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

Augustin Tapsoba (TSE)

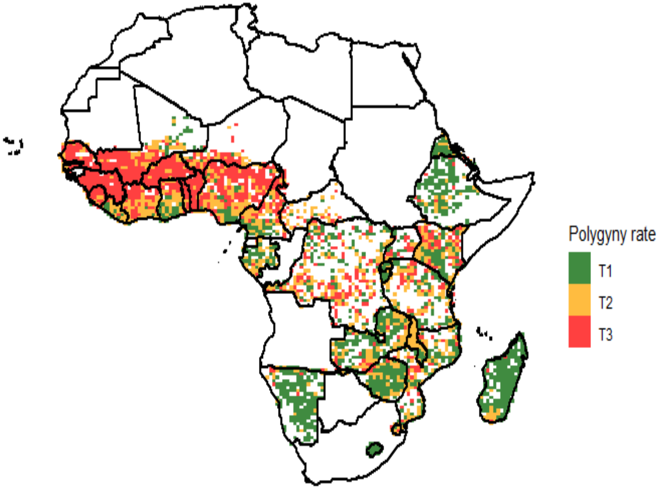
Motivation

- Local norms and culture are crucial for economic development (Ashraf et al., 2020; Collier, 2017)
- Marriage market: important aspect of household welfare and economic development that relies heavily on such norms
- One of the most salient local norms of marriage markets in SSA: Extent to which polygyny is practiced

Figure: Practice of Polygyny across Space in Sub-Saharan Africa

Average polygyny rate: share of women aged 25-49 in union with a polygynous male in each 0.5 × 0.5 decimal degree grid cell (source: DHS surveys). 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%).

▸ Source Variation ▸ KDE Polygyny ▸ Country Trend



- Presence/extent to which polygyny is practiced on a given marriage market as a **local social norm**
- **RQ: How do family formation outcomes respond to changing economic conditions in presence of polygyny?**
- 3 key Family Formation Outcomes (FFO) in SSA
  - **Timing of marriage:** affects health, fertility and socio-economic outcomes for women and their offspring (Jensen and Thorton, 2003; Field and Ambrus, 2008; Duflo et al., 2015; Save the Children, 2004)
  - **Spousal ranking:** 1st spouses have better bargaining power, higher access to HH resources and better outcomes for their children (Munro et al., 2019; Matz, 2016; Reynoso, 2019).
  - **Age gap with husband:** lower bargaining power in the union and a higher likelihood of early widowhood (Carmichael, 2011; Atkinson and Glass, 1985; Van de Putte et al., 2009)

This Paper

- Bride price important source of consumption smoothing
  - Droughts affect the timing of unions for girls **in monogamous setting** (Corno et al., ECMA 2020; Chort et al., 2021; etc...)
- Presence of polygyny changes the structure and incentives on market and gives rise to 2 other key marital outcomes
  - All 3 FFO interact with each other and with short-term variations in aggregate economic conditions in complex ways
- Paper models these links in a simple DS framework
- Predictions tested using variation in agg. income across SSA:
  - Rainfall variation: **negative shock** (droughts) in SSA
  - Global food price shocks: **positive/negative shock**

Overview of Results

- Propose a 2-period model of marriage market with overlapping generations + sequential 1:1 matching + potential polygyny
- Demand for child brides: Demand for 1st spouse/unique spouse (D_1) $\perp$ demand for 2nd spouse from old men (D_2)
- D_2 is more elastic to income and price changes compared D_1
  - - shocks $\implies \uparrow$ in market share of young men looking for 1st spouses at the expense of older men looking for 2nd spouses
    - Opposite effects for + shocks
  - Aggregate shocks have much weaker impact on marriage timing in more polygamous markets - idem for early fertility
    - There is no detectable effect of economic shocks on timing of marriage (and fertility onset) in high polygyny areas
- **Evidence implies clear and important policy conclusions**

Related Literature

- **Marriage markets and economic conditions:** Corno and Voena (2021), Corno et al. (2020), Rexer (2022), Tertilt (2005), Chort et al. (2021), Hoogeveen et al. (2011), Kearney and Wilson (2018)

- **Importance of culture/norms in shaping economic behavior:** *on economic development* (Tertilt, 2005; La Ferrara ,2007; Jayachandran and Pande, 2017) - *HH economic decisions* (Anderson and Bidner, 2015; Ashraf et al., 2020; Bhalotra et al., 2020)

- **Consequences of coping mechanisms used to deal with shocks**: Morten (2019), Shah and Steinberg (2017), Kazianga and Udry (2006), Fafchamps and Lund (2003), Rosenzweig and Stark (1989)
  - **Determinants and consequences of wife seniority ranking in polygyny:** (Matz, 2016; Reynoso, 2019; André and Dupraz, 2019; Munro et al., 2019; Mammen,2019; Rossi, 2018)

Model Overview

Polygyny as sequential 1:1 matching

Table: Marriage Market Structure at t

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

Age bride cohorts: Youngest (12-17); Oldest (18-30)
Groom cohorts: Youngest (15/18-25); Oldest (26-35)

- 1st participation to market: **Parents make marital decisions**
  - Net contribution to parents budget: $w_y^m > 0$ and $w_y^f > 0$
- 2nd participation: Sons' emancipate - make marital decisions
  - **Patrilocality:** They still contribute to their parents HH
  - **Higher contrib. for sons who marry early:** $w_o^{m,h} > w_o^{m,l}$
  - They can look for a 2nd spouse depending on polygyny norm p
    - $p = 0 \implies monogamy$
    - **Variation in p pre-determined and exogenous in model**

- **Equilibrium Matching Process:** Possible multiple equilibria.
- Simplest one supported by data: excess quantity of unmarried old men on market at t compared to unmarried old women ($\mathcal{U}_o^m > \mathcal{U}_o^f$) Age gap Age marriage
- Market is cleared by the youngest generations
- **Preferences:** CRRA utility $u(c) = \frac{c^{1-\gamma}}{1-\gamma}$, $\gamma \geq 1$
- **Income:** $I_t = y_t + \epsilon_t$
- y_t: aggregate income. Can be high (y^H) or low (y^L) with equal probability each year
- ϵ_t: idiosyncratic income. iid following cdf F

Solving the Model: Backward Induction

Marital Decisions

- $\exists\ [\underline{\tau}_t, \bar{\tau}_t]$: All singles at the beginning of stage 2 marry
- An old adult will want to have a second spouse if:

$$\begin{aligned} H_2(y_t, \epsilon_{jt}, \tau_t) &\equiv \left[u\left(y_t + \epsilon_{jt} - w_o^{m,h} - \tau_t + (w_o^f + w_y^f)\right) + V_{M2}^{m,nf}\right] \\ &- \left[u(y_t + \epsilon_{jt} - w_o^{m,h} + w_o^f) + V_M^{m,nf}\right] > 0 \end{aligned}$$

- Decision rule given by $\epsilon^*_{m,2}(\tau_t, y_t)$: $H_2(y_t, \epsilon^*_{m,2}, \tau_t) \equiv 0$
- $\exists\ \epsilon^*_m(\tau_t, y_t)$: Families with $\epsilon_{tj} > \epsilon^*_m$ will want to marry off their son

$$H(y_t, \epsilon_{jt}, \tau_t) \equiv u(y_t + \epsilon_{jt} + w_y^m - \tau_t + w_y^f) - u(y_t + \epsilon_{jt} + w_y^m) - \Omega^m > 0$$

- $\exists\ \epsilon^*_f(\tau_t, y_t)$: Families with $\epsilon_{ti} < \epsilon^*_f$ will want to receive a bride price

$$W(y_t, \epsilon_{it}, \tau_t) \equiv u(y_t + \epsilon_{it} + \tau_t) - u(y_t + \epsilon_{it} + w_y^f) - \Omega^f > 0$$

det

Demand and Supply for Child Brides

- Demand for child brides comes from 3 sources:
  - Old men who cannot find an adult spouse because $\mathcal{U}^m_{o,t} > \mathcal{U}^f_{o,t}$

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

  - Potential young grooms whose family draw $\epsilon_{tj} > \epsilon^*_m$:

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

  - Old married men on the market for a 2nd spouse (with probability p) that have a shock $\epsilon_{tj} > \epsilon^*_{m,2}$

$$D^{(2,old)}(\tau_t, y_t, \tau^*_{t-1}, y_{t-1}) = \frac{p}{(1+a)}\left[\left(1 - F(\epsilon^*_m(\tau^*_{t-1}, y_{t-1})\right) \times \left(1 - F(\epsilon^*_{m,2}(\tau_t, y_t)\right)\right]$$

- Supply of child brides: HH with a low enough shock ϵ_{ti}
  $S(\tau_t, y_t) = F(\epsilon^*_f(\tau_t, y_t))$

- This demand and supply of child brides will determine an equilibrium bride price that clears the market

P1: Change in mkt shares from income shocks

Compare $\frac{\partial H/\partial \tau_t}{\partial H/\partial y_t}$ with $\frac{\partial H_2/\partial \tau_t}{\partial H_2/\partial y_t}$

$$A_{1,2} = \frac{\partial H/\partial \tau_t}{\partial H/\partial y_t} - \frac{\partial H_2/\partial \tau_t}{\partial H_2/\partial y_t} = -\frac{1}{1-B_1} + \frac{1}{1-B_2}$$

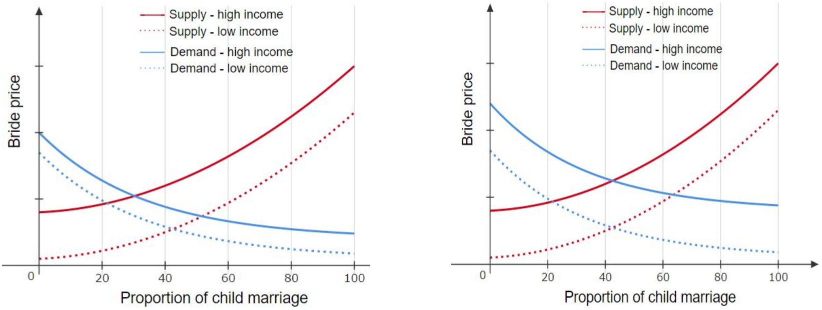
$$B_1 = \left(1 - \frac{\tau_t - w_y^f}{y_t + \epsilon_m^* + w_y^m}\right)^\gamma \;\; ; \;\; B_2 = \left(1 - \frac{\tau_t - w_y^f}{y_t + \epsilon_{m,2}^* - w_o^{m,h} + w_o^f}\right)^\gamma$$

- $A_{1,2} < 0 \iff B2 < B1$. **This is the case if $\epsilon_{m,2}^*$ is low enough** $\iff V_{M2}^{m,nf} - V_M^{m,nf}$ high enough

Prediction 1: Droughts ↑ the market share of younger men that are looking for a first/unique spouse

P2: Change in equilibrium quantity of child marriage

Figure: Illustration of the Comparative Statics for child marriage



(a) Monogamy (b) Polygamy

▸ Algebra

Prediction 2: The impact of (-) shocks on timing of marriage should be weaker in markets with more polygyny

Prediction 3

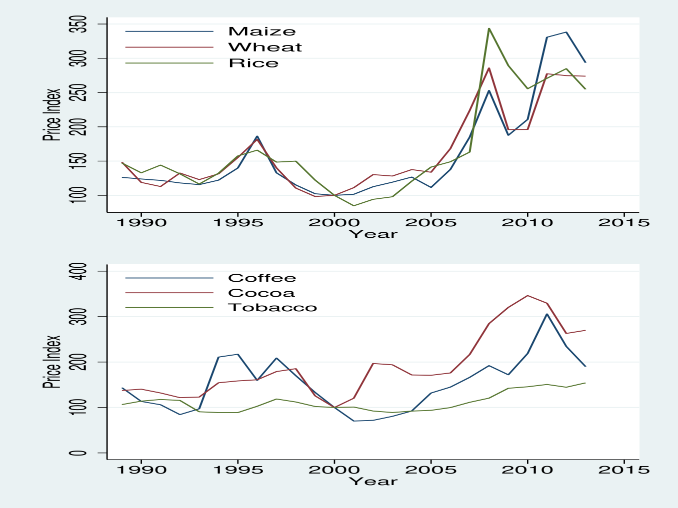
P3: +/- shocks should have symmetric effects on family formation outcomes

- **FFO may react differently to + and - shocks**: asymmetric consumption smoothing (Baugh et al, AER 2021; Shefrin and Thaler, EI 1988; Christelis et al., EJ 2019)
- Evidence on + shocks is crucial for policy conclusions

Data and Measurement

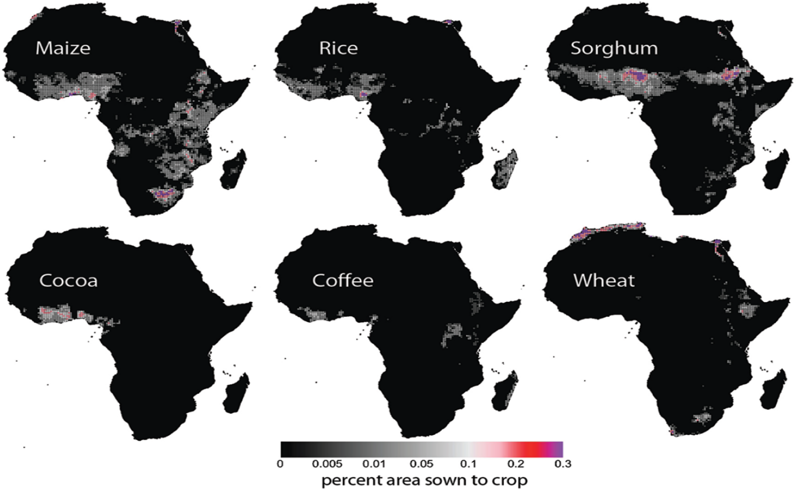
- DHS survey data: 73 survey waves collected between 1994 and 2013 in 31 countries in SSA
- GPS coordinates of each DHS HH cluster is used to match it with corresponding 0.5 $\times$ 0.5 DD weather cell grid
- **Drought:** A calendar year rainfall below the 15th percentile of a location's long-run rainfall distribution (following Corno et al, ECMA 2020; Burke et al, EJ 2015 etc...)
    - Identifying variation relies on random timing of droughts
- **Crop price shocks:** Exploit variation in global crop prices to identify their impact on family formation outcomes
    - **FFO may react differently to + and - shocks**: asymmetric consumption smoothing (Baugh et al, AER 2021; Shefrin and Thaler, EI 1988; Christelis et al., EJ 2019)

Figure: Global Crop Price Index



Note: Price data are taken from IMF and World Bank sources (year 2000 = 100).

Figure: Geographic distribution of crops in year 2000



Construct a PPI (McGuirk and Burke, JPE 2020)

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

- Combine high-resolution time-invariant spatial data on where specific crops are grown (N_{jgc})
  - From M3-Cropland project, described in detail by Ramankutty et al. (2008)
  - j denotes 11 major traded crops in M3-cropland data with international prices
- With annual international price data for each crop (π_{jt})
- Also split PPI:
  - PPI_{gct}^{food}: Index of prices for food crops (more than 1% of calorie consumption in the sample
  - PPI_{gct}^{cash}: the rest

Construct CPI

$$CPI_{ct} = \sum_{j=1}^{n} \left(\pi_{jt} \times S_{jc} \right) \tag{2}$$

- j contains 18 crops that are consumed in Africa with world prices (make up 56% of calorie consumption)
- S_{jc}: crop $j's$ average share of calorie per person in country c
- Spatial variation comes from country-level data on food consumption from the FAO food balance sheets

Impact of Rainfall Shocks

P1: Increase in market shares of young men

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

$$Y_{i,g,k,\tau} = \alpha^l D^l_{i,g,k} + \alpha^m D^m_{i,g,k} + \alpha^h D^h_{i,g,k} + \omega_g + \gamma_k + \delta_\tau + \epsilon_{i,g,k,\tau}.$$

- $Y_{i,g,k,\tau}$: Union characteristics (husband-wife age gap, rank in polygamous HH)
- $D_{i,g,k}$: Dummy=1 if the woman i born in year k and location g has been exposed to a drought between age 12 and 24
- P_g: Average polygyny rate of the cell g in which female i lives
- ω_g (location FE), γ_k (year-of-birth FE), δ_τ marriage year FE
- SE clustered at the grid-cell level
- Model predicts $\alpha = 0$ & $\theta < 0$ (or $\alpha^h < 0$ & $\alpha^l = 0$)

	Husband age gap				Junior wife (2nd wife or higher order)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Any drought ages 12-24 x low polygyny		0.0297		0.0271		0.0123		
		(0.3129)		(0.3130)		(0.0077)		
Any drought ages 12-24 x medium polygyny		0.0735		0.0739		-0.0096		
		(0.2493)		(0.2494)		(0.0093)		
Any drought ages 12-24 x high polygyny		-1.2137***		-1.2113***		-0.0245**		
		(0.2603)		(0.2606)		(0.0115)		
Any drought ages 12-24	0.3799				0.0096			-0.0317***
	(0.3007)				(0.0089)			(0.0122)
Any drought ages 12-24 x polygyny rate	-2.4957***				-0.0581**			
	(0.7842)				(0.0286)			
Any drought ages 12-17 x low polygamy			-0.1019				0.0140*	
			(0.3100)				(0.0075)	
Any drought ages 12-17 x medium polygamy			0.0680				-0.0108	
			(0.2560)				(0.0095)	
Any drought ages 12-17 x high polygamy			-1.3118***				-0.0240**	
			(0.2662)				(0.0117)	
Any drought ages 18-24 x low polygamy			0.2264				0.0095	
			(0.3234)				(0.0090)	
Any drought ages 18-24 x medium polygamy			0.0709				-0.0072	
			(0.2545)				(0.0103)	
Any drought ages 18-24 x high polygamy			-0.9543***				-0.0258**	
			(0.3013)				(0.0124)	
Age at first marriage				-0.0625				
				(0.0696)				
Observations	224,936	224,936	224,936	224,936	226,130	226,130	226,130	71,149
Adjusted R-squared	0.1516	0.1517	0.1518	0.1517	0.0815	0.0815	0.0815	0.0637
Mean dependent variable	9.975	9.975	9.975	9.975	0.175	0.175	0.175	0.516

Sample of women aged 25 or older at the time of the survey. All regressions include birth year FE, grid-cell, and marriage year FE. Column (8) restricts the sample to women in polygynous union in medium and high polygyny areas.

Alternative Specification

P2: Annual hazard of marriage before age $T = 18/25$

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

$$M_{i,g,k,a(t)} = \beta^l D^l_{g,k,a(t)} + \beta^m D^m_{g,k,a(t)} + \beta^h D^h_{g,k,a(t)} + Z_a + \omega_g + \gamma_k + \epsilon_{i,g,k,a(t)}$$

- $M_{i,g,k,a(t)}$: dummy $= 1$ in the year the woman gets married
- $D_{g,k,a(t)}$: rainfall shock in location g during the year t in which the woman i born in year k is age a
- P_g: Average polygyny rate of the cell g in which female i lives
- α_a (age FE), ω_g (location FE), γ_k (year-of-birth FE)
- Identification assumes that $D_{g,k,a(t)} \perp$ potential confounders
- Model predicts $\beta > 0$ & $\gamma < 0$ (or $\beta^l > \beta^m > \beta^h$ and at least $\beta_l > 0$)

Prediction 2: Polygyny, Droughts and Timing of Marriage

	(1)	(2)	(3)	(4)	(5)	(6)
		Married by:			Married by age 25	
	Age 25	Age 25	Age 21	Age 18	Bride price	No bride price
Drought	0.0075***					
	(0.0021)					
Drought x polygyny rate	-0.0137**					
	(0.0065)					
Drought x low polygyny		0.0064***	0.0057***	0.0045**	0.0078***	-0.0028
		(0.0021)	(0.0020)	(0.0020)	(0.0024)	(0.0030)
Drought x medium polygyny		0.0038**	0.0035**	0.0024	0.0036*	0.0024
		(0.0016)	(0.0017)	(0.0017)	(0.0019)	(0.0031)
Drought x high polygyny		0.0004	0.0012	0.0015	-0.0008	0.0016
		(0.0024)	(0.0025)	(0.0025)	(0.0021)	(0.0058)
Observations	2,459,177	2,459,177	2,154,271	1,702,155	1,344,360	369,241
Adjusted R-squared	0.0616	0.0616	0.0683	0.0728	0.0636	0.0645
Mean dependent variable	0.112	0.112	0.105	0.0856	0.118	0.107

Hazard model with observations at $person \times age$ level. Sample of women aged 25 or older at the time of the survey. All regressions include age FE, birth year FE and grid-cell FE.

▸ Alternative specification

Impact of Commodity Price Shocks

Impact of commodity price shocks

$$M_{i,g,k,a(t)} = \beta^F PPI_{g,k,a(t)} + \gamma^F PPI_{g,k,a(t)} \times P_g + \beta^C CPI_{c,k,a(t)}$$
$$+ \quad \gamma^C CPI_{c,k,a(t)} \times P_g + \alpha_a + \omega_g + \gamma_k + \mu_t + \eta_c \times t + \epsilon_{i,g,k,a(t)}.$$

- $PPI_{g,k,a(t)}$: PPI in location g during the calendar year t in which the woman i born in year k is age a
- $CPI_{c,k,a(t)}$ CPI in calendar year t for country c where woman lives
- μ_t: calendar year FE
- $\eta_c \times t$: country-specific time trends
- Identification assumes that CPI & $PPI \perp$ potential confounders after controlling for relevant FEs and common trending factors at the country level

P 3: Symmetric reaction to + shocks

	Whole Sample		Rural					Urban	
	Marriage before age 25		Marriage before age 25			Marriage before age 18		Marriage before age 25	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
PPI	-0.0033***		-0.0071***			-0.0039**		0.0006	
	(0.0013)		(0.0023)			(0.0015)		(0.0014)	
PPI X polygyny rate	0.0076*		0.0157**			0.0080		-0.0030	
	(0.0045)		(0.0066)			(0.0080)		(0.0056)	
PPI × low polygyny		-0.0028***		-0.0060***			-0.0027**		0.0001
		(0.0010)		(0.0020)			(0.0011)		(0.0011)
PPI × medium polygyny		-0.0012		-0.0026*			-0.0032**		0.0010
		(0.0008)		(0.0014)			(0.0016)		(0.0012)
PPI × high polygyny		0.0005		0.0006			0.0012		-0.0018
		(0.0018)		(0.0023)			(0.0035)		(0.0022)
PPI × bride price					-0.0065***				
					(0.0015)				
PPI × no bride price					-0.0032				
					(0.0039)				
PPI × polygyny rate × bride price					0.0096*				
					(0.0049)				
PPI × polygyny rate × no bride price					0.0010				
					(0.0109)				
Observations	1,630,520	1,630,520	974,426	974,426	678,801	635,162	635,162	647,716	647,716
Adjusted R-squared	0.0625	0.0625	0.0701	0.0701	0.0714	0.0835	0.0835	0.0472	0.0472
Mean dependent variable	0.116	0.116	0.134	0.134	0.143	0.0993	0.0993	0.0884	0.0884

Hazard model with observations at $person \times age$ level. All regressions include age FE, birth year FE, grid-cell FE and country × calendar year FE. The PPI is measured in terms of average temporal standard deviations.

▸ PPI: crop VS food ▸ PPI and CPI ▸ Mkt shares

Threats to Identification

Threats to Identification

1. Potential differential effect of production shocks?
    - All locations have same probability of drought
    - Shock has same effect on HH output/consumption ▸ Resources
2. Differential Marriage Market Size and Migration

- Differential Market Size?
    - Differential Migration Behavior? ▸ Drought ▸ PPI
    - More than 75% of women do not move from their village/city at marriage, irrespective of polygyny rates
    - When they do, most of them migrate within 50 $\times$ 50 km grid
        - Average migration distance upon marriage is 20 km in rural Senegal (Mbaye and Wagner, 2017)

All these potential threats are not consistent with evidence on change in market shares

Threats to Interpretation

- Variation in polygyny rates in data driven by another factor?
- Rely on fact that variation in polygyny rates across SSA is driven by combination of several factors ▸ Source Variation
  - ▸ Religion
  - ▸ Ethnicity and kinship
  - ▸ Rural/Urban
  - etc...
- Different factors are more relevant in different parts of SSA: robustness across sub-regions and countries
  - Across sub-regions: ▸ Sub-regions
  - Only within country variation: ▸ Within

Other Robustness

- Results robust to using first or last wave to compute P_g
  ▸ Country Trend ▸ Reg. Waves
- Different cutoffs for drought dummy ▸ cutoffs
- Continuous rainfall variable ▸ log(rainfall)
- Temporal lags and leads ▸ lags
- Supply side effect relevant? ▸ Nigeria
- etc...

Consequences on Female Fertility

Consequences on Female Fertility: Onset and Levels

	Any child before 15	Any child [15-17]		Number of children by 25	
	(1)	(3)	(4)	(5)	(6)
Any drought ages 12-14	-0.0011				
	(0.0028)				
Any drought ages 12-14 x polygamy rate	0.0015				
	(0.0099)				
Any drought ages 15-17		0.0201***			
		(0.0064)			
Any drought ages 15-17 x polygyny rate		-0.0377**			
		(0.0185)			
Any drought ages 15-17 x low polygyny			0.0212***		
			(0.0072)		
Any drought ages 15-17 x medium polygyny			0.0049		
			(0.0052)		
Any drought ages 15-17 x high polygyny			0.0040		
			(0.0059)		
Any drought ages 12-24				0.2056***	
				(0.0626)	
Any drought ages 12-24 x polygyny rate				-0.4419***	
				(0.1619)	
Any drought ages 12-24 x low polygyny					0.2012***
					(0.0768)
Any drought ages 12-24 x medium polygyny					0.0714*
					(0.0391)
Any drought ages 12-24 x high polygyny					-0.0144
					(0.0401)
Observations	326,400	308,584	308,584	326,400	326,400
Adjusted R-squared	0.0425	0.0584	0.0584	0.1522	0.1522
Mean dependent variable	0.0545	0.266	0.266	2.413	2.413

OLS regressions with observations at individual level. Sample of women aged 25 or older at the time of the survey. All regressions include age FE, birth year FE, grid-cell FE and country FE.

▸ Drought hazard ▸ PPI

Conclusion

Concluding Remarks

- Demand for second spouses is more sensitive to income and price changes compared to demand for 1st/unique spouses
- This affects how marital outcomes change when there is an aggregate shock
- **Policy implications: Targeting and type of Interventions**
  - Interventions that generate windfall aggregate income can have unintended (-) consequences for FFO in polygamous areas
    - They should be accompanied by support measures to make sure they do not deteriorate marital outcomes
  - Aggregate income stabilization policies are more efficient/needed in monogamous areas
    - Polygyny creates some inertia for eq. quant. of child marriage and (-) shocks lead to welfare improving change in mkt shares
- **Polygamous areas require policies targeted to one side of market**

Thank You!!!

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- Equilibrium quantity of child marriage:
  $Q^*(y_t) \equiv D(y_t, \tau_t^*) = S(y_t, \tau_t^*)$

- **Change in equilibrium quantity of child marriage**
  - $p = 0$: Polygyny not allowed

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

If $w_o^{m,l}$ is high enough ▸ det

  - $p > 0$: polygyny allowed

$$sgn\Big(\frac{dQ_y^*}{dp}\Big) = sgn\Big[-\frac{dD_y}{dp}\Big[f(\epsilon_f^*(\tau_t, y_t))\Big(\frac{\partial W/\partial \tau_t}{\partial W/\partial y_t} - \frac{\partial H_2/\partial \tau_t}{\partial H_2/\partial y_t}\Big) + f(\epsilon_m^*(\tau_t, y_t))\Big(\frac{\partial H/\partial \tau_t}{\partial H/\partial y_t} - \frac{\partial H_2/\partial \tau_t}{\partial H_2/\partial y_t}\Big)\Big]\Big] > 0$$

- **When $\epsilon_{m,2}^*$ is low enough $\iff$ $V_{M2}^{m,nf} - V_{M}^{m,nf}$ high enough** ▸ det ▸ DS ▸ Wealth ▸ Back

Characteristics of unions that form during droughts

$$Y_{i,g,k,\tau} = \alpha^l D^l_{i,g,k,\tau} + \alpha^m D^m_{i,g,k,\tau} + \alpha^h D^h_{i,g,k,\tau} + \delta_\tau + \omega_g + \gamma_k + \epsilon_{i,g,k,\tau}.$$

- $Y_{i,g,k,\tau}$: Union characteristics (husband's age, rank in polygamous HH)
- $D_{i,g,k}$: Dummy=1 if the year τ in which woman i got married was a drought year
- δ_τ (marriage year FE) ω_g (location FE), γ_k (year-of-birth FE)
- Model predicts $\alpha^h < 0$: Droughts increase likelihood of marrying younger men as first/unique spouses
- Negative selection of women who marry during drought?
    - Only selection effect $\implies$ $\alpha^h > 0$ if there is systematic sorting into being 1st/unique spouse versus 2nd spouse by ability (Matz, 2016; Reynoso, 2019; Munro et al., 2019)

Back

Marriage characteristics by rainfall realizations at the time of union

	Husband age gap			Junior wife (2nd wife or higher order)		
	(1)	(2)	(3)	(4)	(5)	(6)
Drought x low polygamy		-0.0287	-0.0297		0.0033	
		(0.1363)	(0.1362)		(0.0046)	
Drought x medium polygamy		0.1392	0.1389		-0.0071	
		(0.1537)	(0.1537)		(0.0060)	
Drought x high polygamy		-0.3408**	-0.3412**		-0.0047	
		(0.1687)	(0.1687)		(0.0072)	
Drought	0.0809			-0.0003		-0.0197**
	(0.1531)			(0.0055)		(0.0096)
Drought x polygyny rate	-0.5260			-0.0087		
	(0.4380)			(0.0178)		
Age first marriage			-0.0685			
			(0.0694)			
Observations	224,936	224,936	224,936	226,130	226,130	71,149
Adjusted R-squared	0.1514	0.1514	0.1514	0.0814	0.0814	0.0636
Mean dependent variable	9.975	9.975	9.975	0.175	0.175	0.516

OLS regressions with observations at individual level. Sample of married women aged 25 or older at the time of the survey. All regressions include birth year FE, Marriage year FE and grid-cell FE. Column (6) restricts the sample to women in polygynous union in medium and high polygyny areas.

- Equilibrium quantity of child marriage:
  $Q^*(y_t) \equiv D(y_t, \tau_t^*) = S(y_t, \tau_t^*)$

- **Change in equilibrium quantity of child marriage**
  - $p = 0$: Polygyny not allowed

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

If $w_o^{m,l}$ is high enough det

  - $p > 0$: polygyny allowed

$$sgn\Big(\frac{dQ_y^*}{dp}\Big) = sgn\Bigg[-\frac{dD_y}{dp}\Big[f(\epsilon_f^*(\tau_t, y_t))\Big(\frac{\partial W/\partial \tau_t}{\partial W/\partial y_t} - \frac{\partial H_2/\partial \tau_t}{\partial H_2/\partial y_t}\Big) + f(\epsilon_m^*(\tau_t, y_t))\Big(\frac{\partial H/\partial \tau_t}{\partial H/\partial y_t} - \frac{\partial H_2/\partial \tau_t}{\partial H_2/\partial y_t}\Big)\Big]\Bigg] > 0$$

- **When $\epsilon_{m,2}^*$ is low enough $\iff$ $V_{M2}^{m,nf} - V_M^{m,nf}$ high enough** det DS Wealth Back

Prediction 2: Individual level observations

	Married by age 18		Married by age 25		
	(1)	(2)	(3)	(4)	(5)
Any drought ages 12-17	0.0216***				
	(0.0081)				
Any drought ages 12-17 × polygyny rate	-0.0304				
	(0.0207)				
Any drought ages 12-17 × low polygyny		0.0273***			0.0386***
		(0.0094)			(0.0129)
Any drought ages 12-17 × medium polygyny		0.0051			0.0205*
		(0.0073)			(0.0124)
Any drought ages 12-17 × high polygyny		0.0086			-0.0107*
		(0.0059)			(0.0055)
Any drought ages 12-24			0.0347***		
			(0.0116)		
Any drought ages 12-24 × polygyny rate			-0.0857***		
			(0.0261)		
Any drought ages 12-24 × low polygyny				0.0333**	
				(0.0131)	
Any drought ages 12-24 × medium polygyny				0.0145	
				(0.0113)	
Any drought ages 12-24 × high polygyny				-0.0132**	
				(0.0057)	
Any drought ages 18-24 × low polygyny					0.0257*
					(0.0151)
Any drought ages 18-24 × medium polygyny					0.0048
					(0.0109)
Any drought ages 18-24 × high polygyny					-0.0176**
					(0.0075)
Observations	326,400	326,400	326,400	326,400	326,400
Adjusted R-squared	0.1654	0.1654	0.1155	0.1155	0.1157
Mean dependent variable	0.542	0.542	0.845	0.845	0.845

OLS regression with observations at *person* level. Sample of women aged 25 or older at the time of the survey. All regressions include age FE, birth year FE and grid-cell FE.

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+ Shocks and Market Shares on Demand Side

	Junior wife (2nd wife or higher order)			Husband age gap		
	(1)	(2)	(3)	(4)	(5)	(6)
PPI x low polygamy		0.0003			0.0222	0.0217
		(0.0029)			(0.0672)	(0.0669)
PPI x medium polygamy		0.0008			-0.0214	-0.0209
		(0.0040)			(0.0710)	(0.0710)
PPI x high polygamy		0.0111*			0.1386	0.1396
		(0.0066)			(0.1005)	(0.1007)
PPI	-0.0021		0.0192**	-0.0158		
	(0.0040)		(0.0085)	(0.0802)		
PPI x polygyny rate	0.0178			0.1701		
	(0.0156)			(0.2574)		
Age first marriage						-0.1160
						(0.1002)
Observations	108,772	108,772	33,326	110,961	110,961	110,961
Adjusted R-squared	0.0933	0.0933	0.0642	0.1438	0.1438	0.1438
Mean dependent variable	0.182	0.182	0.555	9.758	9.758	9.758

OLS regressions with observations at individual level. Sample of married women aged 25 or older at the time of the survey. All regressions include birth year FE, Marriage year FE and grid-cell FE. Column (3) restricts the sample to women in polygynous union in medium and high polygyny areas.

▸ Back

Option value of marriage for woman's family

$$\begin{aligned}\Omega^f &= \delta\Big[E[\bar{V}^f_{o,t+1}(M_t = 0)] - E[\bar{V}^f_{o,t+1}(M_t = 1)]\Big] \\ &= \delta \sum_{z\in\{H,L\}} \frac{1}{2}\int \big[u\big(y^z_{t+1} + \epsilon_{i,t+1} + \tau^*_{t+1}\big) - u\big(y^z_{t+1} + \epsilon_{i,t+1}\big)\big] dF(\epsilon_{i,t+1})\end{aligned}$$

Option value of marriage for man's family (HH head)

$$\begin{aligned}\Omega^m &= \delta\Big[E[\bar{V}^m_{o,t+1}(M_t = 0)] - E[\bar{V}^m_{o,t+1}(M_t = 1)]\Big] \\ &= \sum_{z\in\{H,L\}} \frac{\delta}{2}\int \big[u\big(y^z_{t+1} + \epsilon_{j,t+1} + w^{m,l}_o\big) - u\big(y^z_{t+1} + \epsilon_{j,t+1} + w^{m,h}_o\big)\big] dF(\epsilon_{j,t+1})\end{aligned}$$

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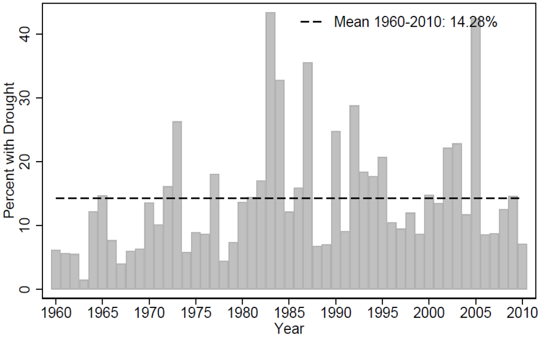
Figure: Share of grid cell with a drought by year



Note: Prevalence of drought in Sub-Saharan Africa presented as the percentage of grid cells with drought in each calendar year. The black dashed line shows the mean of drought over the sample period.

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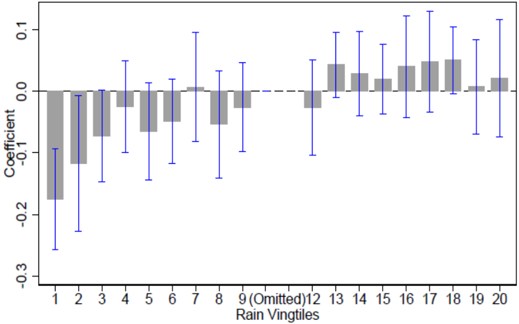
Figure: Crop Yield by Rainfall Vintiles



Note: Coefficients of rainfall vingtiles in regressions with log of annual crop yield (tons per hectare) from 1961 to 2010 as the dependent variable.

Drought and Hazard of Fertility Onset

	Fertility onset before age 25						Fertility onset before age 18	
	Whole Sample		Rural		Urban		Whole Sample	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(11)
Drought	0.0049***		0.0057***		0.0035		0.0024	
	(0.0018)		(0.0020)		(0.0034)		(0.0015)	
Drought × polygyny rate	-0.0045		-0.0061		-0.0007		0.0005	
	(0.0051)		(0.0055)		(0.0111)		(0.0047)	
Drought × low polygyny		0.0040**		0.0032*		0.0052*		0.0029**
		(0.0018)		(0.0019)		(0.0029)		(0.0014)
Drought × medium polygyny		0.0041***		0.0061***		0.0003		0.0017
		(0.0015)		(0.0019)		(0.0022)		(0.0014)
Drought × high polygyny		0.0026		0.0022		0.0055		0.0031*
		(0.0018)		(0.0019)		(0.0046)		(0.0017)
Observations	2,752,317	2,752,317	1,762,118	1,762,118	955,991	955,991	1,827,869	1,827,869
Adjusted R-squared	0.0637	0.0637	0.0706	0.0707	0.0532	0.0532	0.0477	0.0477
Mean dependent variable	0.0992	0.0992	0.107	0.107	0.0853	0.0853	0.0544	0.0544

Hazard model with observations at $person \times age$ level. All regressions include age FE, birth year FE, grid-cell FE and country FE.

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PPI and Hazard of Fertility Onset

	Fertility onset before age 25						Fertility onset before age 18	
	Whole Sample		Rural		Urban		Whole Sample	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
PPI	-0.0030***		-0.0047***		-0.0011		-0.0019**	
	(0.0005)		(0.0012)		(0.0008)		(0.0009)	
PPI × polygyny rate	0.0105***		0.0121***		0.0076*		0.0061*	
	(0.0023)		(0.0038)		(0.0040)		(0.0032)	
PPI × low polygyny		-0.0021***		-0.0038***		-0.0004		-0.0012*
		(0.0005)		(0.0010)		(0.0007)		(0.0007)
PPI × medium polygyny		-0.0003		-0.0010		0.0006		-0.0009
		(0.0008)		(0.0011)		(0.0011)		(0.0009)
PPI × high polygyny		0.0015		0.0005		0.0019		0.0012
		(0.0011)		(0.0015)		(0.0016)		(0.0013)
Observations	1,809,171	1,809,171	1,122,989	1,122,989	673,650	673,650	1,072,799	1,072,799
Adjusted R-squared	0.0651	0.0651	0.0729	0.0729	0.0532	0.0532	0.0512	0.0512
Mean dependent variable	0.111	0.111	0.123	0.123	0.0918	0.0918	0.0576	0.0576

Hazard model with observations at $person \times age$ level. All regressions include age FE, birth year FE, grid-cell FE and country × calendar year FE. The PPI is measured in terms of average temporal standard deviations.

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P 3: PPI food versus cash crops

	Rural		Urban	
	(1)	(2)	(3)	(4)
PPI food crops	-0.0072***		0.0009	
	(0.0023)		(0.0014)	
PPI food crops × polygyny rate	0.0148**		-0.0078	
	(0.0069)		(0.0060)	
PPI cash crops	0.0004		-0.0004	
	(0.0009)		(0.0006)	
PPI cash crops × polygyny rate	0.0000		0.0031*	
	(0.0023)		(0.0018)	
PPI food crops × low polygyny		-0.0062***		0.0000
		(0.0020)		(0.0012)
PPI food crops × medium polygyny		-0.0027*		0.0002
		(0.0015)		(0.0014)
PPI food crops × high polygyny		-0.0001		-0.0038
		(0.0027)		(0.0027)
PPI cash crops × low polygyny		0.0007		-0.0001
		(0.0009)		(0.0005)
PPI cash crops × medium polygyny		-0.0000		0.0006
		(0.0007)		(0.0005)
PPI cash crops × high polygyny		0.0008		0.0007
		(0.0006)		(0.0008)
Observations	974,426	974,426	647,716	647,716
Adjusted R-squared	0.0702	0.0702	0.0472	0.0472
Mean dependent variable	0.134	0.134	0.0884	0.0884

Hazard model with observations at $person \times age$ level. All regressions include age FE, birth year FE, grid-cell FE and country × calendar year FE. The PPI is measured in terms of average temporal standard deviations. ▸ PPI

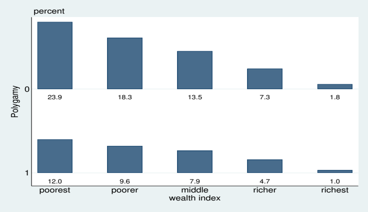
P 3: PPI and CPI

	Rural				Urban			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
PPI	-0.0063***		-0.0063***		-0.0007		-0.0007	
	(0.0023)		(0.0023)		(0.0014)		(0.0014)	
PPI × polygyny rate	0.0136**		0.0137**		0.0008		0.0008	
	(0.0068)		(0.0068)		(0.0062)		(0.0062)	
CPI	0.0065		0.0064		0.0172***		0.0171***	
	(0.0054)		(0.0053)		(0.0058)		(0.0058)	
CPI × polygyny rate	0.0121		0.0122		-0.0214		-0.0213	
	(0.0103)		(0.0103)		(0.0141)		(0.0142)	
PPI × low polygyny		-0.0055***		-0.0055***		-0.0010		-0.0010
		(0.0020)		(0.0020)		(0.0009)		(0.0009)
PPI × medium polygyny		-0.0015		-0.0015		0.0004		0.0004
		(0.0011)		(0.0011)		(0.0012)		(0.0012)
PPI × high polygyny		-0.0001		-0.0000		-0.0006		-0.0006
		(0.0021)		(0.0021)		(0.0024)		(0.0024)
CPI × low polygyny		0.0080		0.0078		0.0158***		0.0158***
		(0.0053)		(0.0053)		(0.0057)		(0.0057)
CPI × medium polygyny		0.0055		0.0054		0.0141**		0.0141**
		(0.0059)		(0.0059)		(0.0063)		(0.0063)
CPI × high polygyny		0.0127*		0.0125*		0.0036		0.0036
		(0.0069)		(0.0069)		(0.0079)		(0.0079)
Observations	965,595	965,595	965,595	965,595	642,518	642,518	642,518	642,518
Adjusted R-squared	0.0679	0.0679	0.0680	0.0680	0.0439	0.0439	0.0439	0.0439
Country × time trend	NO	NO	YES	YES	NO	NO	YES	YES
Mean dependent variable	0.133	0.133	0.133	0.133	0.0880	0.0880	0.0880	0.0880

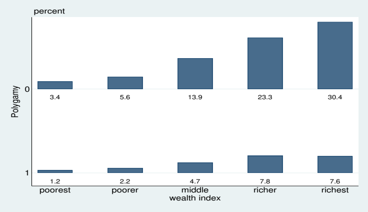
Hazard model with observations at $person \times age$ level. All regressions include age FE, birth year FE, grid-cell FE and country × calendar year FE. The PPI is measured in terms of average temporal standard deviations.

▸ PPI

Figure: Polygamy by household wealth quintiles in high polygyny Areas



(a) Rural



(b) Urban

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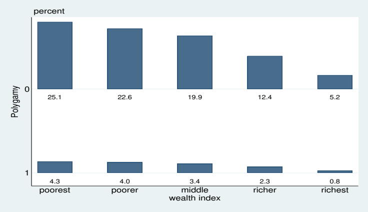
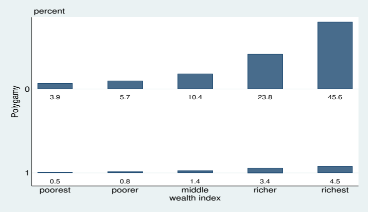
Figure: Polygamy by household wealth quintiles in midium polygyny Areas



(a) Rural



(b) Urban

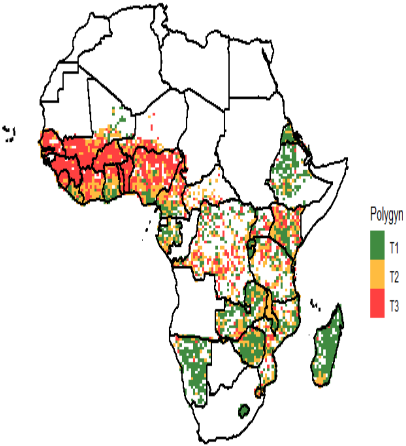
Back

- Practice of polygyny in given area as local norm: result of combination of historical & slow moving cultural/econ factors
  - (i)Traditional customs (ii) slave trade, religion, colonial institutions, etc. (iii) economic growth, inequality, etc...
    - (Boserup, 1970; Becker, 1974; Jacoby, 1995; Gould et al., 2008; Fenske, 2015; De La Croix and Mariani, 2015)

▸ Religion ▸ Back ▸ Interpretation

Tables

C1 represents grid cells with low proportion of Christians (less than 20%), C2 is for areas with medium proportion (between 20 and 70%) and C3 is for areas with high proportion of Christians (more than 70%). 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%).



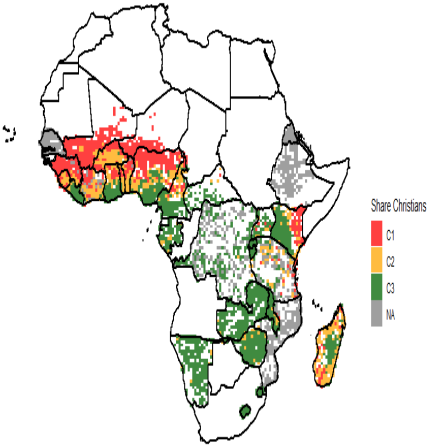


Table: Polygyny, drought and timing of marriage: Robustness to religion

	Full sample				Bride price only			
	Christians		Non-Christians		Christians		Non-Christians	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Drought x low polygyny	0.0055***		0.0089		0.0062***		0.0256***	
	(0.0018)		(0.0080)		(0.0020)		(0.0081)	
Drought x medium polygyny	0.0033*		0.0032		0.0036		0.0043	
	(0.0020)		(0.0033)		(0.0024)		(0.0040)	
Drought x high polygyny	0.0011		-0.0003		-0.0043		0.0007	
	(0.0047)		(0.0033)		(0.0054)		(0.0025)	
Drought		0.0059***		0.0116**		0.0074***		0.0162***
		(0.0022)		(0.0056)		(0.0026)		(0.0063)
Drought x polygyny rate		-0.0085		-0.0232*		-0.0168		-0.0289**
		(0.0100)		(0.0128)		(0.0114)		(0.0127)
Observations	1,428,209	1,428,209	669,376	669,376	651,243	651,243	450,924	450,924
Adjusted R-squared	0.0537	0.0537	0.0707	0.0697	0.0525	0.0525	0.0778	0.0762
Mean dependent variable	0.124	0.124	0.163	0.163	0.126	0.126	0.165	0.165

Hazard model with observations at $person \times age$ level. Sample of women aged 25 or older at the time of the survey. All regressions include age FE, birth year FE and grid-cell FE.

Split by polygyny levels   Back

Polygyny, PPI and Timing of Marriage: Robustness to Religion

	Christians			Non-Christians		
	All	Rural	Urban	All	Rural	Urban
	(1)	(2)	(3)	(4)	(5)	(6)
PPI	-0.0024*	-0.0050**	0.0000	-0.0056*	-0.0082*	0.0011
	(0.0014)	(0.0024)	(0.0017)	(0.0030)	(0.0048)	(0.0034)
PPI × polygyny rate	0.0087*	0.0155**	0.0001	0.0127	0.0200	-0.0063
	(0.0052)	(0.0070)	(0.0080)	(0.0102)	(0.0148)	(0.0107)
Observations	1,010,451	583,406	427,045	394,101	260,375	133,726
Adjusted R-squared	0.0571	0.0653	0.0453	0.0698	0.0774	0.0564
Mean dependent variable	0.0995	0.116	0.0768	0.154	0.171	0.121

Hazard model with observations at $person \times age$ level. All regressions include age FE, birth year FE, grid-cell FE and country × calendar year FE. The PPI is measured in terms of average temporal standard deviations. Back

Figure: Practice of Polygyny across Space with Ethnic Homelands

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%). Blue lines are ethnic homeland boundaries.

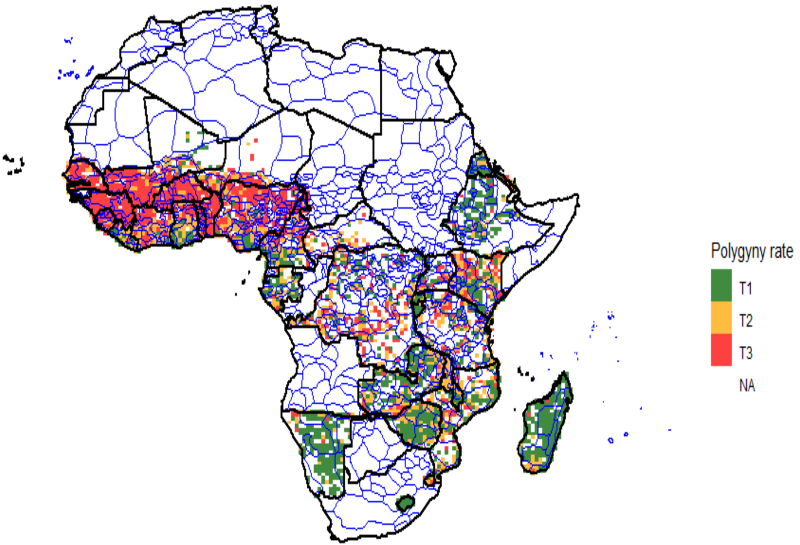


Table: Polygyny, drought and timing of marriage: Robustness to kinship system

	Full sample				Bride price only			
	Not Matrilineal		Matrilineal		Not Matrilineal		Matrilineal	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Drought	0.0078***		0.0088**		0.0087***		0.0123**	
	(0.0022)		(0.0041)		(0.0023)		(0.0053)	
Drought x polygyny rate	-0.0119**		-0.0366**		-0.0143**		-0.0521**	
	(0.0059)		(0.0180)		(0.0061)		(0.0224)	
Drought x low polygyny		0.0073***		0.0043		0.0083***		0.0071*
		(0.0022)		(0.0033)		(0.0023)		(0.0041)
Drought x medium polygyny		0.0043**		0.0025		0.0043**		0.0000
		(0.0020)		(0.0027)		(0.0022)		(0.0037)
Drought x high polygyny		0.0011		-0.0155*		0.0007		-0.0189*
		(0.0019)		(0.0088)		(0.0020)		(0.0106)
Observations	1,316,604	1,316,604	396,997	396,997	1,151,269	1,151,269	193,091	193,091
Adjusted R-squared	0.0656	0.0656	0.0577	0.0577	0.0660	0.0660	0.0517	0.0518
Mean dependent variable	0.121	0.121	0.117	0.117	0.121	0.121	0.101	0.101

Hazard model with observations at $person \times age$ level. Sample of women aged 25 or older at the time of the survey. All regressions include age FE, birth year FE, grid-cell FE and country FE. Back

PPI and Kinship norms

	Not Matrilineal				Matrilineal			
	All	Rural		Urban	All	Rural		Urban
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
PPI	-0.0033***	-0.0066***		0.0005	0.0035	0.0034		-0.0025
	(0.0010)	(0.0015)		(0.0009)	(0.0040)	(0.0054)		(0.0040)
PPI × polygyny rate	0.0045	0.0107**		-0.0037	-0.0305**	-0.0329*		-0.0056
	(0.0035)	(0.0051)		(0.0056)	(0.0150)	(0.0186)		(0.0139)
PPI × low polygyny			-0.0057***				-0.0012	
			(0.0013)				(0.0047)	
PPI × medium polygyny			-0.0045***				-0.0057	
			(0.0013)				(0.0048)	
PPI × high polygyny			-0.0001				-0.0043	
			(0.0019)				(0.0065)	
Observations	858,708	508,770	508,770	341,888	274,078	170,031	170,031	103,793
Adjusted R-squared	0.0648	0.0728	0.0728	0.0473	0.0619	0.0721	0.0721	0.0469
Mean dependent variable	0.125	0.144	0.144	0.0955	0.122	0.140	0.140	0.0929

Hazard model with observations at $person \times age$ level. All regressions include age FE, birth year FE, grid-cell FE and country × calendar year FE. The PPI is measured in terms of average temporal standard deviations. Back

Robustness: Spatial Lag

Polygyny level:	Low	Medium	High
	(1)	(2)	(3)
Drought in cell of residence	0.0061**	0.0040*	0.0005
	(0.0026)	(0.0020)	(0.0025)
Drought in neighboring cell	-0.0002	-0.0003	0.0002
	(0.0016)	(0.0018)	(0.0021)
Observations	941,771	812,391	705,015
Adjusted R-squared	0.0503	0.0532	0.0671
Mean dependent variable	0.0858	0.113	0.146

Hazard model with observations at $person \times age$ level. All columns include age, birth year, grid-cell and country fixed effects.

Back

Robustness: Residence and Education

	Full Sample				Bride price only			
	Residence		Any Schooling		Residence		Any Schooling	
	Rural	Urban	NO	YES	Rural	Urban	NO	YES
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Drought	0.0074***	0.0069**	0.0119**	0.0057**	0.0088***	0.0086***	0.0141**	0.0067***
	(0.0026)	(0.0028)	(0.0046)	(0.0024)	(0.0029)	(0.0028)	(0.0057)	(0.0025)
Drought x polygyny rate	-0.0166**	-0.0050	-0.0243**	-0.0072	-0.0201***	-0.0085	-0.0275**	-0.0126
	(0.0077)	(0.0106)	(0.0110)	(0.0099)	(0.0074)	(0.0100)	(0.0119)	(0.0096)
Observations	1,526,943	906,830	934,051	1,525,072	809,170	521,968	618,738	725,622
Adjusted R-squared	0.0689	0.0472	0.0711	0.0534	0.0724	0.0460	0.0766	0.0495
Mean dependent variable	0.126	0.0877	0.146	0.0909	0.134	0.0937	0.150	0.0906

Hazard model with observations at $person \times age$ level. All columns include age, birth year, grid-cell and country fixed effects.

Back

Polygyny, drought and timing of marriage in Nigeria

	Hazard model: person × age observations				Person level observations	
	Married by 25		Married by 18		Married by 18	
	(1)	(2)	(3)	(4)	(5)	(6)
Drought	0.0207***		0.0182**			
	(0.0067)		(0.0085)			
Drought × polygyny rate	-0.0487**		-0.0417*			
	(0.0195)		(0.0227)			
Drought × low polygyny		0.0192***		0.0175**		
		(0.0053)		(0.0077)		
Drought × medium polygyny		-0.0010		-0.0039		
		(0.0047)		(0.0057)		
Drought × high polygyny		-0.0018		0.0003		
		(0.0060)		(0.0065)		
Any drought ages 12-17					0.0723**	
					(0.0290)	
Any drought ages 12-17 × polygyny rate					-0.1568**	
					(0.0634)	
Any drought ages 12-14 × low polygyny						0.0982**
						(0.0396)
Any drought ages 12-17 × medium polygyny						0.0027
						(0.0199)
Any drought ages 12-17 × high polygyny						0.0000
						(0.0138)
Observations	165,868	165,868	112,030	112,030	23,284	23,284
Adjusted R-squared	0.0702	0.0702	0.0979	0.0979	0.2901	0.2905
Mean dependent variable	0.116	0.116	0.105	0.105	0.570	0.570

Hazard model with observations at $person \times age$ level. All columns include age, birth year, grid-cell and country fixed effects.

Back

Robustness: Within Country Variation

	Full Sample				Bride Price Only			
	$0.2 < \text{IQR} \leq 0.3$		$\text{IQR} > 0.3$		$0.2 < \text{IQR} \leq 0.3$		$\text{IQR} > 0.3$	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Drought	0.0132***		0.0103***		0.0132***		0.0115***	
	(0.0040)		(0.0037)		(0.0038)		(0.0040)	
Drought x polygamy rate	-0.0285**		-0.0535**		-0.0316***		-0.0550**	
	(0.0121)		(0.0238)		(0.0106)		(0.0263)	
Drought x low polygamy		0.0101***		0.0057**		0.0104***		0.0063**
		(0.0038)		(0.0025)		(0.0035)		(0.0026)
Drought x medium polygamy		0.0046**		-0.0002		0.0036		0.0021
		(0.0023)		(0.0045)		(0.0026)		(0.0047)
Drought x high polygamy		-0.0006		-0.0232		-0.0031		-0.0283
		(0.0037)		(0.0170)		(0.0032)		(0.0190)
Observations	713,618	713,618	283,538	283,538	470,469	470,469	261,872	261,872
Adjusted R-squared	0.0604	0.0604	0.0549	0.0549	0.0642	0.0642	0.0547	0.0547
Mean dependent variable	0.120	0.120	0.0991	0.0991	0.120	0.120	0.0981	0.0981

Hazard model with observations at $person \times age$ level. Hazard model with observations at $person \times age$ level. All columns include age, birth year and grid-cell fixed effects. IQR is the interquartile range of grid-cell level polygyny rates within each country. The sample with $IQR > 0.3$ includes the Democratic Republic of Congo, Kenya, Mozambique and Uganda. The sample with $0.2 < IQR \leq 0.3$ includes Cameroon, Côte d'Ivoire, Ghana, Mali, Nigeria, Sierra Leone and Tanzania.

Back

Table: Polygyny, PPI and Timing of marriage: Samples with substantial within-country Variation

	Full Sample				Bride Price Only			
	$0.2 < \text{IQR} \leq 0.3$		$\text{IQR} > 0.3$		$0.2 < \text{IQR} \leq 0.3$		$\text{IQR} > 0.3$	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
PPI	-0.0072***		-0.0093*		-0.0064***		-0.0105*	
	(0.0023)		(0.0051)		(0.0015)		(0.0054)	
PPI × polygyny rate	0.0147**		0.0383*		0.0071		0.0470**	
	(0.0069)		(0.0219)		(0.0055)		(0.0233)	
PPI × low polygyny		-0.0060***		-0.0060		-0.0056***		-0.0065*
		(0.0020)		(0.0038)		(0.0013)		(0.0039)
PPI × medium polygyny		-0.0030*		-0.0004		-0.0059***		0.0004
		(0.0015)		(0.0028)		(0.0015)		(0.0028)
PPI × high polygyny		0.0004		0.0132		-0.0003		0.0162
		(0.0028)		(0.0128)		(0.0025)		(0.0125)
Observations	259,548	259,548	133,427	133,427	162,362	162,362	123,849	123,849
Adjusted R-squared	0.0679	0.0679	0.0631	0.0631	0.0723	0.0723	0.0638	0.0638
Mean dependent variable	0.143	0.143	0.118	0.118	0.147	0.147	0.116	0.116

All columns include age, birth year, grid-cell and country × calendar year fixed effects. IQR is the interquartile range of grid-cell level polygyny rates within each country. The sample with $IQR > 0.3$ includes the Democratic Republic of Congo, Kenya, Mozambique and Uganda. The sample with $0.2 < IQR \leq 0.3$ includes Cameroon, Côte d'Ivoire, Ghana, Mali, Nigeria, Sierra Leone and Tanzania. Observations are at the level of person x age. The PPI is measured in terms of average temporal standard deviations.

Back

Robustness to using log(rain)

	Bride price		No bride price	
	(1)	(2)	(3)	(4)
Log (Rainfall)	-0.0120**		-0.0011	
	(0.0048)		(0.0060)	
Log (Rainfall) x Polygyny rate	0.0309**		-0.0067	
	(0.0141)		(0.0264)	
Log (Rainfall) x Low polygyny		-0.0104**		-0.0028
		(0.0046)		(0.0049)
Log (Rainfall) x Medium polygyny		-0.0027		-0.0000
		(0.0035)		(0.0049)
Log (Rainfall) x High polygyny		0.0050		-0.0092
		(0.0047)		(0.0115)
Observations	1,344,360	1,344,360	369,241	369,241
Adjusted R-squared	0.0636	0.0636	0.0645	0.0645
Mean dependent variable	0.118	0.118	0.127	0.127

Hazard model with observations at $person \times age$ level. Hazard model with observations at $person \times age$ level. All columns include age, birth year, grid-cell and country fixed effects.

Back

Current, lagged, future droughts and timing of marriage by polygyny levels

Polygyny level:	Low	Medium	High
	(1)	(2)	(3)
Drought	0.0060***	0.0038**	0.0007
	(0.0019)	(0.0016)	(0.0024)
Drought Lead 1	0.0005	0.0017	0.0003
	(0.0016)	(0.0019)	(0.0024)
Drought Lag 1	0.0006	-0.0020	-0.0017
	(0.0017)	(0.0019)	(0.0022)
Observations	938,991	810,915	704,377
Adjusted R-squared	0.0504	0.0533	0.0671
Mean dependent variable	0.0858	0.113	0.146

Hazard model with observations at $person \times age$ level. Hazard model with observations at $person \times age$ level. All columns include age, birth year, grid-cell and country fixed effects.

Polygyny, weather shocks, crop yield and income

	Crop yield		HH consumption		GDP per capita	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Drought	-0.125***		-0.0652**		-0.0482*	
	(0.0271)		(0.0284)		(0.0274)	
Drought x Low Polygyny		-0.142***		-0.0433		-0.00398
		(0.0391)		(0.0394)		(0.0261)
Drought x High Polygyny		-0.109***		-0.0835		-0.0912*
		(0.0374)		(0.0505)		(0.0451)
Observations	1,670	1,670	1,335	1,335	1,455	1,455
Adjusted R-squared	0.736	0.736	0.950	0.950	0.917	0.917
Mean dependent variable	-0.109	-0.109	21.19	21.19	6.756	6.756

All regressions include year and country fixed effects. In columns 1 and 2, the dependent variable is the log of the sum of total production of main crops reported divided by the total area harvested for those crops. GDP per capita is measured in constant 2010 US$, while household final consumption expenditures are measured at the aggregate level in current US$. High polygyny countries are countries with average polygyny rates higher than 0.25.

Back

Robustness to definition of polygyny rates

	Married by age 25			
	(1)	(2)	(3)	(4)
Drought	0.0096***	0.0074***		
	(0.0021)	(0.0020)		
Drought x Polygyny rate (1st wave)	-0.0184***			
	(0.0060)			
Drought x Polygyny rate (last wave)		-0.0132*		
		(0.0068)		
Drought x Low polygyny (1st wave)			0.0081***	
			(0.0021)	
Drought x Medium polygyny rate (1st wave)			0.0037**	
			(0.0018)	
Drought x High polygyny rate (1st wave)			-0.0015	
			(0.0025)	
Drought x Low polygyny (last wave)				0.0059***
				(0.0018)
Drought x Medium polygyny rate (last wave)				0.0041**
				(0.0020)
Drought x High polygyny rate (last wave)				0.0018
				(0.0024)
Observations	1,985,343	2,246,344	1,985,343	2,246,344
Adjusted R-squared	0.0598	0.0607	0.0598	0.0607
Mean dependent variable	0.111	0.111	0.111	0.111

Hazard model with observations at $person \times age$ level. All columns include age, birth year, grid-cell and country fixed effects. Back

PPI and robustness to definition of polygyny rate

	ALL		Rural		Urban	
	(1)	(2)	(3)	(4)	(5)	(6)
PPI	-0.0027**	-0.0031**	-0.0064***	-0.0066***	0.0009	0.0006
	(0.0013)	(0.0012)	(0.0023)	(0.0022)	(0.0015)	(0.0013)
PPI $\times$ polygyny rate (1st wave)	0.0043		0.0115**		-0.0045	
	(0.0043)		(0.0058)		(0.0053)	
PPI $\times$ polygyny rate (last wave)		0.0082*		0.0158**		-0.0018
		(0.0042)		(0.0064)		(0.0052)
Observations	1,400,684	1,606,094	802,502	954,825	589,804	642,891
Adjusted R-squared	0.0612	0.0621	0.0690	0.0701	0.0469	0.0464
Mean dependent variable	0.115	0.115	0.134	0.133	0.0882	0.0880

Hazard model with observations at $person \times age$ level. All regressions include age FE, birth year FE, grid-cell FE and country $\times$ calendar year FE. The PPI is measured in terms of average temporal standard deviations. Back

Migration

	Born Here		Marriage Migration	
	(1)	(2)	(3)	(4)
Drought x low polygyny	-0.0003		-0.0020	
	(0.0082)		(0.0079)	
Drought x medium polygyny	-0.0096		0.0001	
	(0.0077)		(0.0056)	
Drought x high polygyny	0.0101		-0.0034	
	(0.0115)		(0.0097)	
Drought		-0.0049		0.0019
		(0.0088)		(0.0082)
Drought x polygyny rate		0.0167		-0.0118
		(0.0262)		(0.0243)
Observations	179,293	179,293	176,256	176,256
Adjusted R-squared	0.1565	0.1565	0.1012	0.1012
Mean dependent variable	0.408	0.408	0.172	0.172

All columns include birth year FE, marriage year FE and grid cell FE. Back

Migration

	Rural		Urban	
	Born Here	Marriage Migration	Born Here	Marriage Migration
	(1)	(2)	(3)	(4)
PPI × low polygyny	-0.0115***	0.0125*	0.0048	0.0005
	(0.0037)	(0.0064)	(0.0036)	(0.0046)
PPI × medium polygyny	0.0006	0.0031	-0.0072	0.0168*
	(0.0058)	(0.0042)	(0.0083)	(0.0087)
PPI × high polygyny	-0.0141*	0.0112*	0.0421*	0.0104
	(0.0076)	(0.0065)	(0.0215)	(0.0103)
Observations	75,097	73,867	29,943	29,294
Adjusted R-squared	0.1829	0.1154	0.1594	0.0980
Mean dependent variable	0.429	0.214	0.308	0.169

All columns include birth year FE, marriage year FE and grid cell FE. Back

Table: Polygyny, religion, drought and timing of marriage

	(1)	(2)	(3)	(4)	(5)	(6)
	Full sample	Polygamy			Christian	
		Low	Medium	High	YES	NO
Drought x Christian	0.0041***	0.0055***	0.0032	0.0002		
	(0.0013)	(0.0017)	(0.0020)	(0.0046)		
Drought x Muslim	0.0019	0.0137	0.0016	0.0001		
	(0.0028)	(0.0100)	(0.0037)	(0.0038)		
Drought x other	0.0025	-0.0002	0.0069	0.0004		
	(0.0039)	(0.0063)	(0.0069)	(0.0063)		
Drought x low polygyny					0.0055***	0.0089
					(0.0018)	(0.0080)
Drought x medium polygyny					0.0033*	0.0032
					(0.0020)	(0.0033)
Drought x high polygyny					0.0011	-0.0003
					(0.0047)	(0.0033)
Observations	2,097,585	872,719	710,744	514,122	1,428,209	669,376
Adjusted R-squared	0.0664	0.0511	0.0558	0.0742	0.0537	0.0707
Interacted age FE	YES	YES	YES	YES	YES	YES
Interacted birth year FE	YES	YES	YES	YES	YES	YES
Grid-cell FE	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES
Mean dependent variable	0.111	0.0841	0.115	0.153	0.124	0.163

Table: Polygyny, drought and timing of marriage in Sub-Saharan Africa by sub-regions

	West Africa				Outside West Africa			
	Full Sample		Bride Price Only		Full Sample		Bride price only	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Drought	0.0153***		0.0118***		0.0030		0.0091***	
	(0.0042)		(0.0040)		(0.0024)		(0.0032)	
Drought x polygyny rate	-0.0313***		-0.0208**		-0.0065		-0.0425**	
	(0.0103)		(0.0090)		(0.0138)		(0.0182)	
Drought x low polygyny		0.0140***		0.0102**		0.0019		0.0055**
		(0.0046)		(0.0042)		(0.0018)		(0.0023)
Drought x medium polygyny		0.0035*		0.0061***		0.0027		-0.0006
		(0.0020)		(0.0022)		(0.0026)		(0.0035)
Drought x high polygyny		-0.0002		0.0001		-0.0011		-0.0153
		(0.0025)		(0.0019)		(0.0084)		(0.0123)
Observations	1,145,604	1,145,604	866,974	866,974	1,313,573	1,313,573	477,386	477,386
Adjusted R-squared	0.0633	0.0633	0.0680	0.0681	0.0619	0.0619	0.0568	0.0568
Mean dependent variable	0.127	0.127	0.128	0.128	0.0988	0.0988	0.101	0.101

All columns include age, birth year, grid-cell fixed effects. Robust standard errors clustered at cell-grid level in parentheses $***p < 0.01, **p < 0.05, *p < 0.1$. Table shows OLS regressions for Sub-Saharan Africa (SSA). Observations are at the level of person x age (from 12 to 24 or age of first marriage). The dependent variable is a binary variable for marriage, coded to one if the woman married at the age corresponding to the observation. Full sample includes women aged 25 or older at the time of interview. The other columns restrict this sample to only women from an ethnic group where the bride price custom is practiced. 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.

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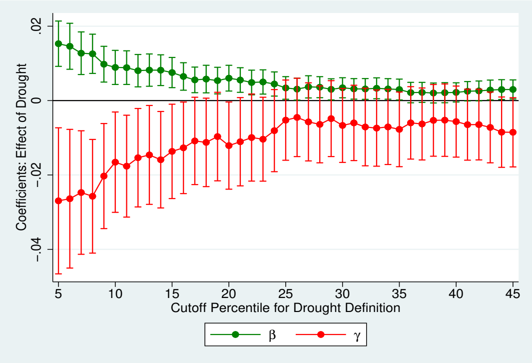
Table: Polygyny, PPI and Timing of Marriage by sub-regions

	West Africa				Outside West Africa			
	Full Sample		Bride price only		Full Sample		Bride Price Only	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
PPI	-0.0072***		-0.0065***		0.0000		-0.0063	
	(0.0023)		(0.0016)		(0.0038)		(0.0048)	
PPI × polygyny rate	0.0158**		0.0090*		-0.0003		0.0247	
	(0.0067)		(0.0053)		(0.0127)		(0.0168)	
PPI × low polygyny		-0.0060***		-0.0056***		-0.0001		-0.0058
		(0.0020)		(0.0014)		(0.0032)		(0.0043)
PPI × medium polygyny		-0.0029*		-0.0056***		0.0001		0.0002
		(0.0015)		(0.0014)		(0.0024)		(0.0025)
PPI × high polygyny		0.0007		-0.0003		-0.0005		0.0054
		(0.0024)		(0.0020)		(0.0046)		(0.0051)
Observations	424,935	424,935	318,190	318,190	549,491	549,491	192,528	192,528
Adjusted R-squared	0.0704	0.0704	0.0742	0.0742	0.0725	0.0725	0.0665	0.0665
Mean dependent variable	0.151	0.151	0.153	0.153	0.120	0.120	0.120	0.120

All columns include age, birth year, grid-cell and country × calandar year fixed effects. Robust standard errors clustered at cell-grid level in parentheses $***p < 0.01, **p < 0.05, *p < 0.1$. Table shows OLS regressions for Sub-Saharan Africa (SSA). Observations are at the level of person x age (from 12 to 24 or age of first marriage). The dependent variable is a binary variable for marriage, coded to one if the woman married at the age corresponding to the observation. Full sample includes women aged 25 or older at the time of interview living in rural areas. The other columns restrict this sample to only women from an ethnic group where the bride price custom is practiced. The PPI is measured in terms of average temporal standard deviations. All Regressions are weighted using country population-adjusted survey sampling weights.

Figure: Robustness definition of drought based on cutoffs



Note: The connected points show the estimated coefficients and the capped spikes show 95% confidence intervals calculated using standard errors clustered at the grid cell level. β is the effect of drought in absence of polygyny. γ is the coefficient on the interaction term between drought and polygyny rates.

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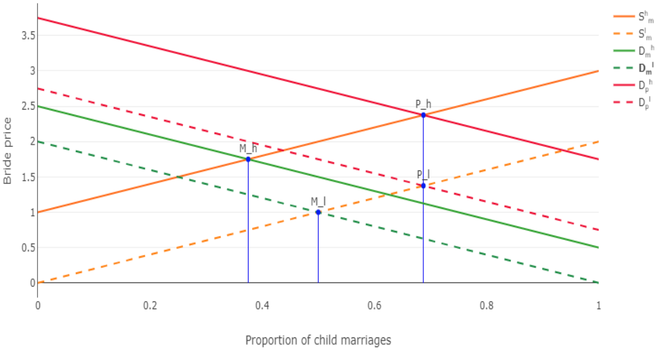
Figure: Equilibrium Outcomes



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Proofs

Proof proposition 1 - Part 1

- Household i wants to marry their daughter by the end of t if:

$$U^f_{o,t}(b_t = 1|M_{t-1} = 0, y_t, \epsilon_{ti}, \tau_t) > U^f_{o,t}(b_t = 0|M_{t-1} = 0, y_t, \epsilon_{ti})$$

$$\iff \quad \frac{(y_t + \epsilon_{ti} + \tau_t)^{1-\gamma}}{1-\gamma} + V^f_M > \frac{(y_t + \epsilon_{ti} + w^f_o)^{1-\gamma}}{1-\gamma} + V^f_U$$

$$\iff \quad \tau_t > \left[(y_t + \epsilon_{ti} + w^f_o)^{1-\gamma} - (1-\gamma)\left(V^f_M - V^f_U\right)\right]^{\frac{1}{1-\gamma}} - y_t - \epsilon_{ti} = \underline{\tau}_t$$

- Similarly, a son in his household j wants to marry if:

$$\frac{(y_t + \epsilon_{tj} - w^{m,l}_o + w^f_g - \tau_t)^{1-\gamma}}{1-\gamma} + V^{m,nf}_M > \frac{(y_t + \epsilon_{tj} - w^{m,l}_o)^{1-\gamma}}{1-\gamma} + V^m_U$$

$$\iff \quad \tau_t < y_t + \epsilon_{tj} - w^{m,l}_o + w^f_g - \left[(y_t + \epsilon_{tj} - w^{m,l}_o)^{1-\gamma} - (1-\gamma)\left(V^{m,nf}_M\right.\right.$$

- For $V^{m,nf}_M - V^m_U \geq 0$ and $V^f_M - V^f_U \geq 0$, we 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 marry at t (QED). Back

Proof proposition 1 - Part 2

- A married man will want to have a second spouse if

$$H_2(y_t, \epsilon_{jt}, \tau_t) \equiv \left[u\Big(y_t + \epsilon_{jt} - w_o^{m,h} - \tau_t + (w_o^f + w_y^f)\Big) + V_{M2}^{m,nf}\right] - \left[u(y_t + \epsilon_{jt} - w_o^{m,h} + w_o^f) + V_M^{m,nf}\right] > 0$$

- Convavity and monotonicity ensure that difference in flow utility is strictly increasing in ϵ_{jt}
- Therefore $\epsilon^*_{m,2}$ is defined such that $H_2(y_t, \epsilon^*_m, \tau_t) \equiv 0$
- $\epsilon^*_{m,2}$ is a decreasing function of $V_{M2}^{m,nf} - V_M^{m,nf}$: crucial bellow

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- **Part 1:** For $p = 0$ (monogamy):

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

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

- $\frac{dQ^*(y_t)}{dy_t} < 0$ because $\epsilon_m^* > \epsilon_f^*$ when $w_o^{m,l}$ is high enough Back

Part 2: Variation in p

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

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

$$= \frac{dD_y}{dp}\left[f(\epsilon_f^*(\tau_t, y_t))\left(\frac{\partial W/\partial \tau_t}{\partial W/\partial \epsilon_f^*} - \frac{\partial H_2/\partial \tau_t}{\partial H_2/\partial \epsilon_{m,2}^*}\right) + f(\epsilon_m^*(\tau_t, y_t))\left(\frac{\partial H/\partial \tau_t}{\partial H/\partial \epsilon_m^*} - \frac{\partial H_2/\partial \tau_t}{\partial H_2/\partial \epsilon_{m,2}^*}\right)\right]$$

$$A_{1,1} = \left(\frac{\partial W/\partial \tau_t}{\partial W/\partial \epsilon_f^*} - \frac{\partial H/\partial \tau_t}{\partial H/\partial \epsilon_m^*}\right) > 0 \qquad A_{1,2} = \left(\frac{\partial H/\partial \tau_t}{\partial H/\partial \epsilon_m^*} - \frac{\partial H_2/\partial \tau_t}{\partial H_2/\partial \epsilon_{m,2}^*}\right) < 0?$$

- $A_{1,2} < 0$ if $\epsilon_{m,2}^*$ low enough $\iff$ $V_{M2}^{m,nf} - V_M^{m,nf}$ high enough
- Moreover, $|A_{1,2}|$ is decreasing function of $\epsilon_{m,2}^*$ and $A_{1,1}$ is independent of it: $A < 0$ for $V_{M2}^{m,nf} - V_M^{m,nf}$ high enough

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Supply and Demand for Child Brides

- Demand for child brides comes from 3 sources:
  - Old men who cannot find an adult spouse because $\mathcal{U}^m_{o,t} > \mathcal{U}^f_{o,t}$

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

  - Potential young grooms whose family draw $\epsilon_{tj} > \epsilon^*_m$:

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

  - Old married men on the market for a 2nd spouse (with probability p) that have a shock $\epsilon_{tj} > \epsilon^*_{m,2}$

$$D^{(2,old)}(\tau_t, y_t, \tau^*_{t-1}, y_{t-1}) = \frac{p}{(1+a)}\left[\left(1 - F(\epsilon^*_m(\tau^*_{t-1}, y_{t-1})\right) \times \left(1 - F(\epsilon^*_{m,2}(\tau_t, y_t)\right)\right]$$

- Supply of child brides: HH with a low enough shock ϵ_{ti} $S(\tau_t, y_t) = F(\epsilon^*_f(\tau_t, y_t))$
- This demand and supply of child brides will determine an equilibrium bride price that clears the market

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- Equilibrium quantity of child marriage:
  $Q^*(y_t) \equiv D(y_t, \tau_t^*) = S(y_t, \tau_t^*)$

- **Proposition 4:**
  - $p = 0$: Polygyny not allowed (Corno et al., 2020)

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

If $w_o^{m,l}$ is high enough det

  - $p > 0$: polygyny allowed

$$sgn\Big(\frac{dQ_y^*}{dp}\Big) = sgn\Big[\frac{dD_y}{dp}(S_\tau - D_\tau) - \frac{dD_\tau}{dp}(S_y - D_y)\Big] > 0$$

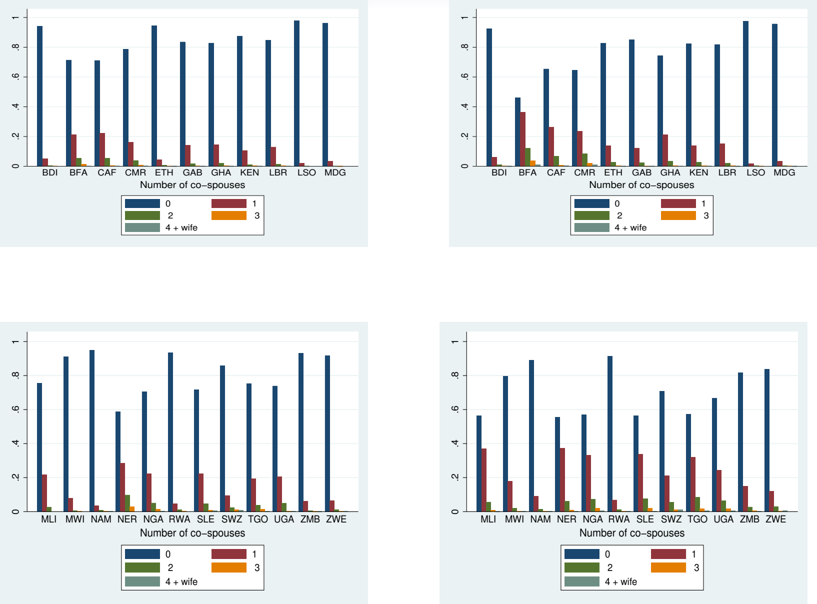
If extra expected utility that men derive from having 2nd spouse ($V_{M2}^{m,nf} - V_M^{m,nf}$) is high enough det DS Wealth

Data and Background

- DHS survey data: 73 survey waves collected between 1994 and 2013 in 31 countries in SSA
  - Women provide info on month, year and age at 1st union
  - Whether married to a polygynous husband and rank in union
- GPS coordinates of each DHS HH cluster is used to match it with corresponding 0.5 $\times$ 0.5 DD weather cell grid
- These grid cells are then used to:
  - Measure exposure to droughts across space and over time
  - Measure local polygyny norms: share of women aged 25 or older married to a polygamous husband
- Rainfall data from University of Delaware ("UDel data")

▸ KDE Polygyny ▸ KDE Christians ▸ Heatmap Polygyny and Religion

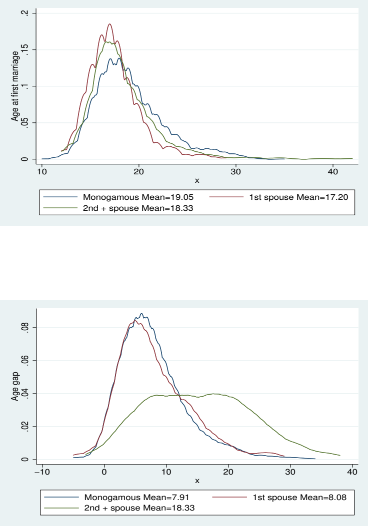
Distribution of Women by Number of Co-spouses



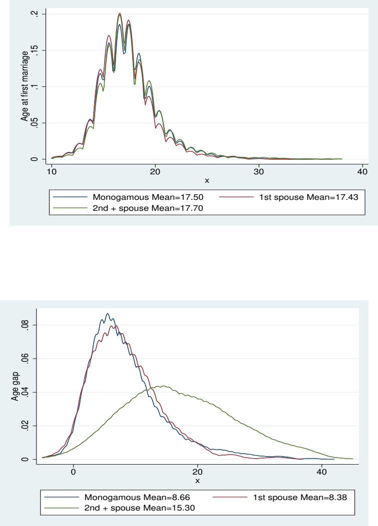
(a) Urban (b) Rural

Figure: KDE of age at first marriage and age gap in Burkina Faso

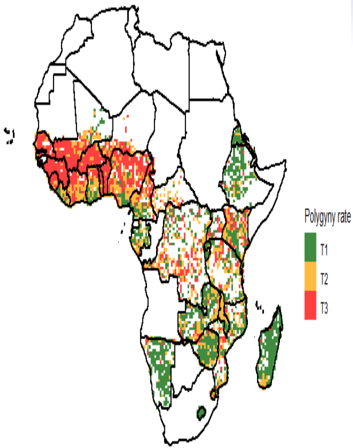
▸ Age gap by country ▸ Age marriage by country



(a) Urban



(b) Rural


Polygyny rate
T1
T2
T3

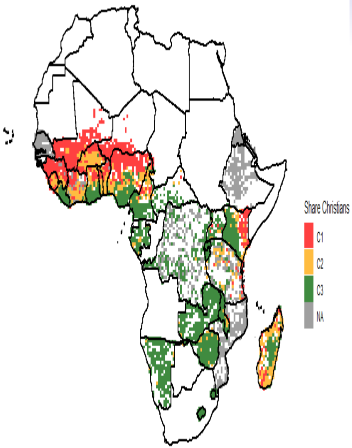
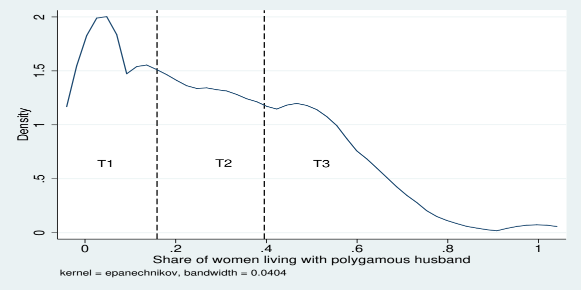

Share Christians
C1
C2
C3
NA

Figure: KDE of the Distribution of Cell-Grids by Polygyny Rate



Note: 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%).

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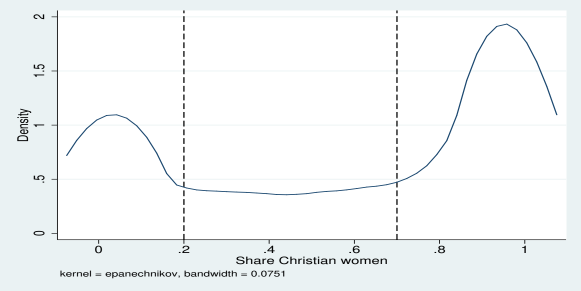
Figure: KDE of the Distribution of Cell-Grids by Share of Christians



Note: C1 represents grid cells with low proportion of Christians (less than 20%), C2 is for areas with medium proportion (between 20 and 70%) and C3 is for areas with high proportion of Christians (more than 70%).

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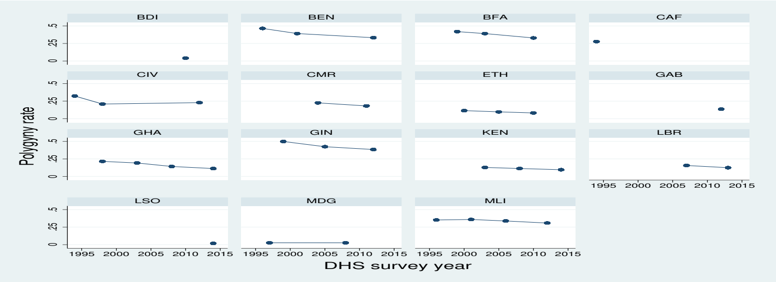
Figure: Polygyny rate: unions within last 10 years

▸ Back ▸ Back r ▸ Stock



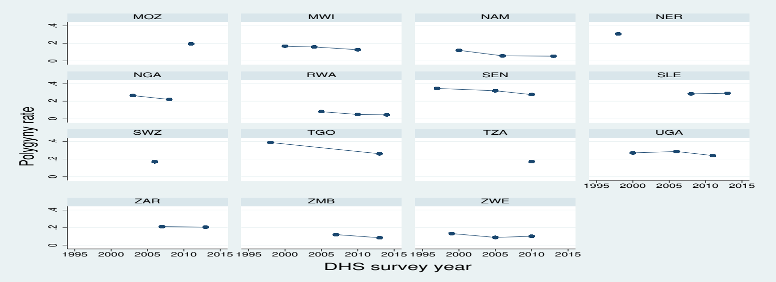
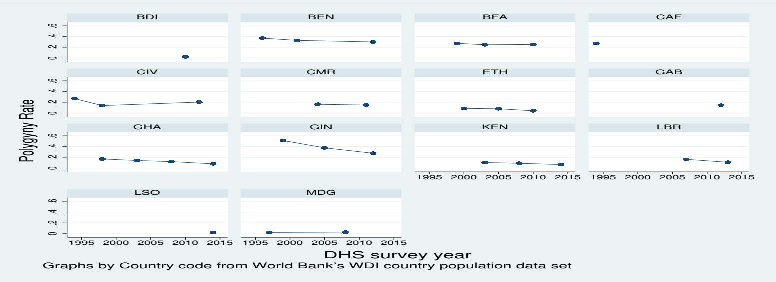


Figure: Polygyny rate: unions within last 5 years

▸ Back ▸ Stock



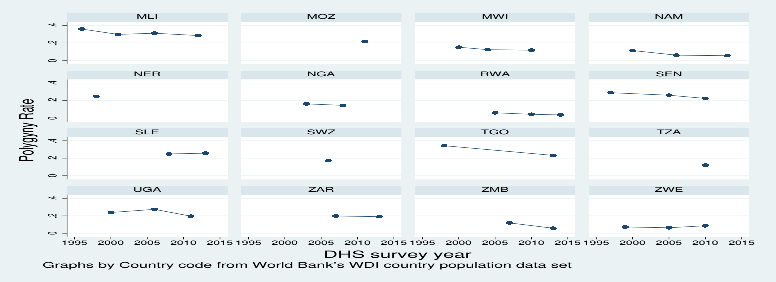
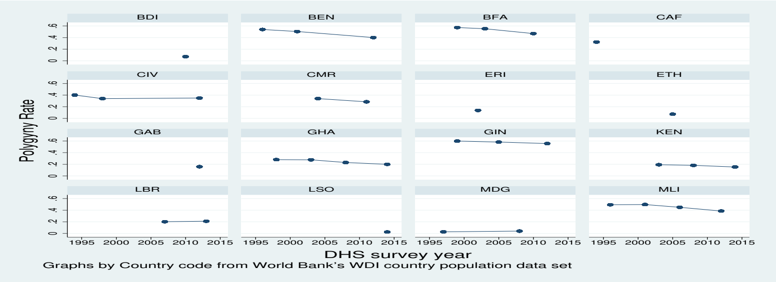


Figure: Stock of Polygynous unions over time in SSA

▸ Flow



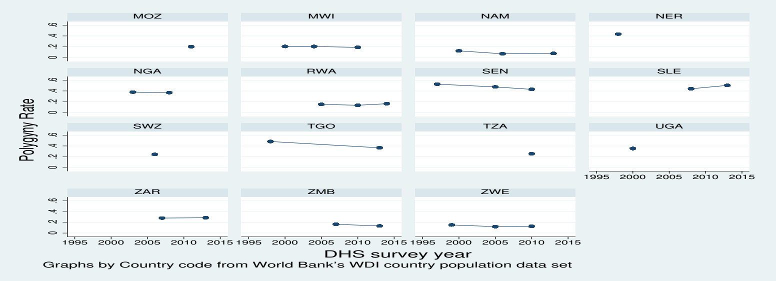


Figure: Age at first marriage by country (1/2) ▸ BFA ▸ Back

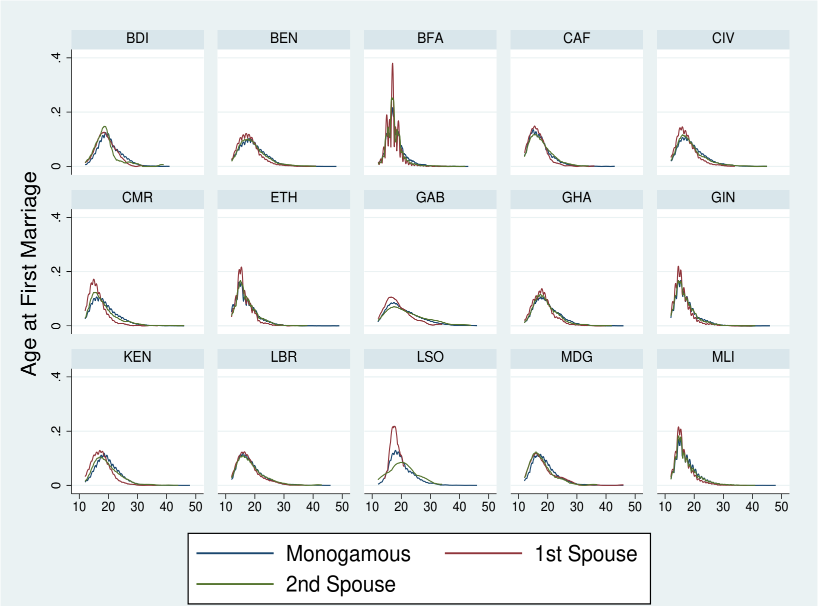


Figure: Age at first marriage (2/2) ▸ BFA ▸ Back

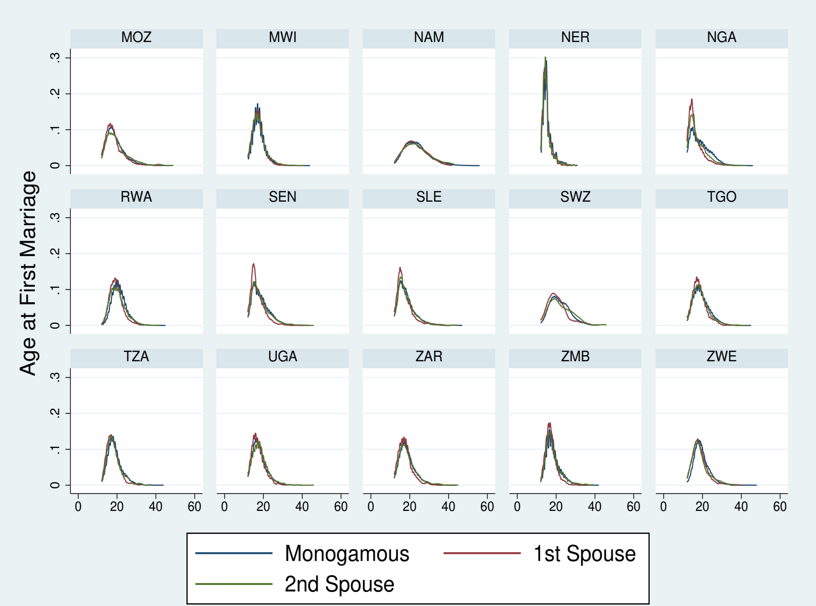
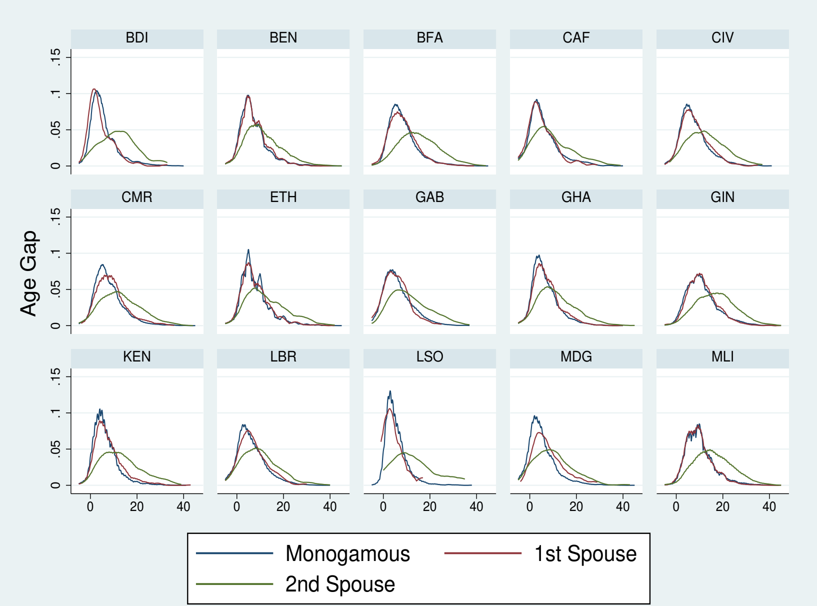
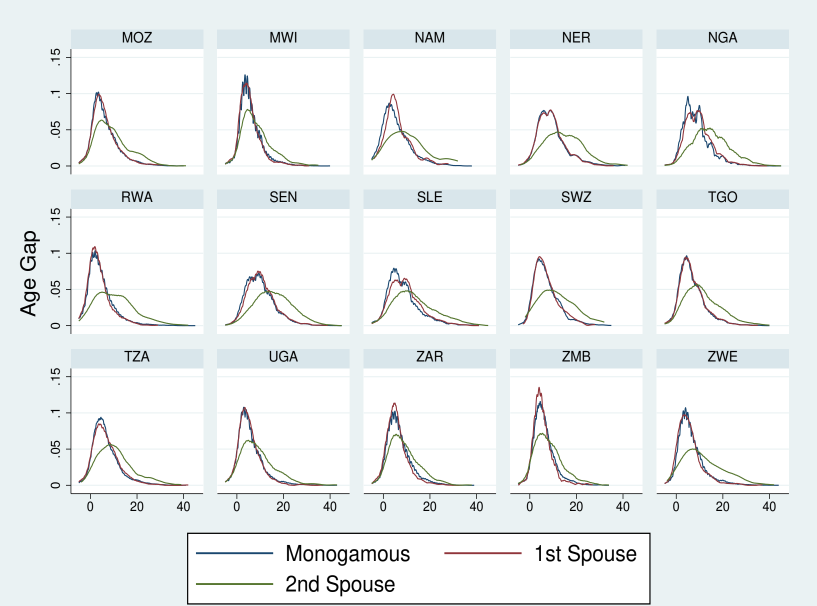


Figure: Age gap by country (1/2) ▸ BFA ▸ Back




MOZ
MWI
NAM
NER
NGA
RWA
SEN
SLE
SWZ
TGO
TZA
UGA
ZAR
ZMB
ZWE
Age Gap
0
.05
.1
.15
0
20
40
Monogamous
1st Spouse
2nd Spouse