Econometrica Supplementary Material

SUPPLEMENT TO "AGE OF MARRIAGE, WEATHER SHOCKS, AND THE DIRECTION OF MARRIAGE PAYMENTS"

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LUCIA CORNO
Department of Economics and Finance, Cattolica University and LEAP

NICOLE HILDEBRANDT
Boston Consulting Group, New York

ALESSANDRA VOENA
Department of Economics, The University of Chicago, NBER, CEPR, and BREAD

APPENDIX A: THEORETICAL APPENDIX

A.1. *Proof of Proposition 1*

A HOUSEHOLD i wants its daughter to get married by the end of the second period if and only if

$$\frac{(y_2+\varepsilon_{2i}+\tau_2)^{1-\gamma}}{1-\gamma}+\xi^f>\frac{\left(y_2+\varepsilon_{2i}+w_2^f\right)^{1-\gamma}}{1-\gamma}$$
$$\iff \quad \tau_2>\left[\left(y_2+\varepsilon_{2i}+w_2^f\right)^{1-\gamma}-(1-\gamma)\xi^f\right]^{\frac{1}{1-\gamma}}-y_2-\varepsilon_{2i}=\underline{\tau_2}.$$

For household j with a son, we follow similar algebra:

$$\frac{\left(y_2+\varepsilon_{2j}+w_2^m+w_2^f-\tau_2\right)^{1-\gamma}}{1-\gamma}+\xi^m>\frac{\left(y_2+\varepsilon_{2j}+w_2^m\right)^{1-\gamma}}{1-\gamma}$$
$$\iff \quad \tau_2<y_2+\varepsilon_{2j}+w_2^m+w_2^f-\left[\left(y_2+\varepsilon_{2j}+w_2^m\right)^{1-\gamma}-(1-\gamma)\xi^m\right]^{\frac{1}{1-\gamma}}=\overline{\tau_2}.$$

For $\xi^s\geq 0$, we have that $\overline{\tau_2}\geq\underline{\tau_2}$, with a strict inequality when either of the two ξ^s is strictly positive. Hence, there exists a $\tau_2^*\in[\underline{\tau_2},\overline{\tau_2}]$ that would ensure that everyone marries.

When $\xi^f<\frac{(y_2+\varepsilon_{2i}+w_2^f)^{1-\gamma}}{1-\gamma}-\frac{(y_2+\varepsilon_{2i})^{1-\gamma}}{1-\gamma}$, then $\underline{\tau_2}>0$ and the payment ought to be a bride price. When $\xi^m<\frac{(y_2+\varepsilon_{2j}+w_2^m)^{1-\gamma}}{1-\gamma}-\frac{(y_2+\varepsilon_{2j}+w_2^m+w_2^f)^{1-\gamma}}{1-\gamma}$, then $\overline{\tau_2}<0$ and the payment ought to be a dowry.

Also, $\frac{\partial\underline{\tau_2}}{\partial\xi^f}<0$ and $\frac{\partial\overline{\tau_2}}{\partial\xi^m}>0$, ensuring that large enough preference realizations can make marriage payments based on historical $\tilde{w}^f$ sustainable even as w_2^f changes.

Lucia Corno: lucia.corno@unicatt.it
Nicole Hildebrandt: nhilde1@gmail.com
Alessandra Voena: avoena@uchicago.edu

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A.2. *Proof of Proposition 2*

First, define $\Omega^f = \delta\{E[V_2^f(M_1 = 0)] - E[V_2^f(M_1 = 1)]\}$ as the option value of marriage for a woman's family and $\Omega^m = \delta\{E[V_2^m(M_1 = 0)] - E[V_2^m(M_1 = 1)]\}$ as the option value of marriage for a man's family. Note that $\operatorname{sgn}(\tau_1) = \operatorname{sgn}(\Omega^f) = -\operatorname{sgn}(\Omega^m)$.

A woman's family would want her to marry in the first period if and only if

$$W(y_1, \epsilon_{1i}, \tau_1) \equiv u\big(y_1 + \epsilon_{1i} + w_1^f + \big(\tau_1 - w_1^f\big)\big) - u\big(y_1 + \epsilon_{1i} + w_1^f\big) - \Omega^f > 0. \tag{A.1}$$

Concavity and monotonicity of the utility function ensure that the right-hand side of equation (A.1) is strictly decreasing in ϵ_{1i}, while Ω^f does not depend on it. Hence, the threshold ϵ_f^* is defined implicitly as $W(y_1, \epsilon_f^*, \tau_1) \equiv 0$.

Similarly, a man's family would want him to marry in the first period if and only if

$$H(y_1, \epsilon_{1j}, \tau_1) \equiv u\big(y_1 + \epsilon_{1j} + w_1^m - \big(\tau_1 - w_1^f\big)\big) - u\big(y_1 + \epsilon_{1j} + w_1^m\big) - \Omega^m > 0. \tag{A.2}$$

Again, concavity and monotonicity of the utility function ensure that the right-hand side of equation (A.2) is strictly increasing in ϵ_{1j}, while Ω^m does not depend on it. Hence, the threshold ϵ_m^* is defined from $H(y_1, \epsilon_m^*, \tau_1) \equiv 0$.

A.3. *Proof of Proposition 3*

Under bride price, given the above-defined thresholds, the supply and the demand for brides are equal to

$$S(\tau_1, y_1) = F\big(\epsilon_f^*(\tau_1, y_1)\big),$$
$$D(\tau_1, y_1) = 1 - F\big(\epsilon_m^*(\tau_1, y_1)\big).$$

Under dowry, the supply and the demand for brides are equal to

$$S(\tau_1, y_1) = 1 - F\big(\epsilon_f^*(\tau_1, y_1)\big),$$
$$D(\tau_1, y_1) = F\big(\epsilon_m^*(\tau_1, y_1)\big).$$

By the implicit function theorem (IFT), the chain rule, and the fact that $F'(\cdot) = f(\cdot) > 0$ (continuity), we have that

$$\frac{\partial S(\tau_1, y_1)}{\partial y_1} = S_y(\tau_1, y_1) = f\big(\epsilon_f^*\big)\frac{\partial \epsilon_f^*}{\partial y_1} = -f\big(\epsilon_f^*\big)\frac{\partial W/\partial y_1}{\partial W/\partial \epsilon_f^*},$$
$$\frac{\partial D(\tau_1, y_1)}{\partial y_1} = D_y(\tau_1, y_1) = -f\big(\epsilon_m^*\big)\frac{\partial \epsilon_m^*}{\partial y_1} = f\big(\epsilon_m^*\big)\frac{\partial H/\partial y_1}{\partial H/\partial \epsilon_m^*}.$$

Given the expressions for $W()$ in equation (A.1) and for $H()$ in equation (A.2), we have that, in the bride price case (with $\tau_1 \geq w_1^f$),

$$\frac{\partial S(\tau_1, y_1)}{\partial y_1} = S_y(\tau_1, y_1) = -f\big(\epsilon_f^*\big) < 0, \qquad \frac{\partial D(\tau_1, y_1)}{\partial y_1} = D_y(\tau_1, y_1) = f\big(\epsilon_m^*\big) > 0,$$

and in the dowry case (with $\tau_1 \leq w_1^f$),

$$\frac{\partial S(\tau_1, y_1)}{\partial y_1} = S_y(\tau_1, y_1) = f\big(\epsilon_f^*\big) > 0, \qquad \frac{\partial D(\tau_1, y_1)}{\partial y_1} = D_y(\tau_1, y_1) = -f\big(\epsilon_m^*\big) < 0.$$

In sum, $\operatorname{sgn}(\tau_1) = -\operatorname{sgn}(S_y(\tau_1, y_1)) = \operatorname{sgn}(D_y(\tau_1, y_1))$.

A.4. *Proof of Proposition 4*

The equilibrium quantity of child marriage is given by $Q_1^*(y_1) \equiv D(y_1, \tau_1^*) = S(y_1, \tau_1^*)$. Hence, $\frac{dQ^*(y_1)}{dy_1} = S_y(y_1, \tau_1^*) + S_\tau(y_1, \tau_1^*)\frac{\partial \tau_1^*}{\partial y_1}$. In both economies, equilibrium prices are defined implicitly as the solution to $S(y_1, \tau_1^*) - D(y_1, \tau_1^*) = 0$. This implies that, by the IFT, $\frac{d\tau_1^*}{dy_1} = -\frac{S_y - D_y}{S_\tau - D_\tau}$ and that

$$\frac{dQ^*(y_1)}{dy_1} = S_y - S_\tau \frac{S_y - D_y}{S_\tau - D_\tau}.$$

After some manipulations and applying the above derivations on the signs of the partial derivatives of supply and demand, we obtain that

$$\operatorname{sgn}\left(\frac{dQ^*(y_1)}{dy_1}\right) = \operatorname{sgn}\left(\frac{S_y}{S_\tau} - \frac{D_y}{D_\tau}\right).$$

This derivation implies the classic result that equilibrium quantities (of child marriage) vary according to aggregate income depending on the relative elasticities of demand and supply with respect to both prices and income.

With similar argument used above, we have that

$$\frac{\partial S(\tau_1, y_1)}{\partial \tau_1} = S_\tau(\tau_1, y_1) = f\left(\epsilon_f^*\right)\frac{\partial \epsilon_f^*}{\partial \tau_1} = -f\left(\epsilon_f^*\right)\frac{\partial W/\partial \tau_1}{\partial W/\partial \epsilon_f^*},$$
$$\frac{\partial D(\tau_1, y_1)}{\partial \tau_1} = D_\tau(\tau_1, y_1) = -f\left(\epsilon_m^*\right)\frac{\partial \epsilon_m^*}{\partial \tau_1} = f\left(\epsilon_m^*\right)\frac{\partial H/\partial \tau_1}{\partial H/\partial \epsilon_m^*},$$

and ultimately,

$$\operatorname{sgn}\left(\frac{dQ^*(y_1)}{dy_1}\right) = \operatorname{sgn}\left(\frac{\partial W/\partial y_1}{\partial W/\partial \tau_1} - \frac{\partial H/\partial y_1}{\partial H/\partial \tau_1}\right).$$

Given these derivations of these partial derivatives and the marginal utility of a CRRA, we have that

$$\begin{aligned}\frac{S_y}{S_\tau} - \frac{D_y}{D_\tau} &= \frac{u'\left(y_1 + \epsilon_f^* + w_1^f + \left(\tau_1 - w_1^f\right)\right) - u'\left(y_1 + \epsilon_f^* + w_1^f\right)}{u'\left(y_1 + \epsilon_f^* + w_1^f + \left(\tau_1 - w_1^f\right)\right)} \\ &\quad - \frac{u'\left(y_1 + \epsilon_m^* + w_1^m - \left(\tau_1 - w_1^f\right)\right) - u'\left(y_1 + \epsilon_m^* + w_1^m\right)}{u'\left(y_1 + \epsilon_m^* + w_1^m - \left(\tau_1 - w_1^f\right)\right)} \\ &= 2 - \left(1 + \frac{\tau_1 - w_1^f}{y_1 + \epsilon_f^* + w_1^f}\right)^\gamma - \left(1 - \frac{\tau_1 - w_1^f}{y_1 + \epsilon_m^* + w_1^m}\right)^\gamma.\end{aligned}$$

First, note that as long as w_2^m is sufficiently large, concavity ensures that $|\Omega^m| < |\Omega^f|$ (marriage payments have a greater impact on the budget constraint of a woman's family than on that of a man's family) and that $\epsilon_m^* > \epsilon_f^*$ both under dowry and bride price.

Second, by the Bernoulli inequality ($(1+x)^r \geq 1 + rx \; \forall r \geq 1,\; x \geq -1$), with $\gamma \geq 1$ the above expression is bounded from above by the term

$$\gamma\big(\tau_1 - w_1^f\big)\left(\frac{1}{y_1 + \epsilon_m^* + w_1^m} - \frac{1}{y_1 + \epsilon_f^* + w_1^f}\right).$$

Third, by the related inequality stating that $(1+x)^r \leq 1 + \frac{rx}{1-(r-1)x} \; \forall r \geq 0,\; x \in (-1, \frac{1}{r-1})$ (Li and Yeh (2013)), when suitable conditions on the parameters are met,[1] the expression is bounded from below by the term

$$\gamma\big(\tau_1 - w_1^f\big)\left(\frac{1}{y_1 + \epsilon_m^* + w_1^m - (\gamma-1)\big(w_1^f - \tau_1\big)} - \frac{1}{y_1 + \epsilon_f^* + w_1^f - (\gamma-1)\big(\tau_1 - w_1^f\big)}\right).$$

In bride price societies, where $\tau_1 > w_1^f$, the upper bound of the expression is negative whenever $w_1^m + \epsilon_m^* > w_1^f + \epsilon_f^*$. In dowry societies, where $\tau_1 < w_1^f$, the lower bound of the expression is positive whenever $w_1^m + \epsilon_m^* > w_1^f + \epsilon_f^* - 2(\gamma-1)(\tau_1 - w_1^f)$. In both cases, these inequalities have the expected sign when w_2^m is sufficiently large, because

$$\frac{\partial \epsilon_m^*}{\partial w_2^m} = \frac{\delta E\big[u'\big(y_2 + \epsilon_{2j} + w_2^m + w_2^f - \tau_2^*\big) - u'\big(y_2 + \epsilon_{2j} + w_2^m + w_2^f\big)\big]}{u'\big(y_1 + \epsilon_{1j} + w_1^m - \big(\tau_1 - w_1^f\big)\big) - u'\big(y_1 + \epsilon_{1j} + w_1^m\big)} \geq 0,$$

since $\operatorname{sgn}(\tau_2^*) = \operatorname{sgn}(\tau_1 - w_1^f)$. A sufficient condition in the bride price case and a necessary one in the dowry case is that $|\Omega^f| > |\Omega^m|$, which occurs when $w_2^m + w_2^f > 2\tau_2^*$ under bride price and when $w_2^m + w_2^f > 0$ under dowry.

A.5. *Proof of Proposition 5*

As described above, equilibrium prices are defined implicitly as the solution to

$$S\big(\tau_1^*, y_1\big) - D\big(\tau_1^*, y_1\big) = 0.$$

By the IFT, the derivative of the equilibrium price with respect to y_1 is

$$\frac{d\tau_1^*}{dy_1} = -\frac{S_y(\tau_1, y_1) - D_y(\tau_1, y_1)}{S_\tau(\tau_1, y_1) - D_\tau(\tau_1, y_1)}.$$

Based on Proposition 3, this derivative is positive in the case of bride price and negative in the case of dowry, which implies that marriage payments are lower when income is lower regardless of whether bride price or dowry prevails.

A.6. *Robustness: Effects of Droughts on w^f and w^m*

We now consider an extension of the model that allows the children's contributions to the budget constraint to depend on contemporaneous droughts, that is, it allows for

[1] Specifically, that $y_1 + \epsilon_m^* + w_1^m > -(\gamma-1)(\tau_1 - w_1^f)$.

$\frac{dw_t^s(y_t)}{dy_t} \neq 0$ for $s \in \{m, f\}$. Based on evidence from the literature, we expect that droughts would compress wages, that is, that $\frac{dw_t^s(y_t)}{dy_t} \geq 0$ when $w_t^s > 0$. For the case in which women consume more than they contribute to the budget constraint ($w_t^f < 0$), which at least historically might have happened in India, we expect that their consumption would be lower with droughts, leading to $\frac{dw_t^f(y_t)}{dy_t} \leq 0$.

We first examine Proposition 3. Taking the appropriate partial derivatives, we have that

$$\begin{aligned}
&S_y(\tau_1, y_1) \\
&\quad = -\operatorname{sgn}(\tau_1 - w_1^f) f(\epsilon_f^*) \\
&\qquad \times \left(1 - \frac{dw_1^f}{dy_1} \frac{u'(y_1 + \epsilon_f^* + w_1^f)}{u'(y_1 + \epsilon_f^* + w_1^f + (\tau_1 - w_1^f)) - u'(y_1 + \epsilon_f^* + w_1^f)}\right), \\
&D_y(\tau_1, y_1) \\
&\quad = \operatorname{sgn}(\tau_1 - w_1^f) f(\epsilon_m^*) \\
&\qquad \times \left(1 + \frac{dw_1^m}{dy_1} + \frac{dw_1^f}{dy_1} \frac{u'(y_1 + \epsilon_m^* + w_1^m - (\tau_1 - w_1^f))}{u'(y_1 + \epsilon_m^* + w_1^m - (\tau_1 - w_1^f)) - u'(y_1 + \epsilon_m^* + w_1^m)}\right).
\end{aligned}$$

This means that Proposition 3 is unaffected by $\frac{dw_1^m(y_t)}{dy_t}$ when this is positive instead of zero. In the bride price case, allowing for $\frac{dw_1^f(y_1)}{dy_1} > 0$ makes households even *more* responsive to droughts: during droughts, young daughters and young daughters-in-law become less productive, making the partial-equilibrium response of demand and supply ($S_y(\tau_1, y_1)$ and $D_y(\tau_1, y_1)$) even larger in absolute value. In the dowry case, on the contrary, it is allowing for $\frac{dw_1^f(y_1)}{dy_1} < 0$ that makes households more responsive to droughts. This implies that for Proposition 3 to hold in a dowry society, any negative effect of droughts on the wages of young women need not be so large that, for instance, daughters move from being productive to being very costly. This is because, in such a case, parents may prefer to have their daughter marry sooner if her productivity drops substantially, and the groom's family may find the temporarily unproductive bride less attractive. Note that when Proposition 3 holds, so does Proposition 5.

We hence are left to study Proposition 4. Irrespective of the effects of droughts on wages, we continue having that $\operatorname{sgn}(\frac{dQ^*(y_1)}{dy_1}) = \operatorname{sgn}(\frac{S_y}{S_\tau} - \frac{D_y}{D_\tau})$. The term that determines the sign, in this case, is equal to

$$\begin{aligned}
\frac{S_y}{S_\tau} - \frac{D_y}{D_\tau} &= 2 - \left(1 + \frac{\tau_1 - w_1^f}{y_1 + \epsilon_f^* + w_1^f}\right)^\gamma - \left(1 - \frac{\tau_1 - w_1^f}{y_1 + \epsilon_m^* + w_1^m}\right)^\gamma \\
&\quad + \frac{dw_1^f}{dy_1}\left[1 - \left(1 + \frac{\tau_1 - w_1^f}{y_1 + \epsilon_f^* + w_1^f}\right)^\gamma\right] + \frac{dw_1^m}{dy_1}\left[1 - \left(1 - \frac{\tau_1 - w_1^f}{y_1 + \epsilon_m^* + w_1^m}\right)^\gamma\right].
\end{aligned}$$

Given this expression, in order for the proof of Proposition 4 to hold, two conditions are sufficient. The first one is that w_t^m is sufficiently large so that the first term has the expected sign, as in the baseline case. This condition appears to be reasonable, and indeed likely since men have access to more opportunities to smooth wage shocks, such as seasonal migration or off-farm employment, compared to women. Relatedly, the second sufficient condition requires that wages of young women would need to be at least as sensitive to droughts as those of men ($\frac{dw_1^m}{dy_1} \leq \frac{dw_1^f}{dy_1}$).

In sum, in the bride price case, hence, allowing droughts to affect w^f and w^m does not modify the predictions of the model under tenable assumptions. For the dowry case, there are two possible scenarios. If young women are on net productive ($w_1^f > 0$ and $\frac{dw_1^f}{dy_1} \geq 0$), our most important prediction, Proposition 4, is also going to continue holding under the same assumptions. Proposition 3, and consequently Proposition 5, may, however, not hold if the drop in a young woman's productivity with droughts is so large that parents find it too burdensome to wait to allow her to marry. If women are on net unproductive ($w_1^f < 0$ and $\frac{dw_1^f}{dy_1} \leq 0$), then for Proposition 4 to hold, the decline in young men's wages with droughts needs to be not too large relative to women's decline in consumption. Such condition can be met more easily if we think that, if households can reduce a young woman's consumption in drought, they may be able to do the same with a young man's consumption, mitigating the negative effect of droughts on his net contribution to the household budget.

APPENDIX: TABLES AND FIGURES

TABLE AI

TRADITIONAL MARRIAGE CUSTOMS IN SUB-SAHARAN AFRICA[a]

Country	% Bride Price	Country	% Bride Price
Benin	91%	Mali	93%
Burkina Faso	83%	Mozambique	43%
Burundi	99%	Namibia	58%
Cameroon	93%	Niger	100%
Central African Republic	65%	Nigeria	91%
Eritrea	45%	Rwanda	100%
Ethiopia	66%	Senegal	98%
Gabon	74%	Sierra Leone	99%
Ghana	94%	Swaziland	97%
Guinea	95%	Tanzania	81%
Ivory Coast	69%	Togo	62%
Kenya	100%	Uganda	97%
Lesotho	100%	Zaire	84%
Liberia	98%	Zambia	19%
Madagascar	13%	Zimbabwe	87%
Malawi	15%		

[a]Data from the *Atlas of Pre-Colonial Societies* (available at http://www.worlddevelopment.uzh.ch/en/atlas.html, last accessed on August 13, 2018).

TABLE AII

WEATHER SHOCKS, CROP YIELDS, AND INCOME IN SUB-SAHARAN AFRICA[a]

	Crop Yields						Income and Consumption	
	(1) Maize	(2) Sorghum	(3) Millet	(4) Rice	(5) Wheat	(6) Average	(7) GDP per Capita	(8) HH Consumption
Drought	−0.11	−0.13	−0.08	−0.11	−0.06	−0.12	−0.05	−0.07
	(0.03)	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
N	1850	1693	1593	1605	1253	1818	1455	1335
Adjusted R^2	0.57	0.64	0.64	0.62	0.63	0.74	0.92	0.95

[a]The dependent variable is the log of annual crop yield (tons per hectare, columns 1–6) or log of GDP and consumption (columns 7–8) 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 the columns labeled “Average,” 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$, while household final consumption expenditures are measured at the aggregate level in current US$. A drought is defined as an annual rainfall realization below the 15th percentile of the national rainfall distribution. Standard errors (in parentheses) are clustered at the country level. All regression specifications include year and country fixed effects.

TABLE AIII

WEATHER SHOCKS, CROP YIELDS, AND INCOME IN INDIA[a]

	Crop Yields						Income and Consumption ($t+1$)	
	(1) Rice	(2) Wheat	(3) Jowar	(4) Maize	(5) Bajra	(6) Average	(7) NSDP p.c.	(8) HH Consumption
Drought	−0.18	−0.05	−0.18	−0.04	−0.19	−0.16	−0.04	−0.02
	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)
Mean of Level	143.7	96.4	43.2	20.4	24.5	291.6	743.7	1218.5
N	8208	7670	7118	7563	6054	8672	434	149,436
Adjusted R^2	0.66	0.69	0.59	0.35	0.56	0.75	0.96	0.23

[a]The dependent variable is the log of annual crop yield (tons per hectare, columns 1–6) for each Indian district from 1957 to 1987, or net state domestic product per capita (1971 INR, 1961–1989), or household consumption (2011 INR, 1994–1998). Crop yield data are from the World Bank India Agriculture and Climate Dataset, NSDP data are from the Economic and Political Weekly Research Foundation India Time Series, and household consumption data are from the Indian National Sample Survey. In the columns labeled “Average,” 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. A drought is defined as an annual rainfall realization below the 15th percentile of the local rainfall distribution (district level for columns 1–6, state level for columns 7–8). Standard errors (in parentheses) are clustered at the district level for columns 1–6 and at the state level for columns 7–8. All regression specifications include year and district (state for columns 7–8) fixed effects.

TABLE AIV

MARRIAGE MIGRATION IN AFRICA AND IN INDIA[a]

	Panel A: Data From DHS			
	Never Migrated	Migrated Before Marriage	Migrated at Marriage	Migrated After Marriage
SSA	41.81%	7.71%	21.88%	28.61%
India	13.21%	9.16%	58.02%	19.62%

	Panel B: Data From IHDS			
	Distance to Wife's Natal Home (hrs)			
	Mean	Median	75th Percentile	90th Percentile
India	3.44	2.00	4.00	6.00

[a]Panel A shows how long ever-married women have lived in their current place of residence (village, town, or city where she is interviewed). *Migrated at Marriage* includes women who report migrating to their current place of residence within one year of getting married.

TABLE AV

EFFECT OF THE SHARE OF LOCAL DROUGHTS IN SSA AND INDIA[a]

	SSA			India	
	(1)	(2)	(3)	(4)	(5)
Ratio of Local Droughts	0.013	0.013	0.012	−0.0040	−0.0039
	(0.0047)	(0.0047)	(0.0045)	(0.0023)	(0.0022)
Birth Year FE	Yes	Yes	Yes	Yes	Yes
Age FE	Yes	Yes	Yes	Yes	Yes
Country FE	No	Yes	Yes	No	No
Country FE × Cohort FE	No	No	Yes	No	No
State FE × Cohort FE	No	No	No	No	Yes
N	1,799,037	1,799,037	1,799,037	318,544	318,544
Adjusted R^2	0.072	0.072	0.072	0.082	0.083

[a]Table shows OLS regressions for the Sub-Saharan Africa (SSA) and India full regression samples: women aged 25 or older at the time of interview. Observations are at the level of person × age (from 12 to 17 or age of first marriage, whichever is earlier). The dependent variable is a binary variable for marriage, coded to 1 if the woman married at the age corresponding to the observation. The share of local droughts is the fraction of grid cells (districts) in the country (state) which experienced a drought in a given year. In India, districts are weighted by area when calculating the share of droughts in a given state. Standard errors (in parentheses) are clustered at the country (SSA) or state (India) level. All regression specifications include grid cell or district fixed effects.

TABLE AVI

EFFECT OF DROUGHTS ON CHILD MARRIAGE, BY ETHNIC CHARACTERISTICS IN SUB-SAHARAN-AFRICA[a]

	(1)	(2)	(3)
Drought × Bride Price	0.0024	0.0033	
	(0.0013)	(0.0016)	
Drought × No Bride Price	−0.00059	0.0014	
	(0.0022)	(0.0029)	
Drought × Matrilineal		−0.0028	
		(0.0024)	
Drought × Female Agriculture		−0.00082	−0.00086
		(0.0023)	(0.0023)
Drought × (BP & Not Matri.)			0.0033
			(0.0017)
Drought × (No BP & Matri.)			−0.0010
			(0.0031)
Drought × (BP & Matri.)			0.00038
			(0.0025)
Drought × (No BP & Not Matri.)			0.0010
			(0.0036)
Interacted Birth Year FE	Yes	Yes	Yes
Interacted Age FE	Yes	Yes	Yes
N	1,260,930	1,260,930	1,260,930
Adjusted R^2	0.074	0.076	0.076

[a] Table shows OLS regressions for the Sub-Saharan Africa full regression samples: women aged 25 or older at the time of interview. Observations are at the level of person × age (from 12 to or age of marriage, whichever is earlier). The dependent variable is a binary variable for marriage, coded to 1 if the woman married at the age corresponding to the observation. The p-value of the Wald test of equality between Drought × bride price and Drought × no bride price in Specification 1 is 0.245. For Specification 2, it is 0.509. Standard errors (in parentheses) are clustered at the grid cell level. A drought is defined as an annual rainfall realization below the 15th percentile of the local rainfall distribution. All regression specifications include grid cell fixed effects. Regressions are weighted by population-adjusted survey sampling weights.

TABLE AVII

EFFECT OF DROUGHTS ON THE TIMING OF MARRIAGE IN INDIA BY IRRIGATION INTENSITY AND BANK DEVELOPMENT[a]

	(1)	(2)	(3)	(4)
Drought × Low Irrig	−0.0060			
	(0.0026)			
Drought × High Irrig	0.0016			
	(0.0028)			
Drought × Low Banking		−0.0057	−0.0058	−0.0055
		(0.0026)	(0.0025)	(0.0024)
Drought × High Banking		−0.0028	−0.0029	−0.0031
		(0.0019)	(0.0019)	(0.0020)
Birth Year FE × High Banking FE	No	Yes	Yes	Yes
Age FE × High Banking FE	No	Yes	Yes	Yes
Birth Year FE × High Irrig FE	Yes	No	No	No
Age FE × High Irrig FE	Yes	No	No	No
N	247,038	329,586	329,586	329,586
Adjusted R^2	0.084	0.085	0.085	0.085

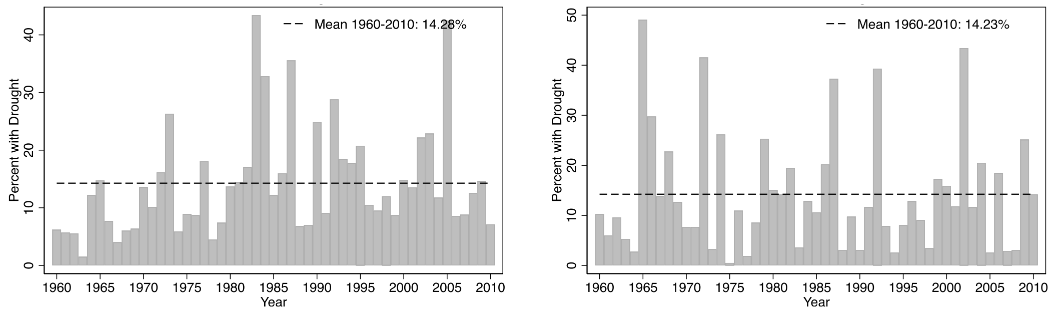
[a]Table shows OLS regressions using additional surveys in India. Each regression sample consists of women aged 25 or older at the time of interview. Deposits and credit per capita are as measured in 1981. The irrigation or banking variable used in each regression is specified at the top of each column. Observations are at the level of person × age (from 12 to 17 or age of first marriage, whichever is earlier). The dependent variable is a binary variable for marriage, coded to 1 if the woman married at the age corresponding to the observation. The p-value of the Wald test of equality between *Drought* × *Low Irrigation* and *Drought* × *High Irrigation* is 0.047. *Low Banking* and *High Banking* relate to different measures in columns 2–4: the number of bank branches per 1000 people between 1960 and 1999 (column 2), the number of per capita bank deposits in 1981 (column 3), and the number of per-capita bank credits in 1981 (column 4, Jayachandran (2006)). The p-value of the Wald test of equality between *Drought* × *Low Banking* and *Drought* × *High Banking* is 0.363 in column 2, 0.362 in column 3, and 0.441 in column 4. Standard errors (in parentheses) are clustered at the district level. A drought is defined as an annual rainfall realization below the 15th percentile of the local rainfall distribution. All regression specifications include district fixed effects.

TABLE AVIII

HETEROGENEITY IN THE EFFECT OF DROUGHT ON CHILD MARRIAGE BY SEX RATIO IN INDIA[a]

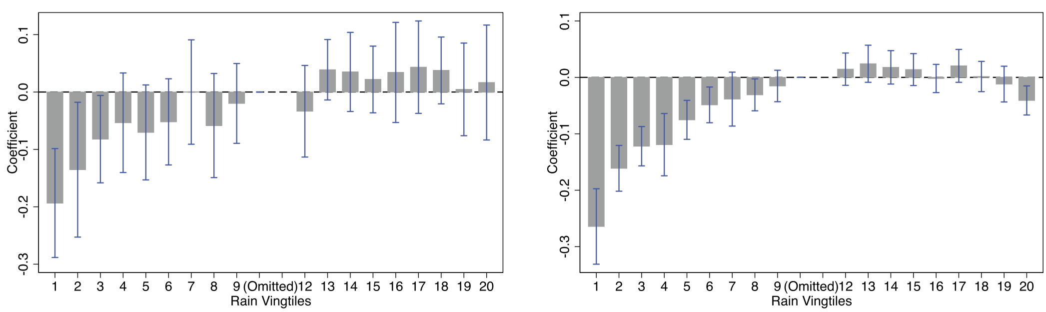
	(1) State	(2) District	(3) State	(4) District
Drought	−0.0048	−0.0054	−0.0033	−0.0045
	(0.0026)	(0.0022)	(0.0024)	(0.0025)
Drought × (sex ratio − 100)	−0.000037	−0.00010		
	(0.00029)	(0.00016)		
Sex ratio - 100	−0.0027	−0.0010		
	(0.0011)	(0.00051)		
Drought × (<85F/100M)			−0.015	0.0047
			(0.0042)	(0.0044)
			{0.000}	{0.969}
Drought × (85-95F/100M)			−0.00061	−0.0013
			(0.0033)	(0.0035)
			{0.079}	{0.020}
Birth Year FE	Yes	Yes	Yes	Yes
Age FE	Yes	Yes	Yes	Yes
Interacted birth year FE	No	No	Yes	Yes
Interacted age FE	No	No	Yes	Yes
N	329,586	329,586	329,586	329,586
Adjusted R^2	0.082	0.082	0.083	0.082

[a] Table shows OLS regressions for the India full regression samples: women aged 25 or older at the time of interview. The number in braces is the p-value of the total additive effect of drought within the corresponding group. Observations are at the level of person × age (from 12 to 17 or age of first marriage, whichever is earlier). The dependent variable is a binary variable for marriage, coded to 1 if the woman married at the age corresponding to the observation. The state-level and district-level sex ratios are taken from the Indian census data between 1961 and 2001 and linearly interpolated/extrapolated for years not in the census. In columns 3 and 4, birth year and age FE are interacted with dummy variables for each sex ratio category. Standard errors (in parentheses) are clustered at the district level. A drought is defined as an annual rainfall realization below the 15th percentile of the local rainfall distribution. All regression specifications include district fixed effects.

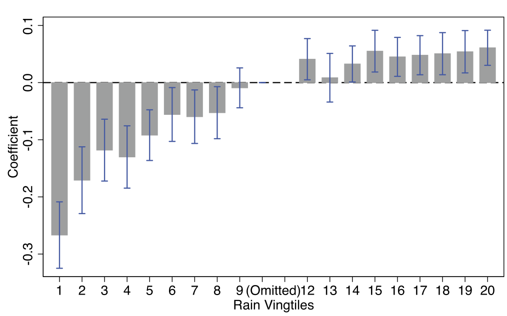


(a) SSA (b) India

FIGURE A1.—Prevalence of drought in Sub-Saharan Africa and India by Year. *Note*: Figure shows the prevalence of drought in Sub-Saharan Africa and India, presented as the percentage of grid cells (SSA) or districts (India) with drought in each calendar year. For all the analyses in this paper, for any grid cell or district, we define a drought as having rainfall lower than the 15th percentile of the long-run rainfall distribution. The black dashed line shows the mean of drought in each sub-figure from 1950 to 2010.

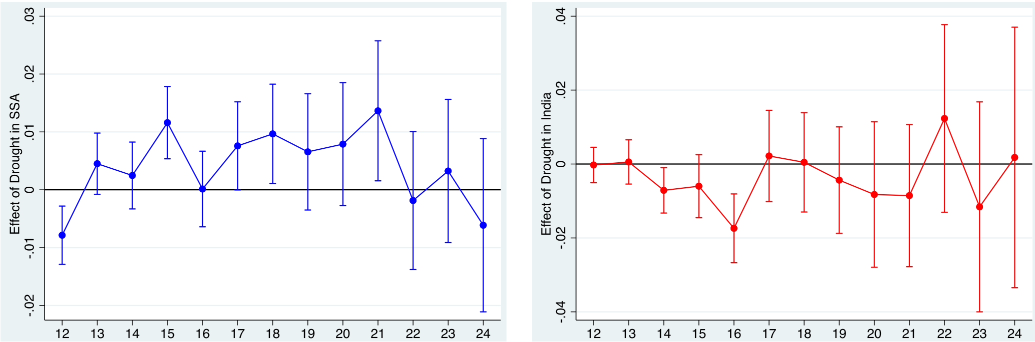


(a) SSA: Average for Main Crops (b) India: Average for Main Crops



(c) India: Rice

FIGURE A2.—Crop yields and rainfall vingtiles in Sub-Saharan Africa and India. *Note*: Part (a) plots the coefficients of rainfall vingtiles in regressions with log of annual crop yield (tons per hectare) from 1961 to 2010 as the dependent variable in SSA. Part (b) plots the coefficients of rainfall vingtiles in regressions with log of annual crop yield (tons per hectare) for Indian districts from 1957 to 1987 as the dependent variable. All regression specifications include year and country or district fixed effects. The capped vertical bars show 95% confidence intervals calculated using robust standard errors clustered at the country level.



(a) SSA (b) India

FIGURE A3.—Effect of droughts on the timing of marriage by age in Sub-Saharan Africa and India. *Note*: Figure shows the effect of droughts by age estimated using the full Sub-Saharan Africa (SSA) and India regression samples. The connected points show the estimated coefficients and the capped spikes show 95% confidence intervals calculated using standard errors clustered at the grid cell (SSA) or district (India) level.

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