Escaping Malthus:
Economic Growth and Fertility Change in the Developing World

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Online Appendix (Not For Publication)

Theory Appendix

In the theoretical framework of Section 5, each household first chooses e to maximize:

$$U = E_0 \sum_{t=1}^{T} \beta^{t-1} \left\{ u_c\left(c_t\right) + u_n\left(n_t\right) + u_h\left(h_t\right) \right\}$$

and then chooses $\{c_t, b_t, A_{t+1}\}_{t=1}^{T}$ to maximize:

$$U = \sum_{t=1}^{T} E_t \beta^{t-1} \left\{ u_c\left(c_t\right) + u_n\left(n_t\right) + u_h\left(h_t\right) \right\}$$

subject to:

$$\begin{aligned}
n_t &= n_{t-1} + b_t \\
n_0 &= 0 \\
b_t &\in [0,1] \\
c_t &= w_t \left(1 - \tau \sum_{k=0}^{K} b_{t-k} \right) - \kappa \sum_{k=0}^{K} b_{t-k} - e \sum_{k=0}^{K} b_{t-k} + \left((1+r) A_t - A_{t+1} \right) \\
h_t &= \mathbf{1}[n_t > 0] h\left(e\right) \\
A_0 &\quad \text{given} \\
A_{T+1} &= 0 \\
A_{t+1} &\geq 0
\end{aligned}$$

The current value formulation of the Lagrangian is:

$$\mathcal{L} \equiv \sum_{t=1}^{T} \beta^{t-1} E_t \left\{ \begin{array}{l} u_c\left(c_t\right) + u_n\left(n_t\right) + u_h\left(h_t\right) + \lambda_t A_{t+1} + \left(\mu_t^0 - \mu_t^1\right) b_t + \\ \nu_t \left[w_t \left(1 - \tau \sum_{k=0}^{K} b_{t-k} \right) - \kappa \sum_{k=0}^{K} b_{t-k} - e \sum_{k=0}^{K} b_{t-k} + \left((1+r) A_t - A_{t+1} \right) - c_t \right] \end{array} \right\}$$

where ν_t is the Lagrange multiplier on the period budget constraint, λ_t is the Lagrange multiplier on the borrowing constraint, and μ_t^0 and μ_t^1 are the Lagrange multipliers on births being between 0 and 1, respectively.

The first order conditions for consumption (in periods 1 to T) and births (in periods 1 to M) are:

$$u_c'\left(c_t\right) = \nu_t$$

$$-\nu_t + \lambda_t + \beta \left[(1+r) E_t \nu_{t+1} \right] = 0$$

$$\sum_{s=t}^{T} \beta^{s-t} E_t u_n'\left(n_s\right) \frac{\partial n_s}{\partial b_t} - \sum_{s=t}^{t+K} \beta^{s-t} E_t \nu_s \left\{ \tau w_s + \kappa + e \right\} + \mu_t^0 - \mu_t^1 = 0$$

which imply equation (7):

$$u'_c(c_t, n_t, h) = \beta(1+r) E_t\left[u'_c(c_{t+1}, n_{t+1}, h)\right] + \lambda_t$$

and equation (8):

$$u'_c(c_t) = \frac{u'_n(n_{t-1}+b_t) + \sum_{s=t+1}^{T} \beta^{s-t} E_t\left\{u'_n(n_s)\frac{\partial n_s}{\partial b_t} - \mathbf{1}_{\{s-t\leq K\}}\nu_s(\tau w_s + \kappa + e)\right\} + \mu_t^0 - \mu_t^1}{\tau w_t + \kappa + e}$$

The first order condition for education (in period 0) is:

$$\sum_{t=1}^{T} \beta^{t-1} E_0\left\{u'_h(h(e;g))\, h_e(e;g)\right\} = E_0\left\{\sum_{t=1}^{M+K}\sum_{k=0}^{K} \beta^{t-1}\nu_t b_{t-k}\right\}$$

The left-hand side has no uncertainty, so we can remove the expectations sign and, noting that $\sum_{t=1}^{T}\beta^{t-1} = \sum_{t=0}^{T-1}\beta^t = \frac{1-\beta^T}{1-\beta}$, rewrite as equation (9):

$$u'_h(h(e;g))\, h_e(e;g)\left(\frac{1-\beta^T}{1-\beta}\right) = E_0\left\{\sum_{t=1}^{M+K}\sum_{k=0}^{K} \beta^{t-1}\nu_t b_{t-k}\right\}$$

Data Appendix

Table A1: Number of WFS/DHS Surveys per Country

Albania	1	Ghana	7	Pakistan	4
Armenia	3	Guatemala	2	Panama	1
Azerbaijan	1	Guinea	3	Paraguay	2
Bangladesh	8	Honduras	2	Peru	9
Benin	5	India	3	Philippines	5
Bolivia	5	Indonesia	8	Rwanda	5
Brazil	2	Jamaica	1	Sao Tome and Principe	1
Burkina Faso	4	Jordan	5	Senegal	8
Burundi	2	Kazakhstan	2	Sierra Leone	1
Cambodia	4	Kenya	7	South Africa	1
Cameroon	5	Korea, Rep.	1	Sri Lanka	1
Central African Republic	1	Kyrgyz Republic	2	Swaziland	1
Chad	2	Lesotho	4	Syria	1
Colombia	7	Liberia	3	Tajikistan	1
Comoros	2	Madagascar	4	Tanzania	5
Congo, Dem. Rep.	2	Malawi	4	Thailand	1
Congo, Rep.	2	Maldives	1	Togo	3
Costa Rica	1	Mali	3	Trinidad and Tobago	2
Cote d'Ivoire	4	Mauritania	1	Tunisia	2
Dominican Republic	8	Mexico	2	Turkey	4
Ecuador	2	Moldova	1	Uganda	5
Egypt	8	Morocco	4	Ukraine	1
El Salvador	1	Mozambique	3	Uzbekistan	1
Ethiopia	3	Namibia	4	Venezuela	1
Fiji	1	Nepal	5	Vietnam	1
Gabon	2	Niger	4	Zambia	5
Gambia	1	Nigeria	5	Zimbabwe	5

Table A2: Country Composition of the Analysis Samples

Country	Period		Cohort	Country	Period		Cohort
	Full sample	Analysis sample			Full sample	Analysis sample	
Albania	✓	✓	✓	Madagascar	✓	✓	✓
Armenia	✓			Malawi	✓	✓	✓
Azerbaijan	✓			Maldives	✓		✓
Bangladesh	✓	✓	✓	Mali	✓	✓	✓
Benin	✓	✓	✓	Mauritania	✓		
Bolivia	✓	✓	✓	Mexico	✓	✓	✓
Brazil	✓	✓	✓	Moldova	✓		
Burkina Faso	✓	✓	✓	Morocco	✓	✓	✓
Burundi	✓	✓	✓	Mozambique	✓	✓	✓
Cambodia	✓	✓	✓	Namibia	✓	✓	✓
Cameroon	✓	✓	✓	Nepal	✓	✓	✓
Central African Rep..	✓	✓	✓	Niger	✓	✓	✓
Chad	✓	✓	✓	Nigeria	✓	✓	✓
Colombia	✓	✓	✓	Pakistan	✓	✓	✓
Comoros	✓	✓	✓	Panama	✓	✓	
Congo, Dem. Rep.	✓	✓	✓	Paraguay	✓	✓	✓
Congo, Rep.	✓	✓	✓	Peru	✓	✓	✓
Costa Rica	✓	✓		Philippines	✓	✓	✓
Cote d'Ivoire	✓	✓		Rwanda	✓	✓	✓
Dominican Republic	✓	✓	✓	Sao Tome and Principe	✓	✓	✓
Ecuador	✓	✓	✓	Senegal	✓	✓	✓
Egypt	✓	✓	✓	Sierra Leone	✓	✓	✓
El Salvador			✓	South Africa	✓	✓	✓
Ethiopia	✓	✓	✓	Sri Lanka			✓
Fiji	✓			Swaziland	✓	✓	✓
Gabon	✓	✓	✓	Syria	✓		
Gambia	✓	✓		Tajikistan	✓	✓	
Ghana	✓	✓	✓	Tanzania	✓	✓	✓
Guatemala	✓	✓	✓	Thailand			✓
Guinea	✓	✓	✓	Togo	✓	✓	✓
Honduras	✓	✓	✓	Trinidad and Tobago	✓	✓	✓
India	✓	✓	✓	Tunisia	✓	✓	
Indonesia	✓	✓	✓	Turkey	✓	✓	✓
Jamaica	✓	✓		Uganda	✓	✓	✓
Jordan			✓	Ukraine	✓		
Kazakhstan	✓			Uzbekistan	✓		
Kenya	✓	✓	✓	Venezuela	✓	✓	
Korea, Rep.	✓			Vietnam			✓
Kyrgyz Republic	✓	✓		Zambia	✓	✓	✓
Lesotho	✓	✓	✓	Zimbabwe	✓	✓	✓
Liberia	✓	✓	✓				

Table A3: Economic Growth and Conception Rates in the Short- and Long-Run

	Mean of conception rate per 1000 in...		Short run regressions		Long run regressions	
	Levels	Changes	Basic	Extended	Basic	Extended
	(1)	(2)	(3)	(4)	(5)	(6)
Ages 15-19	164	-1.5	0.10	0.12	-0.09	-0.03
			[0.07]	[0.07]	[0.09]	[0.08]
Ages 20-24	261	-2.3	0.30	0.33	-0.27	-0.25
			[0.09]	[0.09]	[0.13]	[0.13]
Ages 25-29	253	-2.8	0.56	0.59	-0.43	-0.46
			[0.14]	[0.14]	[0.11]	[0.11]
Ages 30-34	209	-2.8	0.33	0.34	-0.43	-0.48
			[0.16]	[0.16]	[0.14]	[0.12]
Ages 35-39	144	-2.5	0.22	0.21	-0.15	-0.11
			[0.19]	[0.19]	[0.14]	[0.09]
Ages 40-44	65	-1.4	0.23	0.22	0.14	0.16
			[0.19]	[0.20]	[0.05]	[0.05]
TCR	5483	-67	8.77	9.07	-6.15	-5.82
			[2.50]	[2.59]	[2.23]	[1.81]
# cells	58,992	1,595	56,926	56,926	1,595	1,595

Notes: Point estimates and standard errors associated with Figures 2-4. Columns (3)-(4) regress the annual change in the age-specific conception rate on the annual change in 100 $\times$ log GDP per adult, controlling for country, year, and single-year age effects; columns (5)-(6) regress the average annual rate of change in the age-specific conception rate on average annual rate of economic growth, controlling for single-year age effects. "Extended" models also control for the initial level of GDP per adult (PPP) and population density; and the change or trend in female education, urbanization, infant mortality, and conflict. Column (4) also an indicator for missing mortality information (3% of all cells). "Conception rate" only includes conceptions that resulted in live birth; "TCR" refers to the total conception rate per 1000; estimates equal 5 times the sum of age-group-specific estimates. Brackets contain standard errors clustered by country.

Table A4: Cyclicality in the Composition of Births

		Average characteristics of...				
		Mothers				Children
	Concep. rate	Age	Education	% urban	% ever mar.	% male
	(1)	(2)	(3)	(4)	(5)	(6)
Δ log GDPpa	0.24	-0.0001	-0.0022	-0.013	-0.009	0.012
× 100	[0.07]	[0.001]	[0.0009]	[0.013]	[0.014]	[0.016]
Outcome mean	201	23	3.5	35	92	51
Outcome SD	(52)	(3)	(2.5)	(19)	(10)	(3)
# cells	2,831	2,831	2,831	2,831	2,831	2,831

Notes: Regressions of annual changes in average characteristics on annual changes in 100 × log GDP per adult, controlling for country and year fixed effects, as well as changes in age composition, average years of education, percent urban, and percent married among all women in each cell. "Conception rate" only includes conceptions that resulted in live birth. Brackets contain standard errors clustered by country.

Table A5: Can Marriage Explain the Procyclicality of Conceptions?

	Conception rate			Marriage	
	Overall	Pre-marital	Post-marital	Rate	Hazard
	(1)	(2)	(3)	(4)	(5)
Δ log GDPpa	0.23	0.14	0.33	-0.05	-0.13
× 100	[0.07]	[0.09]	[0.16]	[0.06]	(0.12)
Outcome level mean	201	97	270	52	195
Outcome level SD	(52)	(36)	(78)	(23)	(73)
Number of cells	2831	2830	2831	2831	2830

Notes: Regressions of the changes in outcomes on annual changes in 100 × log GDP per adult, controlling for country and year fixed effects, as well as changes in the age composition of each cell. All rates are per 1000. Columns (2) and (5) have smaller sample sizes because 1 cell has no never-married women. Brackets contain standard errors clustered by country.

Table A6: Aggregate Heterogeneity in the Procyclicality of Conceptions

	Lagged GDPpa, PPP	Lagged contraceptive prevalence	Female labor force share in 1990	Lagged average years of education	Lagged share urban at survey
	(1)	(2)	(3)	(4)	(5)
Coefficient below	8.46	8.58	9.95	8.83	8.80
variable's median	[3.19]	[3.32]	[3.62]	[3.42]	[3.37]
Coefficient above	9.68	10.22	8.33	9.24	7.86
variable's median	[2.65]	[3.24]	[3.15]	[1.94]	[1.78]
p-value for difference	0.741	0.725	0.725	0.911	0.779
Number of cells	56,926	48,092	56,926	56,926	56,926

Notes: Total conception rate coefficients based on regressions of annual changes in the age-specific conception rate on annual changes in 100 $\times$ log GDP per adult, controlling for country, year, and age fixed effects. Coefficients are estimated by 5-year age group and then summed and multiplied by 5 to obtain TCR coefficient. Brackets contain standard errors clustered by country. Sample sizes vary because data on some of the aggregate variables are not available for the full sample. "GDPpa" is GDP per adult, from the Penn World Table; contraceptive prevalence is the estimated share of women of childbearing age using modern contraceptives, from the UN; female labor force share is the percent of the labor force aged 15-64 that is female, from the WDI; average years of education and share urban are estimates from WFS/DHS survey data.

Table A7: Regional Heterogeneity in Procyclicality

		p-values: coefficients equal within pair		
		Africa	C/W Asia	S/SE Asia
	(1)	(2)	(3)	(4)
Africa	9.43			
	[2.96]			
Central/Western Asia	4.53	0.01		
	[2.96]			
South/Southeast Asia	-2.46	0.18	0.44	
	[8.43]			
Latin America/Caribbean	10.81	0.69	0.09	0.12
	[2.33]			
p-value: all coefficients equal	0.15			
Number of cells	56,926			

Notes: Total conception rate coefficients based on full-sample regressions of annual changes in the age-specific conception rate on annual changes in 100 $\times$ log GDP per adult interacted with region indicators, controlling for country, year, and age fixed effects. An additional (unreported) interaction term is included for the group of five countries (Albania, Fiji, Korea, Moldova, Ukraine) that did not fit into these regional classifications. We do not interact the year and age effects with region indicators to conserve statistical power. Analyses are run by 5-year age group; age group associations are summed and multiplied by 5 to obtain TCR association. Brackets contain standard errors clustered by country.

Table A8: Comparison of Procyclicality Results with Other Datasets

	Country-years in the WFS/DHS Mean 2005 GDPpa, PPP = 5,239 Mean GDPpa growth = 0.91			Country-years in the HFD Mean 2005 GDPpa, PPP = 46,993 Mean GDPpa growth = 2.41		
	WFS/DHS		WDI	HFD		WDI
	Mean rate	Regression	Regression	Mean rate	Regression	Regression
	(1)	(2)	(3)	(4)	(5)	(6)
Ages 15-19	138	0.163		28	0.173	
		[0.078]			[0.062]	
Ages 20-24	258	0.145		103	0.397	
		[0.097]			[0.135]	
Ages 25-29	261	0.475		126	0.179	
		[0.108]			[0.086]	
Ages 30-34	224	0.340		83	0.189	
		[0.107]			[0.066]	
Ages 35-39	161	0.358		35	0.141	
		[0.151]			[0.029]	
Ages 40-44	80	0.155		8	0.030	
		[0.277]			[0.008]	
Total fertility rate per 1000	5601	8.19	0.21	1920	5.55	6.44
		[2.63]	[0.24]		[1.14]	[1.31]
Num. of cells	57,126	55,479	2,460	23,310	23,130	760

Notes: "WFS" = World Fertility Survey; "DHS" = Demographic and Health Survey; "HFD" = Human Fertility Database; "WDI" = World Development Indicators. Coefficients from regressions of annual changes in the age-specific fertility rate on the weighted average of current and lagged annual changes in 100 $\times$ log GDP per adult, with weight 0.25 on the current change and weight 0.75 on the lagged change. In the WFS/DHS and HDI, unit of observation is a country-year-age cell, and the dependent variable is the age-specific birth rate; analyses are run by 5-year age group and include country, year, and age fixed effects. Total fertility rate estimates equal 5 times the sum of age-group-specific estimates. In the WDI, unit of observation is a country-year cell, and the dependent variable is the total fertility rate; analyses are adjusted for country and year indicators. Brackets contain standard errors clustered by country. Sample includes all WFS/DHS and HFD cells that can be matched with macroeconomic data from the Penn World Table and total fertility rate data from the WDI, excluding cells with $<$ 30 obs and from country-age combinations spanning $<$ 20 yrs. WFS/DHS countries are listed in Table A1; HFD countries include Austria, Belarus, Bulgaria, Canada, Czech Republic, Estonia, Finland, France, Germany, Hungary, Iceland, Japan, Lithuania, Netherlands, Norway, Portugal, Russia, Slovakia, Slovenia, Sweden, Switzerland, Ukraine, United Kingdom, and the United States. We omit Japanese data for 1966, when birth rates dropped 25% due to superstition surrounding the year of the fire horse.

Table A9: Alternative Long-Run Covariates

	Secondary school gross enrollment rate		Sectoral composition of value added		Female lab. force participation		POLITY IV score	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ages 15-19	-0.06	-0.02	-0.06	-0.05	-0.11	-0.11	-0.14	-0.09
	[0.10]	[0.11]	[0.08]	[0.10]	[0.10]	[0.09]	[0.07]	[0.07]
Ages 20-24	-0.43	-0.36	-0.33	-0.37	-0.27	-0.27	-0.38	-0.38
	[0.16]	[0.17]	[0.13]	[0.17]	[0.14]	[0.15]	[0.11]	[0.11]
Ages 25-29	-0.42	-0.33	-0.46	-0.52	-0.42	-0.44	-0.48	-0.49
	[0.14]	[0.17]	[0.12]	[0.13]	[0.15]	[0.15]	[0.11]	[0.13]
Ages 30-34	-0.29	-0.12	-0.35	-0.42	-0.42	-0.45	-0.42	-0.41
	[0.14]	[0.15]	[0.15]	[0.20]	[0.17]	[0.17]	[0.14]	[0.16]
Ages 35-39	-0.08	0.06	-0.08	-0.05	-0.39	-0.41	-0.12	-0.08
	[0.15]	[0.16]	[0.15]	[0.19]	[0.16]	[0.16]	[0.13]	[0.13]
Ages 40-44	0.20	0.28	0.14	0.17	0.07	0.05	0.14	0.14
	[0.07]	[0.07]	[0.06]	[0.08]	[0.08]	[0.09]	[0.05]	[0.05]
TCR	-5.35	-2.42	-5.69	-6.16	-7.74	-8.12	-7.00	-6.57
	[2.92]	[3.09]	[2.50]	[3.16]	[3.00]	[2.96]	[2.16]	[2.30]
Covariate?		✓		✓		✓		✓
# cells	1,297	1,297	1,424	1,424	1,261	1,261	1,532	1,532

Notes: Regressions of the average annual rate of change in the age-specific conception rate on the average annual rate of economic growth. Each pair of columns restricts to the subsample with non-missing information on the average annual rate of change in the specified covariate. The even-numbered columns report models that include an age-specific coefficient on the average annual rate of change in the covariate. "TCR" refers to the total conception rate per 1000; estimates equal 5 times the sum of age-group-specific estimates. Brackets contain standard errors clustered by country.

Table A10: Comparison of Long-Run Results with Other Datasets

	Country-ages in the WFS/DHS		Country-ages in the HFD	
	WFS/DHS	UN	HFD	UN
	(1)	(2)	(3)	(4)
Ages 15-19	-0.116	-0.008	0.191	0.36
	[0.069]	[0.090]	[0.160]	[0.152]
Ages 20-24	-0.286	-0.354	-0.181	0.511
	[0.126]	[0.109]	[0.482]	[0.263]
Ages 25-29	-0.476	-0.562	-0.673	-0.184
	[0.116]	[0.148]	[0.314]	[0.247]
Ages 30-34	-0.423	-0.529	-0.073	-0.329
	[0.132]	[0.158]	[0.177]	[0.234]
Ages 35-39	-0.220	-0.332	-0.030	-0.275
	[0.142]	[0.107]	[0.176]	[0.228]
Ages 40-44	0.152	-0.076	-0.024	-0.130
	[0.069]	[0.066]	[0.083]	[0.121]
Total fertility rate per 1000	-6.84	-9.30	-3.95	-0.23
	[2.27]	[2.52]	[3.58]	[3.35]
Num. of cells	1601	317	510	96

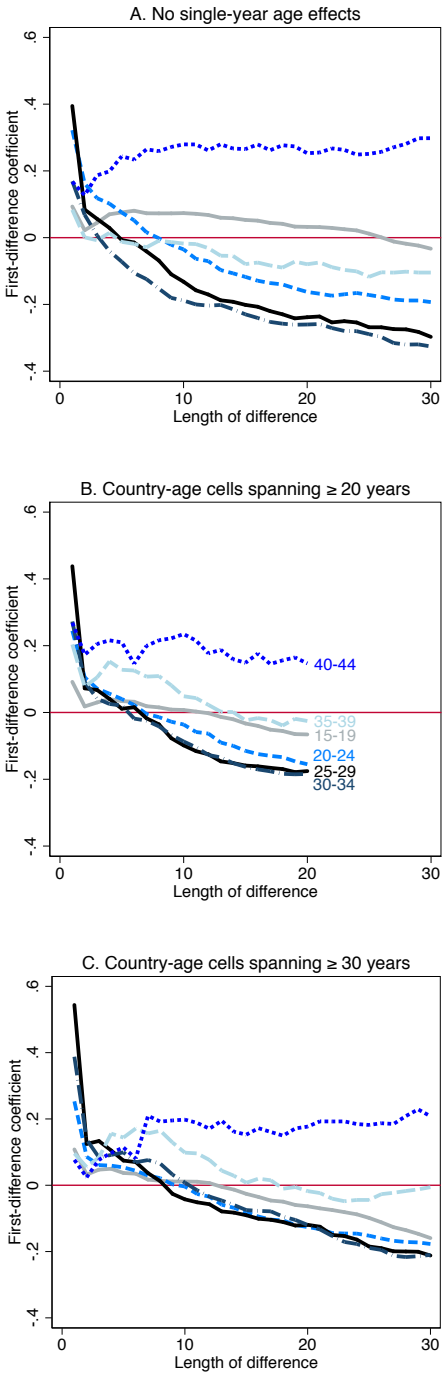
Notes: "WFS" = World Fertility Survey; "DHS" = Demographic and Health Survey; "HFD" = Human Fertility Database; "UN" = United Nations World Population Prospects, 2015 Revision. Coefficients from regressions of the average annual rate of change in the conception rate on the average annual rate of economic growth. The unit of observation is a country-age cell, and the dependent variable is the average annual rate of change in age-specific birth rate. Total fertility rate estimates equal 5 times the sum of age-group-specific estimates. Brackets contain standard errors clustered by country. WFS/DHS countries are listed in Table A1; HFD countries include Austria, Bulgaria, Canada, Finland, France, Germany, Hungary, Iceland, Japan, Netherlands, Norway, Portugal, Sweden, Switzerland, Taiwan, United Kingdom, and the United States. We omit Japanese data for 1966, when birth rates dropped 25% due to superstition surrounding the year of the fire horse.

Table A11: Economic Growth over the Lifecycle and Completed Fertility

	Children Ever Born		Surviving Children	
	(1)	(2)	(3)	(4)
Avg. change in 100 × log GDPpa during ages...				
15-19	-7	-15	-5	-12
	[13]	[10]	[12]	[10]
20-24	-3	-15	2	-8
	[14]	[12]	[14]	[13]
25-29	10	1	7	-1
	[16]	[15]	[16]	[13]
30-34	38	26	29	18
	[14]	[12]	[12]	[11]
35-39	43	35	36	28
	[13]	[12]	[12]	[10]
40-44	25	34	18	26
	[17]	[12]	[15]	[12]
Cohort avg. ed.		-226		-226
		[54]		[54]
Cohort % urban		-4.7		-4.7
		[5.3]		[5.3]
Cohort FE	✓	✓	✓	✓
Country FE	✓	✓	✓	✓
Fertility measure	Ever-born	Ever-born	Surviving	Ever-born
Num. cells	935	935	935	935

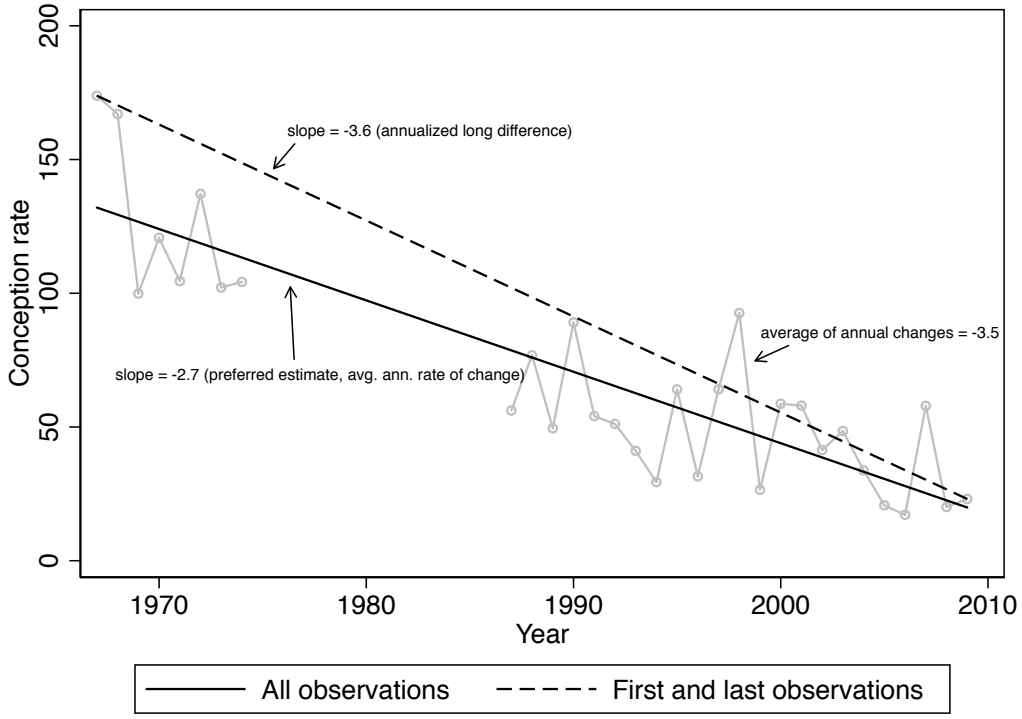
Notes: Sample includes single-age cohorts over age 45 when surveyed. Dependent variable is the number of children per 1000 women. Brackets contain SEs clustered by country.

Figure A1: First-Difference Models with Varying Time Horizons, Constant Samples



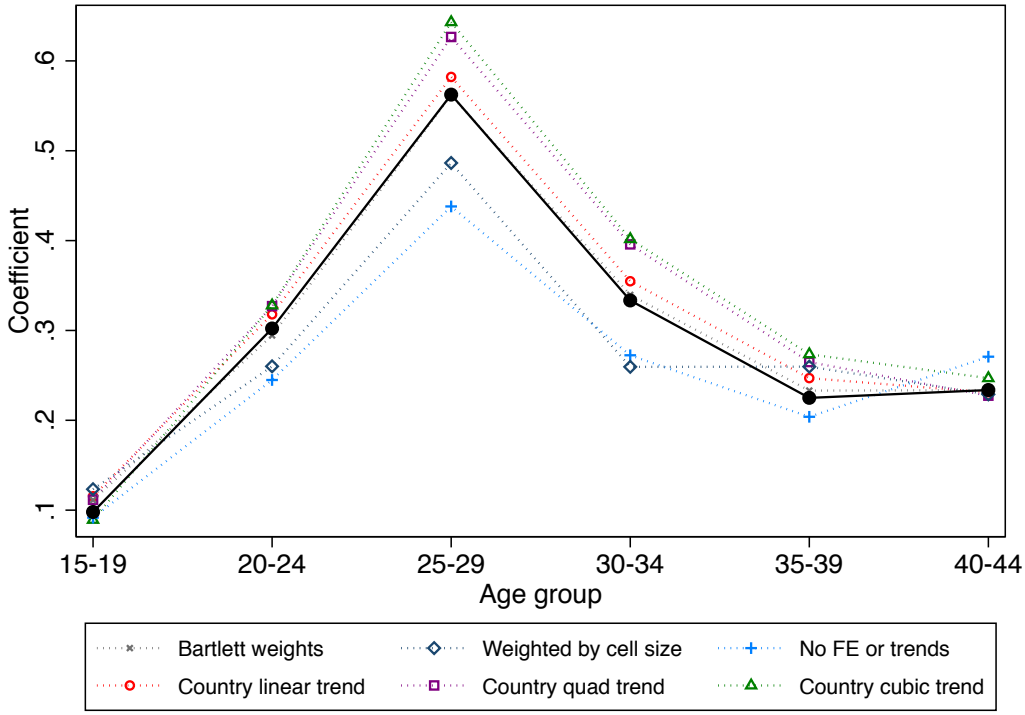
Notes: Reproduces Figure 1 without age effects or using samples that do not change for different time horizons. For each 5-year age group, each panel plots coefficients from regressions of the change in the conception rate from year t – Δ to year t on the change in 100 $\times$ log GDP per adult over the same period, controlling for single-year age indicators.

Figure A2: Estimating the Average Annual Rate of Fertility Change: 40 year olds, Nepal



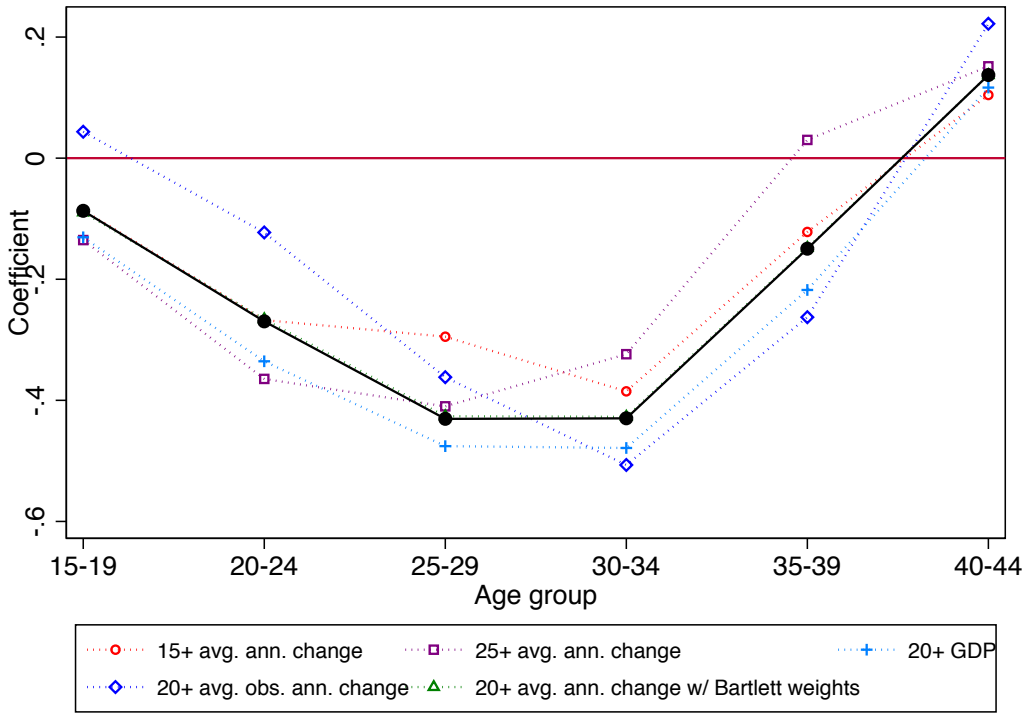
Notes: The figure plots estimated conception rates at age 40 over time in Nepal, with two trend lines, one estimated using all years and one estimated using just the first and last year of the series. We use the slope of the "all observations" trend as our estimate of the average annual rate of change because the other trend line (which is equivalent to the annualized long difference) uses less data, and the average of annual changes ignores trends during the data gap in the late 1970s and early 1980s.

Figure A3: Alternative Short-Run Models



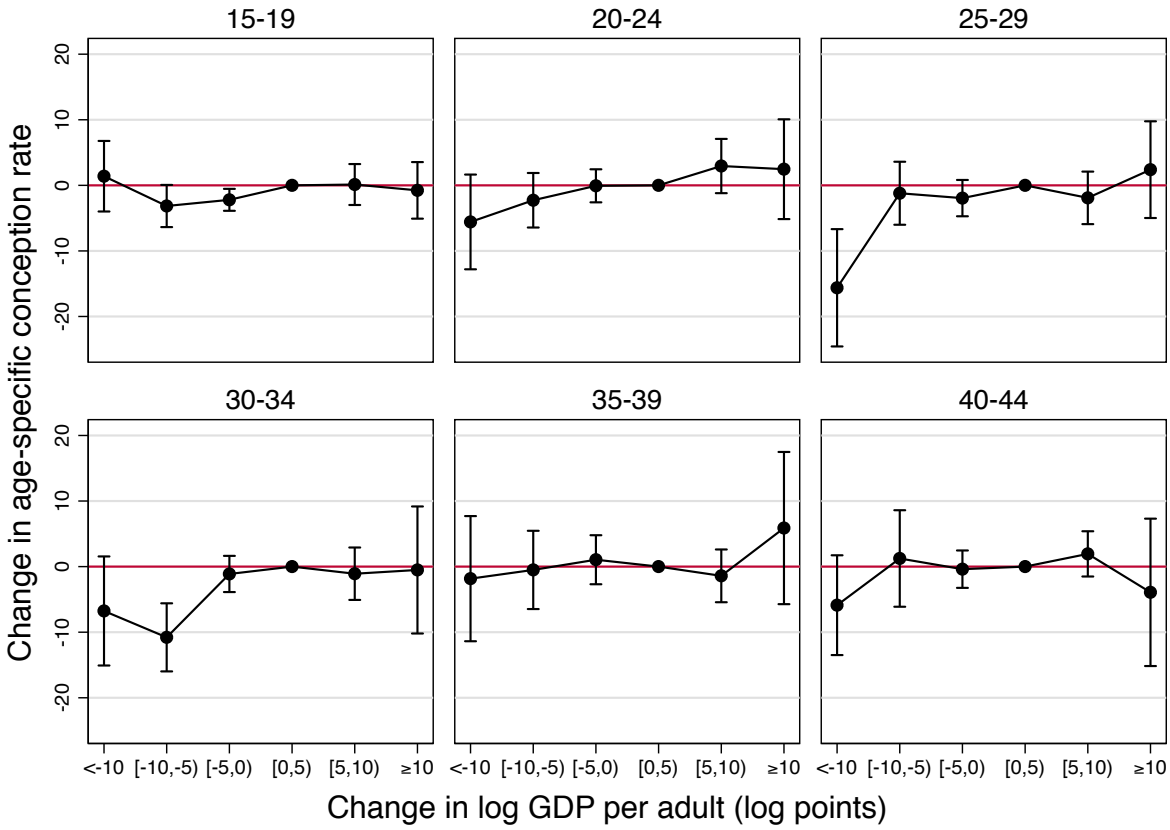
Notes: Age-group-specific coefficients from regressions of the change in the conception rate on the change in log GDP per adult. The thick black plot represents the coefficients from the short-run model reported in Figure 3. "Bartlett" uses a Bartlett kernel to downweight longer recall periods. The remaining models add country-specific polynomials in time to the baseline model.

Figure A4: Alternative Long-Run Models



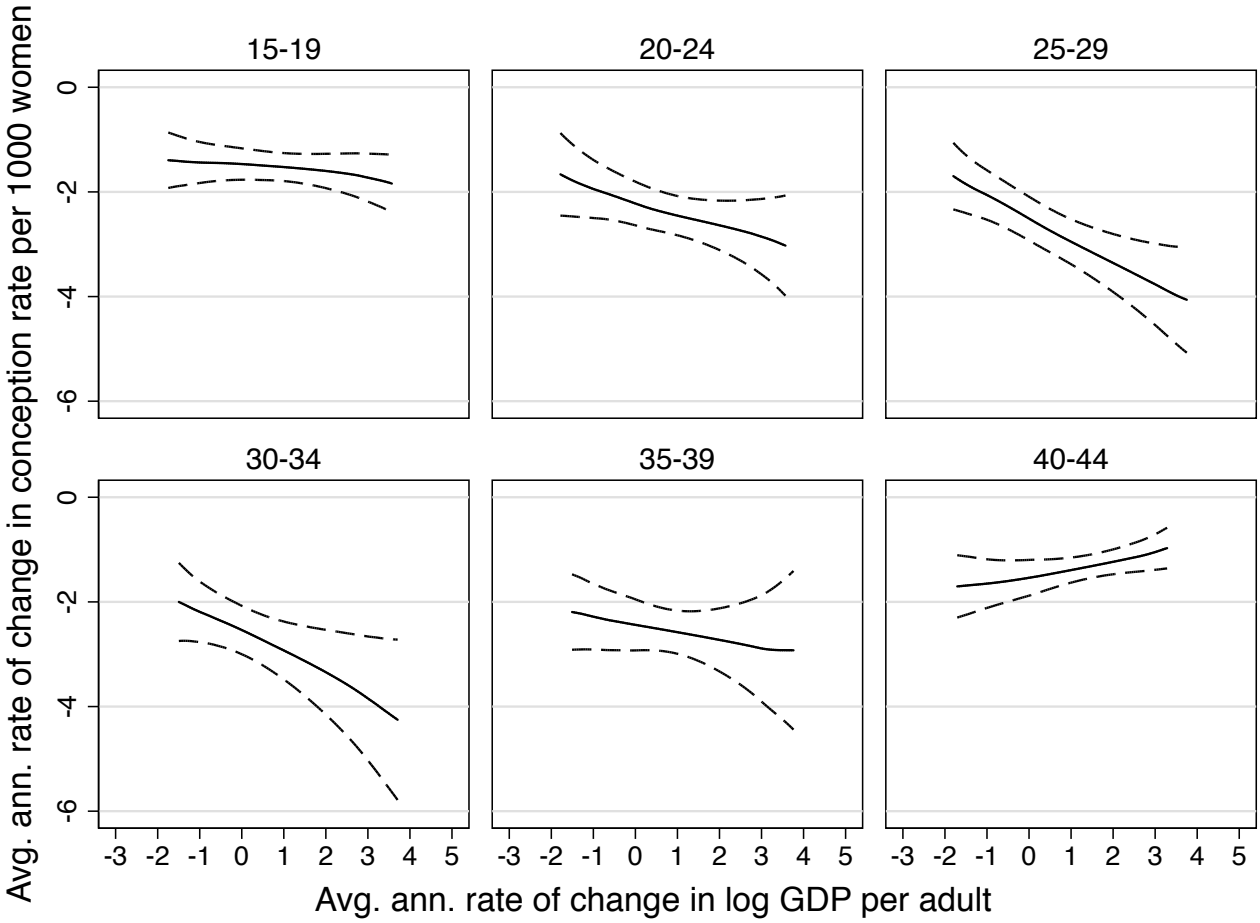
Notes: The figure compares results from different methods of computing the average annual rate of change. The thick black plot represents the coefficients from the long-run model reported in Figure 4. "15+" and "25+" use alternative minimum time horizons (15 and 25 years) to estimate the slope of the annual trend. "20+ avg. obs. ann. change" uses the average of observed annual changes (leaving out gaps in the panel) instead of the slope of the annual trend. "20+ Bartlett weights" downweights observations with longer recall periods, and "20+ GDP" uses GDP instead of GDP per adult.

Figure A5: Non-Linear Estimates by Age Group, Short Run



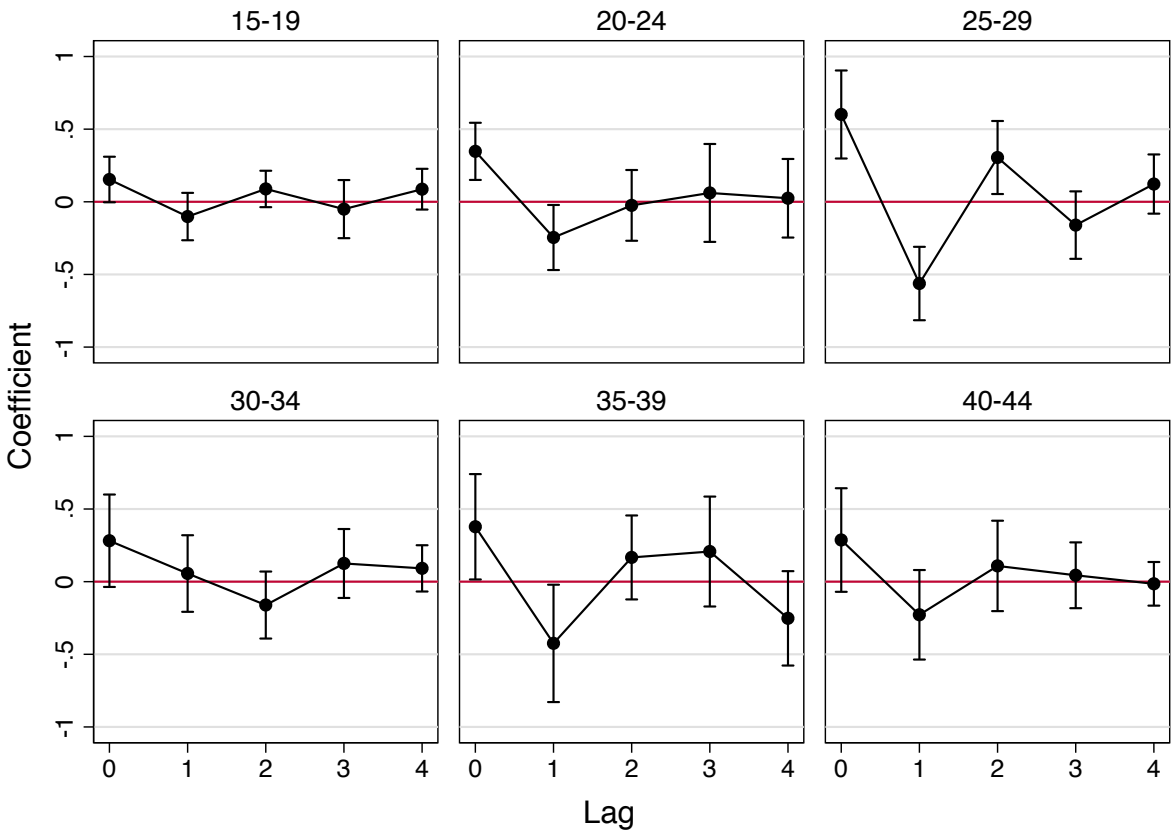
Notes: Semi-parametric results summarized in Figure 5, here shown by age group with 95% confidence intervals. Coefficients from regressions of annual changes in the age-specific conception rate on binned annual economic growth, controlling for country, year, and age fixed effects. Confidence intervals are clustered at the country level.

Figure A6: Non-Linear Estimates by Age Group, Long Run



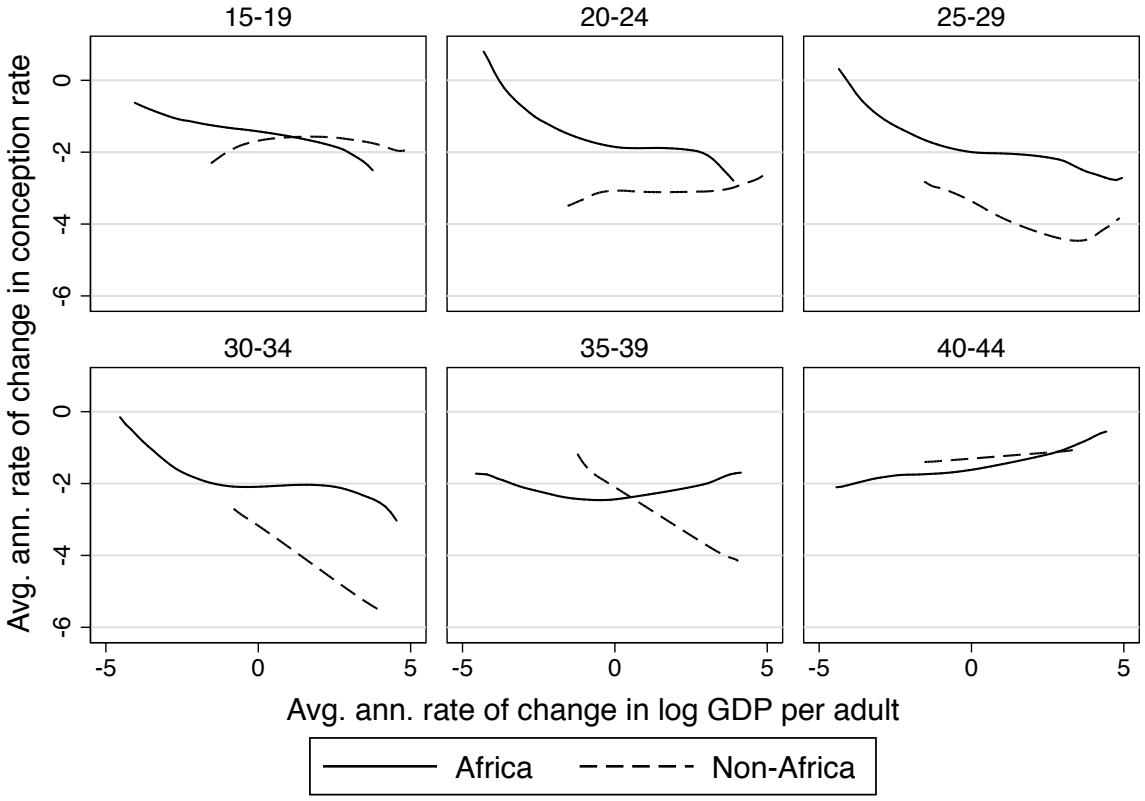
Notes: Non-parametric results summarized in Figure 6, here shown by age group with 95% confidence intervals. Local linear regressions; the dependent variable is the estimated trend in conception rates within a country-age cell, while the independent variable is the estimated trend in log GDP per adult in the same cell. Bandwidth equals 2, and confidence intervals are block bootstrapped at the country level.

Figure A7: Distributed Lag Models by Age Group



Notes: Distributed lag model summarized in Figure 7, here shown by age group with 95% confidence intervals. Coefficients from regressions of annual changes in the age-specific conception rate on current and lagged annual changes in 100 $\times$ log GDP per adult, controlling for country, year, and age fixed effects. Confidence intervals are clustered at the country level. Sample includes observations that have both lagged conception rates and lagged growth rates.

Figure A8: Non-Linear Estimates by Age Group and Region, Long Run



Notes: Replicates Figure A6, splitting the sample into African and non-African countries. Local linear regressions; the dependent variable is the estimated trend in conception rates within a country-age cell, while the independent variable is the estimated trend in log GDP per adult in the same cell. Bandwidth equals 2, and confidence intervals are block bootstrapped at the country level.