbid this practice. In my data, 20% of Christian women live in a polygynous household versus 47% for non-Christian women. The share of Christians in a given cell is therefore a good and stable proxy for the extent to which polygyny is practiced in each cell.

This category of proxy relies on the fact that religion is a cultural trait that is transmitted across generations. Children often inherit the religion of their parents and marry partners within this religion. Because of patriarchal norms, women tend to convert to the religion of their husbands in case of interfaith marriages, but rarely the reverse.[18]

Religion is also a suitable proxy for my analysis because of its strong spatial sorting in SSA.[19] Figure A3b shows that the distribution of cells by the share of non-Christian women is bimodal. Most cells have either a low or high share of Christians and fewer cells have a mix close to 50-50. A bigger mass of cells has a low share of non-Christians, which means that more cells will be (almost) entirely ruled by monogamous marriage norms. This suggests that in terms of the underlying polygyny norms, medium polygyny areas are not equidistant from low and high polygyny areas. They are rather closer to the former. I show below that the results obtained with the religion-based proxies are not driven by religion per se, but come from its correlation with polygyny norms.

### 3.2.3 Ruling Out Ethnographic Atlas Historic Polygyny Measure as a Proxy

The Ethnographic Atlas (Murdock, 1967) provides some historical information on the practice of polygyny in Africa, but polygyny is reported for 95% of ethnic groups, and there is little information on the intensity at which it occurred. This historical information is, therefore, not enough to capture the substantial spatial variation in the contemporary practice of polygyny

[18]Using DHS data from 15 countries in SSA, Crespin-Boucaud (2020) show that there are only 2.4% of Christian-Muslim unions and 9.7% of interfaith marriages.

[19]Other individual level proxies of polygyny (e.g, education) are less persistent over time and present a less clear spatial sorting, which is what is leveraged to capture variations in polygyny norms across areas.

across SSA documented in Section 2.1.1. In the analysis below, I also show robustness to taking into account the historic ethnic correlates of polygyny.

## 3.3 Proxy for Communal Land Rights

I follow Le Rossignol et al. (2024) and use the role of traditional leaders in allocating land from the Afrobarometer data (Afrobarometer, 2019) as a proxy for contemporary land rights in each cell. Their paper shows that traditional leaders are more likely to have an active role in allocating land in areas where communal property rights are more common.

For that, I use the question on how much influence traditional leaders currently have in allocating land. Respondents could select one of the following responses: (i) "None", (ii) "A small amount", (iii) "Some’, (iv) "A lot", (v) "Don’t know", (vi) "Refused".[20] To capture the (lack of) influence of traditional leaders in allocating land in each cell, I compute the share of people that respond "none" or "A small amount" to this questions (TLNI). This proportion varies between 0 and 100% with an average value of 40%.

## 3.4 Rainfall Data and Construction of Rainfall Shocks

Rainfall data from the University of Delaware (UDel data) is used to construct a measure of local rainfall shocks. The long-run time series of rainfall observations between 1950 and 2010 are used to fit a gamma distribution of calendar year rainfall for each cell. Following the literature, a drought is defined as a calendar year rainfall below the 15th percentile of a grid cell’s long-run rainfall distribution (Burke et al., 2015; Corno et al., 2020). I also explore robustness around that threshold and with a continuous rainfall measure. As shown in Figure A8, the lowest deciles of rainfall realizations are associated with a substantial drop in crop yield (15% on average). There is no clear positive relationship between higher rainfall realizations and crop yields.

## 3.5 Data and Construction of Crop Price Shocks

Following McGuirk and Burke (2020), I construct a local price series that combines plausibly exogenous temporal variations in global crop prices with spatial variations in crop production and consumption patterns across SSA. The price data comes from the IMF (International

[20] In the data, 91 % of respondents report an informative answer when asked this question ((i) to (iv)). The Afrobarometer data covers all the countries in my DHS sample except Burundi, Central African Republic, Democratic Republic of Congo, Madagascar, and Rwanda.

Monetary Fund) *International Finance Statistics series* and the World Bank *Global Economic Monitor*. The evolution of global crop prices and their exogeneity to local economic activities are discussed in Appendix A.3.

**Producer Price Index (PPI).** The PPI is obtained by combining the temporal variation in world prices with rich, high-resolution spatial variations in crop-specific agricultural land cover around the year 2000 from the M3-Cropland project (see Ramankutty et al. (2008) for more details). This land cover is mostly driven by variations in soil suitability for different crops. Figure A10 presents the crop-specific geographic distribution for a selection of six major commodities (maize, rice, wheat, sorghum, cocoa, and coffee). The PPI in year $t$ for cell $g$ in country $c$ is given by:

$$PPI_{gct} = \sum_{j=1}^{n} \left( \pi_{jt} \times N_{jgc} \right), \tag{1}$$

where $j$ represents a crop in a list of 11 major traded crops that are in the M3-Cropland dataset and for which international prices exist. $N_{jgc}$ represents crop $j$'s share of land in cell $g$ and $\pi_{jt}$ the global price index for this crop in year $t$. The index varies over time only because of plausibly exogenous international price changes.

I also construct a consumer price index (CPI) by combining global crop prices with cross-country variation in consumption patterns across SSA (see Section A.3 for details).

### 3.6 Other Data Sources

Data on precolonial ethnic correlates of polygyny such as the presence of bride price payment and the kinship system, come from the Ethnographic Atlas (Murdock, 1967). The ethnic homeland boundaries are taken from Murdock's maps (Murdock, 1959) digitized by Nunn (2008). Data on the location of Catholic and Protestant missions, plus several geographic/ecological controls discussed below are taken from Fenske (2015) who assembled them from various primary sources.

## 4 Empirical Results

I exploit the persistent spatial variation in polygyny norms in SSA to test the model's predictions. Table A2 shows descriptive statistics of the main variables used in this analysis.

## 4.1 Evidence from Rainfall Shocks

### 4.1.1 Prediction 1: Droughts and Market Shares of Men in Polygynous Markets

**Empirical Specification.** Prediction 1 implies that girls exposed to droughts during their prime marriageable age should be less likely to marry as junior wives in markets characterized by strong polygyny norms. I test this prediction using the following equation as main specification:

$$Y_{i,g,k,\tau} \quad = \quad \alpha D_{i,g,k} + \theta D_{i,g,k} \times P_g + \omega_g + \zeta_k + \delta_\tau + \epsilon_{i,g,k,\tau}. \tag{2}$$

where $Y_{i,g,k,\tau}$ is a dummy variable equal to one if woman $i$ married as a junior wife as opposed to marrying as a first/unique wife. $D_{i,g,k}$ is a dummy equal to 1 if a woman $i$ born in cell $g$ in year $k$ has been exposed to drought between ages 12 and 24 (peak marriageable years). Robustness to splitting this time window is shown below. $P_g$ is a proxy for the local norms regarding the practice of polygyny in a given cell $g$. Several alternative proxies are used to capture these norms as discussed in Section 3.2: stock and flow polygyny prevalence-based proxies and religion-based proxies. $\omega_g$ is a set of cell fixed effects (FE) included to account for time-invariant local unobservable characteristics, such as geographic, economic, and cultural factors. $\zeta_k$ and $\delta_\tau$ are year-of-birth FE and country-specific survey wave FE. They account for the effects of any common shock that occurs at a specific time. Several other optional covariates are included for robustness checks below.

For prevalence-based proxies, the share of polygynous unions remains relatively stable over large time widows and despite some limited yearly fluctuations. In order to abstract from these short-term fluctuations, I split the continuous proxies into terciles (low, medium and high polygyny areas), as shown in Figure 1. This allows me to rely only on the major and stable spatial variations in local polygyny norms for identification across all the specifications (See Section 3.2.1). It also allows the detection of any potential non-linear effects of droughts in Equation 2.[21] I nonetheless show that my empirical results hold when using the continuous prevalence-based proxies.

Sampling weights re-weighted by each country's population in the survey year are used to make the results representative of the countries included in the analysis. Standard errors are

[21] Non-linear effects in Equation 2 may happen for at least two reasons. First, the variation in religion-based proxies suggest that, in terms of the underlying polygyny norms, medium polygyny areas are not equidistant from low and high polygyny areas (see Section 3.2.2). Second, variations in polygyny rates below a certain threshold may not lead to any effect that is detectable using Equation 2 if polygyny concerns too few men and women on the market (threshold effect).

clustered at the cell level to allow for serial correlation in the error terms across women in the same area. Larger clustering units at the ethnic homeland and regional levels are also used for robustness. I also show robustness to correcting standard errors for spatial and serial correlation using the procedure developed by Conley (1999) and implemented by Colella et al. (2023).

A drought is defined as a calendar year rainfall below the 15th percentile of each cell's historical rainfall distribution, and I also show robustness to varying this threshold. This implies that all the cells have the same probability of experiencing a drought in any given year, but the timing is random. Therefore, exposure to drought within a fixed time window is plausibly exogenous in this setting.[22]

**Ruling Out Potential Endogeneity of Prevalence-Based Proxies.** In my main specification, I use the long-term average proportion of women who live in a polygynous household (stock) as a proxy for polygyny norms. This time-invariant variation in polygyny rates is absorbed by the cell FE in Equation 2 and assumed to be orthogonal to time-varying shocks such as droughts. However, the proportion of polygynous unions in a given cell fluctuates over time around the underlying unobserved stable share of people whose social values allow it. This could be a potential source of endogeneity in Equation 2. In fact, the changes in market shares due to aggregate shocks hypothesized in the model above is one example of such yearly fluctuations.

I rule out this concern in several ways. First, I show that the differences across areas with low, medium and high polygyny rates in the proportion of new brides who marry as junior wives over each of the four decades of the study period are stable and sizable (see Section 3.2.1 and Figure A6). This means that the random timing of droughts on average once every 15 years are not likely to affect the core differences in the underlying polygyny norms across these three types of areas.

Second, I use the alternative proxies for $P_g$ to directly rule out the endogeneity concerns. In the analysis below, the flow proxies are defined over various time windows to confirm that any choice of time window yields qualitatively similar conclusions. This exercise includes a data-demanding specification in which I use only unions that occurred in the 1970s (the first

[22] Only 4% of cultivated land is irrigated in Africa compared to 42 percent in South Asia (World Bank, 2023). The fact that the rainfall shocks are defined at a broad cell level in areas with little use of irrigation for agricultural productions minimizes concerns regarding potential spatial spillover effects. Throughout the paper, I document the average intention-to-treat effects of rainfall and crop price shocks. These reduced-form parameters only require the shocks to be exogenous and do not involve any exclusion restrictions or monotonicity assumptions (Angrist et al., 1996). In particular, the exclusion restriction assumption can be problematic in the case of rainfall shocks (Sarsons, 2015).

decade with a substantial number of unions in my sample) to compute the flow proxy while including in the analysis only women born after 1970. These women were too young to be active in the marriage market in the 1970s: They were at most 10 years old or not born yet.[23] This flow proxy is therefore by construction orthogonal to droughts shocks and marital outcomes of these women.

Finally, the religion-based proxy relies on the persistence of religious affiliation across time and generations. This proxy is not likely to be correlated with droughts or other unobserved factors that vary yearly. All these three arguments taken together make a strong case for the causal interpretation of the results documented below.

**Main Results.** The estimates of Equation 2 are reported in Table 1. It uses the sample of married women aged 25 or older in their first marriage at the time of the survey. Columns 1-4 show that girls who experience a drought between ages 12 and 24 are more likely to marry as a junior wife as opposed to marrying as a first/unique wife in high polygyny areas. The coefficient associated to the drought dummy ($\alpha$) is small and positive while the interaction term with polygyny rate ($\theta$) is negative, sizable, and statistically significant at 5% level (column 1). The point estimates in column 2 suggest a decrease in the likelihood of marrying as a junior wife by 3.8 pp in high polygyny areas. This represents 17% of the average proportion of junior wives in these areas (p<0.01). The equivalent coefficients for low and medium polygyny areas are close to zero and not statistically significant (0.9 and -0.4 pp, respectively). The Wald test of equality of coefficients for low versus high polygyny areas and medium versus high polygyny areas are both rejected at a 5% level. This is consistent with the idea that the impact of droughts in Equation 2 presents some non-linearity for the reasons discussed in footnote 21. Column 3 augments the main specification to account for marriage year FE. Column 4 adds birth year FE and marriage year FE interacted with the polygyny terciles. The estimates remain stable in both columns.

Columns 5-6 use religion as proxy for polygyny norms. The estimated $\alpha$ associated to the droughts dummy is close to zero while the interaction term between drought and the share of Christians in each grid cells is negative and statistically significant (column 5). Column 6 shows that droughts reduce the likelihood of marrying as a junior wife by 2.6 pp (p<0.01) for non-Christian women. They have no detectable impact among Christian women. The difference in estimated coefficient across the two groups is statistically significant (p<0.05).

[23] A large share of cells have only few unions that occur in a given decade. I aggregate cells into their corresponding ethnic homelands to reduce noisy variations in polygyny rates in this specification.

Table 1: Polygyny Norms and the Effect of Droughts on Men's Market Shares

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| **Dependent Variable:** | **Junior Wife Indicator** | | | | | |
| **Proxy for Local Polygyny Norms:** | **Long-Term Polygyny Rate** | | | | **Religion** | |
| $D_{12-24}$ | 0.0115 | | | | -0.0007 | |
| | (0.0090) | | | | (0.0087) | |
| $D_{12-24}\times$ Polygyny Rate | -0.0771** | | | | | |
| | (0.0334) | | | | | |
| $D_{12-24}\times$ Low Polygyny (T1) | | 0.0095 | 0.0086 | 0.0080 | | |
| | | (0.0070) | (0.0071) | (0.0067) | | |
| $D_{12-24}\times$ Medium Polygyny (T2) | | -0.0041 | -0.0029 | -0.0053 | | |
| | | (0.0086) | (0.0087) | (0.0087) | | |
| $D_{12-24}\times$ High Polygyny (T3) | | -0.0381*** | -0.0344*** | -0.0300** | | |
| | | (0.0133) | (0.0130) | (0.0135) | | |
| $D_{12-24}\times$ Share non-Christians | | | | | -0.0291** | |
| | | | | | (0.0138) | |
| $D_{12-24}\times$ Christian | | | | | | -0.0040 |
| | | | | | | (0.0083) |
| $D_{12-24}\times$ non-Christian | | | | | | -0.0258*** |
| | | | | | | (0.0089) |
| Observations | 172111 | 172111 | 172111 | 172111 | 171131 | 168953 |
| Marriage Year FE | NO | NO | YES | YES | NO | NO |
| Birth Year FE $\times$ Polygyny Tercile FE | NO | NO | NO | YES | NO | NO |
| Marriage Year FE $\times$ Polygyny Tercile FE | NO | NO | NO | YES | NO | NO |
| Christian Religion FE | NO | NO | NO | NO | NO | YES |
| Adjusted R-squared | 0.080 | 0.081 | 0.082 | 0.083 | 0.081 | 0.084 |
| Number of clusters | 2988 | 2988 | 2988 | 2988 | 2909 | 2837 |
| Mean dependent variable | 0.132 | 0.132 | 0.132 | 0.132 | 0.132 | 0.133 |
| P-value of Wald Test: Low versus High Polygyny Areas | | 0.00187 | 0.00393 | 0.0125 | | |
| P-value of Wald Test: Medium versus High Polygyny areas | | 0.0311 | 0.0418 | 0.124 | | |
| P-value of Wald Test: Low versus Medium Polygyny Areas | | 0.224 | 0.304 | 0.224 | | |
| P-value of Wald Test: Christian versus non-Christian | | | | | | 0.0409 |

The full regression sample includes married women aged 25 or older who have only been married once at the time of each DHS survey. All the regressions include birth year FE, country $\times$ survey wave FE and cell FE. $D_{12-24}$ is a dummy variable equal to 1 if a woman has been exposed to any drought between ages 12 and 24. A drought is defined as an annual rainfall realization below the 15th percentile of the local rainfall distribution. The proportion of junior wives is 3.2%, 10.7%, and 22.7% in low, medium, and high polygyny areas, respectively. All regressions are weighted using country population-adjusted survey sampling weights. Robust standard errors clustered at the cell-grid level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

**Threats to Interpretation: Results not Driven by Polygyny Correlates.** As argued in Section 2.1.2, polygyny norms have many correlates. It is therefore necessary to make sure that the documented differential effects of droughts are not driven by religion per se, or any of the other correlates of polygyny. For that, I augment Equation 2 with controls for each of the main correlates of polygyny, plus an interaction term of these correlates with the drought variable. Table A4 shows robustness to accounting for the differential impact of the following correlates : (i) being Christian or not, (ii) the number of Catholic and Protestant missions in each ethnic homeland, (iii) whether women come from an ethnic group that traditionally has a matrilineal kinship system, practices bride price, or has significant female participation in agriculture. The second group of correlates concern education and rural residence (column 4) and the mean and standard deviation of wealth index in each grid cell (column 5). The last group of correlates are geographic correlates of polygyny: absolute latitude, distance to the nearest coast, terrain ruggedness, and elevation. In all the specifications the estimated impact of droughts range between -2.1 pp and -4.9 pp in high polygyny areas with p<0.05 in 7 out of the 9 coefficients and the rest have p<0.06. The difference in the estimated impact between low and high polygyny areas and remains statistically significant at 5% level in all specifications.

**Robustness to Flow Proxies of $P_g$.** Table A5 shows robustness to using flow proxy measures of polygyny norms. Column 1 uses only unions that occurred in 1970s and 1980s in each grid cell to compute polygyny rates, while column 2 uses those that occurred in 1990s and 2000s.[24] Column 3 uses only cells that remain in the same tercile when using unions that occurred either in the 1970s/1980s (like in column 1) or in the 1990s/2000s (like in column 2) to compute polygyny rates. This is the case for more than 75% if women in my sample.

The main disadvantage of the flow proxies is that by focusing on a specific time window (e.g., decade), they create noisy measures of polygyny at cell level given the small number of marriages in each unit. One way to avoid this issue is to aggregate the data at ethnic homeland level to run the analysis. Column 4 shows that this aggregation yields robust results for the stock proxy. The effects seem to be more linear at this level of aggregation. Droughts reduce the likelihood of marrying as a junior wife by 1.4 pp in medium polygyny areas (p<0.1) and 2.9 pp in high polygyny areas (p<0.05). They have no detectable effect in low polygyny areas. Column 5 uses only unions that occurred in the 1970s in each ethnic homeland to compute the polygyny norm proxy. This regression also includes only women born after 1970. These women were too

[24] I aggregate the data over windows of two decades to reduce noisy variation in cell level polygyny rates.

young to be active on the marriage market in the 1970s, as argued above. The results remain robust with this specification, despite a drastic drop in sample size.

**Sample, Time Window and Clustering Robustness.** Columns 1-3 of Table A6 show that my results persist with different sample restrictions. Column 1 uses only grid cells with at least 30 marriages available to construct the main polygyny rate proxy (stock). This corresponds to only half of the cells in my data but they account for 93% of women in my sample. Column 2 uses only the latest survey available in each country. Column 3 includes cohorts of women exposed to civil wars in my sample. Column 4 splits the prime marriageable age window (age 12-24) and shows that the documented effects are present for both women exposed to droughts during the child marriage time window (age 12-17) or later.[25]

Columns 5-7 of Table A6 shows robustness to alternative clustering of standard errors to account for potential correlation in error terms across space between different grid cells. Columns 5 shows robustness of the inference precision to clustering at ethnic homeland level and column 6 at region level. Column 7 shows similar robustness using Conley standard errors.

**Robustness to Varying the Drought Threshold.** I also show robustness to varying the threshold used so far to define a drought year. For that, I re-estimate the main regression with the continuous polygyny rate interaction term, varying the cutoff levels to define a drought from the 5th percentile to the 30th percentile. Figure A7a plots the estimated coefficients for different cutoff percentiles, along with 95% confidence intervals. The estimated effects is stable around the 15th percentile threshold used in the main specification.

### 4.1.2 Mechanism: The Shadow Price of Junior wives

**Rural-Urban Residence.** I check in this section that the documented effects of droughts on the likelihood of marrying as a junior wife is stronger in rural areas. Columns 1 of Table 2 report the results of adding interaction terms with the three drought variables in main specification with dummies for residing in urban or rural clusters. I control for rural residence FE and its interaction with polygyny tercile FE. I then split the sample into rural and urban areas in columns 2-3. The estimates confirm that my main results are concentrated in rural areas: droughts decrease the likelihood of marrying as a junior wife only in high polygyny areas. There is no detectable link between droughts and the likelihood of marrying as a junior in urban areas across all three

[25]My formal model makes the simplifying assumption that women older than 17 only marry older men as a unique wife. In practice, young and older adult men also compete for some of these girls, so their marital outcomes are also affected by local shocks.

polygyny levels. The estimated impact of droughts in high polygyny areas is 7 times higher in rural areas (-4.54 pp, p<0.01) than in urban ones (-0.6 pp, p>0.1). The test of equality of these two coefficient is borderline significant at the conventional level with a p-value of 0.107.

This evidence is consistent with the shadow price of junior wives mechanism described in Section 2.2.3. However, the absence of effect in urban areas could be due to droughts having a smaller impact on income and marital decisions. I then focus on rural areas to provide further evidence of the role played by the net shadow price of marrying a second wife below.

**Communal Land Rights.** I test here the hypothesis that the demand for second wives is more sensitive to aggregate shocks than the demand for first/unique wives in areas with communal land rights but less so in areas with private property rights. Communal land rights reduce the impact of rainfall shocks on the income of vulnerable households because they allow for flexible redistribution of resources (Goldstein and Udry, 2008; Le Rossignol et al., 2024). Finding a bigger shift in market shares in these areas is therefore a strong evidence in support of the shadow price of junior wives mechanism described in Section 2.2.3.

I follow Le Rossignol et al. (2024) and use the role of traditional leaders in allocating land from the Afrobarometer data as a proxy for the existence of communal land ownership in each cell, as described in Section 3.3. Columns 4 of Table 2 report the results of augmenting Equation 2 with the interaction between drought and the share of people who report that traditional leaders have little influence in land allocation. I then split the sample into areas where a majority of respondents say that the influence of traditional leaders in allocating land in their community is high (column 5, TLNI$< 50\%$) and low (column 6, TLNI$\geq 50\%$). The results show that the documented impact of droughts on the likelihood of marrying as a junior wife is concentrated in areas where traditional leaders play an important role in land allocation. The interaction term in high polygyny areas (column 4) is large, positive and statistically significant at $10\%$ level. Droughts do not have a detectable impact on the the likelihood of marrying as a junior wife even in high polygyny areas in column 6.

Table 2: Polygyny Norms and the Effect of Droughts on Men's Market Shares

| | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** |
|---|---|---|---|---|---|---|
| | **Dependent Variable: Junior Wife Indicator** | | | | | |
| | | | | | **Rural: TLNI for Land:** | |
| **Sample:** | **All** | **Rural** | **Urban** | **Rural** | **Low** | **High** |
| $D_{12-24}\times$ LP $\times$ Rural | 0.0103 | | | | | |
| | (0.0078) | | | | | |
| $D_{12-24}\times$ MP $\times$ Rural | 0.0029 | | | | | |
| | (0.0093) | | | | | |
| $D_{12-24}\times$ HP $\times$ Rural | -0.0454*** | | | | | |
| | (0.0158) | | | | | |
| $D_{12-24}\times$ LP $\times$ Urban | 0.0079 | | | | | |
| | (0.0100) | | | | | |
| $D_{12-24}\times$ MP $\times$ Urban | -0.0155 | | | | | |
| | (0.0151) | | | | | |
| $D_{12-24}\times$ HP $\times$ Urban | -0.0061 | | | | | |
| | (0.0183) | | | | | |
| $D_{12-24}\times$ LP | | 0.0100 | 0.0030 | 0.0172 | 0.0133 | 0.0093 |
| | | (0.0068) | (0.0125) | (0.0170) | (0.0089) | (0.0178) |
| $D_{12-24}\times$ MP | | 0.0040 | -0.0165 | 0.0021 | 0.0017 | -0.0021 |
| | | (0.0095) | (0.0148) | (0.0239) | (0.0133) | (0.0190) |
| $D_{12-24}\times$ HP | | -0.0433*** | -0.0075 | -0.0688** | -0.0456** | -0.0144 |
| | | (0.0164) | (0.0206) | (0.0280) | (0.0186) | (0.0177) |
| $D_{12-24}\times$ LP $\times$ TLNI | | | | -0.0102 | | |
| | | | | (0.0428) | | |
| $D_{12-24}\times$ MP $\times$ TLNI | | | | -0.0081 | | |
| | | | | (0.0550) | | |
| $D_{12-24}\times$ HP $\times$ TLNI | | | | 0.0993* | | |
| | | | | (0.0601) | | |
| Observations | 172111 | 122780 | 49331 | 88012 | 57457 | 30555 |
| Adjusted R-squared | 0.081 | 0.084 | 0.071 | 0.086 | 0.078 | 0.103 |
| Number of clusters | 2988 | 2870 | 1286 | 1259 | 772 | 487 |
| **P-values:** | | | | | | |
| LP versus HP | 0.00184 | 0.00334 | 0.662 | 0.00860 | 0.00570 | 0.337 |
| MP versus HP | 0.00830 | 0.0122 | 0.723 | 0.0559 | 0.0418 | 0.629 |
| LP versus MP | 0.545 | 0.601 | 0.323 | 0.599 | 0.458 | 0.660 |
| HP: Rural versus Urban | 0.107 | | | | | |
| Mean dependent variable | 0.132 | 0.146 | 0.0972 | 0.144 | 0.151 | 0.131 |

OLS regressions with observations at the individual level from the DHS data. All the regressions include birth year FE, country $\times$ survey wave FE and cell FE. Column 1 includes a rural dummy and a rural dummy interacted with with polygyny tercile FE. The P-values in this column refer to the coefficients for rural areas. The full regression sample includes married women aged 25 or older who have only been married once at the time of the survey. HP, MP, and LP stand for high, medium and low polygyny dummies, respectively. TLNI (Traditional Leaders Not Influential) is the share of people in the Afrobarometer survey that report that traditional leaders have little or no influence in allocating land. Low TLNI corresponds to areas with a TLNI$< 50\%$. $D_{12-24}$ is a dummy variable equal to 1 if a woman has been exposed to any drought between ages 12 and 24. A drought is defined as an annual rainfall realization below the 15th percentile of the local rainfall distribution. All regressions are weighted using country population-adjusted survey sampling weights. Robust standard errors clustered at the cell-grid level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

#### 4.1.3 Consequences on Husband-Wife Age Gap

A direct consequence of marrying a young bachelor as first/unique wife as opposed to a married man as a junior wife is the husband-wife age gap. This marital outcome is often associated with having less bargaining power (Browning et al., 1994; Carmichael, 2011; Oreffice, 2011) and a higher likelihood of early widowhood (Lambert et al., 2018). Husband-wife age gap is higher for women who marry as junior wives (see Section 2.1.3) . A shift in the market shares on the demand side will therefore affect husband-wife age gap.

This outcome is also interesting to consider given that it is properly defined in both monogamous and polygynous markets. The likelihood of marrying as a junior wife is non-zero only in markets that have some polygyny. In low polygyny areas, this outcome variable relies on the variation induced by a small proportion of people. Husband-wife age gap on the contrary is properly defined for everyone. My model predicts that droughts should not significantly affect husband-wife age gap in monogamous areas and those where polygyny is present but rare. However, in markets where polygyny is more common we should be able to detect a decrease in the age gap.[26]

Table 3 confirms that exposure to droughts between age 12 and 24 decreases husband-wife age gap only in high polygyny areas. Column 1 shows the specification with interaction with the continuous polygyny rate proxy. The drought coefficient is small and positive while the interaction term is negative and statistically significant. Column 2 shows that droughts decrease the age gap by 0.8 years in high polygyny areas (7.2% of the average age, $p<0.01$) and have no detectable impact in low and medium polygyny areas. This result is robust to accounting for marriage year FE (column 3). Column 4 shows robustness to adding birth year FE interacted with polygyny terciles and marriage year FE interacted with polygyny terciles. Column 5 uses the husband's age as the outcome variable, instead of the husband-wife age gap. It shows that the documented effects are indeed driven by changes in the age of the husbands that women marry and not changes in their own age at marriage.

[26]The model predicts that in monogamous markets, droughts reduce the marriage age of girls, but those girls get married to younger men, so the husband-wife age gap should not be affected. This is not the case in polygynous markets since women can also be induced to marry older men. I also confirm empirically that droughts do not affect the timing of marriage for girls in the high polygyny areas below.

Table 3: Polygyny Norms and the Effect of Droughts on Men's Market Shares: Consequences for Husband-Wife Age gap

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| **Dependent Variable:** | | **Husband-Wife Age Gap** | | | **Husband's Age at Marriage** |
| $D_{12-24}$ | 0.4096 | | | | |
| | (0.3158) | | | | |
| $D_{12-24}\times$ Polygyny Rate | -2.0042** | | | | |
| | (0.8243) | | | | |
| $D_{12-24}\times$ Low Polygyny | | 0.1309 | 0.0424 | -0.0891 | -0.2859 |
| | | (0.3474) | (0.3203) | (0.3016) | (0.2773) |
| $D_{12-24}\times$ Medium Polygyny | | 0.1448 | 0.1361 | 0.0389 | 0.1013 |
| | | (0.2063) | (0.2050) | (0.2022) | (0.2214) |
| $D_{12-24}\times$ High Polygyny | | -0.8449*** | -0.8900*** | -0.6842*** | -0.9255*** |
| | | (0.2387) | (0.2442) | (0.2424) | (0.2602) |
| Observations | 174166 | 174166 | 174166 | 174166 | 174166 |
| Marriage Year FE | NO | NO | YES | YES | NO |
| Birth Year FE $\times$ Polygyny Tercile FE | NO | NO | NO | YES | NO |
| Marriage Year FE $\times$ Polygyny Tercile FE | NO | NO | NO | YES | NO |
| Adjusted R-squared | 0.155 | 0.155 | 0.164 | 0.167 | 0.112 |
| Number of clusters | 2991 | 2991 | 2991 | 2991 | 2991 |
| Mean dependent variable | 9.396 | 9.396 | 9.396 | 9.396 | 27.03 |
| P-value: Low versus High | | 0.0196 | 0.0190 | 0.121 | 0.0862 |
| P-value: Medium versus High | | 0.00168 | 0.00129 | 0.0216 | 0.00263 |
| P-value: Low versus Medium | | 0.973 | 0.804 | 0.725 | 0.270 |

OLS regressions with observations at the individual level from the DHS data. All the regressions include birth year FE, country $\times$ survey wave FE and cell FE. The full regression sample includes married women aged 25 or older who have only been married once at the time of the survey. $D_{12-24}$ is a dummy variable equal to 1 if a woman has been exposed to any drought between ages 12 and 24. A drought is defined as an annual rainfall realization below the 15th percentile of the local rainfall distribution. All regressions are weighted using country population-adjusted survey sampling weights. The average husband-wife age gap is 7.1, 8.8, and 11.8 years in low, medium, and high polygyny areas, respectively. Robust standard errors clustered at the cell-grid level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

#### 4.1.4 Prediction 2: Effect of Rainfall Shocks on the Timing of Marriage and on Child Marriage in the Presence of Polygyny

**Main Empirical Strategy.** The second prediction of the model is that exposure to droughts should have a weaker impact on the timing of marriage and on child marriage in more polygynous areas (which can become null at some point). This also confirms the model's first prediction, because this attenuation effect directly results from the higher elasticity of the demand for second brides to income shocks compared to the demand for first/unique wives. I test this prediction of the model using a discrete-time duration model (Currie and Neidell, 2005; Corno et al., 2020). The duration of interest is the time between age $t_0 = 12$, when a girl first reaches marriageable age, and age $t_m$, when she marries. The original data is converted into a person-year panel format. A girl married at age $t_m$ contributes $(t_m - t_0 + 1)$ observations to the sample: one observation for each at-risk year until she is married, after which she exits the data. To test for the impact of exposure to droughts on the timing of marriage, I consider the period between ages 12 and 24 (peak marriageable years). In the case of child marriage, I restrict the data to the years before age 18.[27] This data is then merged with the yearly rainfall data.

This stacked person-year sample allows us to estimate a discrete-time duration model to test prediction 2 with the following specification:

$$M_{i,g,k,a(t),\tau} = \beta D_{g,k,a(t)} + \gamma D_{g,k,a(t)} \times P_g + Z_a + \omega_g + \zeta_k + \delta_\tau + \epsilon_{i,g,k,a(t),\tau}. \tag{3}$$

The dependent variable $M_{i,g,k,a(t),\tau}$ is a binary variable coded as 1 in the year the woman is married. $D_{g,k,a(t)}$ is a dummy for a drought in cell $g$ during the calendar year $t$ in which the woman born in year $k$ is of age $a$. $P_g$ is a proxy for polygyny norms, as defined in Equation 2. $Z_a$ is a vector of age FE that control for the fact that marriage hazard varies by age. $\omega_g$ is a set of cell FE, $\zeta_k$ is a set of year-of-birth FE, and $\delta_\tau$ represents country-specific survey wave FE. The impact of weather shocks on the hazard of child marriage is identified from within-cell and within-year-of-birth variation in weather shocks and marriage outcomes. As discussed in Section 4.1.1, the timing of droughts is plausibly random in a given cell. Sampling weights and clustering are handled similarly to what was done for Equation 2.

**Main Results.** Column 1 of Table 4 shows estimation results with the interaction term between droughts and the continuous polygyny rate variable. The coefficient $\beta$ is positive and statistically significant (+0.9 pp, p<0.01) and $\gamma$ is negative and significant (-1.6 pp, p<0.05). Column 2 shows that girls (age 12-24) who experience a drought in low polygyny areas are 0.77 pp (p<0.01) more likely to marry within that same year, which corresponds to an increase of 4.8$\%$ in the average annual hazard of marriage in these areas. This effect drops to an increase of 0.44 pp (p<0.5) in medium polygyny areas but the difference with the previous coefficient is not statistically significant. The estimated effect for women living in high polygyny areas is close to zero and statistically insignificant. The demand and supply of child brides are equally sensitive to aggregate shocks in these areas. The Wald test of equality of coefficients for low versus high polygyny areas is rejected at 5$\%$ level. These results are consistent with the documented

[27] The data is right-censored for females who marry after age 24 for the timing of marriage specification and age 17 for the child marriage specification.

differences between these three types of areas for Prediction 1. They are robust to including birth year FE interacted with polygyny terciles and age FE interacted with polygyny terciles (column 3).

Table 4: Polygyny, Droughts, and Timing of Marriage in SSA

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| **Dependent Variable:** | **Binary variable coded as 1 in the year in which the woman gets married** | | | | |
| **Proxy for Polygyny Norms:** | **Long-Term Polygyny Rate** | | | **Religion** | |
| $D_t$ | 0.0090*** | | | 0.0082*** | |
| | (0.0025) | | | (0.0019) | |
| $D_t \times$ Polygyny Rate | -0.0162** | | | | |
| | (0.0071) | | | | |
| $D_t \times$ Low Polygyny (T1) | | 0.0077*** | 0.0072*** | | |
| | | (0.0026) | (0.0024) | | |
| $D_t \times$ Medium Polygyny (T2) | | 0.0044** | 0.0043** | | |
| | | (0.0018) | (0.0018) | | |
| $D_t \times$ High Polygyny (T3) | | 0.0003 | 0.0004 | | |
| | | (0.0024) | (0.0025) | | |
| $D_t \times$ Share non-Christians | | | | -0.0102*** | |
| | | | | (0.0034) | |
| $D_t \times$ Christian | | | | | 0.0052*** |
| | | | | | (0.0016) |
| $D_t \times$ non-Christian | | | | | -0.0018 |
| | | | | | (0.0025) |
| Observations | 2168194 | 2168194 | 2168194 | 2158084 | 2076806 |
| Birth Year FE $\times$ Polygyny Tercile FE | NO | NO | YES | NO | NO |
| Age FE $\times$ Polygyny Tercile FE | NO | NO | YES | NO | NO |
| Christian Religion FE | NO | NO | NO | NO | YES |
| Adjusted R-squared | 0.069 | 0.069 | 0.071 | 0.069 | 0.069 |
| Number of clusters | 3062 | 3062 | 3062 | 3026 | 3025 |
| Mean dependent variable | 0.126 | 0.126 | 0.126 | 0.126 | 0.126 |
| P-value: T1 versus T3 | | 0.0398 | 0.0518 | | |
| P-value: T2 versus T3 | | 0.175 | 0.205 | | |
| P-value: T1 versus T2 | | 0.303 | 0.341 | | |
| P-value: Christian versus non-Christian | | | | | 0.0319 |

OLS regressions with observations at the person x age level (from 12 to 24 or age at first marriage) from the DHS data. All regressions include age FE, birth year FE, cell FE, and country $\times$ survey wave FE. The dependent variable is a dummy equal to one if the girl is married at the age corresponding to a given observation. The full sample includes ever-married women aged 25 or older at the time of the interview. $D_t$ is a dummy variable equal to 1 if a woman has been exposed to any drought at year $t$. A drought is defined as an annual rainfall realization below the 15th percentile of the local rainfall distribution. All regressions are weighted using country population-adjusted survey sampling weights. The average annual hazard of marriage is 10.2 %, 12.4 %, and 16.2 % in low, medium, and high polygyny areas, respectively. Robust standard errors clustered at the cell-grid level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Columns 4-5 confirm this heterogeneity when using religion as a proxy for polygyny norms. Column 4 uses the drought dummy and its interaction with the share of non-Christians in each cell to capture the attenuation effect. The two coefficients of interest are sizable, with expected signs, and statistically significant at 1% level. Column 5 includes a separate drought dummy for Christian and non-Christian women and shows that droughts increase the hazard of marriage only for the former group (by 0.52 pp, p<0.01).

**Robustness on Interpretation and on the proxies of $P_g$.** Similar to what was done for Prediction 1, I show in Table A7 that the documented evidence in support for Prediction 2 are not driven by religion *per se* or any of the other main correlates of Polygyny. Table A8 is the equivalent of the robustness exercise conducted in Table A5 for prediction 1. It shows as well that the results on marriage timing are robust to using flow proxies for $P_g$ defined using different time windows and to aggregating polygyny rates at ethnic homeland level.

**Bride Price Placebo.** In my model, bride price is the reason why the timing of marriage is sensitive to income shocks. There is substantial historical heterogeneity in marriage payments norms across ethnic groups in SSA. These norms have strong predictive value with respect to modern practices (Ashraf et al., 2020). As a placebo test, I check that the documented polygyny-driven attenuation effect of droughts on marriage timing is present only among women who come from an ethnic group in which there is a bride price custom. Columns 1-3 of Table A9 show that this is the case. For women from a bride price ethnic group, droughts increase the timing of marriage in low polygyny areas (by 0.98 pp, p<0.01) and medium polygyny areas (by 0.47 pp, p<0.05) but not in high polygyny areas. The attenuation effect is more precisely estimated in this sample. The difference of impact between low *versus* high polygyny areas is significant at 1% level and the one between medium *versus* high polygyny areas becomes statistically significant at 10% level. There is no effect of droughts on the timing of marriage among women from ethnic groups that do not practice bride price payments, irrespective of whether polygyny is common or not.

**Timing Placebo.** Rainfall shocks are assumed to be i.i.d. across time. My model predicts that only contemporaneous droughts should affect the timing of unions, irrespective of the extent to which polygyny is practiced.[28] Columns 4, 5, and 6 of Table A9 run separate regressions for low, medium, and high polygyny areas, respectively. They all show that past and future shocks do not have any detectable impact on marriage timing. Only current shocks have an effect on

[28]Markets clear independently from one period to another even though they involve overlapping generations. This comes from the fact that these markets are cleared by the youngest generations that enter each period with the outside option of waiting to marry the next one, as discussed in Section A.1 and Section A.2.2. Past shocks can also affect current marital outcomes if households can borrow, but vulnerable households have limited access to credit markets in SSA.

marriage hazard in a given year in low polygyny areas (an increase of 0.75 pp, $p<0.01$) and medium polygyny areas (an increase of 0.43 pp, $p<0.05$). This confirms that it is the specific and random timing of droughts that drives the results, and not other confounders.

**Sample and Clustering Robustness.** Column 1 of Table A10 shows robustness to including unmarried women to the main sample. Column 2 restricts the main sample to women who live in a cell with at least 30 observations available for the computation of the polygyny rate. Column 3 uses only the latest survey wave in each country to run the analysis. Column 4 show robustness to adding country-specific time trends to the main specification. Column 5 adds calendar year FE to the previous specification. The inference precision of my results on marriage timing is also robust to clustering at the ethnic homeland and region levels.

**Alternative Definition of Rainfall Shocks and Timing of Child marriage.** Figure A7b shows robustness to varying the 15th percentile threshold. Table A11 examines the association between the continuous rainfall level and the marriage timing. It shows that an increase in annual rain by 1 meter is associated with a decline in the marriage hazard by 1.15 pp in low polygyny areas ($p<0.05$) and has no significant effect in high and medium polygyny areas (columns 1-2).

Columns 3-4 of Table A11 show robustness to using only unions that occur before age 18 for the analysis. The precision of the attenuation effect is more precise within the sample of women from a bride price ethnic group (column 4) compared to the overall sample (column 3).

**Evidence not Driven by Supply Side Mechanisms.** My model does not assume any differential reaction of the market's supply side across monogamous and polygynous areas. The empirical evidence presented in this paper cannot be explained by such mechanisms. Young bachelors and older men compete to a great extent for the same brides on the market. This means that in general, any alternative mechanism that relies solely on the difference on how the supply side of the market react to the shocks cannot explain the changes in the market shares on the demand side documented for Prediction 1. Section A.5 shows that, in particular, the type of supply-side mechanism suggested in Rexer (2022) plays a minor role in how the marriage market clears from one year to another with changing economic conditions.

#### 4.1.5 Consequences on Fertility Onset and Impact on Child Marriage

Early female fertility is a direct and dramatic consequence of child marriage, and is one of the most far-reaching risks facing teenage girls in developing countries (Duflo et al., 2015; Chari et al., 2017). Adolescent pregnancy is associated with increased risks of maternal and fetal complications, including premature delivery, and worse health and socioeconomic outcomes for the next generation. Pregnancy complications and childbirth are the leading causes of death for girls aged 15 to 19 in developing countries (Save the Children, 2004). Fertility is, therefore, one of the main channels through which temporary shocks such as droughts can have long-term consequences when they affect the timing of marriages.

Polygyny weakens the impact of droughts on marriage timing. I show in Section A.4 that this attenuation effect also translates into a weaker impact of droughts on the likelihood of child marriage and on early fertility onset. Being exposed to a drought at age 15, 16 and 17 increases the likelihood of getting married (by 9.5 %, p<0.01) and giving birth (by 6.4%, p<0.01) only in low polygyny areas. This effect translates into women having more children by age 25 (increase of 10 %, p<0.01) in these areas. There is no detectable impact of droughts on these outcomes in medium and high polygyny areas. The differences in the equilibrium reaction of polygynous and monogamous markets to aggregate shocks therefore leads to differences in the impact of these shocks on fertility onset.

## 4.2 Evidence from Global Crop Price Shocks

I test the predictions of my model using a second source of variation in agricultural income: global crop price shocks. This source of income shock brings two key elements to my analysis. First, this is an important robustness check since crop price shocks are very different compared to rainfall shocks. Fluctuations in global crop prices affect the real income of farmers for a given harvest level through market prices while droughts affect farm output quantity itself before any market effects. They both affect income locally but through two separate channels.

Second, the PPI allows me to test whether marriage markets react symmetrically to positive and negative shocks. Droughts yield a negative income shock but unusually high rainfall levels do not lead to a clear positive income shock in SSA (see Section 3.4). In contrast, the PPI captures the effects of the spikes in global crop prices during my sample period. These are positive income shocks for impacted farmers in SSA (McGuirk and Burke, 2020).

I focus on the impact of crop price shocks on the timing of marriage and on child marriage (Prediction 2). This prediction is a direct consequence of the fact that aggregate shocks affect the market shares of young and older men in polygynous markets (Prediction 1).[29]

[29]There is not much variation in the crop price data to test Prediction 1 directly. The global crop price data covers

Table 5: Polygyny, PPI, and Timing of Marriage

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| **Dependent Variable: Binary variable coded as 1 in the year in which the woman gets married** | | | | | |
| $\text{PPI}_t$ × Low Polygyny | | -0.0080*** | -0.0079*** | -0.0076*** | -0.0073*** |
| | | (0.0025) | (0.0026) | (0.0026) | (0.0026) |
| $\text{PPI}_t$ × Medium Polygyny | | -0.0013 | -0.0012 | -0.0012 | -0.0016 |
| | | (0.0011) | (0.0011) | (0.0011) | (0.0014) |
| $\text{PPI}_t$ × High Polygyny | | 0.0004 | 0.0015 | 0.0007 | 0.0015 |
| | | (0.0023) | (0.0023) | (0.0023) | (0.0024) |
| $\text{PPI}_t$ | -0.0090*** | | | | |
| | (0.0028) | | | | |
| $\text{PPI}_t$ × Polygyny Rate | 0.0207*** | | | | |
| | (0.0076) | | | | |
| Observations | 874155 | 874155 | 874155 | 874155 | 874155 |
| Birth Year FE × Polygyny Tercile FE | NO | NO | YES | NO | NO |
| Age FE × Polygyny Tercile FE | NO | NO | YES | NO | NO |
| Country × time trend | NO | NO | NO | YES | YES |
| Calendar Year FE | NO | NO | NO | NO | YES |
| Adjusted R-squared | 0.075 | 0.075 | 0.077 | 0.076 | 0.077 |
| Number of clusters | 2892 | 2892 | 2892 | 2892 | 2892 |
| Mean dependent variable | 0.151 | 0.151 | 0.151 | 0.151 | 0.151 |
| **P-values:** | | | | | |
| Low versus High Polygyny | | 0.0119 | 0.00645 | 0.0129 | 0.00703 |
| Medium versus High Polygyny | | 0.502 | 0.284 | 0.456 | 0.217 |
| Low versus Medium Polygyny | | 0.0133 | 0.0171 | 0.0189 | 0.0357 |

OLS regressions with observations at the person x age level (from 12 to 24 or age at first marriage) from the DHS data. All regressions include age FE, birth year FE, cell FE, and country × survey wave FE. The dependent variable is a dummy equal to one if the girl is married at the age corresponding to a given observation. The full sample includes ever-married women aged 25 or older at the time of the interview. $PPI_t$ is the producer price index at year $t$. It is measured in terms of average temporal standard deviations. All regressions are weighted using country population-adjusted survey sampling weights. Robust standard errors clustered at the cell-grid level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

**PPI and Timing of Marriage.** I study the impact of crop price shocks on the timing of marriage and the hazard of child marriage by substituting droughts for PPI shocks in Equation 3. The estimated effects in rural areas are displayed in Table 5. Column 1 shows that a rise in PPI significantly decreases the hazard of marriage the same year in monogamous areas. This effect lessens as we move to areas where polygyny is more commonly practiced. Estimates in column 2 suggest that a standard deviation rise in PPI decreases the hazard of marriage the same year by 0.8 pp (p<0.01) in low polygyny areas and has no detectable effect in medium and high polygyny areas. The Wald test of equality of the effect of PPI in low versus high polygyny areas

a period of 25 years (1989-2013), and there is little variation at the cohort level to properly test whether women who have been exposed to crop price shocks between ages 12-24 have different likelihood of marrying younger men with a low age gap as first/unique wives.

is rejected at 1% level. Column 3 shows that these results are robust to adding birth year FE interacted with polygyny terciles and age FE interacted with polygyny terciles. Column 4 shows robustness to adding country-specific time trends to account for any potential trends in the PPI. Column 5 includes calendar year FE to the previous specification. The estimated coefficients remain remarkably stable across all these specifications.

Table A15 shows further robustness and heterogeneity analysis on the impact of PPI. The rise in global food prices could also impact consumer prices (CPI), as argued in Section 3.5. Column 1 augments my main specification to account for the effect of the CPI in low, medium and high polygyny areas. Column 2 accounts for the effect of droughts in low, medium and high polygyny areas. The estimated impact of PPI on marriage timing remains stable in both specifications. Columns 3 and 4 show that the estimated effects are concentrated among women from a bride price ethnic group. Column 5 shows that the PPI has no impact on marriage timing in urban areas. These areas rely less on farming activities so they are not expected to benefit from a rise in food prices.

### 4.3 Further Threats to Identification

Section A.6 discusses in detail further potential threats to identification that can be ruled out in my analysis. It shows that the documented evidence is not driven by the following factors: (i) a differential effect of the aggregate shocks on income and crop yields across monogamous and polygynous areas, (ii) a differential of migration behavior across these areas, or (iii) a differential size of local marriage markets across monogamous and polygynous areas. Moreover, each of these threats could challenge the evidence presented in support of a specific prediction of the model, but none is consistent with all the predictions taken together. They cannot offer a plausible alternative explanation for why aggregate shocks (positive and negative) would have a strong impact on marriage timing for girls *only* in low polygyny areas and, at the same time, have a strong effect on the age of the men they marry *only* in polygynous areas, precisely in the directions predicted by the model.

## 5 Concluding Remarks

Polygyny is not merely a cultural curiosity but has significant implications for economic development within Sub-Saharan Africa. This paper shows novel evidence that in many areas of this region, the demand for junior wives is more sensitive to local income shocks than the demand for first/unique wives. This happens because the shadow price of marrying a junior wife is low enough and relatively poor men find it optimal to remarry in normal times.

The higher sensitivity of the demand for junior wives affects the marital outcomes of girls who are exposed to aggregate shocks during their prime marriageable age. It also affects how the timing of marriage and fertility onset reacts to aggregate shocks in polygynous markets compared to monogamous ones.

This paper also makes a broad point on policy design and evaluation in culturally diverse settings. An evaluator studying the impact of short-term economic shocks on marital outcomes would find dramatically different results depending on whether their data consists of people living predominantly in monogamous or polygynous areas. Moreover, the extent to which polygyny is practiced across space provides an observable characteristic that can be used when designing and evaluating the effects of these types of policies. This is a potentially valuable tool for the spatial targeting of alternative policy interventions that could be effective even if completed at the more broad cross-country level or across relatively large regions (see Figure 1).

More speculatively, this paper also speaks to the potential consequences on household formation of increasingly popular interventions that generate short-term local economic stimuli, such as large-scale cash transfer programs (e.g., Egger et al., 2022) and public works programs (e.g., Franklin et al., 2023). The difference in sensitivity between the demand for first/unique wives and the demand for junior wives documented in this paper highlights a potential channel through which such policies could deteriorate marital outcomes in the presence of polygyny. They could indeed fund additional second unions in equilibrium without necessarily decreasing child marriage. Other channels could push towards the opposite effects. These policies could, for instance, increase human capital investments or raise the long-term shadow price of junior wives. Identifying the overall welfare effect of such policies is left for future research.

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# Online Appendix

## A.1 Model

This section formalizes the intuition behind the conceptual framework discussed in Section 2.2.

### A.1.1 Set Up and Notations

**Market Structure.** The marriage market at each period $t$ involves men and women of two consecutive birth cohorts, as shown in Table A1.[30] The unmarried market participants are denoted by $\mathcal{U}$. The subscripts indicate their cohort ($y$ for young and $o$ for old), and the superscripts their gender ($m$ for male and $f$ for female). Each birth cohort is active on the market for up to two periods. Agents can marry only once per period.

Table A1: Marriage Market Structure at $t$

| Birth cohort | $B_1$ | $B_2$ | $B_3$ |
|---|---|---|---|
| Demand: Male Side | | $\mathcal{U}_y^m$ | $\mathcal{U}_o^m + p\mathcal{M}_o^m$ |
| Supply: Female Side | $\mathcal{U}_y^f$ | $\mathcal{U}_o^f$ | |
| Emancipation | No | No | Yes |

Age bride cohorts: Young (12-17); Old (18-29)
Age groom cohorts: Young (18-29); Old (30-40)

On the demand side, young adult sons (cohort $B_2$, age 18-29) are the youngest men on the market, and older adult sons are the oldest (cohort $B_3$, age 30-40).[31] Men who married young at period $t-1$ (denoted by $\mathcal{M}_o^m$) can be open to the idea of marrying a second bride at period $t$ if their family's marital norms allow it. The extent to which this happens in a given market is determined exogenously by local social norms. $p \in [0, 1]$ denotes the share of men for whom polygyny is not forbidden, discouraged, or frowned upon (by religion, ethnic traditions, or any other social norms). $p = 0$ means that the market is exclusively monogamous. In polygynous markets ($p > 0$), not everyone looking for a second wife can afford one, and the equilibrium quantity of second marriages is endogenous.

On the supply side, adolescent daughters (cohort $B_1$, age 12-17) are already active and can be married by their parents as child brides (see Section 2.1.5). Young adult daughters (cohort

[30] This overlapping generation setup differs from the model presented in Corno et al. (2020). Their framework features a single cohort of men and women who enter the market at the same time and match with each other over two periods that correspond to women's life stages.

[31] The cohort age cutoffs are only illustrative and correspond to the life stages of men and women.

$B_2$) are the oldest active cohort, while older daughters (cohort $B_3$) are no longer active on the market because their fertility prospects are too limited at this age. Women leave the market for good upon marriage, and I assume that there is no divorce or remarriage in this setting for simplicity (see Section 2.1.6).[32]

Until young adulthood, sons are part of their parents' production and consumption unit. The parents decide whether to support the marriage of their son at this stage. The son emancipates and creates his own production/consumption unit when he becomes an older adult. He then makes his own marital decisions.[33]. Daughters move from their parents' consumption/production unit to that of their husband's family when they get married (patrilocality).[34]

I assume a balanced sex ratio by birth cohort, and the population grows at a constant rate ($a$) from one cohort to the next. For simplicity, I also assume that each family has only one child (male or female) of marriageable age at a time. I follow Corno et al. (2020) and assume that Credit markets are incomplete, and there is no borrowing or savings across periods. The next period is discounted at a rate $\delta$.

**Income and Preferences.** Assumptions on income and preferences follow closely those in Corno et al. (2020). Household income at period $t$ is the sum of an aggregate income $y_t$ and an idiosyncratic component $\epsilon_t$: $I_t = y_t + \epsilon_t$. Aggregate income can be high ($y^H$) or low ($y^L$) with equal probability in each period (depending on aggregate shocks). The idiosyncratic components are i.i.d. with pdf $f()$ and cdf $F()$. Households have Constant Relative Risk Aversion Utility (CRRA) over consumption in each period: $u(c) = \frac{c^{1-\gamma}}{1-\gamma}, \gamma \geq 1$.

Children have a positive net contribution to the budget of the household to which they are affiliated. This contribution is denoted by $w_g^s > 0$, where $s \in \{f, m\}$ denotes the gender of the child and $g \in \{y, o\}$ their cohort. Sons are assumed to be more productive than daughters ($w_g^m > w_g^f$). For simplicity, I also assume that the contributions of children to their parents' budget are not directly affected by aggregate shocks ($\frac{dw_y^s}{dy_t} = \frac{dw_o^s}{dy_t} = 0$).

**Marriage and Bride Price.** I assume that the female side of the marriage market is homogeneous for simplicity, following existing marriage market models in SSA (Jacoby, 1995; Corno et al.,

[32]The model can easily accommodate exogenous divorce and re-marriage. They affect old unmarried cohorts and the market is cleared by the demand and supply of child brides, as argued below.

[33]There is ample evidence that parents are very involved in the first union of their sons, especially the young ones (see Section 2.1.3)

[34]Data from the Atlas of Precolonial Societies (Murdock, 1967) shows that patrilocality is the traditional norm in 82% of ethnic groups in Sub-Saharan Africa (SSA). The other groups are either neolocal (couple moves to either family) or matrilocal (husband moves to wife's family).

2020). All the brides are equally valued by men. Any marriage involves the payment of a unique bride price (denoted by $\tau_t$) that clears supply and demand at period $t$.[35] These modeling simplifications are justified by the discussions in Section 2.1.5 and Section 2.2.1.

**The role of credit markets in financing marriages.** The model also abstract from credit markets following Jacoby (1995). Formal credit markets are rare and not accessible to vulnerable households. Private informal transfers tend to happen within families or clans in many parts of SSA and play the role of an inter-generational exchange designed to alleviate borrowing constraints (Weekes-Vagliani, 1985; Jacoby, 1995; La Ferrara, 2007). Such transfers within families/clans do not change the model's conclusions.

**Future Utility.** Families derive some utility in future periods from having a married child. This captures, for instance, the future net contributions of their child's family to their own resources, the utility of acquiring offspring, or that which they derive from avoiding the stigma of having an unmarried child.

Let $V_M^{m,y}$ denote the discounted sum of expected utility for the father of a young son who marries. $V_M^{m,o}$ is the discounted sum of expected utility for an older son who marries. The decision-maker on the supply side is always the girl's father. $V_M^f$ denotes the discounted sum of expected utility for the parents of a married daughter. $V_U^s$ is the sum of expected utility if a child remains single ($s \in \{m, f\}$) when he/she exits the market.

### A.1.2 Equilibrium Matching Process and Market Clearing

At each period $t$, the market has two overlapping generations. Theoretically, various equilibria in the matching pattern can exist. However, the data is consistent with a subset of equilibria characterized by a substantial share of inter-generational unions.[36] The simplest one is such that:

- There is an excess quantity of unmarried older men on the market (second participation) at $t$ compared to the quantity of unmarried women of the oldest cohort ($\mathcal{U}_o^m > \mathcal{U}_o^f$). This is because many women of this cohort have already been married to older men at $t-1$.
- The unmarried older men on the market ($\mathcal{U}_o^m$) marry women from the youngest ($\mathcal{U}_y^f$) or

[35] The fact that older women and divorced women tend to get lower bride prices is implicitly captured in the model through the market clearing process discussed below.

[36] The age of marriage for women that are unique, first, or second brides are very similar. There is also a large age gap between a husband and his first/unique wife (10 years on average in high polygyny areas). Moreover, men marry a second wife on average 12 years after marrying their first wife (see Section 2.1.3).

the oldest generation ($\mathcal{U}_o^f$) as their unique brides.

- Men from the youngest cohort ($\mathcal{U}_y^m$) can only marry women from the youngest cohort ($\mathcal{U}_y^f$).
- All the second wives are from the youngest generation ($\mathcal{U}_y^f$).[37]

**Market Clearing.** Bachelors from the oldest generation on the market have the highest willingness to pay a given bride price to be matched since they will remain unmarried otherwise. Similarly, unmarried women from the oldest generation are the most willing to accept a bride price to be married. In contrast, young girls have the outside option of waiting one extra period. The market is, therefore, cleared by the supply and demand of child brides.

### A.1.3 Marital Decisions in Phase 2: Young/Old Adulthood

Let us denote marital decision at period $t$ by $b_t = 1$ if the person gets married and $0$ otherwise. Marital status at the beginning of period $t$ is given by the state variable $M_{t-1}$. It takes the value $1$ if the person is married at the beginning of period $t$. The payoffs for families of adult children (second participation in the market) unmarried at the beginning of period $t$ are:[38]

$$U_{o,t}^f(b_t|M_{t-1}=0, y_t, \epsilon_{it}, \tau_t) = u\Big(y_t + \epsilon_{it} + w_o^f + b_t(\tau_t - w_o^f)\Big) + b_t V_M^f + (1-b_t)V_U^f,$$
$$U_{o,t}^m(b_t|M_{t-1}=0, y_t, \epsilon_{jt}, \tau_t) = u\Big(y_t + \epsilon_{jt} - w_o^{m,l} - b_t(\tau_t - w_g^f)\Big) + b_t V_M^{m,o} + (1-b_t)V_U^{m,o},$$

where $g \in \{o, y\}$. The payoffs for families of adult children married at the beginning of $t$ are:

$$U_{o,t}^f(b_t|M_{t-1}=1, y_t, \epsilon_{it}) = u\Big(y_t + \epsilon_{it}\Big) + V_M^f,$$
$$U_{o,t}^m(b_t|M_{t-1}=1, y_t, \epsilon_{jt}) = u\Big(y_t + \epsilon_{jt} + w_o^{f,1} - w_o^{m,h} - b_t(\tau_t - w_y^{f,2})\Big) + b_t V_{M2}^{m,o} + (1-b_t)V_M^{m,o},$$

where $V_{M2}^{m,o}$ is the discounted sum of expected utility for a son who marries a second wife. $w_o^{m,l}$ is the net contribution of an unmarried older son to his parents' budget, and $w_o^{m,h}$ is that of a married son. All other terms are defined above. After their economic emancipation, older sons still contribute to their parents' household consumption due to patrilocality. This contribution

[37]The model can easily accommodate other equilibria that are qualitatively equivalent to the one considered here, including those in which some older women marry as second brides. What matters is that a substantial share of second wives marry as child brides, which is the case in the data, as argued in the previous footnote.

[38]Adult sons are economically emancipated, so the utility function used here corresponds to their own and not their parents (unlike for daughters).

is higher if they are married before emancipation ($w_o^{m,h} > w_o^{m,l}$), providing parents with an incentive to marry their sons as early as possible when they are deemed ready for marriage.[39] In SSA, men with a higher age at first marriage are negatively selected (Tertilt, 2005; Rexer, 2022) and less likely to become polygamous (Antoine et al., 2018).[40] Any bride price $\tau_t$, such that $U^s_{o,t}(b_t = 1|M_{t-1} = 0, y_t, \epsilon_{st}, \tau_t) \geq U^s_{o,t}(b_t = 0|M_{t-1} = 0, y_t, \epsilon_{st}, \tau_t)$, with $s \in \{m, f\}$ is acceptable for a union to occur between a pair of families. The main incentive for not remaining single comes from the high expected lifetime utility that agents derive from marriage.

**Proposition 1.**

- There exists a non-empty interval $[\underline{\tau}_t, \bar{\tau}_t]$, such that with the bride price $\tau_t^* \in [\underline{\tau}_t, \bar{\tau}_t]$, everyone who is single at the beginning of their second participation to the market gets married.

- There is a threshold of idiosyncratic component $\epsilon^*_{m,2}$ that determines the decision to take a second wife (or not) for all the men on the market for a second wife. Those with $\epsilon_{jt} > \epsilon^*_{m,2}$ are willing to marry again.

**Proof.** See Appendix Section A.2.1.

The first part of Proposition 1 is trivial and has been established in Corno et al. (2020). The intuition behind the second part of this proposition is that under the concavity assumption in the utility function, wealthier men have a higher willingness to pay a bride price for a second wife. Importantly, the threshold $\epsilon^*_{m,2}$ is a decreasing function of the extra utility that men derive from marrying a second wife ($V^{m,o}_{M2} - V^{m,o}_{M}$). A higher value of this extra utility leads to a lower shadow price of marrying a second wife.

### A.1.4 Marital Decisions in Phase 1: Adolescence/Young Adulthood

Parents are the decision-makers at this stage. For a given bride price $\tau_t$, their payoffs are:

$$\begin{aligned} U^f_{y,t}(b_t|M_{t-1} = 0, y_t, \epsilon_{it}, \tau_t) &= u\Big(y_t + \epsilon_{it} + w^f_y + b_t(\tau_t - w^f_y)\Big) + \delta E[\bar{V}^f_{o,t+1}(M_t)], \\ U^m_{y,t}(b_t|M_{t-1} = 0, y_t, \epsilon_{jt}, \tau_t) &= u\Big(y_t + \epsilon_{jt} + w^m_y - b_t(\tau_t - w^f_y)\Big) + \delta E[\bar{V}^m_{o,t+1}(M_t)], \end{aligned}$$

[39] Several factors support this assumption. First, being single can prevent the newly emancipated son from producing resources at his full potential. Having a wife brings socio-emotional stability, extra labor force, and motivation to a young man. Second, this could capture some reciprocity of the son towards his parents since they helped him get married early, and he does not have to pay a bride price right away after his emancipation.

[40] Given the relative homogeneity in the role and value of brides there is no benefit in searching longer for a match in SSA.

where $\bar{V}^s_{o,t+1}$ represents the sum of future utility for parents ($s \in \{m, f\}$). The expectation terms are taken with respect to the future realizations of aggregate income and idiosyncratic components. These expectation terms are independent of current aggregate shocks $y_t$ as explained in Section A.2.2. A family with a potential young bride and a family with a potential young groom will want to marry them if $U^s_{y,t}(b_t = 1|M_{t-1} = 0, y_t, \epsilon_{st}, \tau_t) \geq U^s_{y,t}(b_t = 0|M_{t-1} = 0, y_t, \epsilon_{st}, \tau_t)$. For any union to happen during stage 1 for a family with a daughter, the bride price has to be higher than the net contribution of their daughter: $\tau_t > w^f_y$. With these constraints, two threshold rules on $\epsilon_{it}$ and $\epsilon_{jt}$ will determine the number of people who find it optimal to marry given aggregate income $y_t$ and bride price $\tau_t$.

**Proposition 2.** There exist two thresholds of idiosyncratic temporary income, $\epsilon^*_f(\tau_t, y_t)$ and $\epsilon^*_m(\tau_t, y_t)$, which determine the marital decision during the first period of participation in the market. All families on the supply side with $\epsilon_{it} < \epsilon^*_f(\tau_t, y_t)$ and all families on the demand side with $\epsilon_{jt} > \epsilon^*_m(\tau_t, y_t)$ will want their children to marry.

**Proof.** See Appendix Section A.2.2.

This proposition is an extension of the model in Corno et al. (2020) but in a framework with sequential matching and overlapping generations. The intuition behind this result remains the same: under concavity, the wealthiest families on the demand side want to pay the bride price, and the poorest families on the supply side want to receive it for consumption smoothing.

### A.1.5 Supply and Demand of Child Brides

The market is cleared by the demand and supply of child brides (age 12-17) as argued in Section A.1.2. The demand for child brides comes from three sources, given the equilibrium matching pattern described in the same section:

- Older single men who cannot find an adult wife because a significant portion of women in their marriage cohort have already married older men in the previous period ($t-1$):

$$D^{(1,old)}(\tau^*_{t-1}, y_{t-1}) = \frac{1}{1+a}\Big[F(\epsilon^*_m(\tau^*_{t-1}, y_{t-1})) - \Big(1 - F(\epsilon^*_f(\tau^*_{t-1}, y_{t-1}))\Big)\Big].$$

- Potential young men whose families have experienced a shock of sufficient magnitude to enable them to marry a bride ($\epsilon_{jt} > \epsilon_m^*$):

$$D^{(1,young)}(\tau_t, y_t) = 1 - F(\epsilon_m^*(\tau_t, y_t)).$$

- Married men who are seeking a second wife and have experienced a shock of sufficient magnitude to allow them to enter into a second marriage ($\epsilon_{jt} > \epsilon_{m,2}^*$):

$$D^{(2,old)}(\tau_t, y_t, \tau_{t-1}^*, y_{t-1}) = \frac{p}{(1+a)}\Big[\Big(1 - F(\epsilon_m^*(\tau_{t-1}^*, y_{t-1})\Big) \times \Big(1 - F(\epsilon_{m,2}^*(\tau_t, y_t)\Big)\Big].$$

The supply for child brides comes from households with a low enough shock ($\epsilon_{it} < \epsilon_f^*$): $S(\tau_t, y_t) = F(\epsilon_f^*(\tau_t, y_t))$. This demand and supply of child brides will determine an equilibrium bride price that clears the market: $Q^*(y_t) \equiv D(y_t, \tau_t^*) = S(y_t, \tau_t^*)$.

### A.1.6 Comparative Statics and Testable Implications

**Comparative Statics 1.** The demand for child brides is increasing in aggregate income ($D_y = \frac{\partial D(\tau_t, y_t)}{\partial y_t} > 0$), and the supply of child brides is decreasing in aggregate income ($S_y = \frac{\partial S(\tau_t, y_t)}{\partial y_t} < 0$).

**Proof.** See Appendix Section A.2.3. This result is also a direct extension of the model in Corno et al. (2020) but in a framework with sequential matching that allows polygyny.

**Comparative Statics 2.**

- Lower aggregate income will increase the market shares of young men looking for a first/unique wife at the expense of older men who are looking for a second wife if the shadow price of marrying a junior wife is low enough

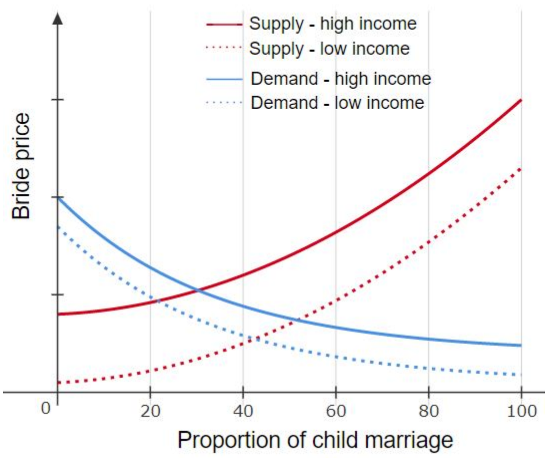
- This also leads to a weaker rise in the equilibrium quantity of child marriage in response to the shock as $p$ increases: $Q_y^* = \frac{dQ^*(y_t)}{dy_t} < 0$ when $p = 0$, and $\frac{dQ_y^*}{dp} > 0$ when $p > 0$.

**Proof.** See Appendix Section A.2.4.

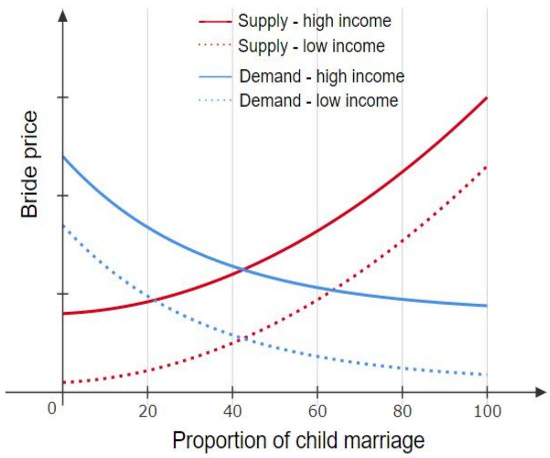
The threshold for marrying a second wife ($\epsilon_{m,2}^*$) is an increasing function of the shadow price of a junior wife. When the latter is low enough, concavity implies that the demand for second brides will be more sensitive to income and price changes when aggregate income is low compared to the demand for first/unique brides. See Section 2.2.3 for a discussion on the areas in which this is likely to be the case.

Figure A1 illustrates the comparative statics regarding child marriage. In a monogamous market, child marriage increases when the aggregate income is low because the supply curve is more income-elastic than the demand (both curves have similar price-elasticities here). When polygyny is permitted (panel (b)), the income-elasticity of the overall demand is much higher than in the case of monogamy because of the demand for second brides. This elasticity is, therefore, closer to that of the supply curve. Panel (b) shows a particular case in which the supply and demand have the same income elasticity (in addition to having the same price elasticity), so there is no change in the equilibrium quantity of child marriage.

Figure A1: Illustration of the Comparative Statics




(a) Monogamy




(b) Polygyny

## A.2 Model Proofs

### A.2.1 Proposition 1

**Part 1.** A household wants their adult daughter (oldest generation) to marry if and only if:

$$\begin{aligned} & U^f_{o,t}(b_t = 1 | M_{t-1} = 0, y_t, \epsilon_{it}, \tau_t) > U^f_{o,t}(b_t = 0 | M_{t-1} = 0, y_t, \epsilon_{it}) \\ \iff \quad & \frac{(y_t + \epsilon_{it} + \tau_t)^{1-\gamma}}{1-\gamma} + V^f_M > \frac{(y_t + \epsilon_{it} + w^f_o)^{1-\gamma}}{1-\gamma} + V^f_U \\ \iff \quad & \tau_t > \left[ (y_t + \epsilon_{it} + w^f_o)^{1-\gamma} - (1-\gamma)\left(V^f_M - V^f_U\right)\right]^{\frac{1}{1-\gamma}} - y_t - \epsilon_{it} = \underline{\tau}_t . \end{aligned}$$

Similarly, an unmarried old son in his household $j$ wants to marry if:

$$\frac{(y_t+\epsilon_{jt}-w_o^{m,l}+w_g^f-\tau_t)^{1-\gamma}}{1-\gamma}+V_M^{m,o}>\frac{(y_t+\epsilon_{jt}-w_o^{m,l})^{1-\gamma}}{1-\gamma}+V_U^{m,o}$$

$$\iff \quad \tau_t<y_t+\epsilon_{jt}-w_o^{m,l}+w_g^f-\Big[(y_t+\epsilon_{jt}-w_o^{m,l})^{1-\gamma}-(1-\gamma)\Big(V_M^{m,o}-V_U^{m,o}\Big)\Big]^{\frac{1}{1-\gamma}}=\bar{\tau}_t.$$

For $V_M^{m,o}-V_U^{m,o}\geq 0$ and $V_M^f-V_U^f\geq 0$, I have $\bar{\tau}_t\geq \underline{\tau}_t$. Any bride price $\tau_t^*\in[\underline{\tau}_t,\bar{\tau}_t]$ is an equilibrium price that makes all the old agents want to marry at $t$ (QED).

**Part 2.** An old son who is looking for a second wife will find it optimal to remarry if $H_2(y_t,\epsilon_{jt},\tau_t)\equiv\Big[u\Big(y_t+\epsilon_{jt}-w_o^{m,h}-\tau_t+(w_o^f+w_y^f)\Big)+V_{M2}^{m,o}\Big]-\Big[u(y_t+\epsilon_{jt}-w_o^{m,h}+w_o^f)+V_M^{m,o}\Big]>0$. Concavity and monotonicity ensure that the difference in flow utility is strictly increasing in $\epsilon_{jt}$ (since $\tau_t>w_g^f$). Therefore $\epsilon_{m,2}^*$ is defined such that $H_2(y_t,\epsilon_m^*,\tau_t)\equiv 0$ (QED).

### A.2.2 Proposition 2

Define $\Omega^f=\delta\Big[E[\bar{V}_{o,t+1}^f(M_t=0)]-E[\bar{V}_{o,t+1}^f(M_t=1)]\Big]$: Option value of marriage for woman's family and $\Omega^m=\delta\Big[E[\bar{V}_{o,t+1}^m(M_t=0)]-E[\bar{V}_{o,t+1}^m(M_t=1)]\Big]$: Option value of marriage for man's family (household head). Everyone finds it optimal to marry by the end of the next period (before leaving the market), so future utility terms beyond phase 2 cancel out. The presence of a potential second wife next period does not affect the future stream of utility expected by a man's parents at $t$ (as argued in Section A.1.1).

$$\Omega^f=\delta\sum_{z\in\{H,L\}}\frac{1}{2}\int\Big[u\Big(y_{t+1}^z+\epsilon_{i,t+1}+\tau_{t+1}^*\Big)-u\Big(y_{t+1}^z+\epsilon_{i,t+1}\Big)\Big]dF(\epsilon_{i,t+1})>0.$$

$$\Omega^m=\sum_{z\in\{H,L\}}\frac{\delta}{2}\int\Big[u\Big(y_{t+1}^z+\epsilon_{j,t+1}+w_o^{m,l}\Big)-u\Big(y_{t+1}^z+\epsilon_{j,t+1}+w_o^{m,h}\Big)\Big]dF(\epsilon_{j,t+1})<0.$$

The future expected equilibrium bride price $\tau_{t+1}^*$ is independent of $y_t$ and $\tau_t^*$ in the case of monogamy ($p=0$), even though we have overlapping generations in the model. Men leave the market after a union in this case, so even if a negative shock leads to more child marriages at period $t$, this will not change the excess quantity of older men looking for a child bride at $t+1$. The other components that clear the market come from the new generations that will enter the market at $t+1$ (supply of child brides and demand for child brides from young bachelors). When polygyny is allowed ($p > 0$), the demand for child brides depends on two additional components: (i) the steady state demand for second brides, which is orthogonal to $y_t$, and (ii) the fluctuations in the demand for second brides around this steady that come from changes in $y_t$. The latter component is relatively small compared to the others and is assumed to play no role in how households build their expectation about the market clearing price next period. The primary driver of the marital decision on the supply side of the market in this model is to smooth consumption with the bride price and not necessarily to maximize the bride price that they could receive in the future based on short-term fluctuations in aggregate income.

This modeling approach allows for tractable comparative statics. It is also consistent with the way polygyny is practiced in SSA. In most of the empirical exercise, markets are assumed to clear on a yearly basis. However, most men go back to the market for a second wife between 5 and 15 years after their first union. Therefore, the demand for a second wife at year $t$ comes from several cohorts of men that entered the market at different points in time, and this smooths out the effect of short-term shocks. In particular, an income shock at year $t$ will not systematically affect the demand for a second wife at $t+1$ even if it affects the equilibrium quantity of child marriage at $t$. These men will wait for a few years before re-entering the market, and even then, they will compete with other married men from different cohorts.

A woman's family will want her to marry young at period $t$ if and only if $W(y_t, \epsilon_{it}, \tau_t) \equiv u(y_t + \epsilon_{it} + \tau_t) - u(y_t + \epsilon_{it} + w_y^f) - \Omega^f > 0$. Concavity and monotonicity of the utility function ensure that the difference in flow utilities is decreasing in $\epsilon_{it}$, while $\Omega^f$ does not depend on it. Therefore $\epsilon_f^*$ is defined such that $W(y_t, \epsilon_f^*, \tau_t) \equiv 0$.

Similarly, a son's family will want him to marry if $H(y_t, \epsilon_{jt}, \tau_t) \equiv u(y_t + \epsilon_{jt} + w_y^m - \tau_t + w_y^f) - u(y_t + \epsilon_{jt} + w_y^m) - \Omega^m > 0$. Again, concavity and monotonicity ensure that the difference in flow utilities is strictly increasing in $\epsilon_{jt}$, while $\Omega^f$ does not depend on it. Therefore $\epsilon_m^*$ is defined such that $H(y_t, \epsilon_m^*, \tau_t) \equiv 0$.

### A.2.3 Comparative Statics 1

By the Implicit Function Theorem (IFT), the chain rule, the fact that $F()$ is strictly increasing, and the fact that $D^{(1,old)}$ is independent of $y_t$ and $\epsilon_t$, we have:

$$\frac{\partial S(\tau_t, y_t)}{\partial y_t} = S_y(\tau_t, y_t) = f(\epsilon_f^*(\tau_t, y_t))\frac{\partial \epsilon_f^*(\tau_t, y_t)}{\partial y_t} = -f(\epsilon_f^*(\tau_t, y_t))\frac{\partial W/\partial y_t}{\partial W/\partial \epsilon_f^*} = -f(\epsilon_f^*(\tau_t, y_t)) < 0$$

$$\begin{aligned}
&\frac{\partial D(\tau_t, y_t)}{\partial y_t} = D_y(\tau_t, y_t) = D_y^{(1,young)}(\tau_t, y_t) + D_y^{(2,old)}(\tau_t, y_t, \tau_{t-1}, y_{t-1}) \\
= \quad & -f(\epsilon_m^*(\tau_t, y_t))\frac{\partial \epsilon_m^*(\tau_t, y_t)}{\partial y_t} - f(\epsilon_{m,2}^*(\tau_t, y_t))\frac{\partial \epsilon_{m,2}^*(\tau_t, y_t)}{\partial y_t} \times \frac{p}{(1+a)}\Big[1 - F(\epsilon_m^*(\tau_{t-1}, y_{t-1})\Big] \\
= \quad & f(\epsilon_m^*(\tau_t, y_t))\frac{\partial H/\partial y_t}{\partial H/\partial \epsilon_m^*} + f(\epsilon_{m,2}^*(\tau_t, y_t))\frac{\partial H_2/\partial y_t}{\partial H_2/\partial \epsilon_{m,2}^*} \times \frac{p}{(1+a)}\Big[1 - F(\epsilon_m^*(\tau_{t-1}, y_{t-1})\Big] \\
= \quad & f(\epsilon_m^*(\tau_t, y_t)) + f(\epsilon_{m,2}^*(\tau_t, y_t)) \times \frac{p}{(1+a)}\Big[1 - F(\epsilon_m^*(\tau_{t-1}, y_{t-1})\Big] > 0
\end{aligned}$$

With similar arguments, we also have:

$$\frac{\partial S(\tau_t, y_t)}{\partial \tau_t} = S_\tau(\tau_t, y_t) = f(\epsilon_f^*(\tau_t, y_t))\frac{\partial \epsilon_f^*(\tau_t, y_t)}{\partial \tau_t} = -f(\epsilon_f^*(\tau_t, y_t))\frac{\partial W/\partial \tau_t}{\partial W/\partial \epsilon_f^*} > 0.$$

The denominator is negative because of the concavity and monotonicity of $u$, and the numerator is positive because $u$ is increasing.

$$\begin{aligned}
&\frac{\partial D(\tau_t, y_t)}{\partial \tau_t} = D_\tau(\tau_t, y_t) = D_\tau^{(1,young)}(\tau_t, y_t) + D_\tau^{(2,old)}(\tau_t, y_t, \tau_{t-1}, y_{t-1}) \\
= \quad & -f(\epsilon_m^*(\tau_t, y_t))\frac{\partial \epsilon_m^*(\tau_t, y_t)}{\partial \tau_t} - f(\epsilon_{m,2}^*(\tau_t, y_t))\frac{\partial \epsilon_{m,2}^*(\tau_t, y_t)}{\partial \tau_t} \times \frac{p}{(1+a)}\Big[1 - F(\epsilon_m^*(\tau_{t-1}, y_{t-1})\Big] \\
= \quad & f(\epsilon_m^*(\tau_t, y_t))\frac{\partial H/\partial \tau_t}{\partial H/\partial \epsilon_m^*} + f(\epsilon_{m,2}^*(\tau_t, y_t))\frac{\partial H_2/\partial \tau_t}{\partial H_2/\partial \epsilon_{m,2}^*} \times \frac{p}{(1+a)}\Big[1 - F(\epsilon_m^*(\tau_{t-1}, y_{t-1})\Big] < 0.
\end{aligned}$$

### A.2.4 Comparative Statics 2

The equilibrium quantity of child marriage is given by $Q^*(y_t) \equiv D(y_t, \tau_t^*) = S(y_t, \tau_t^*)$.
We have: $\frac{dQ^*(y_t)}{dy_t} = S_y(y_t, \tau_t^*) + S_\tau(y_t, \tau_t^*)\frac{\partial \tau_t^*}{\partial y_t}$.
The equilibrium price is defined implicitly as solution to $S(y_t, \tau_t^*) - D(y_t, \tau_t^*) = 0$.
By the Implicit Function Theorem (IFT): $\frac{d\tau_t^*}{dy_t} = -\frac{S_y - D_y}{S_\tau - D_\tau}$.
Therefore, $\frac{dQ^*(y_t)}{dy_t} = S_y - S_\tau\frac{S_y - D_y}{S_\tau - D_\tau} = \left(\frac{S_y}{S_\tau} - \frac{D_y}{D_\tau}\right)\frac{S_\tau D_\tau}{D_\tau - S_\tau}$.
**Part 1.** For $p = 0$ (monogamy): $\frac{dQ^*(y_t)}{dy_t} < 0$

$$sgn\Big(\frac{dQ^*(y_t)}{dy_t}\Big) = sgn\Big(\frac{S_y}{S_\tau} - \frac{D_y}{D_\tau}\Big) = sgn\Big(\frac{\partial W/\partial y_t}{\partial W/\partial \tau_t} - \frac{\partial H/\partial y_t}{\partial H/\partial \tau_t}\Big) < 0? \tag{E.1}$$

$$\begin{aligned}
\frac{S_y}{S_\tau} - \frac{D_y}{D_\tau} &= \frac{u'(y_t + \epsilon_f^* + \tau_t) - u'(y_t + \epsilon_f^* + w_y^f)}{u'(y_t + \epsilon_f^* + w_y^f + (\tau_t - w_y^f))} \\
&+ \frac{u'(y_t + \epsilon_m^* + w_y^m - \tau_t + w_y^f) - u'(y_t + \epsilon_m^* + w_y^m)}{u'(y_t + \epsilon_m^* + w_y^m - (\tau_t - w_y^f))} \\
&= 2 - \Big(1 + \frac{\tau_t - w_y^f}{y_t + \epsilon_f^* + w_y^f}\Big)^\gamma - \Big(1 - \frac{\tau_t - w_y^f}{y_t + \epsilon_m^* + w_y^m}\Big)^\gamma.
\end{aligned}$$

The Bernoulli inequality states that: $(1+x)^r \geq 1 + rx \quad \forall r \geq 1, x \geq -1$. So we have:

$$\frac{S_y}{S_\tau} - \frac{D_y}{D_\tau} \leq \gamma(\tau_t - w_y^f)\Big(\frac{1}{y_t + \epsilon_m^* + w_y^m} - \frac{1}{y_t + \epsilon_f^* + w_y^f}\Big).$$

Since $\tau_t > w_y^f$, the upper bound $< 0$ if $\epsilon_m^* + w_y^m > \epsilon_f^* + w_y^f$.

As long as $w_o^{m,l}$ is sufficiently large (compared to $\Delta w = w_o^{m,h} - w_o^{m,l}$), concavity ensures that $|\Omega^m| < |\Omega^f|$, and, therefore, $\epsilon_m^* > \epsilon_f^*$.

**Part 2.** The negative effect of income shock on child marriage is decreasing with $p$ because the demand for a second wife is more sensitive to income and bride price changes than the demand for a first wife.

$$\frac{dQ_y^*}{dp} = -S_\tau \frac{-\frac{dD_y}{dp}(S_\tau - D_\tau) + \frac{dD_\tau}{dp}(S_y - D_y)}{(S_\tau - D_\tau)^2} > 0?$$

$$A = -\frac{dD_y}{dp}(S_\tau - D_\tau) + \frac{dD_\tau}{dp}(S_y - D_y) < 0?$$

$$\frac{dD_\tau}{dp} = f(\epsilon_{m,2}^*(\tau_t, y_t)) \times \frac{1}{(1+a)}[1 - F(\epsilon_m^*(\tau_{t-1}^*, y_{t-1})] \times \frac{\partial H_2/\partial \tau_t}{\partial H_2/\partial y_t} < 0$$

$$\frac{dD_y}{dp} = f(\epsilon_{m,2}^*(\tau_t, y_t)) \times \frac{1}{(1+a)}[1 - F(\epsilon_m^*(\tau_{t-1}^*, y_{t-1})] > 0$$

$$\frac{dD_\tau}{dp} = \frac{\partial H_2/\partial \tau_t}{\partial H_2/\partial y_t} \times \frac{dD_y}{dp}$$

$$\begin{aligned}
A &= -\frac{dD_y}{dp}\Big[-f(\epsilon_f^*(\tau_t,y_t))\frac{\partial W/\partial\tau_t}{\partial W/\partial y_t}-\Big(f(\epsilon_m^*(\tau_t,y_t))\frac{\partial H/\partial\tau_t}{\partial H/\partial y_t}+p\times\frac{dD_\tau}{dp}\Big)\Big]\\
&+ \frac{dD_\tau}{dp}\Big[-f(\epsilon_f^*(\tau_t,y_t))-\Big(f(\epsilon_m^*(\tau_t,y_t))+p\times\frac{dD_y}{dp}\Big)\Big]\\
&= \frac{dD_y}{dp}\Big[f(\epsilon_f^*(\tau_t,y_t))\frac{\partial W/\partial\tau_t}{\partial W/\partial y_t}+\Big(f(\epsilon_m^*(\tau_t,y_t))\frac{\partial H/\partial\tau_t}{\partial H/\partial y_t}+p\times\frac{\partial H_2/\partial\tau_t}{\partial H_2/\partial y_t}\times\frac{dD_y}{dp}\Big)\Big]\\
&- \frac{\partial H_2/\partial\tau_t}{\partial H_2/\partial y_t}\times\frac{dD_y}{dp}\Big[f(\epsilon_f^*(\tau_t,y_t))+\Big(f(\epsilon_m^*(\tau_t,y_t))+p\times\frac{dD_y}{dp}\Big)\Big]\\
&= \frac{dD_y}{dp}\Big[f(\epsilon_f^*(\tau_t,y_t))\Big(\frac{\partial W/\partial\tau_t}{\partial W/\partial y_t}-\frac{\partial H_2/\partial\tau_t}{\partial H_2/\partial y_t}\Big)+f(\epsilon_m^*(\tau_t,y_t))\Big(\frac{\partial H/\partial\tau_t}{\partial H/\partial y_t}-\frac{\partial H_2/\partial\tau_t}{\partial H_2/\partial y_t}\Big)\Big]
\end{aligned}$$

$$A_1 = \frac{\partial W/\partial\tau_t}{\partial W/\partial y_t}-\frac{\partial H_2/\partial\tau_t}{\partial H_2/\partial y_t}=\Big(\frac{\partial W/\partial\tau_t}{\partial W/\partial y_t}-\frac{\partial H/\partial\tau_t}{\partial H/\partial y_t}\Big)+\Big(\frac{\partial H/\partial\tau_t}{\partial H/\partial y_t}-\frac{\partial H_2/\partial\tau_t}{\partial H_2/\partial y_t}\Big)$$

$A_{1,1}=\frac{\partial W/\partial\tau_t}{\partial W/\partial y_t}-\frac{\partial H/\partial\tau_t}{\partial H/\partial y_t}>0$ from Equation E.1, and independent of $V_{M2}^{m,o}-V_M^{m,o}$.

To get the sign of $A_1$, We need to compare $\frac{\partial H/\partial\tau_t}{\partial H/\partial y_t}$ (the relative income and price elasticity of the demand for first wives) with $\frac{\partial H_2/\partial\tau_t}{\partial H_2/\partial y_t}$ (the relative income and price elasticity of the demand for a second wife). Let us consider $A_{1,2}=\frac{\partial H/\partial\tau_t}{\partial H/\partial y_t}-\frac{\partial H_2/\partial\tau_t}{\partial H_2/\partial y_t}$.

$$\begin{aligned}
A_{1,2} &= \frac{\partial H/\partial\tau_t}{\partial H/\partial\epsilon_m^*}-\frac{\partial H_2/\partial\tau_t}{\partial H_2/\partial\epsilon_{m,2}^*}=\frac{-u'(y_t+\epsilon_m^*+w_y^m-\tau_t+w_y^f)}{u'(y_t+\epsilon_m^*+w_y^m-\tau_t+w_y^f)-u'(y_t+\epsilon_m^*+w_y^m)}\\
&- \frac{-u'(y_t+\epsilon_{m,2}^*-w_o^{m,h}-\tau_t+(w_o^f+w_y^f))}{u'(y_t+\epsilon_{m,2}^*-w_o^{m,h}-\tau_t+(w_o^f+w_y^f))-u'(y_t+\epsilon_{m,2}^*-w_o^{m,h}+w_o^f)}\\
&= -\frac{1}{1-B_1}+\frac{1}{1-B_2}=\frac{B_2-B_1}{(1-B_1)(1-B_2)}.
\end{aligned}$$

We have $0<B_1=\frac{u'(y_t+\epsilon_m^*+w_y^m)}{u'(y_t+\epsilon_m^*+w_y^m-\tau_t+w_y^f)}<1$ and $0<B_2=\frac{u'(y_t+\epsilon_{m,2}^*-w_o^{m,h}+w_o^f)}{u'(y_t+\epsilon_{m,2}^*-w_o^{m,h}-\tau_t+(w_o^f+w_y^f))}<1$

$$B_1=\Big(\frac{y_t+\epsilon_m^*+w_y^m-\tau_t+w_y^f}{y_t+\epsilon_m^*+w_y^m}\Big)^\gamma=\Big(1-\frac{\tau_t-w_y^f}{y_t+\epsilon_m^*+w_y^m}\Big)^\gamma$$

$$B_2=\Big(\frac{y_t+\epsilon_{m,2}^*-w_o^{m,h}-\tau_t+w_y^f+w_o^f}{y_t+\epsilon_{m,2}^*-w_o^{m,h}+w_o^f}\Big)^\gamma=\Big(1-\frac{\tau_t-w_y^f}{y_t+\epsilon_{m,2}^*-w_o^{m,h}+w_o^f}\Big)^\gamma$$

$A_{1,2} < 0 \iff B2 < B1$: This is the case if $\epsilon^*_{m,2}$ is low enough. As noted earlier in Section A.2.1, $\epsilon^*_{m,2}$ is a decreasing function of $V^{m,o}_{M2} - V^{m,o}_{M}$ so this will happen if the extra utility that men derive from having a second wife ($V^{m,o}_{M2} - V^{m,o}_{M}$) is high enough.

Moreover, since $A_{1,2}$ is an increasing function of $\epsilon^*_{m,2}$ and $A_{1,1}$ is independent of $\epsilon^*_{m,2}$, we have $A_1 < 0$ for $\epsilon^*_{m,2}$ low enough.[41] So $A < 0$ which implies that $\frac{dQ^*_y}{dp} > 0$.

This means that a negative aggregate income shock increases child marriage to a lesser extent in areas with high polygyny rates than in areas with low polygyny rates. This happens because the demand for a second wife is more sensitive to income and bride price changes than the demand for first/unique wives.

## A.3 Crop Price Variation and CPI

Figure A9 shows the evolution of the price index for three main food crops (maize, wheat, and rice) and cash crops (coffee, cocoa, and tobacco) in SSA. There is a substantial variation in prices for the period 1989-2013, with notable spikes around 1995 and during the recent world food price crises in 2007-2008 and 2010-2011.

Africa accounts for less than 6% of the global cereal production, and it is unlikely that local phenomena that occur in SSA would affect world prices (McGuirk and Burke, 2020). Global commodity prices tend to undergo several years of boom and bust during commodities super-cycles. World Bank (2014) argues that the spikes in global food prices around 2007 and 2010 were, for instance, driven by factors such as weather shocks in main supplier regions (Australia, China, and Latin America, for example) and demand shocks from booming economies (China and Latin America, for example). It is unlikely that any of these factors would drive aggregate income and marital outcomes in opposite directions for rural and urban areas, as predicted in the model, other than through their effect on world food prices.

**Consumer Price Index (CPI).** The CPI is constructed similarly to the PPI, but the spatial variation comes from country-level data on food consumption in the FAO food balance sheets (see McGuirk and Burke (2020) for more details). The CPI in year $t$ for country $c$ is given by:

[41] $A = \frac{dD_y}{dp}[f(\epsilon^*_f(\tau_t, y_t)(A_{1,1} + A_{1,2}) + f(\epsilon^*_m(\tau_t, y_t))A_{1,2}]$ is a function of the distribution $f()$ of idiosyncratic components at the cutoffs $\epsilon^*_{m,2}(\tau_t, y_t)$, $\epsilon^*_m(\tau_t, y_t)$, and $\epsilon^*_f(\tau_t, y_t)$. However, its sign depends on the sign and magnitude of $A_{1,2}$ with respect to $A_{1,1}$.

$$CPI_{ct} = \sum_{j=1}^{n} \Big(\pi_{jt} \times S_{jc}\Big), \tag{E.2}$$

where crops $j = 1, ..n$ are contained in a set of 18 crops consumed in Africa and for which world prices exist, making up 56% of calorie consumption in the sample. The list includes essential staples, such as maize, wheat, rice, and sorghum, as well as sugar and palm oil, which are used to process other foods.

## A.4 Consequences on Fertility Onset and Impact on Child Marriage

In this section, I test whether documented differences in the effect of aggregate shocks on marriage timing lead to differences in their impact on fertility onset, using the following specification:

$$F_{i,g,k} \;=\; \beta^l D^l_{i,g,k} + \beta^m D^m_{i,g,k} + \beta^h D^h_{i,g,k} + \omega_g + \zeta_k + \epsilon_{i,g,k}. \tag{E.3}$$

$F_{i,g,k}$ is a dummy equal to 1 if woman $i$ has her first child or gets married before age 18. $D_{i,g,k}$ is a dummy equal to 1 if a girl born in cell $g$ in year $k$ has been exposed to droughts between ages 12 and 17. All the other variables and indices are defined as in Equation 2.[42] Very few women have their first child before age 15 in my sample (5% versus 27% between age 15 and 17). Droughts have no detectable effect on fertility onset between ages 12 and 14 (column 1 of Table A12). Column 2 of Table A12 show that women exposed to droughts at age 15-17 are 1.98 pp (9.5 % of the mean dependent variable, p<0.01) more likely to give birth to their first child before age 18 in low polygyny areas. The estimated coefficient is close to zero and insignificant in medium and high polygyny areas.

Early fertility onset leads to more births during the first years of reproductive life in SSA due to the limited use of contraception. Column 4 of Table A12 shows that exposure to droughts between ages 12 and 24 increases fertility levels by age 25, only in low polygyny areas. Women exposed to droughts in these areas have 0.2 more children than the other women (10 % percent of the average number of children in these areas, p<0.01). Droughts have no significant effect

[42]This specification is more suitable to study the impact of droughts on fertility onset compared to the duration model. Rainfall shocks are i.i.d. over time, and a drought that occurs in a given year might also affect fertility the following year, given the time lag between marriage, conception, and first birth.

on the number of children in medium and high polygyny areas.

To study the impact of droughts on child marriage, an alternative approach to the duration model is to look at the impact of exposure to any drought between ages 12 and 17 on the likelihood of marrying before age 18.[43] For that, I replace fertility onset outcome in Equation E.3 by a dummy for child marriage. Similar to the fertility outcome, column 4 of Table A12 also shows that droughts do not have a detectable impact on the probability of getting married before age 15, irrespective of the extent to which polygyny is practiced. Only 15% of unions occur before age 15 in my sample. Conditional on being single by age 15, droughts lead to an increase in the probability of being married before age 18 by 1.6 pp ($p<0.01$) in low polygyny areas (column 5), which represents 6.4% of the mean dependent variable in these areas. The estimated impact is small (magnitudes divided by 2 at least) and statistically insignificant in medium and high polygyny areas. The difference between coefficients is statistically significant between low and medium polygyny ($p=0.016$) areas but not between low and high polygyny areas. The latter test is rejected with more precision ($p=0.038$) when I restrict the analysis to women from a bride price ethnic group in column 6 with similar magnitudes for the point estimates.

## A.5 Supply Side Mechanism

My model does not assume any differential reaction of the market's supply side across monogamous and polygynous areas. The presence of polygyny could also affect women's incentives in the market. Rexer (2022) argues that women can match with wealthier already-married men if polygyny is allowed, yielding a greater option value of waiting when they are exposed to good rainfall conditions. However, this supply-side mechanism implies that income shocks will have a more significant effect on the equilibrium quantity of child marriage in polygynous markets. The empirical evidence documented in this paper supports the opposite: income shocks have a stronger effect on child marriage in monogamous markets than in polygynous ones. Table A13 shows that my main results are robust to using only the survey data from Nigeria, the country studied in Rexer (2022). The supply side mechanism, therefore, plays a minor role in how the marriage market clears from one year to another with changing economic conditions.

[43] This approach is agnostic about the exact timing structure of the link between yearly rainfall shocks and child marriage.

## A.6 Further Threats to Identification

### A.6.1 Potential Differential Effect of Aggregate Shocks?

The first threat to the identification is whether my results could be driven by the fact that a given shock could impact household economic conditions differently in monogamous and polygynous areas. The global commodity price shocks affect real income for a given output level. There is no obvious reason for the value of this output to differ between monogamous and polygynous areas. However, rainfall shocks affect agricultural production, and evidence suggests that polygynous and monogamous households have different production technologies (Akresh et al., 2012; Damon and McCarthy, 2019). Droughts could, in theory, lead to a larger/smaller drop in household resources in monogamous areas compared to polygynous ones. We know surprisingly little on this topic. Dessy et al. (2021) use household-level production data and find that the extent to which polygyny is practiced in rural communes of Mali does not affect the impact of droughts on crop yield. Rather, in their data, they find that polygyny improves farm households' capacity to recover from droughts in subsequent years. Whether their finding can be generalized to other settings in SSA is an open question.

However, irrespective of the direction in which polygyny may impact the link between droughts and household income, this type of argument cannot explain the fact that droughts affect marriage timing **only** in low/medium polygyny areas and at the same time increase the likelihood of marrying men with a lower age gap as first wives **only** for women in high polygyny areas. These two effects confirm that droughts affect substantially household resources and marital decisions in all areas, but those with monogamous and polygynous norms react differently to them.

Moreover, I use country level data on crop yields, household consumption and GDP per capita to investigate further how polygyny affects household income in my setting. For that, I split SSA into countries with low and high polygyny based on a polygyny rate threshold of 25%. Table A16 shows that droughts reduce, for instance, the average cereal yield by 17% ($p<0.01$) in low polygyny countries versus 6% in high polygyny countries ($p=0.069$), and these coefficients are statistically different from each other ($p=0.03$). This weaker impact on crop yields could still lead to a stronger effect of droughts on household income in high polygyny countries if agriculture plays a larger role in these countries.[44] Column 2 shows indeed that

[44]This effect could also be driven to some extent by systematic differences in measurement errors (e.g., due to

the impact of droughts on household consumption is large and statistically significant only in high polygyny areas: 13 % ($p<0.05$) for high polygyny countries versus 1% ($p>0.1$) in the others. This is also the case for their impact GDP per capita impact. These last two outcomes are the more homogeneously measured across countries than the first one. They both suggest that the presence of polygyny exacerbates the impact of droughts on household income. This result should be taken with caution given the level of aggregation. Even if this is the case, such exacerbation effect of polygyny cannot be behind the weaker impact of drought on marriage timing which is also confirmed by the evidence from the PPI shocks.

### A.6.2 Differential Marriage Market Size and Migration?

**Differential Migration Behavior.** A potential concern for identifying the documented attenuation effect is whether marriage migration happens more (or less) often during droughts and whether this occurs differently in polygynous and monogamous areas. Table A14 shows that this is not the case. Column 1 shows that women who marry during droughts do not appear less likely to remain in their village/city of birth compared to others, and this is irrespective of the extent to which polygyny is practiced. Column 3 shows that they are not more likely to have migrated in order to marry during a drought in both monogamous and polygynous areas. Columns 2 and 4 show similar patterns for PPI shocks.

**Differential Market Size.** One could argue that the weaker effect of aggregate shocks on the timing of marriage in polygynous areas is due to the fact that local marriage markets are geographically much broader in these areas. If unions between people born in very far away locations are common in polygynous areas, this will introduce measurement error in my measure of exposure to the shocks since it is constructed based on the area of residence at the time of the survey. A broader marriage market also means that it less likely that rainfall shocks or PPI shocks would affect most of the people in the relevant market, which is what is consider to be an aggregate shock in this paper. This could also explain the weaker impact of these shocks.

In my sample, more than 75% of women do not move at the time of marriage, irrespective of the extent to which polygyny is practiced in the area in which they live. When migration does occur, previous literature suggests that it happens across relatively short distances, even in high polygyny areas. For instance, Mbaye and Wagner (2017) use a large-scale survey in rural Senegal (high polygyny country) to examine the distance between the natal home and the

own consumption) in the FAO cereal yield data.

current location of married women. The average distance is of 20 km, so it still fits easily within the 50 $\times$ 50 km cell grids considered in this paper. Moreover, I find a strong effect of aggregate shocks on the likelihood of women marrying younger men only in high polygyny areas and on the likelihood of being a first/unique wife instead of a second wife. This also suggests that there is no systematic attenuation bias in polygynous areas due to women marrying and moving outside the cell grids considered here.

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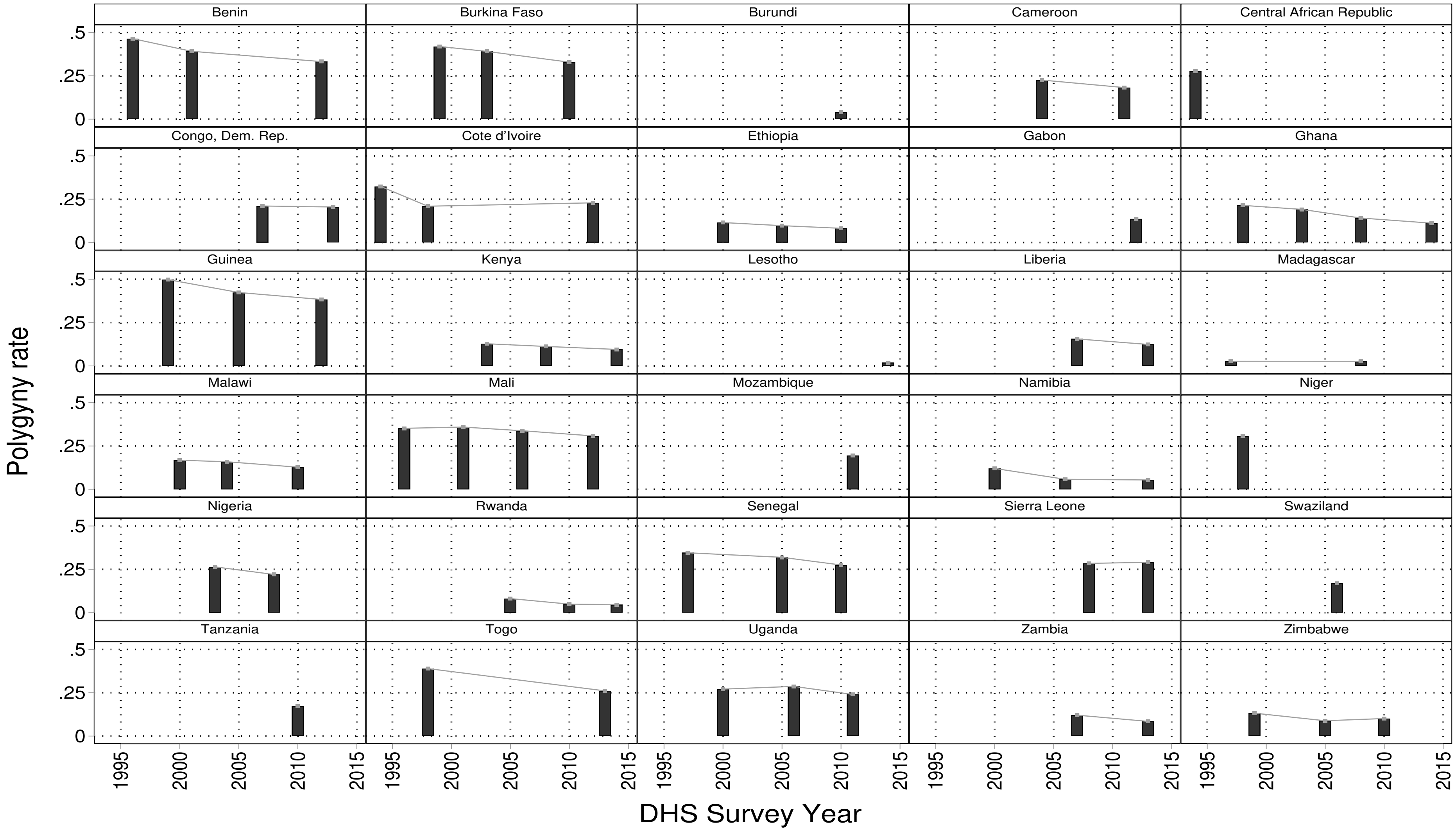
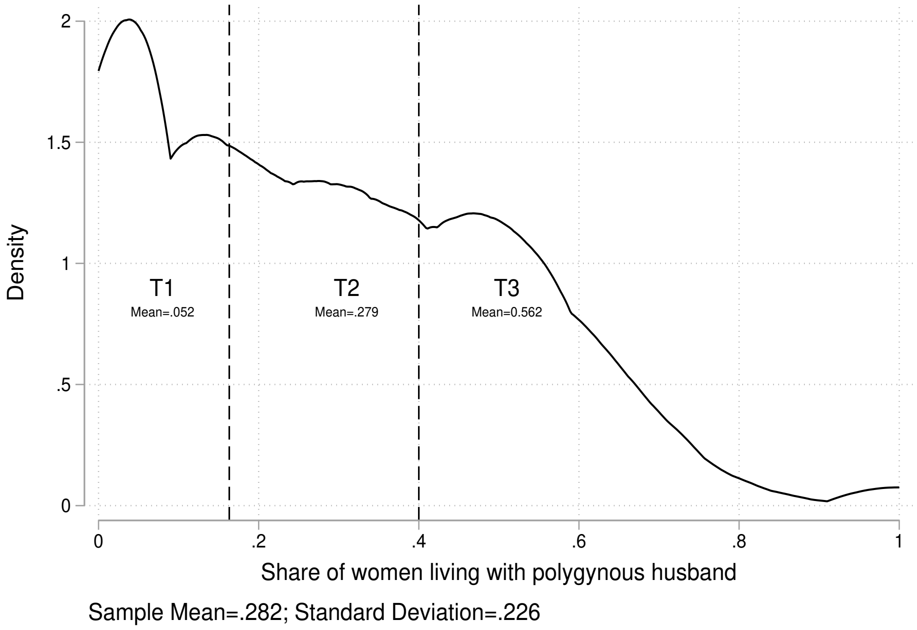
## A.7 Figures and Tables

Figure A2: Evolution of Polygyny Rate over Time for Marriages within the Last Ten Years Preceding Each Survey

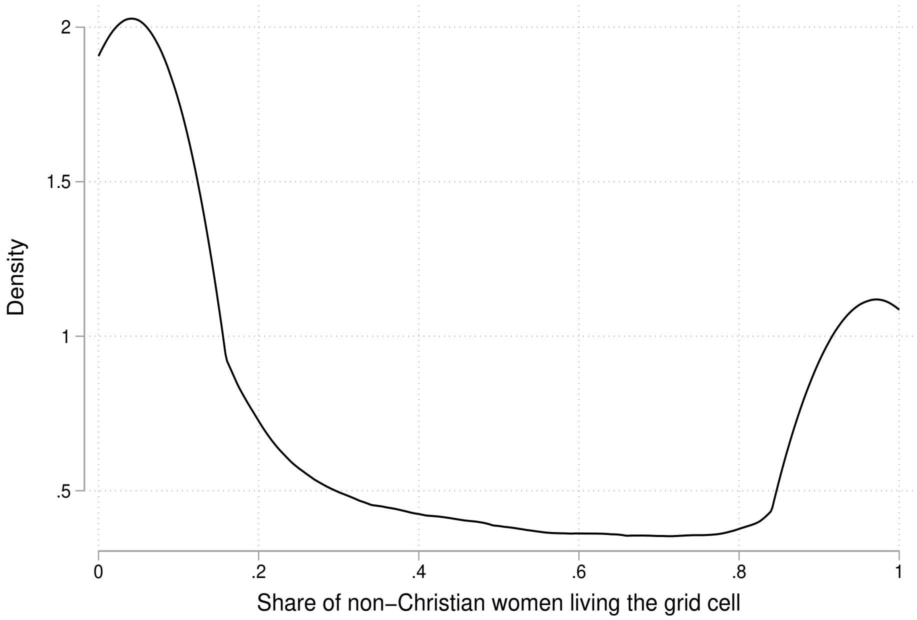



Note: This figure displays the average proportion of polygynous unions among all the unions that occurred within the 10 years preceding each DHS survey wave. The x-axis shows the timing of each survey. The sample includes all the women aged 25 and older at each survey wave.

Figure A3: Distribution of Grid Cells by Polygyny Rate and Religion



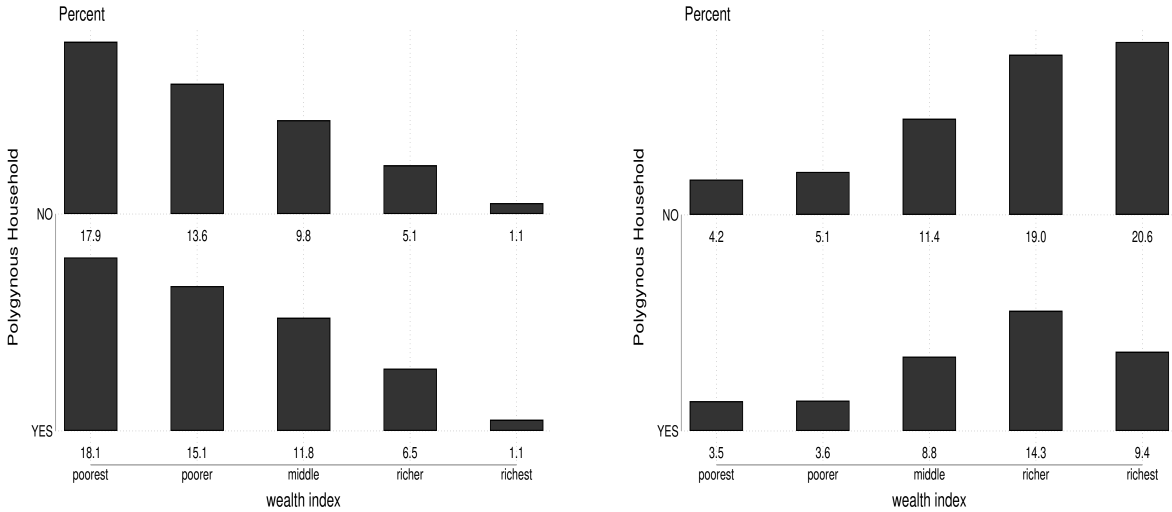

(a)




(b)

**Note.** (a) Polygyny rate is the share of women aged 25 and older that are in a union with a polygynous male in each 0.5 × 0.5 decimal degree weather grid cell. T1 represents grid cells with low polygyny (less than 16%), T2 is for areas with medium polygyny (between 16 and 40%), and T3 is for areas with high polygyny (more than 40%). The average polygyny rate is 28% with a standard deviation of 0.23. (b) The share of non-Christian women is the proportion of women who follow Islam, Traditional African religions, or report being atheist.

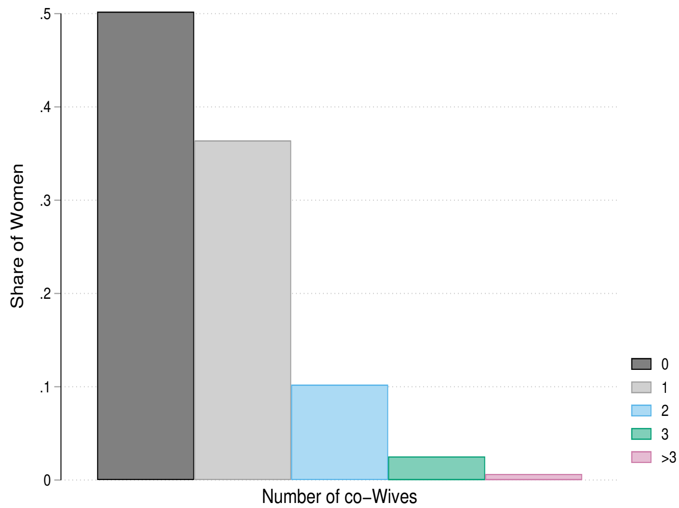
Figure A4: Polygyny by Household Wealth Quintiles in High Polygyny Areas




(a) Rural (b) Urban

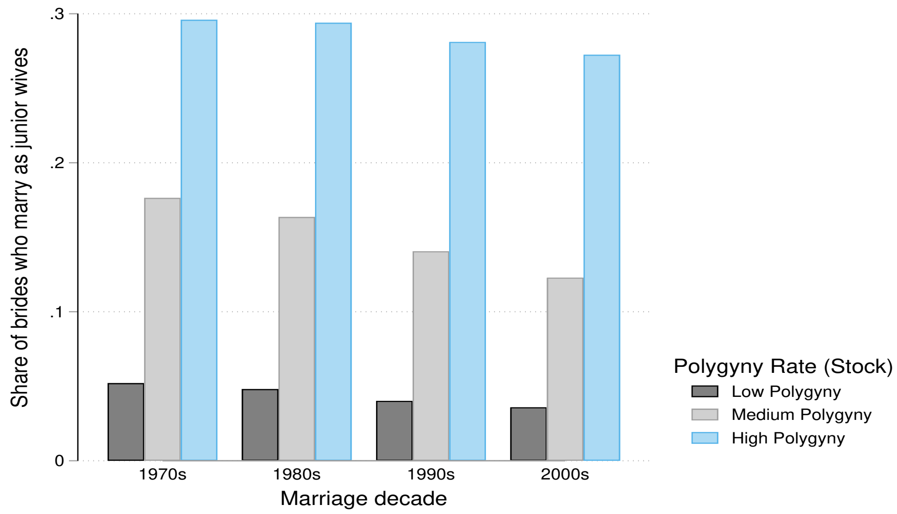
Note: This graph shows the distribution (in percentages) of women by wealth and polygyny status of their household. It uses the most recent DHS survey wave in each country. High Polygyny areas are cell grids in the top tercile of polygyny distribution: polygyny rate >40 %.

Figure A5: Distribution of Women by Number of Co-wives in High Polygyny Areas



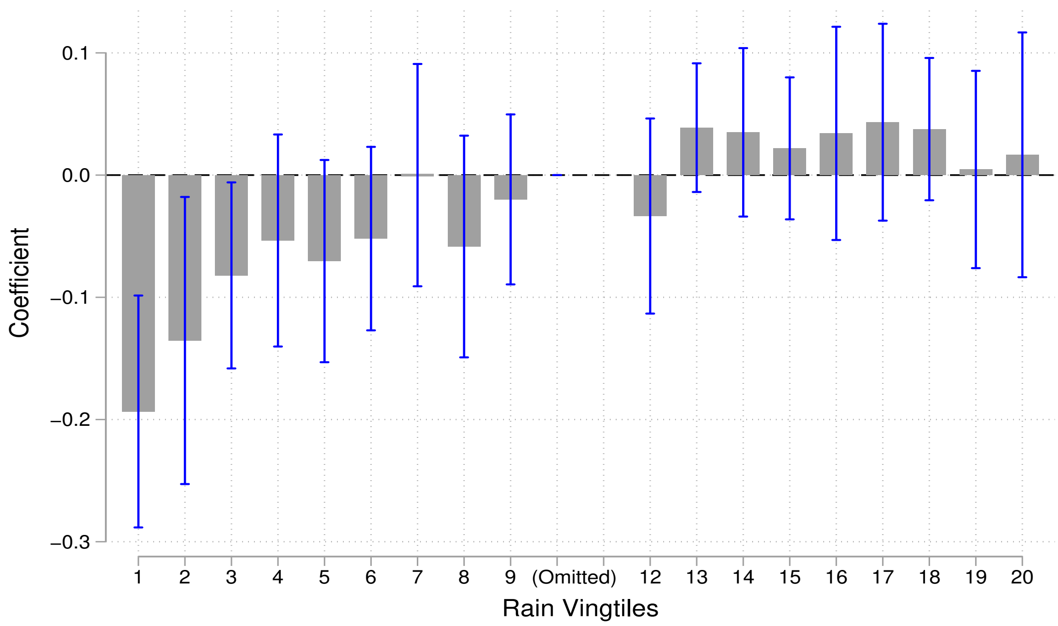

Note: This graphs uses the most recent DHS survey wave in each country. High Polygyny areas are cell grids in the top tercile of polygyny distribution: polygyny rate >40 %.

Figure A6: Distribution of the Flow of Polygynous Unions by Marriage Decade



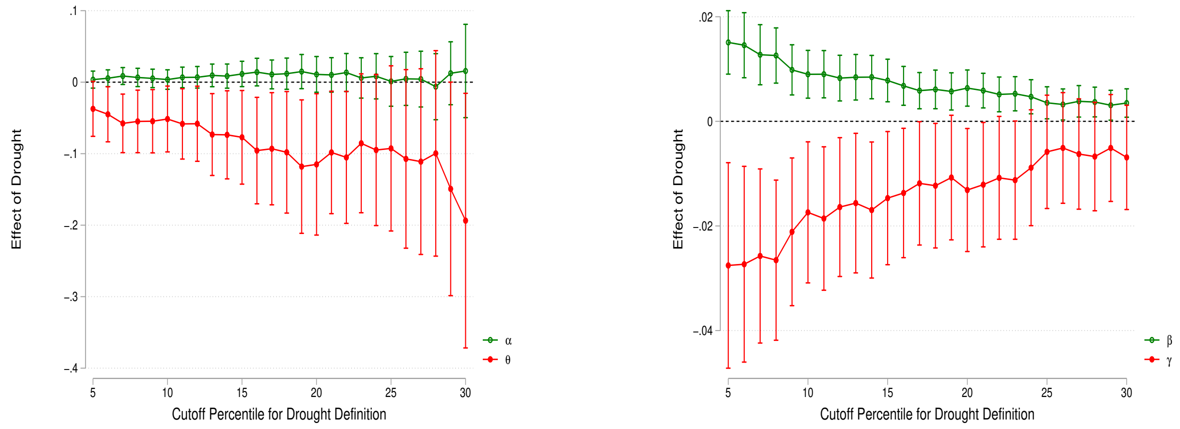

Note: This graph shows the share of junior wife marriages (unions in which the bride marries as second or higher order wife) among all the unions that occur in a given decade for cells with low, medium and high polygyny levels. These three polygyny levels correspond to the terciles of the share of women who live in a polygynous household (stock measure of polygyny rate) in the DHS data. There are 41.062, 98.395, 109.671, and 60.194 unions in the 1970s, 1980s, 1990s, and 2000s, respectively. Only 1.5% of unions occur before 1970 and less than 1% after 2010 in my data.

Figure A8: Crop Yield by Rainfall vingintiles




Note: Coefficients of regression of the log of annual crop yield (tons per hectare) for five main staple crops (maize, sorghum, millet, rice, and wheat) on rainfall vingintiles. It uses country-level crop data from 1960-2010 from the FAOStat. The regression includes year and country FE. Replication from Corno et al. (2020).

Figure A7: Robustness Definition of Drought Based on Cutoffs

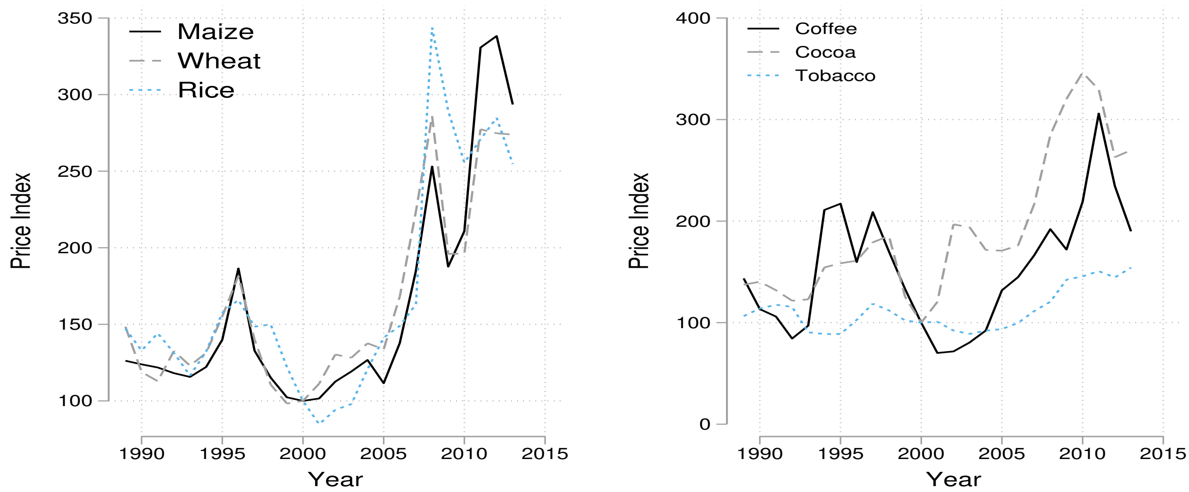



(a) Impact on Junior Wife Indicator

(b) Impact on marriage Timing

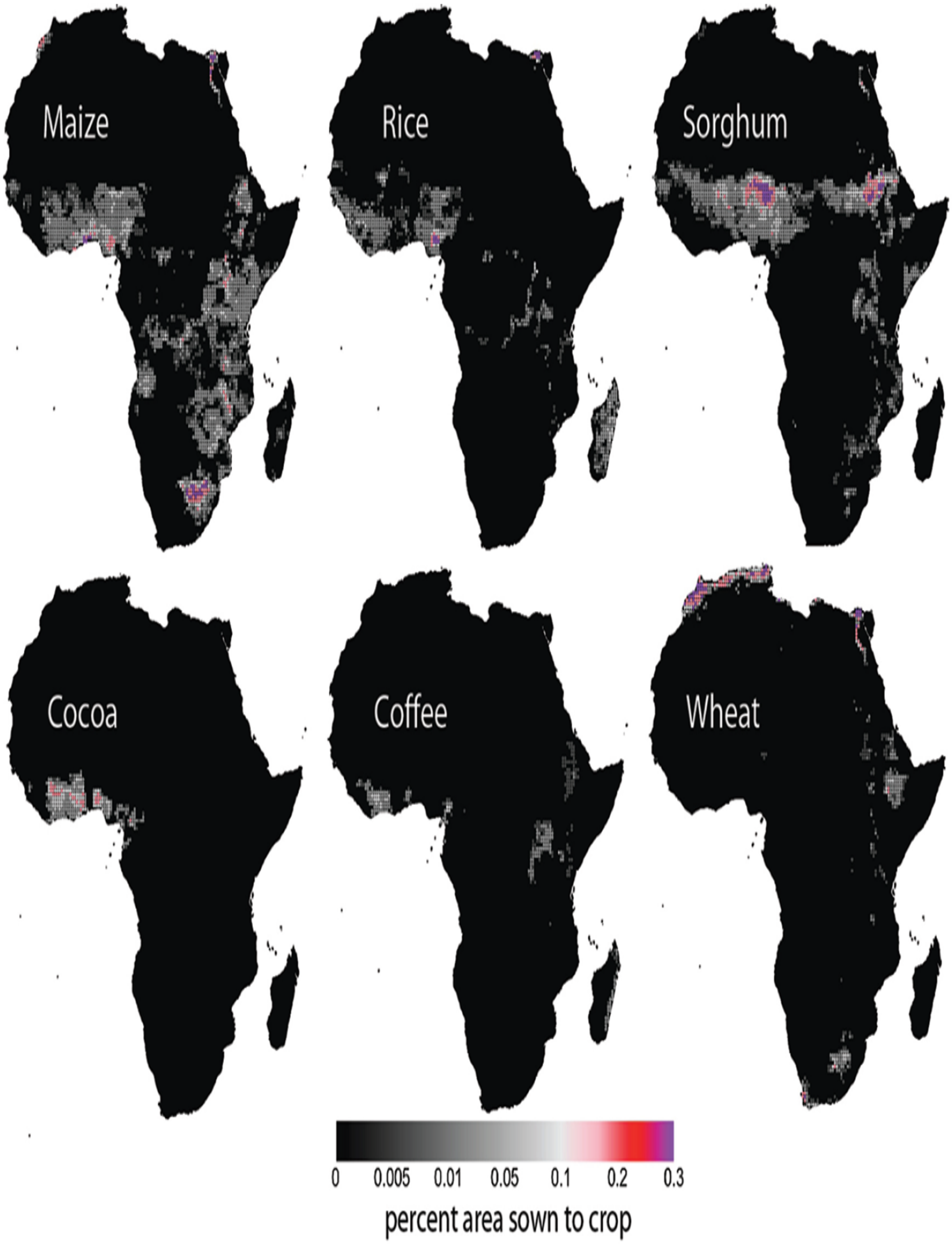
Notes: The connected points show the estimated coefficients, and the capped spikes show 95% confidence intervals calculated using standard errors clustered at the cell level. Panel (a) shows threshold robustness in the definition of droughts for Prediction 1 (column 1 of Table 1). $\alpha$ is the effect of exposure to a drought between age 12 and 24 on the likelihood of marrying as a junior wife in the absence of polygyny. $\theta$ is the coefficient of the interaction term between drought and polygyny rates. Panel (b) shows threshold robustness in the definition of droughts for Prediction 2 (column 1 of Table 4). $\beta$ is the effect of droughts on marriage timing in the absence of polygyny. $\gamma$ is the coefficient on the interaction term between droughts and polygyny rates.

Figure A9: Fluctuations in Global Crop Price




Note: Price data are taken from IMF and World Bank sources with 2000 as the base year (index=100) following McGuirk and Burke (2020).

Figure A10: Geographic Distribution of Crops in Year 2000




Source: McGuirk and Burke (2020)

Table A2: Summary Statistics

| | (1) Obs. | (2) Mean | (3) SD |
|---|---|---|---|
| **Panel A: Indivual Characteristics for All Sample** | | | |
| Age of respondent at the time of the survey | 322,103 | 34.521 | 7.014 |
| Percent of married women in polygynous household | 246,494 | 0.317 | 0.465 |
| Percent women married as junior wives | 242,070 | 0.169 | 0.375 |
| Percent married between ages 12 and 17 | 322,103 | 0.453 | 0.498 |
| Percent married between ages 12 and 24 | 322,103 | 0.849 | 0.358 |
| Percent exposed to a drought between ages 12 and 24 | 322,103 | 0.889 | 0.314 |
| Percent exposed to a drought between ages 12 and 17 | 322,103 | 0.639 | 0.480 |
| Percent with first child between ages 12 and 17 | 322,103 | 0.313 | 0.464 |
| Husband-wife age gap: unique wives | 156,987 | 7.799 | 6.761 |
| Husband-wife age gap: first wives | 32,755 | 9.471 | 7.952 |
| Husband-wife age gap: second wives | 32,376 | 14.979 | 9.717 |
| Age at first marriage: unique wives | 164,956 | 18.903 | 4.443 |
| Age at first marriage: first wives | 34,377 | 16.792 | 3.532 |
| Age at first marriage: second wives | 34,309 | 17.882 | 4.401 |
| **Panel B: Individual Characteristics for High Polygyny Areas** | | | |
| Husband-wife age gap: unique wives | 43,280 | 9.848 | 7.662 |
| Husband-wife age gap: first wives | 22,177 | 10.188 | 8.183 |
| Husband-wife age gap: second wives | 20,754 | 16.169 | 9.732 |
| Age at first marriage: unique wives | 46,335 | 17.200 | 3.841 |
| Age at first marriage: first wives | 23,182 | 16.358 | 3.309 |
| Age at first marriage: second wives | 21,885 | 17.142 | 4.012 |
| **Panel C: Other Individual Characteristics** | | | |
| Percent married between ages 12 and 17: low polygyny areas | 106,238 | 0.307 | 0.461 |
| Percent married between ages 12 and 17: medium polygyny areas | 107,581 | 0.435 | 0.496 |
| Percent married between ages 12 and 17: high polygyny areas | 108,284 | 0.632 | 0.482 |
| Percent of people in grid cell who say "traditional leaders have little or no influence in land allocation" | 247,016 | 0.403 | 0.213 |
| **Panel D: Person $\times$ Age Level Observations (Survival Data)** | | | |
| Average CPI at a given age between 12 and 24 | 1,594,494 | -0.591 | 0.578 |
| Average PPI at a given age between 12 and 24 | 1,594,494 | 3.149 | 4.918 |
| Percent of years with a drought at a given age | 2,427,599 | 0.161 | 0.368 |
| Percent married at a given age between 12 and 24 | 2,427,599 | 0.113 | 0.317 |
| Percent married at a given age between 12 and 17 | 1,679,140 | 0.088 | 0.284 |

The full sample includes all the women aged 25 or older at the time of each DHS survey wave. Summary statistics are weighted by the population-adjusted survey sampling weights. Column 1 shows the number of observations, column 2 the average and column 3 the standard deviation of each variable.

Table A3: Correlates of Polygyny

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Dependent Variable: Binary variable coded as 1 if woman is married to a polygynous man** | | | | | | | | | |
| Matrilineal | -0.0366*** | | | | | | | | | -0.0265** |
| | (0.0141) | | | | | | | | | (0.0113) |
| Bride Price | | 0.0461*** | | | | | | | | 0.0435*** |
| | | (0.0142) | | | | | | | | (0.0134) |
| Female agriculture | | | -0.0725*** | | | | | | | -0.0453*** |
| | | | (0.0230) | | | | | | | (0.0166) |
| Catholic Missions | | | | -0.0069** | | | | | | 0.0057 |
| | | | | (0.0035) | | | | | | (0.0039) |
| Protestant Missions | | | | | -0.0064*** | | | | | -0.0027* |
| | | | | | (0.0016) | | | | | (0.0015) |
| Is Christian | | | | | | -0.1750*** | | | | -0.1430*** |
| | | | | | | (0.0132) | | | | (0.0107) |
| Lives in Rural Area | | | | | | | 0.1011*** | | | 0.0777*** |
| | | | | | | | (0.0113) | | | (0.0107) |
| Has no Education | | | | | | | | 0.1429*** | | 0.0859*** |
| | | | | | | | | (0.0105) | | (0.0092) |
| Wealth (mean) | | | | | | | | | -0.0332*** | -0.0128* |
| | | | | | | | | | (0.0102) | (0.0069) |
| Wealth (SD) | | | | | | | | | 0.0080 | -0.0033 |
| | | | | | | | | | (0.0093) | (0.0073) |
| Observations | 155762 | 155762 | 155762 | 198480 | 198480 | 191474 | 198480 | 198478 | 193499 | 147291 |
| Adjusted R-squared | 0.140 | 0.140 | 0.142 | 0.128 | 0.130 | 0.148 | 0.137 | 0.142 | 0.135 | 0.174 |
| Number of clusters | 378 | 378 | 378 | 472 | 472 | 432 | 472 | 472 | 450 | 368 |
| Mean dependent variable | 0.373 | 0.373 | 0.373 | 0.340 | 0.340 | 0.338 | 0.340 | 0.340 | 0.340 | 0.369 |

OLS regressions with observations at the individual level from the DHS data. The full regression sample includes married women aged 25 or older who have been married only once at the time of the survey. "Wealth (mean)" and "Wealth (SD)" are cell-level average and standard deviation of household wealth score, respectively. "Catholic Missions" and "Protestant Missions" are the number of Catholic and Protestant missions per unit area of each ethnic group's homeland, respectively. All the other regressors are dummy variables. The additional controls are: absolute latitude, ruggedness and elevation, distance to the coast, constraints on rainfed agriculture, a dummy for malaria endemicity, dummies for geographic sub-regions within SSA, country FE, birth year FE, age, and age squared. All regressions are weighted using country population-adjusted survey sampling weights. The data on missions and geographic/ecological controls are taken from Fenske (2015) who gathered them from various primary sources. by Robust standard errors are clustered at the ethnic homeland level and shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A4: Prediction 1: Robustness to Correlates of Polygyny

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| | **Dependent Variable: Junior Wife Indicator** | | | | | | | | |
| | **Group 1** | | | **Group 2** | | **Group 3** | | | |
| $D_{12-24}\times$ Low Polygyny | 0.0157 | 0.0150 | 0.0139 | 0.0254* | 0.0152* | 0.0111 | 0.0177* | 0.0104 | 0.0194* |
| | (0.0148) | (0.0102) | (0.0121) | (0.0137) | (0.0082) | (0.0121) | (0.0105) | (0.0113) | (0.0114) |
| $D_{12-24}\times$ Medium Polygyny | 0.0040 | 0.0023 | 0.0042 | 0.0071 | 0.0000 | -0.0073 | 0.0003 | -0.0074 | 0.0004 |
| | (0.0115) | (0.0094) | (0.0112) | (0.0115) | (0.0103) | (0.0145) | (0.0130) | (0.0114) | (0.0123) |
| $D_{12-24}\times$ High Polygyny | -0.0221* | -0.0226** | -0.0215* | -0.0342*** | -0.0374** | -0.0499** | -0.0395** | -0.0492*** | -0.0429*** |
| | (0.0115) | (0.0111) | (0.0112) | (0.0131) | (0.0160) | (0.0233) | (0.0187) | (0.0165) | (0.0160) |
| Observations | 109066 | 109066 | 109066 | 168000 | 168000 | 138383 | 138383 | 138383 | 138383 |
| Christian religion control interactions | YES | NO | NO | | | | | | |
| Christian missions control interactions | NO | YES | NO | | | | | | |
| Other ethnicity control interactions | NO | NO | YES | | | | | | |
| Education and urban control interactions | | | | YES | NO | | | | |
| Wealth control interactions | | | | NO | YES | | | | |
| Absolute latitude control interactions | | | | | | YES | NO | NO | NO |
| Distance to cost control interactions | | | | | | NO | YES | NO | NO |
| Ruggedness control interactions | | | | | | NO | NO | YES | NO |
| Elevation control interactions | | | | | | NO | NO | NO | YES |
| Adjusted R-squared | 0.089 | 0.085 | 0.085 | 0.084 | 0.081 | 0.080 | 0.080 | 0.080 | 0.080 |
| Number of clusters | 1747 | 1747 | 1747 | 2767 | 2767 | 2232 | 2232 | 2232 | 2232 |
| P-value: Low versus High Polygyny | 0.0222 | 0.0105 | 0.0239 | 0.00165 | 0.00169 | 0.00136 | 0.00125 | 0.000505 | 0.000293 |
| P-value: Medium versus High Polygyny | 0.0740 | 0.0797 | 0.0890 | 0.0165 | 0.0222 | 0.0227 | 0.0250 | 0.0167 | 0.0141 |
| P-value: Low versus Medium Polygyny | 0.376 | 0.332 | 0.437 | 0.128 | 0.184 | 0.146 | 0.171 | 0.162 | 0.130 |
| Mean dependent variable | 0.137 | 0.137 | 0.137 | 0.132 | 0.132 | 0.134 | 0.134 | 0.134 | 0.134 |

OLS regressions with observations at the individual level from the DHS data. The full regression sample includes married women aged 25 or older at the time of the survey that have been married only once. All the regressions include birth year FE, country-specific survey wave FE, and cell FE. $D_{12-24}$ is a dummy variable equal to 1 if a woman has been exposed to any drought between ages 12 and 24. "Ethnicity Control Interactions" consist of indicator variables for an individual belonging to an ethnic group that: (i) is matrilineal, (ii) practices bride price, (iii) has female-dominated agriculture, plus these indicator variables respectively interacted with the drought dummy. "Christian Missions Control Interactions" is the interaction of the number of Catholic and Protestant missions (separately) with the drought dummy. "Christian religion control interactions" consist of a dummy for a woman being Christian and this dummy interacted with the drought variable. "Education and urban control interactions" consist of indicator variables for : (i) being educated, (ii) residing in an urban area, plus these indicator variables interacted with the drought dummy. "Wealth control interactions" is the interaction of the mean and standard deviation of household wealth index (at cell level) with the drought dummy. "Absolute latitude", "distance to coast", "ruggedness", and "elevation control interactions" are interactions of each of these variables with the drought dummy. A drought is defined as an annual rainfall realization below the 15th percentile of the local rainfall distribution. All regressions are weighted using country population-adjusted survey sampling weights. Robust standard errors clustered at the cell-grid level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A5: Prediction 1: Robustness to Alternative Proxies of Polygyny Norms

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| **Dependent Variable:** | **Junior Wife Indicator** | | | | |
| **Polygyny rate at the level of:** | **Grid-Cell** | | | **Ethnic Homeland (EH)** | |
| **Polygyny rate from unions in:** | **1970s and 1980s** | **1990s and 2000s** | **Stable Cells** | **Any Year** | **1970s** |
| $D_{12-24}\times$ Low Polygyny | 0.0050 | 0.0118* | 0.0081 | | |
| | (0.0073) | (0.0067) | (0.0085) | | |
| $D_{12-24}\times$ Medium Polygyny | -0.0156* | -0.0111 | -0.0134 | | |
| | (0.0083) | (0.0093) | (0.0106) | | |
| $D_{12-24}\times$ High Polygyny | -0.0251* | -0.0336*** | -0.0279* | | |
| | (0.0143) | (0.0129) | (0.0165) | | |
| $D_{12-24}\times$ Low Polygyny (EH) | | | | 0.0074 | 0.0104 |
| | | | | (0.0073) | (0.0098) |
| $D_{12-24}\times$ Medium Polygyny (EH) | | | | -0.0145* | -0.0189* |
| | | | | (0.0083) | (0.0109) |
| $D_{12-24}\times$ High Polygyny (EH) | | | | -0.0293** | -0.0339*** |
| | | | | (0.0138) | (0.0126) |
| Observations | 170605 | 170889 | 129255 | 172111 | 99137 |
| Adjusted R-squared | 0.081 | 0.081 | 0.093 | 0.080 | 0.088 |
| Number of clusters | 2749 | 2760 | 1636 | 2988 | 2233 |
| P-value: Low versus High Polygyny | 0.0635 | 0.00218 | 0.0577 | 0.0203 | 0.00606 |
| P-value: Medium versus High Polygyny | 0.560 | 0.157 | 0.459 | 0.341 | 0.329 |
| P-value:Low versus Medium Polygyny | 0.0608 | 0.0455 | 0.110 | 0.0419 | 0.0446 |
| Mean dependent variable | 0.132 | 0.132 | 0.138 | 0.132 | 0.133 |

OLS regressions with observations at the individual level from the DHS data. The full regression sample includes married women aged 25 or older at the time of the survey that have been married only once. All the regressions include birth year FE, country-specific survey wave FE, and cell FE. Column 3 uses only cells that remain in the same tercile when using unions that occurred either in the 1970s/1980s (as in column 1) or in the 1990s/2000s (like in column 2) to compute polygyny rates. Column (5) restricts the sample to only women born after 1970 and uses unions that occurred in the 1970s to compute the polygyny rates. $D_{12-24}$ is a dummy variable equal to 1 if a woman has been exposed to any drought between ages 12 and 24. A drought is defined as an annual rainfall realization below the 15th percentile of the local rainfall distribution. All regressions are weighted using country population-adjusted survey sampling weights. Robust standard errors clustered at the cell-grid level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A6: Prediction 1: Sample Robustness, Time Window, and Clustering

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| | Dependent Variable: Junior Wife Indicator | | | | | | |
| | Sample Robustness: | | | Time Window | Clustering Level: | | Conley SE |
| | # Obs. in Cell $\geq$ 30 | Latest Survey | With War Cohorts | | Ethnic Homeland | Region | |
| $D_{12-24}\times$ Low Polygyny | 0.0109 | 0.0083 | 0.0074 | | 0.0095 | 0.0095* | 0.0095 |
| | (0.0075) | (0.0091) | (0.0047) | | (0.0058) | (0.0054) | (0.0064) |
| $D_{12-24}\times$ Medium Polygyny | -0.0066 | 0.0059 | 0.0035 | | -0.0041 | -0.0041 | -0.0041 |
| | (0.0091) | (0.0100) | (0.0071) | | (0.0103) | (0.0092) | (0.0082) |
| $D_{12-24}\times$ High Polygyny | -0.0346** | -0.0432*** | -0.0229** | | -0.0381*** | -0.0381*** | -0.0381*** |
| | (0.0138) | (0.0120) | (0.0113) | | (0.0143) | (0.0135) | (0.0122) |
| $D_{12-17}\times$ Low Polygyny | | | | 0.0141* | | | |
| | | | | (0.0074) | | | |
| $D_{12-17}\times$ Medium Polygyny | | | | -0.0054 | | | |
| | | | | (0.0089) | | | |
| $D_{12-17}\times$ High Polygyny | | | | -0.0384*** | | | |
| | | | | (0.0136) | | | |
| $D_{18-24}\times$ Low Polygyny | | | | 0.0025 | | | |
| | | | | (0.0078) | | | |
| $D_{18-24}\times$ Medium Polygyny | | | | -0.0016 | | | |
| | | | | (0.0094) | | | |
| $D_{18-24}\times$ High Polygyny | | | | -0.0362*** | | | |
| | | | | (0.0140) | | | |
| Observations | 160247 | 94465 | 223124 | 172111 | 172111 | 172111 | 172111 |
| Adjusted R-squared | 0.080 | 0.069 | 0.083 | 0.081 | 0.081 | 0.081 | |
| Number of clusters | 1511 | 2672 | 3195 | 2988 | 709 | 440 | |
| P-value: Low versus High | 0.00453 | 0.000681 | 0.0140 | 0.000781 | 0.00212 | 0.00103 | 0.000723 |
| P-value: Medium versus High | 0.0882 | 0.00152 | 0.0474 | 0.0393 | 0.0515 | 0.0463 | 0.0208 |
| P-value: Low versus Medium | 0.138 | 0.863 | 0.642 | 0.0925 | 0.238 | 0.206 | 0.189 |
| P-value: Ages 18-24: Low versus High | | | | 0.0184 | | | |
| P-value: Ages 18-24: Medium versus High | | | | 0.0407 | | | |
| Mean dependent variable | 0.134 | 0.125 | 0.113 | 0.132 | 0.132 | 0.132 | 0.132 |

OLS regressions with observations at the individual level from the DHS data. The full regression sample includes married women aged 25 or older at the time of the survey that have been married only once. Column 1 restricts the sample to cells with at least 30 unions used to compute the polygyny rate. Column 2 uses the latest DHS wave in each country. Column 3 includes women exposed to a war by age 24. All the regressions include birth year FE, country-specific survey wave FE, and cell FE. $D_{12-24}$ is a dummy variable equal to 1 if a woman has been exposed to any drought between ages 12 and 24. $D_{12-17}$ and $D_{18-24}$ are the equivalent dummies for exposure between ages 12-17 and 18-24, respectively. A drought is defined as an annual rainfall realization below the 15th percentile of the local rainfall distribution. The first three P-values in column 4 are for age window 12-17. All regressions are weighted using country population-adjusted survey sampling weights. Robust standard errors are in parentheses. They are clustered at cell-grid level in columns 1-4, ethnic homeland level in column 5, region level in column 6. Column 7 uses Conley Standard Errors (SE) which allow for serial and spatial correlation within a radius of 500km. *** p<0.01, ** p<0.05, * p<0.1.

Table A7: Prediction 2: Robustness to Polygyny Correlates

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| | Dependent Variable: Binary variable coded as 1 in the year in which the woman gets married | | | | | | | | |
| | Group 1 | | | Group 2 | | Group 3 | | | |
| $D_t \times$ Low Polygyny (T1) | 0.0109** | 0.0089** | 0.0136*** | 0.0147*** | 0.0233*** | 0.0131*** | 0.0119*** | 0.0117*** | 0.0117** |
| | (0.0044) | (0.0035) | (0.0041) | (0.0045) | (0.0046) | (0.0037) | (0.0038) | (0.0043) | (0.0048) |
| $D_t \times$ Medium Polygyny (T2) | 0.0050 | 0.0035 | 0.0069** | 0.0087*** | 0.0160*** | 0.0080*** | 0.0072** | 0.0053** | 0.0055** |
| | (0.0030) | (0.0024) | (0.0028) | (0.0033) | (0.0034) | (0.0028) | (0.0028) | (0.0024) | (0.0026) |
| $D_t \times$ High Polygyny (T3) | 0.0001 | -0.0003 | 0.0007 | 0.0015 | 0.0058* | 0.0057 | 0.0045 | 0.0013 | 0.0013 |
| | (0.0022) | (0.0023) | (0.0022) | (0.0028) | (0.0032) | (0.0037) | (0.0034) | (0.0030) | (0.0029) |
| Observations | 1245430 | 1245430 | 1245430 | 2037246 | 2037246 | 1749132 | 1749132 | 1749132 | 1749132 |
| Christian religion control interactions | YES | NO | NO | | | | | | |
| Christian missions control interactions | NO | YES | NO | | | | | | |
| Other ethnicity control interactions | NO | NO | YES | | | | | | |
| Education and urban control interactions | | | | YES | NO | | | | |
| Wealth inequality control interactions | | | | NO | YES | | | | |
| Absolute latitude control interactions | | | | | | YES | NO | NO | NO |
| Distance to cost control interactions | | | | | | NO | YES | NO | NO |
| Ruggedness control interactions | | | | | | NO | NO | YES | NO |
| Elevation control interactions | | | | | | NO | NO | NO | YES |
| Adjusted R-squared | 0.070 | 0.070 | 0.070 | 0.070 | 0.068 | 0.068 | 0.068 | 0.068 | 0.068 |
| Number of clusters | 1792 | 1792 | 1792 | 2735 | 2735 | 2293 | 2293 | 2293 | 2293 |
| P-value: Low versus High Polygyny | 0.0206 | 0.0245 | 0.00362 | 0.00328 | 7.37e-05 | 0.0674 | 0.0523 | 0.0192 | 0.0277 |
| P-value: Medium versus High Polygyny | 0.175 | 0.256 | 0.0687 | 0.0423 | 0.00299 | 0.490 | 0.428 | 0.240 | 0.225 |
| P-value: Low versus Medium Polygyny | 0.117 | 0.141 | 0.0705 | 0.0827 | 0.0338 | 0.164 | 0.188 | 0.106 | 0.122 |
| Mean dependent variable | 0.123 | 0.123 | 0.123 | 0.126 | 0.126 | 0.125 | 0.125 | 0.125 | 0.125 |

OLS regressions with observations at the person $\times$ age level (age 12 to 24 or age at first marriage) from the DHS data. The main regression sample includes women aged 25 or older at the time of the survey that have been ever married. All regressions include age FE, birth year FE, cell FE, and country $\times$ survey wave FE. $D_t$ is a dummy variable equal to 1 if a woman has been exposed to a drought at year $t$. A drought is defined as an annual rainfall realization below the 15th percentile of the local rainfall distribution. "Ethnicity Control Interactions" consist of indicator variables for an individual belonging to an ethnic group that: (i) is matrilineal, (ii) practices bride price, (iii) has female-dominated agriculture, plus these indicator variables respectively interacted with the drought dummy. "Christian Missions Control Interactions" is the interaction of the number of Catholic and Protestant missions (separately) with the drought dummy. "Christian religion control interactions" consist of a dummy for a woman being Christian and this dummy interacted with the drought variable. "Education and urban control interactions" consist of indicator variables for : (i) being educated, (ii) residing in an urban area, plus these indicator variables interacted with the drought dummy. "Wealth inequality control interactions" is the interaction of the standard deviation in household wealth index (at cell level) with the drought dummy. "Absolute latitude", "distance to coast", "ruggedness", and "elevation control interactions" are interactions of each of these variables with the drought dummy. All regressions are weighted using country population-adjusted survey sampling weights. Robust standard errors clustered at the cell-grid level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A8: Prediction 2: Robustness to Alternative Proxies of Polygyny Norms

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| **Dependent Variable:** | **Binary variable coded as 1 in the year in which the woman gets married** | | | | |
| **Polygyny rate at the level of:** | **Grid-Cell** | | | **Ethnic Homeland (EH)** | |
| **Polygyny rate from unions in:** | **1970s and 1980s** | **1990s and 2000s** | **Stable Cells** | **Any Year** | **1970s** |
| $D_t\times$ Low Polygyny | 0.0046** | 0.0083*** | 0.0065*** | | |
| | (0.0022) | (0.0026) | (0.0025) | | |
| $D_t\times$ Medium Polygyny | 0.0059** | 0.0050*** | 0.0058** | | |
| | (0.0024) | (0.0018) | (0.0023) | | |
| $D_t\times$ High Polygyny | 0.0024 | -0.0006 | 0.0005 | | |
| | (0.0024) | (0.0024) | (0.0028) | | |
| $D_t\times$ Low Polygyny (EH) | | | | 0.0050*** | 0.0064** |
| | | | | (0.0019) | (0.0027) |
| $D_t\times$ Medium Polygyny (EH) | | | | 0.0086*** | 0.0121*** |
| | | | | (0.0026) | (0.0030) |
| $D_t\times$ High Polygyny (EH) | | | | -0.0024 | -0.0025 |
| | | | | (0.0022) | (0.0030) |
| Observations | 2146047 | 2155320 | 1622317 | 2169937 | 1144866 |
| Adjusted R-squared | 0.069 | 0.068 | 0.068 | 0.069 | 0.074 |
| Number of clusters | 2809 | 2796 | 1648 | 3104 | 2333 |
| P-value: Low versus High Polygyny | 0.503 | 0.0102 | 0.109 | 0.0106 | 0.0255 |
| P-value: Medium versus High Polygyny | 0.314 | 0.0604 | 0.144 | 0.00112 | 0.000726 |
| P-value:Low versus Medium Polygyny | 0.704 | 0.292 | 0.837 | 0.249 | 0.165 |
| Mean dependent variable | 0.126 | 0.126 | 0.124 | 0.126 | 0.123 |

OLS regressions with observations at the person $\times$ age level (age 12 to 24 or age at first marriage) from the DHS data. The main regression sample includes women aged 25 or older at the time of the survey that have been ever married. All regressions include age FE, birth year FE, cell FE, and country $\times$ survey wave FE. $D_t$ is a dummy variable equal to 1 if a woman has been exposed to a drought at year $t$. A drought is defined as an annual rainfall realization below the 15th percentile of the local rainfall distribution. Column 3 uses only cells that remain in the same tercile when using unions that occurred either in the 1970s/1980s (like in column 1) or in the 1990s/2000s (like in column 2) to compute polygyny rates. Column (5) restricts the sample to only women born after 1970 and uses unions that occurred in the 1970s to compute the polygyny rates. $D_{12-24}$ is a dummy variable equal to 1 if a woman has been exposed to any drought between ages 12 and 24. A drought is defined as an annual rainfall realization below the 15th percentile of the local rainfall distribution. All regressions are weighted using country population-adjusted survey sampling weights. Robust standard errors clustered at the cell-grid level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A9: Prediction 2: Bride Price and Timing of Droughts Placebos

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| **Dependent Variable:** | **Binary variable coded as 1 in the year in which the woman gets married** | | | | | |
| **Sample:** | **ALL** | **Bride Price (BP):** | | **Polygyny Tercile:** | | |
| | | **YES** | **NO** | **Low (LP)** | **Medium (MP)** | **High (HP)** |
| $D_t\times$ LP $\times$ BP | 0.0098*** | | | | | |
| | (0.0031) | | | | | |
| $D_t\times$ MP $\times$ BP | 0.0047** | | | | | |
| | (0.0022) | | | | | |
| $D_t\times$ HP $\times$ BP | -0.0008 | | | | | |
| | (0.0021) | | | | | |
| $D_t\times$ LP $\times$ No BP | -0.0047 | | | | | |
| | (0.0032) | | | | | |
| $D_t\times$ MP $\times$ No BP | 0.0031 | | | | | |
| | (0.0034) | | | | | |
| $D_t\times$ HP $\times$ No BP | 0.0018 | | | | | |
| | (0.0057) | | | | | |
| $D_t\times$ LP | | 0.0098*** | -0.0054* | | | |
| | | (0.0030) | (0.0032) | | | |
| $D_t\times$ MP | | 0.0046** | 0.0018 | | | |
| | | (0.0022) | (0.0035) | | | |
| $D_t\times$ HP | | -0.0006 | -0.0004 | | | |
| | | (0.0022) | (0.0059) | | | |
| $D_t$ | | | | 0.0075*** | 0.0043** | 0.0004 |
| | | | | (0.0024) | (0.0018) | (0.0025) |
| $D_{t-1}$ | | | | 0.0017 | -0.0018 | -0.0023 |
| | | | | (0.0022) | (0.0020) | (0.0023) |
| $D_{t+1}$ | | | | 0.0017 | 0.0020 | 0.0004 |
| | | | | (0.0019) | (0.0021) | (0.0025) |
| Observations | 1545012 | 1211095 | 333917 | 767291 | 735330 | 663342 |
| Adjusted R-squared | 0.070 | 0.070 | 0.074 | 0.064 | 0.062 | 0.072 |
| Number of clusters | 2372 | 2092 | 1028 | 1119 | 984 | 959 |
| Mean dependent variable | 0.125 | 0.123 | 0.137 | 0.102 | 0.124 | 0.163 |
| **P-values** | | | | | | |
| LP VS. HP | 0.00452 | 0.00488 | 0.455 | | | |
| MP VS. HP | 0.0718 | 0.0858 | 0.751 | | | |
| LP VS. MP | 0.176 | 0.168 | 0.128 | | | |
| LP: BP VS. No BP | 0.000660 | | | | | |
| MP: BP VS. No BP | 0.703 | | | | | |
| HP: BP VS. No BP | 0.671 | | | | | |

OLS regressions with observations at the person $\times$ age level (age 12 to 24 or age at first marriage) from the DHS data. The main regression sample includes women aged 25 or older at the time of the survey that have been ever married. All regressions include age FE, birth year FE, cell FE, and country $\times$ survey wave FE. $BP$ and $NoBP$ stand for ethnic groups with and without bride price, respectively. $LP$, $MP$, and $HP$ correspond to low, medium and high polygyny areas, respectively. The first three rows of Wald test P-values concern women from bride price ethnic groups in column (1). $D_t$ is a dummy variable equal to 1 if a woman has been exposed to a drought at year $t$. A drought is defined as an annual rainfall realization below the 15th percentile of the local rainfall distribution. All regressions are weighted using country population-adjusted survey sampling weights. Robust standard errors clustered at cell level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A10: Prediction 2: Sample, Specification, and Clustering Robustness

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| | **Dependent Variable: Binary variable coded as 1 in the year in which the woman gets married** | | | | | | |
| | **Sample Robustness:** | | | **Specification Robustness** | | **Clustering Level:** | |
| | **Inc. Unmarried** | **# Obs. in Cell $\geq$ 30** | **Latest Survey** | | | **Ethnic Homeland** | **Region** |
| $D_t \times$ Low Polygyny | 0.0064*** | 0.0097*** | 0.0089*** | 0.0068*** | 0.0051** | 0.0077*** | 0.0077*** |
| | (0.0021) | (0.0027) | (0.0031) | (0.0024) | (0.0023) | (0.0028) | (0.0028) |
| $D_t \times$ Medium Polygyny | 0.0037** | 0.0033* | 0.0061*** | 0.0030* | 0.0019 | 0.0044** | 0.0044** |
| | (0.0016) | (0.0018) | (0.0022) | (0.0018) | (0.0018) | (0.0018) | (0.0017) |
| $D_t \times$ High Polygyny | 0.0002 | -0.0000 | 0.0020 | -0.0010 | -0.0027 | 0.0003 | 0.0003 |
| | (0.0024) | (0.0024) | (0.0026) | (0.0024) | (0.0024) | (0.0031) | (0.0027) |
| Observations | 2427599 | 2004020 | 1195697 | 2168194 | 2168194 | 2168194 | 2168194 |
| Country $\times$ Time Trend | | | | YES | YES | | |
| Calendar year FE | | | | NO | YES | | |
| Adjusted R-squared | 0.062 | 0.068 | 0.067 | 0.070 | 0.071 | 0.069 | 0.069 |
| Number of clusters | 3062 | 1511 | 2740 | 3062 | 3062 | 719 | 450 |
| P-value: Low versus High Polygyny | 0.0509 | 0.00703 | 0.0833 | 0.0212 | 0.0234 | 0.0736 | 0.0511 |
| P-value: Medium versus High Polygyny | 0.233 | 0.267 | 0.227 | 0.180 | 0.117 | 0.223 | 0.183 |
| P-value: Low versus Medium Polygyny | 0.285 | 0.0494 | 0.447 | 0.204 | 0.294 | 0.266 | 0.323 |
| Mean dependent variable | 0.113 | 0.125 | 0.120 | 0.126 | 0.126 | 0.126 | 0.126 |

OLS regressions with observations at the person $\times$ age level (age 12 to 24 or age at first marriage) from the DHS data. The main regression sample includes women aged 25 or older at the time of the survey that have been ever married. Column 1 adds unmarried women to this sample. Column 2 restricts the main sample to women who live in cells with at least 30 unions used to compute the polygyny rate. Column 3 uses the latest DHS wave in each country. All the regressions include birth year FE, age FE, country-specific survey wave FE, and cell FE. $D_t$ is a dummy variable equal to 1 if a woman has been exposed to a drought during calendar year $t$. A drought is defined as an annual rainfall realization below the 15th percentile of the local rainfall distribution. All regressions are weighted using country population-adjusted survey sampling weights. Robust standard errors clustered at region level (column 7), ethnic homeland level (column 6), and grid cell level (other columns) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A11: Prediction 2: Robustness to Continuous Rainfall and Hazard of Child Marriage

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | **Dependent Variable: Binary variable coded as 1 in the year in which the woman gets married** | | | |
| **Time Window for Unions:** | **Before age 25** | | **Before age 18** | |
| **Sample:** | **All** | **Bride Price Ethnic Group** | **All** | **Bride Price Ethnic Group** |
| Log(rainfall)$_t$ $\times$ Low Polygyny | -0.0115*** | -0.0153*** | | |
| | (0.0036) | (0.0056) | | |
| Log(rainfall)$_t$ $\times$ Medium Polygyny | -0.0029 | -0.0020 | | |
| | (0.0037) | (0.0046) | | |
| Log(rainfall)$_t$ $\times$ High Polygyny | -0.0001 | 0.0050 | | |
| | (0.0059) | (0.0050) | | |
| $D_t\times$ Low Polygyny | | | 0.0047** | 0.0075*** |
| | | | (0.0022) | (0.0027) |
| $D_t\times$ Medium Polygyny | | | 0.0026 | 0.0018 |
| | | | (0.0018) | (0.0021) |
| $D_t\times$ High Polygyny | | | 0.0006 | -0.0007 |
| | | | (0.0026) | (0.0019) |
| Observations | 2168194 | 1211095 | 1557928 | 879523 |
| Adjusted R-squared | 0.069 | 0.070 | 0.074 | 0.079 |
| Number of clusters | 3062 | 2092 | 3062 | 2092 |
| Mean dependent variable | 0.126 | 0.123 | 0.0946 | 0.0922 |
| P-value of Wald test: Low versus High Polygyny Areas | 0.0984 | 0.00655 | 0.224 | 0.0119 |
| P-value of Wald test: Medium versus High Polygyny Areas | 0.680 | 0.307 | 0.517 | 0.388 |
| P-value of Wald test: Low versus Medium Polygyny Areas | 0.0941 | 0.0655 | 0.469 | 0.0894 |

OLS regressions with observations at the person $\times$ age level from the DHS data. The main regression sample includes women aged 25 or older at the time of the survey that have been ever married. Columns 1-2 use observations between age 12 and 24 or age at first marriage. Columns 3-4 use observations between age 12 and 17 or age at first marriage. All regressions include age FE, birth year FE, cell FE, and country $\times$ survey wave FE. $D_t$ is a dummy variable equal to 1 if a woman has been exposed to a drought at year $t$. A drought is defined as an annual rainfall realization below the 15th percentile of the local rainfall distribution. $Log(rainfall)$ is the logarithm of the rainfall realisation. All regressions are weighted using country population-adjusted survey sampling weights. Robust standard errors clustered at cell level in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table A12: Prediction 2: Consequences on Fertility Onset and Impact on Child Marriage

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| **Dependent Variable:** | **First Child at Age:** | | **Number of Births** | **Married at Age:** | | |
| | **12-14** | **15-17** | **by 25** | **12-14** | **15-17** | **15-17** |
| $D_{12-14}\times$ Low Polygyny | -0.0018 | | | -0.0020 | | |
| | (0.0025) | | | (0.0030) | | |
| $D_{12-14}\times$ Medium Polygyny | -0.0013 | | | -0.0057 | | |
| | (0.0029) | | | (0.0038) | | |
| $D_{12-14}\times$ High Polygyny | 0.0017 | | | -0.0040 | | |
| | (0.0039) | | | (0.0061) | | |
| $D_{15-17}\times$ Low Polygyny | | 0.0198*** | | | 0.0161*** | 0.0137** |
| | | (0.0065) | | | (0.0053) | (0.0062) |
| $D_{15-17}\times$ Medium Polygyny | | 0.0021 | | | -0.0025 | -0.0034 |
| | | (0.0052) | | | (0.0057) | (0.0067) |
| $D_{15-17}\times$ High Polygyny | | 0.0043 | | | 0.0072 | -0.0035 |
| | | (0.0065) | | | (0.0072) | (0.0055) |
| $D_{12-24}\times$ Low Polygyny | | | 0.2081*** | | | |
| | | | (0.0678) | | | |
| $D_{12-24}\times$ Medium Polygyny | | | 0.0341 | | | |
| | | | (0.0356) | | | |
| $D_{12-24}\times$ High Polygyny | | | -0.0223 | | | |
| | | | (0.0456) | | | |
| Observations | 322103 | 304439 | 322103 | 322103 | 280076 | 155388 |
| Adjusted R-squared | 0.043 | 0.058 | 0.151 | 0.169 | 0.127 | 0.151 |
| Number of clusters | 3062 | 3060 | 3062 | 3062 | 3038 | 2082 |
| Mean dependent variable | 0.0623 | 0.267 | 2.432 | 0.153 | 0.354 | 0.348 |
| P-value of Wald test: Low versus High Polygyny Areas | 0.458 | 0.0977 | 0.00600 | 0.763 | 0.332 | 0.0383 |
| P-value of Wald test: Medium versus High Polygyny Areas | 0.532 | 0.790 | 0.321 | 0.815 | 0.288 | 0.997 |
| P-value of Wald test:Low versus Medium Polygyny Areas | 0.900 | 0.0339 | 0.0235 | 0.440 | 0.0164 | 0.0525 |

OLS regressions with observations at individual level. All regressions include birth year FE, cell FE, and country-specific survey wave FE. The full sample includes women aged 25 or older at the time of the interview. Column 2 only include girls who did not give birth by age 15. Columns 5-6 only includes those who were not yet married by age 15. Column 6 only uses women who belong to an ethnic group that historically practice bride price custom. The average proportion of women who have their first child between age 15 and 17 is 20.93% in low polygyny areas, 26.91% in medium polygyny areas, and 33.19% in high polygyny areas. The average proportion of women who marry between age 15 and 17 is 25.25% in low polygyny areas, 34.80% in medium polygyny areas, and 50.13% in high polygyny areas. The average number of children by age 25 are: 2.01 in low polygyny areas, 2.43 in medium polygyny areas, and 2.88 in high polygyny areas. Robust standard errors clustered at the cell-grid level are in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table A13: Prediction 2: The Case of Nigeria

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| **Dependent Variable: Binary variable coded as 1 in the year in which the woman gets married** | | | | |
| **Time Window for Unions:** | **Before age 25** | | **Before age 18** | |
| $D_t\times$ Low Polygyny | 0.0287*** | | 0.0182** | |
| | (0.0069) | | (0.0087) | |
| $D_t\times$ Medium Polygyny | 0.0029 | | -0.0025 | |
| | (0.0055) | | (0.0059) | |
| $D_t\times$ High Polygyny | 0.0009 | | -0.0002 | |
| | (0.0062) | | (0.0067) | |
| Log(rainfall)$_t$ $\times$ Low Polygyny | | -0.0500*** | | -0.0381** |
| | | (0.0175) | | (0.0191) |
| Log(rainfall)$_t$ $\times$ Medium Polygyny | | -0.0114 | | -0.0071 |
| | | (0.0120) | | (0.0149) |
| Log(rainfall)$_t$ $\times$ High Polygyny | | 0.0157 | | 0.0238 |
| | | (0.0177) | | (0.0193) |
| Observations | 146621 | 146621 | 103125 | 103125 |
| Adjusted R-squared | 0.070 | 0.070 | 0.094 | 0.094 |
| Number of clusters | 268 | 268 | 268 | 268 |
| P-value: Low versus High Polygyny | 0.00307 | 0.00848 | 0.0899 | 0.0194 |
| P-value: Medium versus High Polygyny | 0.802 | 0.203 | 0.791 | 0.194 |
| P-value:Low versus Medium Polygyny | 0.00392 | 0.0656 | 0.0465 | 0.197 |
| Mean dependent variable | 0.134 | 0.134 | 0.117 | 0.117 |

OLS regressions with observations at the person $\times$ age level from the DHS data in Nigeria. The main regression sample includes women aged 25 or older at the time of the survey that have been ever married. All regressions include age FE, birth year FE, cell FE, and survey wave FE. $D_t$ and $Log(rainfall)$ are defined in notes of Table A11. All regressions are weighted using survey sampling weights. Robust standard errors clustered at cell level in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table A14: Marriage Migration Patterns by Rainfall Realization at the Time of Marriage

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | **Dependent Variable is a dummy variable for:** | | | |
| | **Being born in survey location** | | **Marriage migration** | |
| $D_t\times$ Low Polygyny | 0.0033 | | -0.0079 | |
| | (0.0105) | | (0.0096) | |
| $D_t\times$ Medium Polygyny | -0.0073 | | 0.0052 | |
| | (0.0088) | | (0.0066) | |
| $D_t\times$ High Polygyny | 0.0079 | | 0.0004 | |
| | (0.0120) | | (0.0099) | |
| $PPI_t\times$ Low Polygyny | | -0.0053 | | 0.0055 |
| | | (0.0046) | | (0.0046) |
| $PPI_t\times$ Medium Polygyny | | -0.0016 | | 0.0050 |
| | | (0.0054) | | (0.0047) |
| $PPI_t\times$ High Polygyny | | 0.0055 | | 0.0086 |
| | | (0.0096) | | (0.0069) |
| Observations | 175798 | 104776 | 172790 | 102908 |
| Adjusted R-squared | 0.167 | 0.175 | 0.112 | 0.112 |
| Number of clusters | 2412 | 2350 | 2412 | 2348 |
| Mean dependent variable | 0.380 | 0.361 | 0.192 | 0.226 |

OLS regressions at individual level using DHS data. The main sample includes women aged 25 or older at the time of the survey that have been ever married. All columns include Birth year FE, cell FE, country-specific survey wave and marriage year FE. $D_t$ is a dummy variable equal to 1 if a woman has been exposed to a drought at the year $t$ in which she got married. A drought is defined as an annual rainfall realization below the 15th percentile of the local rainfall distribution. $PPI_t$ is the producer price index at year $t$. Robust standard errors clustered at the cell level are in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table A15: Polygyny, PPI, and Timing of Marriage: Robustness

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| **Dependent Variable:** | **Binary variable coded as 1 in the year in which the woman gets married** | | | | |
| **Sample:** | **Rural:** | | | | **Urban** |
| | **All** | **All** | **Bride Price** | **No Bride Price** | |
| $PPI_t \times$ Low Polygyny | -0.0081*** | -0.0080*** | -0.0044*** | -0.0020 | -0.0014 |
| | (0.0027) | (0.0025) | (0.0016) | (0.0039) | (0.0010) |
| $PPI_t \times$ Medium Polygyny | -0.0008 | -0.0012 | -0.0012 | -0.0026 | 0.0016 |
| | (0.0012) | (0.0011) | (0.0010) | (0.0043) | (0.0016) |
| $PPI_t \times$ High Polygyny | -0.0005 | 0.0003 | 0.0031 | 0.0038 | -0.0040 |
| | (0.0025) | (0.0023) | (0.0019) | (0.0078) | (0.0030) |
| Observations | 865721 | 865721 | 468448 | 159863 | 508200 |
| CPI $\times$ Polygyny Tercile FE | YES | NO | | | |
| Drought $\times$ Polygyny Tercile FE | NO | YES | | | |
| Adjusted R-squared | 0.075 | 0.075 | 0.075 | 0.082 | 0.058 |
| Number of clusters | 2593 | 2892 | 1907 | 863 | 1296 |
| P-value: Low versus High Polygyny | 0.0357 | 0.0129 | 0.00195 | 0.511 | 0.410 |
| P-value: Medium versus High Polygyny | 0.907 | 0.544 | 0.0391 | 0.470 | 0.100 |
| P-value: Low versus Medium Polygyny | 0.0124 | 0.0121 | 0.0875 | 0.907 | 0.107 |
| Mean dependent variable | 0.150 | 0.151 | 0.149 | 0.156 | 0.109 |

OLS regressions with observations at the person x age level (from 12 to 24 or age at first marriage) from the DHS data. All regressions include age FE, birth year FE, cell FE, and country $\times$ survey wave FE. The dependent variable is a dummy equal to one if the girl is married at the age corresponding to a given observation. The full sample includes ever-married women aged 25 or older at the time of the interview. $PPI_t$ is the producer price index at year $t$. $CPI$ is the consumer price index at year $t$. They are both measured in terms of average temporal standard deviations. $Drought$ is a dummy variable equal to 1 if a woman has been exposed to any drought at year $t$: annual rainfall realization below the 15th percentile of the local rainfall distribution. All regressions are weighted using country population-adjusted survey sampling weights. Robust standard errors clustered at the cell-grid level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A16: Polygyny, Weather Shocks, Crop Yield, and Income

| | **(1)** | **(2)** | **(3)** |
|---|---|---|---|
| **Dependent Variable:** | **Log (Crop Yield)** | **Log(HH Consumption)** | **Log(GDP per Capita)** |
| Drought $\times$ Low Polygyny Country | -0.172*** | -0.0176 | -0.0101 |
| | (0.0383) | (0.0332) | (0.0241) |
| Drought $\times$ High Polygyny Country | -0.0634* | -0.127** | -0.103* |
| | (0.0339) | (0.0577) | (0.0530) |
| Observations | 1,670 | 1,335 | 1,455 |
| Adjusted R-squared | 0.738 | 0.950 | 0.917 |
| P-value: Low versus High Polygyny | 0.0355 | 0.138 | 0.110 |
| Mean dependent variable | -0.109 | 21.19 | 6.756 |

All regressions include year and country FE. The dependent variable is the log of annual crop yield (tons per hectare, columns 1), log of household consumption (columns 2), and log of GDP per capita (columns 3) for each included country from 1961 to 2010. Crop yield data are from FAOStat; income data are from the World Development Indicators from the World Bank for 1960-2013. Regressions include all SSA countries in the FAOStat and WDI databases. In columns 1 and 2, the dependent variable is the log of the sum of the total production of main crops reported divided by the total area harvested for those crops. GDP per capita is measured in constant 2010 US \$, while household final consumption expenditures are measured at the aggregate level in current US \$. A drought is defined as an annual rainfall realization below the 15th percentile of the national rainfall distribution. High polygyny countries are countries with average polygyny rates higher than 0.25. It includes 17 countries out of 37 in total: Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Congo, Côte d'Ivoire, the Democratic Republic of the Congo, Guinea, Mali, Niger, Nigeria, Senegal, Sierra Leone, Togo, Uganda, and Tanzania. For countries not in the DHS sample, I use polygyny rates reported in Tertilt (2005) (Table A1). Standard errors (in parentheses) are clustered at the country level.*** p<0.01, ** p<0.05, * p<0.1.