Fertility and the Education of African Parents and Children

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Abstract

Sub-Saharan Africa exhibits higher fertility and lower education than other world regions. Economic and demographic theory posit that these phenomena are linked, with slow fertility decline connected to slow education growth among both adults and children. Using microdata from 33 African countries, this paper documents the co-evolution of adult education, fertility, and child education in female birth cohorts surrounding the onset of the region's fertility transition. Fertility change displays a robust negative relationship with the educational outcomes of adult women but a more nuanced relationship with the educational outcomes of children. As fertility declines, children's grade attainment rises, but their school enrollment does not. The divergence is partly explained by a split in how women's education relates to fertility and child education. Rising women's education predicts declining fertility and rising children's grade attainment, but it is less systematically linked to enrollment change.

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1 Introduction

Sub-Saharan Africa is the only UN region with a total fertility rate (TFR) in excess of four children per woman, the result of later and slower fertility decline (UN 2019). Educational progress too has lagged other regions, such that the continent now comes last in educational attainment among prime-age adults (Barro and Lee 2013).[1] I study cohort patterns of fertility and education in Africa to provide new evidence on the extent to which these phenomena are linked.

Both economic and demographic theory propose such links. First, the family may serve as a conduit for educational change. Since Becker and Lewis (1973) and Willis (1973), economists have emphasized how investing in children's education is more expensive in large families, leading to a 'quality-quantity tradeoff.' Social demographers have stressed Caldwell's (1980) related characterization of mass primary education as a prerequisite for fertility decline, due to its effects on childrearing costs, the extent of child labor, dependency norms, the pace of cultural change, and the spread of Western values. The Caldwellian theory primarily concerns effects running from schooling to fertility, whereas the Beckerian theory predicts effects in both directions, but they have common predictions for the co-evolution of fertility and children's schooling. Second, women's education may reduce fertility by changing the opportunity costs of time, women's autonomy, attitudes about the family, and knowledge about contraception (Cochrane 1979; Jejeebhoy 1995; Diamond et al. 1999). The two sets of theories are interconnected because fertility and child education decisions may both vary with maternal education.[2] They suggest that Africa's fertility transition—which Bongaarts (2017) calls "unique" for its late onset and slow pace—shapes its education trajectory, and vice versa. Using data on the early cohorts of Africa's fertility transition, I ask whether populations with faster fertility decline have exhibited faster education growth among both adults and children.

In the triangle linking adult education, fertility, and child education in Africa, the legs involving child education have the least empirical evidence, while that linking adult women's education to fertility has considerably more. In recent data on African countries and on women within them,

[1] For regional time series of TFR and average educational attainment, see Appendix Figures A1 and A2 an the accompanying discussion in Section 2.

[2] Axinn and Barber (2001) integrate all of these theories in their research on mass education and fertility in Nepal. They also emphasize community-level effects, which Kravdal (2002) estimates in the African context.

higher women's education predicts lower fertility (Castro Martin 1995; Bongaarts 2010). Quasi-experimental and experimental studies suggest that this association partly reflects a negative effect of women's education on fertility. Cohort difference-in-differences analyses in Nigeria and Uganda find that policies promoting primary schooling reduced teenage and early adult fertility (Osili and Long 2008; Keats 2018).[3] Experimental evidence from Kenya corroborates these results, with a randomized primary school subsidy reducing both dropout and teenage fertility (Duflo et al. 2015). Similar evidence exists at the secondary level. In Kenya, girls just above a test score cutoff for secondary school admission obtained more schooling and experienced fewer teenage births than those just below (Ozier 2018). In Ghana, random assignment to a secondary school scholarship raised educational attainment and reduced pregnancies through age 28 (Duflo et al. 2021). Relative to these studies, I contribute new continent-wide facts on the relationship between cohort education and cohort fertility.

Evidence on fertility and children's outcomes in Africa is less clear cut. The aggregate panel approach I take here is new to a literature that has focused on cross-sectional variation across countries and families within them. Across African countries, Lloyd et al. (2003) find declining fertility only in countries with extensive primary schooling. Relative to their results, I take advantage of expansions in data availability over the subsequent two decades to study *changes in* (rather than *levels of*) children's schooling. Within African countries, cross-family variation displays positive, negative, and null relationships between sibship size and educational attainment, in large part reflecting contextual variation in differential fertility (Buchmann and Hannum 2001; Eloundou-Enyegue and Williams 2006; Vogl 2016). Furthermore, twin births predict larger family sizes but are unrelated to children's schooling (Alidou and Verpoorten 2019), suggesting the absence of a family size effect. However, the family-level effect of an unexpected child may not be relevant to the population-level forces driving fertility change (Galor 2012), and the null result may reflect confounding (Bhalotra and Clarke 2019). The analysis here does not speak to specific causal pathways, instead capturing how fertility and children's education comove in aggregate.

[3] Cohort declines in ideal family size in Malawi, Uganda, and Ethiopia also coincided with exposure to universal primary education (Behrman 2015).

The connection between parental education and child education forms the final leg of the triangle. Although it does not directly involve fertility, it relates to fertility change because parents choose fertility and educational investment in a joint process. In Africa as elsewhere, children of more educated parents obtain more schooling themselves (Beegle et al. 2016; Alesina et al. 2021). Evidence suggests that this intergenerational persistence in part reflects an effect of parental education on child education. In Rwanda after the genocide, orphans with more educated adoptive parents obtained more schooling (de Walque 2009). In Zimbabwe, parents from cohorts exposed to reforms promoting secondary school had more educated children (Agüero and Ramachandran 2020). The analysis here also tracks parent and child education across parental cohorts, with more geographic breadth but less focus on policy-induced variation.

A cohort orientation is key to understanding how fertility decline relates to education growth in the parents' and children's generations. Indeed, Kebede et al. (2019) rely on a cohort orientation to illuminate how slow growth in women's education has "stalled" fertility decline in several African countries.[4] But the advantages of a cohort orientation go further, especially when a researcher seeks to jointly study the outcomes of parents and children. In period data, the children represented in the child schooling aggregate may have parents outside the age range of the fertility aggregate, and the fertility aggregate may weight the parents' generation differently from the adult schooling aggregate. In contrast, averages of fertility as well as women's, husbands', and children's education by women's birth cohort characterize the resources and decisions of a coherent group of families.

To highlight this point, the paper begins by analyzing standard cross-country data, which have a period orientation. Cross-sectional analyses of these data may be meaningful, but panel analyses are less so. Furthermore, the most broadly available aggregate data on children's schooling are gross enrollment rates, which have well-known deficiencies. As Lloyd et al. (2003) point out, enrollment is a crude proxy for attainment and learning, and gross rates—which divide the number of enrolled children by the number or school-age children—are biased by delayed school starting and grade repetition, since students enrolled outside the schooling level appropriate for their age are counted

[4]Although Kebede et al.'s (2019) conceptual contribution concerns cohorts, they rely on cross-sectional estimates of the education-fertility association.

in the numerator but not the denominator.

To improve on cross-country period data, I assemble 112 Demographic and Health Surveys in 33 African countries, with data on the educational attainment of women and their spouses, their number of children, and the school enrollment and grade attainment of their children. The units of analysis are groups of women interviewed in the same survey, born in the same year, and living in the same place.[5] I define *place* as either a country or a subnational region, so that survey respondents are aggregated into either survey-cohort cells or region-survey-cohort cells.[6] For expositional simplicity, I refer to the survey-cohort cells as *national cohorts* and the region-survey-cohort cells as *regional cohorts*. In the analyses of national cohorts, I include country fixed effects and birth year fixed effects, so that the estimated relationships reflect variation across cohorts within countries, controlling for continent-wide cohort trends. In the analyses of regional cohorts, I include region fixed effects and survey-by-birth year fixed effects, so that the estimated relationships reflect variation across cohorts within regions, controlling for survey-specific (and therefore also country-specific) cohort trends. Each aggregation has benefits and drawbacks for interpretation. Concerns about selective internal migration suggest using country borders, while concerns about time-varying, country-level confounders suggest using region borders.

These analyses find that women's and children's education have grown more in places with faster fertility decline, but the relationships are more nuanced in panel variation than in cross-sectional or cohort time-series variation. On the one hand, rising women's education robustly predicts declining fertility. Between successive national or regional cohorts, a one-year increase in women's average grades completed is associated with a decline in fertility of 0.15-0.21, whether one measures fertility with children ever born, surviving children, or ideal family size. On the other hand, panel results involving children's schooling are more intricate. Fertility decline is associated with rising children's grade-for-age but is unrelated to changes in enrollment. A partial explanation for the discordant attainment and enrollment results is that women's education is far more predictive of children's grade attainment than enrollment. Husbands' education predicts both attainment and enrollment but

[5] DHS data lack detailed information on place of birth.

[6] Since surveys are fielded within national borders, aggregations by survey are aggregated by country too.

is less systematically linked with fertility.

Two points may help explain the discordant enrollment and attainment results more deeply. First, enrollment and attainment have diverged on the continent, with unprecedented shares of children in school but low progression and completion rates (Lewin 2009). Enrollment gains may primarily reflect expansions in school access, while attainment may more closely proxy for the intensity of human capital investment (as in Becker) or socialization (as in Caldwell). Indeed, as governments have expanded access, school resources have not kept up with the size of the student population (Bold et al. 2017). Second, as children face less competition from other children in their own families, they may face more competition from children in other families. Due to population momentum, cohort size peaks decades after average family size (Lam and Marteleto 2008). Even as their families shrink, children's access to public resources may decline due to a rising number of children in the population. Enrollment may be more sensitive to public resources per child, while attainment may be more sentitive to family resources per child. The paper does not seek to disentangle these pathways but instead to contribute new facts on changing cohort fertility and its relation to educational progress in two generations.

2 Cross-Country Facts and Their Limitations

To motivate the survey analysis, this section uses standard cross-country datasets to document how women's education, fertility, and children's school enrollment relate, inside and outside sub-Saharan Africa. Data on population, age structure, and fertility are from the *World Population Prospects* (United Nations 2019); data on average educational attainment by age and sex are from the Barro-Lee dataset (Barro and Lee 2013); data on school enrollment are from the *World Development Indicators* (World Bank 2020).[7]

The organization of the three datasets favors a period analysis—of averages at a point in time—

[7]The Barro-Lee data come in five-year bins for each country. I use the 2019 revision of the *World Population Prospects* instead of the 2022 revision because the former provides data at the same frequency as Barro-Lee, whereas the latter is annual. The WDI provides only annual data, which I aggregate to match the five-year frequency of the other datasets.

in contrast to the cohort approach I will take in analyzing the survey data. To measure fertility at a point in time, I rely on TFR, which captures how many children a woman would expect to have if she experienced the current cross-section of age-specific fertility rates over her lifecycle. To measure adult education at a point in time, I compute average educational attainment for men and women ages 15-49, matching the reproductive age range. To measure children's school enrollment, I use gross primary and secondary school enrollment rates. Data availability motivates the use of gross rather than net enrollment rates. The net enrollment rate—enrolled children of school age divided by all children of school age—may be conceptually preferable to the gross enrollment rate—which counts all children in the numerator, irrespective of age. However, gross rates are available for many more country-period cells. For example, 1639 country-period cells have gross secondary enrollment rates, while only 897 have net secondary enrollment rates. Delayed school starting and grade repetition inflates the gross rates reported here.

Appendix Figures A1 and A2 report regional time series in TFR and adult average educational attainment, based on population-weighted country averages. TFR has fallen since 1950 in all world regions, but the onset and pace of decline vary. Compared with other regions that had high initial fertility, sub-Saharan Africa started declining later and then declined at a slower rate. The Middle East and North Africa, which had the world's highest TFR in 1950, reached sub-Saharan Africa's current level three decades ago. Sub-Saharan Africa's TFR is now more than 50 percent higher than the next-highest region's. Similarly, educational attainment has steadily increased since 1950 in all world regions, but it has done so more slowly in sub-Saharan Africa than elsewhere. For both men and women, the region started in fourth place among the six regional groupings; currently, it is last.

According to leading economic and demographic theories, slow educational growth among adults impedes fertility decline, and higher fertility tends goes hand in hand with lower investment in children's education. The regional time series are over-determined, and patterns in the disaggregated country-period panel can shed better light on the links to the theory. Figure 1 displays the connections among adult schooling, fertility, and child schooling in the pooled panel of countries. Restricting to countries and periods with data on all three variables leads to a sample of 1,108 observations from 142 countries during 1970-2015. Notably, this time span includes periods before and after the onset of continent-wide fertility decline, which Appendix Figure A1 places in the early-1980s. To give intuition into the mechanics of the relationships, Figure 1 plots the data in three dimensions. Panels A-C relate children's enrollment rates and TFR to women's average educational attainment, respectively. Panels D-E reproject the same data to relate children's enrollment rates to TFR. Each panel draws scatterplots and local linear regressions separately for sub-Saharan Africa and the rest of the world.

A useful starting point to Figure 1 is Panel C, which plots the TFR against the average education of women of childbearing age. Africa and the rest of the world exhibit similar negative slopes, with each additional year of schooling associated with a reduction of just under half a child per woman. The African scatterplot is denser at lower levels of education, so that women's education explains much of Africa's higher fertility. But at most education levels, African countries average higher TFR than non-African countries, so women's education does not fully explain the fertility gap.

Theory suggest that higher fertility should be mirrored by lower children's education. Panels A-B look at primary and secondary enrollment rates across the distribution of women's average education. Inside and outside Africa, enrollment rates are higher in contexts with more educated women. At the primary level (Panel A), the curves for Africa and the rest of the world overlap, and they flatten at higher levels of women's attainment. Both patterns are hard to interpret because of delayed school starting and grade repetition, which leads to gross primary enrollment rates in excess of 100 for 57 percent of the sample. At the secondary level (Panel B), the curves increase in parallel over a broader range of women's attainment, with each additional year of women's attainment predicting a more than 7 percentage point increase in child enrollment. Furthermore, the enrollment gap between Africa and the rest of the world is the reverse of the fertility gap in Panel C. At a given level of women's education, African countries have more children and less schooling.

If women's education is negatively related to the TFR but positively related to children's enrollment rates, then the TFR will be negatively related to children's enrollment rates. Panels D-E confirm this prediction. These variables are jointly determined, but the local linear regressions treat the TFR as the independent variable, following a long-standing practice of regressing children's academic outcomes on their family sizes (Buchmann and Hannum 2001). The curves have negative slopes as expected, although they flatten at low fertility levels for primary enrollment in a pattern similar to Panel A. In this pooled panel of countries, higher school enrollment tends to accompany lower fertility.

Figure 1's period orientation is practically useful because it enables one to merge all three cross-country datasets, but it suffers a conceptual limitation because the children whose schooling is reflected in the enrollment rate do not necessarily hail from the same families as the adults whose fertility and education are reflected in the TFR and average attainment. In this sense, Panels A-B and D-E are useful descriptions of cross-country variation, but they lack a direct interpretation in terms of the joint fertility and child investment choices of any actual women or couples. The analysis of the Demographic and Health Surveys will take a cohort perspective, capturing the average own- and child-outcomes of women born in the same time and place.

The cross-country datasets have two further shortcomings. First, their aggregation precludes investigation into the geographic heterogeneity in fertility and human capital change within countries. Second, they offer limited measures of fertility and schooling. For fertility, TFR reflects births only, without attention to child survival or wantedness. For schooling, gross enrollment rates are sensitive to delayed starts and grade repetition, and they fail to capture attainment and learning. The Demographic and Health Surveys address these shortcomings as well.

3 Africa Demographic and Health Surveys

I assemble data from all Demographic and Health Surveys (ICF 1986-2021) in sub-Saharan Africa that (i) are in standard format and in the public domain; (ii) contain data on husbands' and children's schooling outcomes; and (iii) allow linkage of children to their mothers in the household roster. Because the analysis focuses on cross-cohort changes, I also restrict attention to countries with multiple surveys. The final sample contains 112 surveys in 33 countries.[8]

The DHS interviews nationally-representative samples of women of childbearing age, typically 15-49, with survey modules on the respondents' reproductive histories, their characteristics and those of their spouses, and the survival and education of their children. For women's and husbands' education, I use the number of grades completed. For children's education, I use enrollment and grades completed among coresident children aged 7 to 14: are old enough to exceed every country's school-starting age and young enough to be included in every survey's education module.[9] For fertility, I use counts of children ever born and surviving children to measure realized fertility, as well as ideal family size to measure desired fertility. Ideal family size is based on the question: "if you could go back to the time you did not have any children and could choose exactly the number of children to have in your whole life, how many would that be?" (Rutstein and Rojas 2006).[10] Women's responses to this queation may in part reflect *ex post* rationalization.

Since most women are interviewed before the end of the reproductive period, the design of the surveys precludes the study of completed fertility. One can approximate completed fertility by including only the oldest respondents, but this strategy reduces the sample size and cohort coverage of the dataset. Additionally, the oldest women have fewer 7-14 year-old children than their slightly younger counterparts, and those children have higher birth order and later maternal age at birth. Appendix Table A1 details these patterns.

Facing these tradeoffs, I include women aged 40-49 in the study sample and use cumulative fertility at age 40 to proxy for completed fertility. Both DHS and UN data suggest that African women finish most of their childbearing by age 40. The oldest women in the study sample, age 49,

[8]The countries in the sample include Benin, Burkina Faso, Burundi, Cameroon, Chad, Comoros, Côte d'Ivoire, Democratic Republic of Congo, Ethiopia, Gabon, Gambia, Ghana, Guinea, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Tanzania, Togo, Uganda, Zambia, and Zimbabwe. Angola, Central African Republic, and Eswatini are excluded because each had exactly one survey.

[9]The DHS has two questions about enrollment: whether the child is currently in school and whether the child attended during this academic year. In surveys that include both questions, answers differ in 1.6 percent of children, presumably due to summer vacation. I rely on the 'academic year' answer when available (80 surveys) and supplement with the 'current' answer when necessary (32 surveys).

[10]I top code ideal family size at 20. The variable is unavailable for 12 percent of women due to non-numeric responses (85 percent of missing cases) and non-response (15 percent of missing cases). In dropping non-numeric responses, I follow DHS guidelines (Rutstein and Rojas 2006).

bore 91 percent of their children before turning 40. UN data similarly indicate that African women give birth to 90 percent of their children by age 40 (Appendix Figures A3-A4).

The 40-49 age range leads to a sample with children born at a range of maternal ages and women from a range of cohorts. Sample children were born when their mothers were in their 20s, 30s, and 40s. Sample women were born between the late 1940s and early 1980s. Furthermore, all of these cohorts could bear children after 1980, when age-specific fertility rates started declining across the continent (Appendix Figures A5-A6).

Table 1 reports summary statistics, with column (1) listaing means and standard deviations for the 211,149 women aged 40-49. These women average 5.7 children ever born at age 40, 4.7 surviving children at age 40, and an ideal number of children of 5.92. Marriage rates are high, with 79 percent currently married and 97 percent ever married. Schooling is low, with women averaging 3.5 grades completed, their husbands 4.6.[11]

Column (2) of Table 1 moves on to the children of these women. Data are available for 283,463 children aged 7-14 who coreside with 144,074 mothers. By construction, this sample overrepresents families with children: mothers have 6.8 children ever born and 5.8 surviving children by age 40, roughly one child more than the woman sample in column (1). Families with children are more disadvantaged than families without; both the educational attainment of both mothers and their husbands is lower than in column (1). Three-quarters of children are enrolled in school, and the average child completed 2.5 grades by the date of the interview.

Samplewide averages mask age variation in children's educational outcomes. Figure 2 unpacks this age variation, revealing a modest hump shape in enrollment (Panel A) and a rising pattern in grade attainment (Panel B). Enrollment rates start from 61 percent at age 7, grow to 82 percent at age 11, and then trail off to 75 percent at age 14. Average attainment starts from 0.5 grades at age 7 and steadily grows to 4.5 grades at age 14. The start and end points imply that grades rise 0.57 with each year of age, less than the 1-for-1 relationship that would obtain if all children were enrolled and progressing to higher grades annually. Even among currently enrolled children, the

[11] Another 12 percent of women lack data on husbands' schooling. All never-married women, 60 percent of formerly married women, and 5 percent of currently married women lack these data.

slope is substantially less than 1: average attainment rises from 0.8 grades at age 7 to 5.4 grades at age 14, implying a slope of 0.66. This pattern, reflecting both year-to-year enrollment churn and grade repetition, suggests that grade attainment conveys more information than enrollment about the extent of educational investment.

To study regional aggregates, I form temporally consistent region boundaries. Successive surveys for the same country often rely on different region classifications. Although most recent surveys are georeferenced, providing geographic coordinates for survey clusters, many older surveys are not. I harmonize boundary files across survey waves and, when necessary, superimpose cluster coordinates from one survey on the boundary file from another.[12] This effort leads to 198 subnational regions across the 33 countries.[13]

All calculations using individual observations apply survey weights. When working with individual-level data from more than one survey, I rescale each survey's weights to sum to its sample size. This procedure ensures representativeness within each survey while weighting surveys by their contribution to the sample. When working with cell-level data, I weight cells by the number of individual observations within them.

4 Place and Cohort Patterns

This section builds toward the panel analysis with two sets of graphical results describing variation across places and across women's birth cohorts. First, I graph average fertility and schooling across surveys and places in an analogue to Figure 1. Second, I report continent-wide cohort effects in fertility and schooling.

Figure 3 describes the joint distribution of adult education, fertility, and child schooling across surveys and survey-region cells. The figure displays five scatterplots with associated local linear regressions: of children's grade attainment on women's grade attainment (Panel A), of children's

[12] Subnational boundary files are available at https://spatialdata.dhsprogram.com/boundaries/.

[13] Two of the 33 countries had surveys with unmappable regions, in which case I treat the entire country as one region. Burundi's 1987 survey had four ecological regions that do not map onto known administrative boundaries. Côte d'Ivoire's 1998 survey only distinguished between the capital city, all other cities, and the countryside. In regional analyses that include survey-by-birth year fixed effects, the fixed effects aborb all variation from these countries.

enrollment on women's grade attainment (Panel B), of women's fertility on women's education (Panel C), of children's enrollment on women's fertility (Panel D), and of children's grade attainment on women's fertility (Panel E). Unlike Figure 1, the children's outcomes correspond to the offspring of the same cohort of women whose fertility and education are represented in the graph. In this way, Figure 3 coherently accounts for the joint determination of child quality and quantity.

Despite its more precise intergenerational linkage than Figure 1, Figure 3 comes to largely the same conclusion. Countries and regions with more educated women have lower average fertility and higher child schooling outcomes, and much as a consequence, average fertility and child schooling outcomes are negatively correlated. The local linear regressions indicate that when women from a country or subnational region have no schooling, they tend to have seven children, of whom four-in-ten are enrolled in school during ages 7-14. In contrast, when women from a country or region have 8 years of schooling on average, they tend to have four children, of whom more than 9 in 10 are enrolled. At the lowest levels of average fertility, child school enrollment approaches 100 percent; at the highest levels, enrollment sinks to 50 percent or lower.

The patterns in Figure 3 pool two sources of variation: across space and over time between surveys. One can think of the latter as cohort variation, since each survey captures outcomes for the cohort of women born 40-49 years before. The regression analyses below model this cohort variation more explicitly with fixed effects for the year of the respondent's birth. As a first step toward describing rates of change in fertility and human capital outcomes, I estimate continent-wide cohort effects in the individual-level data using regressions of each outcome on 5-year cohort indicators and country indicators. For the child outcomes, I interact the country indicators with child age indicators to accommodate age variation in enrollment and attainment. Figure 4 plots the estimated cohort effects.

Compared with their compatriots born in the 1940s, women born in the 1970s report having and wanting fewer children, as well as having more educated families. In Panel A, women in the post-1975 cohort have 1.3 fewer children ever born at age 40 than women in the pre-1945 cohort, but just 0.4 fewer surviving children, a consequence of simultaneous mortality decline. The ideal number of children also falls, by 1.8.[14] That desired fertility falls more than realized fertility suggests that the former does not merely reflect *ex post* rationalization.

The rest of Figure 4 details rising education among parents and children. Panel B evidences rapid cross-cohort growth in education for both women and their husbands, with the last cohort gaining more than 3.5 years on the first. Finally, Panels C-D shows that children with mothers from later cohorts have higher enrollment rates and higher average grade attainment. On average, compared to children of the pre-1945 cohort, children of the post-1975 cohort are 21 percentage points more likely to be enrolled and have completed 1.2 more grades.

5 Panel Analyses

Both the pooled scatterplots in Figure 3 and the continent-wide cohort effects in Figure 4 suggest that lower fertility coincides with higher education among both adults and children. But these patterns offer limited insight into the process of fertility decline. The pooled scatterplots may in large part reflect cross-sectional variation, which speaks less to how education and fertility co-evolve during fertility decline and more to how the determinants of fertility and education are distributed across space. The cohort effects do speak to change, but common trends in time series too have a fraught interpretation. To address these limitations, I analyze differential rates of change across African countries and regions in a panel regression framework.

5.1 Methods

I study changes in national and regional cohort averages. To this end, I collect women into two units of analysis: survey-cohort cells and region-survey-cohort cells. The additional disaggregation by survey avoids concerns about incompatability between surveys. For children, I also disaggregate by age to allow flexible treatment of child age effects, leading to survey-cohort-age cells and region-survey-cohort-age cells. In this nomenclature, 'cohort' refers to the mother's year of birth, while

[14]While cumulative fertility at a specific age reflects cohort variation alone, ideal family size at the time of the interview may also reflect period variation between surveys and age variation within the 40-49 age range.

'age' refers to the child's age. These aggregations lead to 1260 survey-cohort cells, 7364 region-survey-cohort cells, 9691 survey-cohort-age cells, and 50,035 region-survey-cohort-age cells with complete data

Each level of aggregation has benefits and drawbacks. Analysis of national cohorts minimizes risk of bias from migration, since external migration is rarer than internal. At the same time, it raises risk of bias from confounding national trends and policies. In contrast, analysis of regional cohorts raises risk of bias from migration, since the DHS collects detailed information only on the respondent's *current* place of residence, but eliminates risk of bias from nationwide confounders.

The analysis has four regression specifications: national and regional, for women and children. The model for women's survey-cohort cells relates mean fertility ($\bar{y}_{scb}$) to mean covariates ($\bar{X}_{scb}$), conditional on country fixed effects (δ_c) and birth year fixed effects (τ_b):

$$\bar{y}_{scb} = \bar{X}'_{scb}\beta + \delta_c + \tau_b + \varepsilon_{scb} \tag{1}$$

where s denotes survey, c denotes country, and b denotes the respondent's year of birth. Identification of β comes from differential within-country variation across cohorts. The model for women's region-survey-cohort cells takes a similar form:

$$\bar{y}_{rsb} = \bar{X}'_{rsb}\beta + \delta_r + \tau_{sb} + \varepsilon_{rsb} \tag{2}$$

where r denotes the subnational region. Relative to model (1), this model replaces the country fixed effect with a region fixed effect (δ_r) and the birth year fixed effect with a survey-by-birth year fixed effect (τ_{sb}). The survey-by-birth year fixed effect allows cohort effects to vary by survey: similar to (but more flexible than) allowing them to vary by country, since surveys are nested within countries. Here, identification of β comes from differential within-region variation across cohorts, but comparisons are within-survey.

For children's outcomes, I allow the fixed effects to vary by child age. The model for survey-cohort-age cells takes the form:

$$\bar{y}^a_{scb} = \bar{X}'_{scb}\beta + \delta^a_c + \tau^a_b + \varepsilon^a_{scb} \tag{3}$$

where a denotes the *child's* age, and b denotes the *mother's* birth year. Child outcomes are averaged within cells, while women's covariates are still averaged across all women in the mother's survey-cohort cell. The age-disaggregation of children's average outcomes ($\bar{y}^a_{scb}$) allows me to interact child age indicators with the country fixed effect (δ^a_c) and the birth year fixed effect (τ^a_b), so that the regression compares children of the same age. These interactions help rule out spurious correlations between average women's characteristics and the age composition of children in a survey-cohort cell. The pooling of women's average covariates ($\bar{X}_{scb}$) keeps these averages unaffected by selection into motherhood. Identification of β comes from differential within-country variation across cohorts, controlling for the age composition of children. For region-survey-cohort-age cells, the model becomes:

$$\bar{y}^a_{rsb} = \bar{X}'_{rsb}\beta + \delta^a_r + \tau^a_{sb} + \varepsilon^a_{rsb} \tag{4}$$

As in model (3), I interact child age with the region fixed effect (δ^a_r) and the survey-by-birth year fixed effect (τ^a_{sb}). Identification of β now comes from differential within-region variation across cohorts, controlling for the survey and the age composition of children. In this case, the survey-by-birth year fixed effect has the added benefit of controlling for nationwide period effects, which are likely to be important for children's schooling.

The definition of $\bar{X}$ varies. For fertility outcomes, the main covariate is women's average highest grade completed. Some models also include the husbands' average highest grade completed. Because selection into marriage may affect the distribution of husbands' characteristics, these models also control for rates of never marriage and current marriage.[15] For children's education outcomes, I use the same covariates or replace them with women's fertility. When adult education is on the right-hand side, β represents an association between resources and parenthood outcomes. When fertility

[15] I report the coefficients for the marriage variables, but they are not the focus of the paper. For more on the role of nuptiality in African fertility change, see Grant and Kohler (2022).

is on the right-hand side, β represents an association between codetermined parenthood outcomes.

5.2 Results

Table 2 reports estimations that treat fertility as the outcome. Women's average schooling is associated with lower ever-born (Panel A), surviving (Panel B), and desired (Panel C) fertility—with and without fixed effects—while husbands' average schooling shows no consistent links. Columns (1)-(4) use national cohorts. With no fixed effects or covariates, an extra grade of women's average education is associated with 0.24 fewer children ever born per woman, 0.12 fewer surviving children per woman, and 0.24 fewer desired children (column [1]). Controlling for husbands' average education and marital status strengthens the women's education coefficients for realized fertility and weakens that for desired fertility, albeit moderately (column [2]). With the addition of country and cohort fixed effects (columns [3]-[4]), the women's education coefficients for realized fertility stabilize at -0.18 to -0.21. In other words, as women's average educational attainment rises across cohorts by one grade, realized fertility falls by one-fifth of a child. The result is remarkably similar for ever-born and surviving fertility, implying that any child survival benefits of rising maternal education have not offset fertility reduction. The coefficient for desired fertility is similar in column (3) but falls somewhat in column (4) because rising husbands' education is associated with falling ideal family size.

Looking at regional cohorts within countries, columns (5)-(8) find similar associations for ever-born and desired fertility but slightly smaller ones for surviving fertility. Accounting for region and survey-cohort fixed effects (columns [7]-[8]), a one-grade increase in women's average educational attainment predicts a 0.18-0.21 reduction in children ever born, a 0.14-0.15 reduction in surviving children, and a 0.15-0.18 reduction in ideal family size. The coefficients on husbands' education are negative and statistically significant for ever-born and desired fertility, but they are small in magnitude. For surviving fertility, the coefficient for husbands is even smaller and not significantly different from zero.

Columns (1)-(2) and (5)-(6) serve as a useful point of comparison, but columns (3)-(4) and

(7)-(8) are of principal interest because they net out fixed heterogeneity with fixed effects. These estimations suggest that rising women's education predicts falling fertility, while rising husbands' education has far less predictive power, and in many cases none at all. In all estimations, the coefficients for women and husbands are significantly different from each other at the 5 percent level. Whether we prefer the national or regional estimates depends on the magnitude of bias stemming from time-varying country-level confounders (favoring within-country estimates) and internal migration (favoring cross-country estimates). Fortunately, estimates for women's schooling are similar using either unit of aggregation, despite relying on entirely separate sources of variation.

Investments in children may be key to understanding the above associations. In this vein, Table 3 analyzes the same right-hand side variation as Table 2, but with children's outcomes on the left-hand side: enrollment in Panel A and grade attainment in Panel B. As Figure 2 demonstrated, the outcomes are related, but only grade attainment detects variation in student progression.

Indeed, Table 3 finds discordant results for the two outcomes, particularly for women. In pooled estimations without fixed effects, women's average educational attainment is positively associated with both children's outcomes (columns [1] and [5]). However, this result weakens with the addition of fixed effects or marital covariates, especially when enrollment is the outcome. In the enrollment regressions (Panel A), adding fixed effects reduces the coefficient on women's average schooling from 0.06 to 0.01 for both the national and regional cohorts. The coefficient loses statistical significance in the national cohorts (column [3]) but remains significant in the regional cohorts (column [7]). When one adds marital covariates, both coefficients shrink further, rendering them both statistically non-significant (columns [4] and [8]).

Children's enrollment growth loads most onto rising husbands' education, not women's. A one-grade increase in husbands' average schooling is associated with a 1-2 percentage point increase in children's enrollment. Net of husbands' education, place fixed effects, and cohort fixed effects, women's education is not significantly related to children's enrollment. Here and throughout Table 3, however, the coefficients on women's and husbands' education do not differ at the 5 percent level.

The weak results for women's schooling may stem from enrollment being a poor proxy for investment in children. Indeed, the grade attainment regressions (Panel B) find stronger results. In the fixed effect specifications without marital covariates, rising women's schooling unambiguously predicts rising children's average grades completed (columns [3] and [7]). Within a place across cohorts, a one-grade increase in women's average attainment is associated with a 0.12-0.15 grade increase in children's average attainment. After one controls for husbands' attainment, the coefficients for women's attainment shrink to 0.05-0.08 (columns [4] and [8]). Only the regional cohorts coefficient is individually significant, but the national cohorts coefficient has a large standard error. The men's coefficient is larger than the women's coefficient in the national cohorts sample (0.13 versus 0.05) and smaller than the women's coefficient in the regional cohorts sample (0.06 versus 0.08), but neither difference is statistically significant. Overall, Table 3 suggests that both women's and men's education matter for children's grade-for-age, but primarily men's education matters for children's enrollment.[16]

The varied cohort associations linking women's, men's, and children's schooling imply that fertility decline may be associated with rising children's attainment but not enrollment. Table 4 tests this proposition directly by estimating the relationship between women's fertility and the educational outcomes of their children. As in Table 3, I rely on models (3)-(4), in this case using women's average realized or desired fertility as the independent variable. Panel A considers enrollment, and Panel B turns to grade attainment.

Columns (1) and (3) of Table 4 omit all fixed effects, finding an expected pattern in which children of higher fertility cohorts exhibit lower enrollment and grade attainment. These findings mirror the pooled scatterplots in Figure 3, panels D-E, but extend them from ever-born fertility to surviving and desired fertility. The pooled regressions combine cross-cohort variation with cross-place variation, which may not be relevant for learning about the evolution of children's schooling during the process of fertility decline. Indeed, in columns (2) and (4), the addition of place and cohort fixed effects weakens the associations considerably.

Columns (2) and (4) confirm that realized fertility decline is linked with attainment growth but

[16] Appendix Figures A7-A8 report separate results by sex and single year of age. Results are similar for boys and girls. Grade attainment coefficients rise with age, befitting an outcome that cumulates with age.

not enrollment growth. Net of the fixed effects in models (3)-(4), cohort averages of children ever born and surviving children have small and statistically insignificant relationships with children's enrollment (Panel A). In contrast, falling cohort fertility is associated with rising grade-for-age (Panel B). As ever-born fertility declines by one child, children's average attainment rises significantly, by 0.18 grades in the national cohorts and 0.06 grades in the regional cohorts. This result carries to surviving fertility in the regional but not national cohorts. Specifically, as surviving fertility declines by one child across cohorts, children's average attainment rises by a by a statistically significant 0.04 grades in the regional cohorts but a non-significant 0.007 grades in the national cohorts. As in previous tables, the estimates for national cohorts have very large standard errors; one cannot reject associations of the same magnitude as the estimates for regional cohorts.

Table 4's results for desired fertility differ from those for realized fertility. *Both* children's schooling outcomes negatively covary with average ideal family size, with and without fixed effects. Across successive national cohorts, a one child decline in average ideal family size is associated with a 2.5 percentage point increase in school enrollment and a 0.2 grade increase in attainment. Across regional cohorts within countries, the same decline in desired fertility is associated with a 0.6 percentage point enrollment increase and a 0.05 grade attainment increase. Thus, desired fertility produces coherent results for children's enrollment and attainment, but realized fertility does not.

The discrepancy between results for desired and realized fertility may seem surprising at first, but Table 2 helps reconcile them. Women's education is consistently linked with lower fertility, but husbands' education is not. In constrast, *both* women's and husbands' education are linked with lower ideal family size. Since rising husbands' education predicts falling desired fertility and rising child enrollment, enrollment negatively comoves with desired fertility.

The magnitudes of the coefficients in Table 4 vary considerably, both across fertility measures and levels of aggregation. In the regional cohorts sample, however, similar fixed effect estimates obtain for all three fertility measures (Panel B, column [4]). A one child decline in ever-born, surviving, or desired fertility predicts a 0.04-0.06 grade increase in attainment for age. These magnitudes are smaller than the comparable national estimates (Panel B, column [2]), but they are much more precisely estimated. Overall, Table 4 is consistent with theoretical predictions that fertility decline and rising educational invement go hand in hand.[17]

6 Conclusion

A number of demographic and economic theories predict the coincidence of fertility decline and education growth among adults and children. Cohort evidence from sub-Saharan Africa supports these predictions, but with some nuance depending on how one measures children's education. As more educated female cohorts replace less educated, both realized and desired fertility decline. Children's grade attainment rises too, but school enrollment less so. Partly as a result of these patterns, declining *realized* fertility is associated with rising children's grade attainment but not enrollment. In contrast, declining *desired* fertility is associated with gains in both children's outcomes.

In their early application of Caldwell's (1980) hypothesis to African data, Lloyd et al. (2003) anticipate the superiority of attainment data to enrollment data in choosing to analyze 4^{th} grade completion rates. However, much of their reasoning focuses on the deficiencies of gross enrollment rates, which the DHS avoids, and on variation in school starting ages across countries, which the fixed effects here absorb. They do also cite variation in grade progression, which turns out to be key to understanding why attainment growth is associated with fertility decline, while enrollment growth is not. One can view the results here as a panel extension of Lloyd et al.'s seminal analysis, confirming a link between fertility decline and children's schooling while also uncovering nuance in that link. Unlike Lloyd et al., however, I have not focused on Caldwell's specific emphasis on *mass* education, which does not easily fit into my panel regression framework.

The contrast between children's enrollment and attainment relates to the tendency of universal education programs to focus on putting "butts in seats" (Pritchett 2009): children in school with little attention to grade progression or learning. Indeed, many African countries have achieved unprece-

[17] Appendix Figure A9 reports heterogeneity and sensitivity checks, finding similar associations for boys and girls, little age heterogeneity in enrollment associations, and growing attainment associations as children age. When the fertility-child schooling association is negative, adding women's schooling and marital covariates shrinks the association. The negative dependence of fertility on women's schooling and positive dependence of children's grade attainment on women's schooling explain some of the association between fertility decline and grade-for-age growth.

dented gains in "enrollment without learning" (Bold et al. 2017). In the Caldwellian framework, children's school attendance may reshape childrearing costs and dependency norms even without learning, but the link to fertility decline is undoubtedly stronger if students learn while in school. In the Beckerian framework, the main mechanisms depend on parental human capital investment, and government spending on "butts in seats" may advance neither human capital nor parental investment. Children's attainment, in contrast, may better reflect investments by parents and the socializing influence of schools, so its relation to fertility decline matches the theory. The decoupling of enrollment from attainment and learning helps explain the discrepancy between my enrollment results and my attainment results.

The patterns documented here suggest that current human capital shapes Africa's demographic future, and current demography shapes its human capital future, even if the share of children attending school plays a less clear role. These issues are pivotal for academic reseach at the intersection of population and human capital. Projections of women's educational attainment already weigh heavily in controversies about African population projections (Vollset et al. 2020; Gietel-Basten and Sobotka 2020). In the opposite direction, simulations of the economic consequences of fertility decline in Africa depend on the strength of the schooling response to fertility decline. Ashraf et al. (2013) find that increased schooling accounts for one quarter of the economic benefit from exogenous fertility decline over a horizon of 50 years. The overall economic benefit is modest in their calibration to Nigerian data, but their findings make clear that the role of fertility decline in economic growth, whatever its extent, depends on the strength of education-fertility linkages.

The analyses here contribute clean panel facts on the triangle linking adult education, fertility, and child education. The existing literature on fertility change in Africa has focused disproportionately on period fertility (see, e.g., Casterline 2017 and references therein), making the cohort results here novel. The cohort orientation is especially useful for jointly analyzing parents' outcomes and children's outcomes, since in period data parents and children may come from different families. However, the paper does not address the race between shrinking family sizes and rising children's cohort sizes at the onset of the fertility transition (Lam and Marteleto 2008). An investigation into that issue would require multilevel modeling of maternal cohort variation (which governs family size) and child cohort variation (which governs crowding).

The findings here also do not shed light on the causal pathways that form the education-fertility triangle, leaving ample questions for future research. For instance, how have family planning programs in Africa affected child investment? How have schooling expansions shaped contemporary fertility trends? Which mechanisms mediate the effect of women's education on fertility? Answers to these questions will help policymakers better combine population policy and education policy in the world region destined to become the world's most populous within half a century (UN 2019).

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Table 1: Summary Statistics, Individual-Level Data, Africa DHS

	Women 40-49	Children 7-14
	(1)	(2)
A. Woman/mother variables		
Children ever born at age 40	5.69 (2.76)	6.84 (2.36)
Surviving children at age 40	4.71 (2.33)	5.84 (2.01)
Ideal number of children*	5.92 (2.99)	6.33 (3.07)
Grades completed	3.53 (4.39)	3.06 (4.07)
Currently married	0.79 (0.41)	0.86 (0.35)
Never married	0.03 (0.17)	0.01 (0.10)
Husband’s grades completed*	4.55 (5.05)	4.17 (4.79)
B. Child variables		
School enrollment		0.75 (0.43)
Grades completed		2.45 (2.33)
Number of women/mothers	211,149	144,074
Number of children		283,463
Number of surveys	112	112
Number of regions	198	198
Number of countries	33	33

Notes: Means with standard deviations in parentheses. Sampling weights are rescaled by each survey’s contribution to the overall sample. Column (1) includes all women aged 40-49, both mothers and non-mothers. Column (2) includes children aged 7-14 with mothers aged 40-49 and reports the mothers’ characteristics in Panel A. * ideal family size and husband’s grades completed are available only for 88 percent subsamples.

Table 2: Adult Education and Fertility, Africa DHS

	Survey/cohort cells				Region/survey/cohort cells			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Children ever born at 40								
Women's highest grade	-0.242**	-0.288**	-0.198**	-0.208**	-0.259**	-0.274**	-0.206**	-0.184**
	[0.044]	[0.080]	[0.031]	[0.032]	[0.027]	[0.041]	[0.038]	[0.041]
Husbands' highest grade		0.114		0.033		0.070		-0.020*
		[0.065]		[0.027]		[0.039]		[0.008]
Currently married		-0.308		0.587		0.523		0.906**
		[0.867]		[0.348]		[0.437]		[0.128]
Never married		-6.473**		-1.430		-4.638**		-1.769**
		[1.594]		[1.328]		[0.968]		[0.394]
B. Surviving children at 40								
Women's highest grade	-0.116**	-0.150*	-0.175**	-0.191**	-0.134**	-0.145**	-0.147**	-0.137**
	[0.035]	[0.059]	[0.044]	[0.038]	[0.023]	[0.030]	[0.029]	[0.033]
Husbands' highest grade		0.089		0.049		0.057		-0.003
		[0.049]		[0.030]		[0.028]		[0.011]
Currently married		-0.030		0.594*		0.560		0.802**
		[0.479]		[0.291]		[0.282]		[0.137]
Never married		-4.79**		-1.949		-3.496**		-1.740**
		[1.217]		[1.007]		[0.756]		[0.376]
C. Ideal number of children								
Women's highest grade	-0.237**	-0.193	-0.187**	-0.102*	-0.316**	-0.268**	-0.177**	-0.154**
	[0.075]	[0.134]	[0.040]	[0.042]	[0.043]	[0.078]	[0.026]	[0.030]
Husbands' highest grade		0.095		-0.096**		0.030		-0.026*
		[0.115]		[0.026]		[0.080]		[0.011]
Currently married		4.248*		-0.214		2.327		0.534**
		[1.814]		[0.241]		[1.165]		[0.128]
Never married		-3.815		-2.002		-2.940*		-0.978**
		[2.323]		[1.140]		[1.309]		[0.279]
N	1260	1260	1260	1260	7364	7364	7364	7364
Country FE			X	X				
Cohort FE			X	X				
Region FE							X	X
Survey × cohort FE							X	X

Notes: Brackets contain standard errors clustered by country. Analyses are weighted by the number of observations in the cell. * p<0.05, ** p<0.01

Table 3: Adult Education and Child Education, Africa DHS

	Survey/cohort/age cells				Region/survey/cohort/age cells			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. School enrollment								
Women's highest grade	0.055**	0.018	0.011	-0.007	0.055**	0.022**	0.012**	0.0057
	[0.007]	[0.010]	[0.008]	[0.010]	[0.005]	[0.006]	[0.004]	[0.0042]
Husbands' highest grade		0.026*		0.022**		0.027**		0.009**
		[0.010]		[0.006]		[0.007]		[0.003]
Currently married		-0.535**		-0.027		-0.313**		0.014
		[0.131]		[0.081]		[0.098]		[0.015]
Never married		-0.0561		-0.029		-0.060		-0.084
		[0.216]		[0.253]		[0.123]		[0.049]
B. Grades completed								
Women's highest grade	0.254**	0.241**	0.151**	0.050	0.274**	0.218**	0.117**	0.080**
	[0.031]	[0.076]	[0.047]	[0.047]	[0.024]	[0.057]	[0.014]	[0.012]
Husbands' highest grade		0.035		0.132**		0.063		0.055**
		[0.057]		[0.033]		[0.045]		[0.011]
Currently married		1.539**		-0.184		0.581*		0.038
		[0.491]		[0.413]		[0.269]		[0.068]
Never married		1.104		-1.011		0.707		-0.129
		[1.107]		[1.390]		[0.760]		[0.174]
N	9691	9691	9691	9691	50,035	50,035	50,035	50,035
Country × age FE			X	X				
Cohort × age FE			X	X				
Region × age FE							X	X
Survey × cohort × age FE							X	X

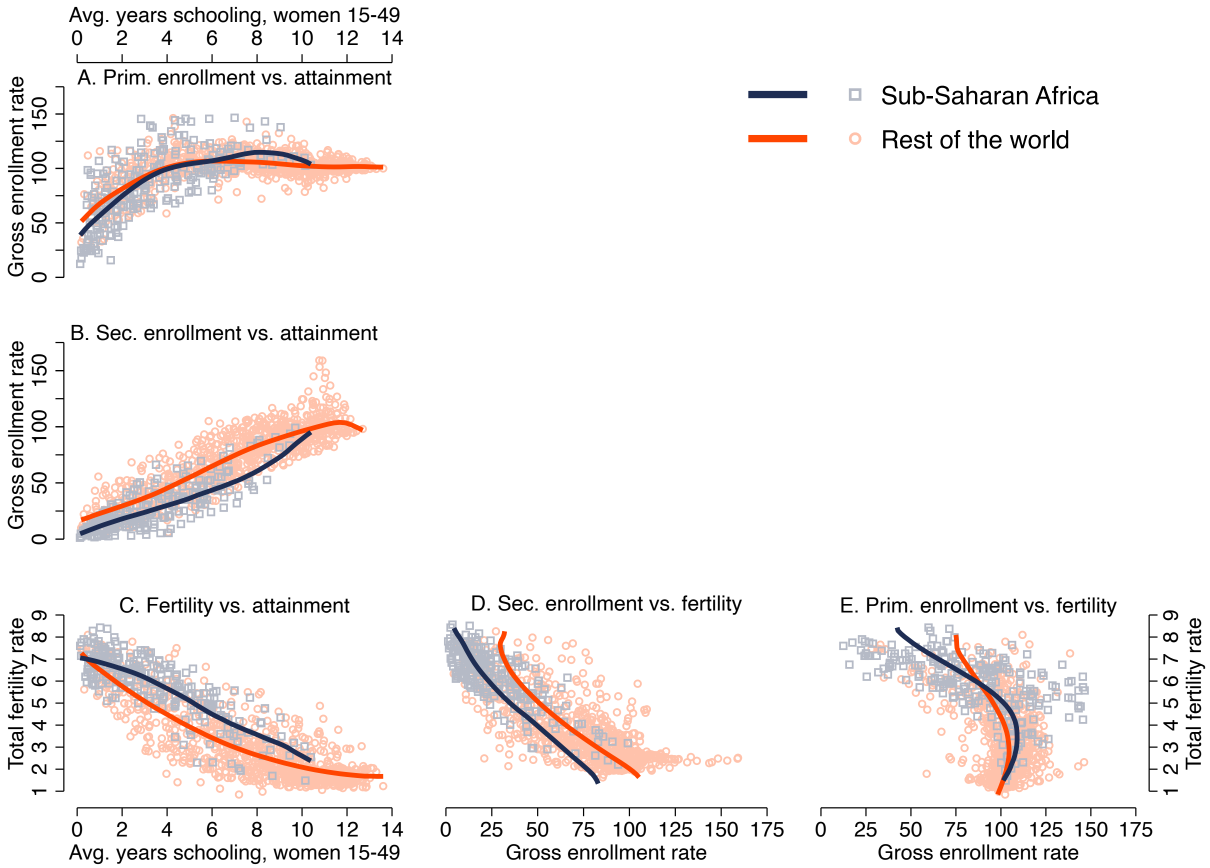
Notes: Brackets contain standard errors clustered by country. Analyses are weighted by the number of observations in the cell. * p<0.05, ** p<0.01

Table 4: Fertility and Child Education, Africa DHS

	Survey/cohort/age cells		Region/survey/cohort/age cells	
	(1)	(2)	(3)	(4)
A. Enrollment				
Children ever born at 40	-0.108**	-0.003	-0.090**	0.0016
	[0.022]	[0.017]	[0.013]	[0.0039]
Surviving children at 40	-0.099**	0.032	-0.072**	0.0068
	[0.034]	[0.019]	[0.019]	[0.0035]
Ideal number of children	-0.076**	-0.025*	-0.070**	-0.0055*
	[0.009]	[0.011]	[0.005]	[0.0023]
B. Grades completed				
Children ever born at 40	-0.570**	-0.183*	-0.506**	-0.057**
	[0.079]	[0.079]	[0.044]	[0.015]
Surviving children at 40	-0.545**	-0.007	-0.445**	-0.041*
	[0.116]	[0.086]	[0.072]	[0.016]
Ideal number of children	-0.226**	-0.192**	-0.271**	-0.054**
	[0.073]	[0.056]	[0.036]	[0.013]
N	9691	9691	50,035	50,035
Country × age FE		X		
Cohort × age FE		X		
Region × age FE				X
Survey × cohort × age FE				X

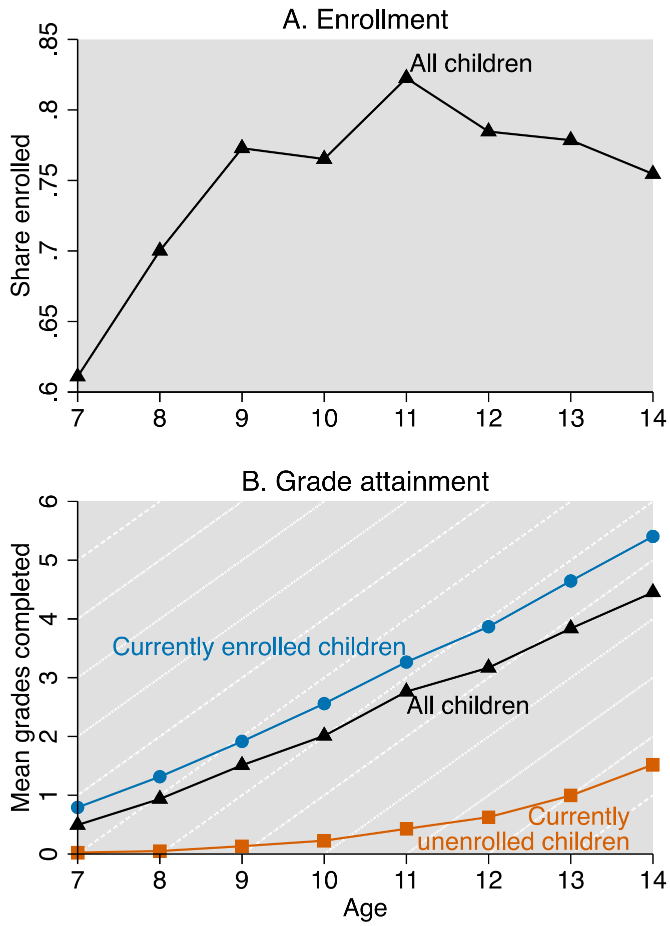
Notes: Each coefficient is from a separate regression. Brackets contain standard errors clustered by country. Analyses are weighted by the number of observations in the cell. * p<0.05, ** p<0.01

Figure 1: Fertility and Education across Time and Space, Cross-Country Datasets



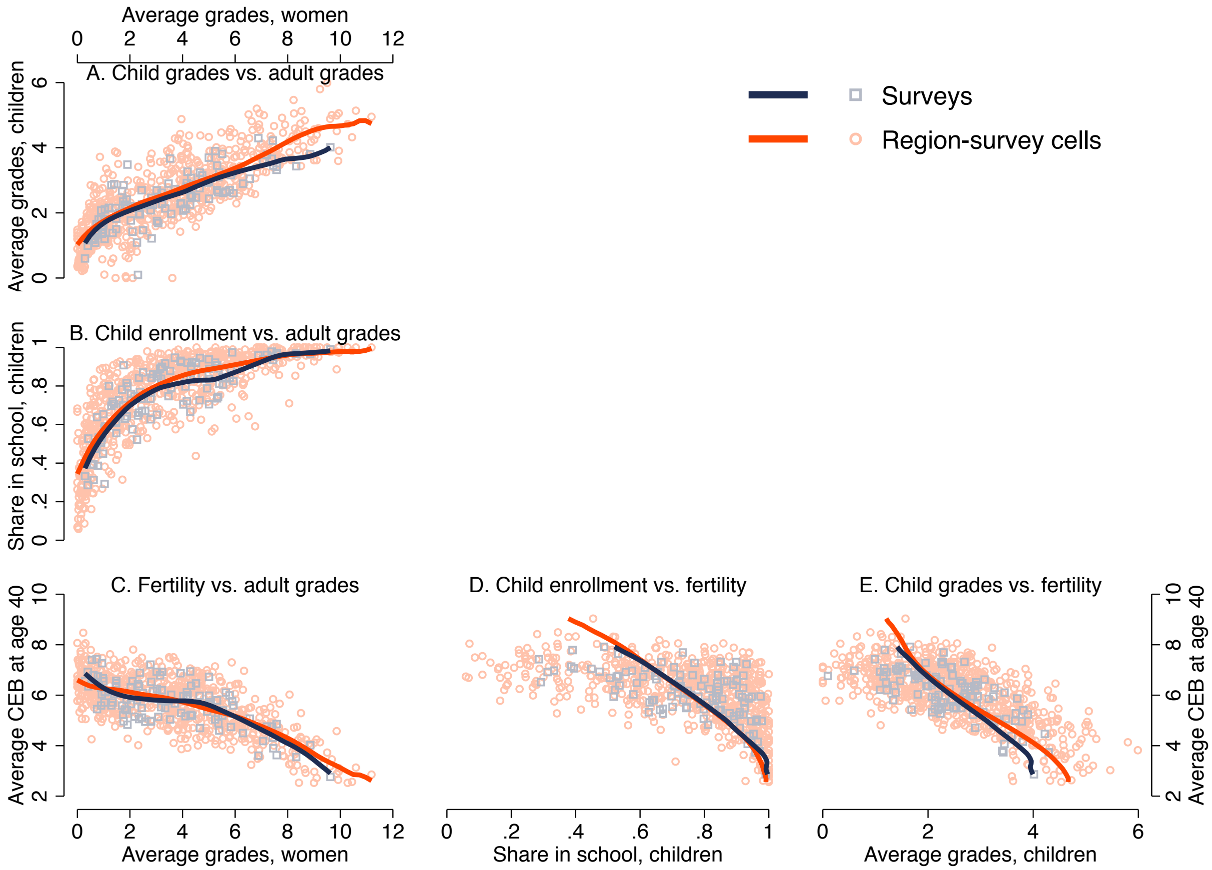
Notes: Curves are local linear regressions with bandwidths of 1. In Panels D-E, the enrollment rate (on the horizontal axis) is treated as the dependent variable. Sample includes 1,108 observations, reflecting 142 countries in five-year periods between 1970-75 and 2010-15. Total fertility rates are from UN (2019), educational attainment is from Barro and Lee (2013), and gross school enrollment is from World Bank (2020).

Figure 2: Attainment and Enrollment by Age Among Children, Africa DHS



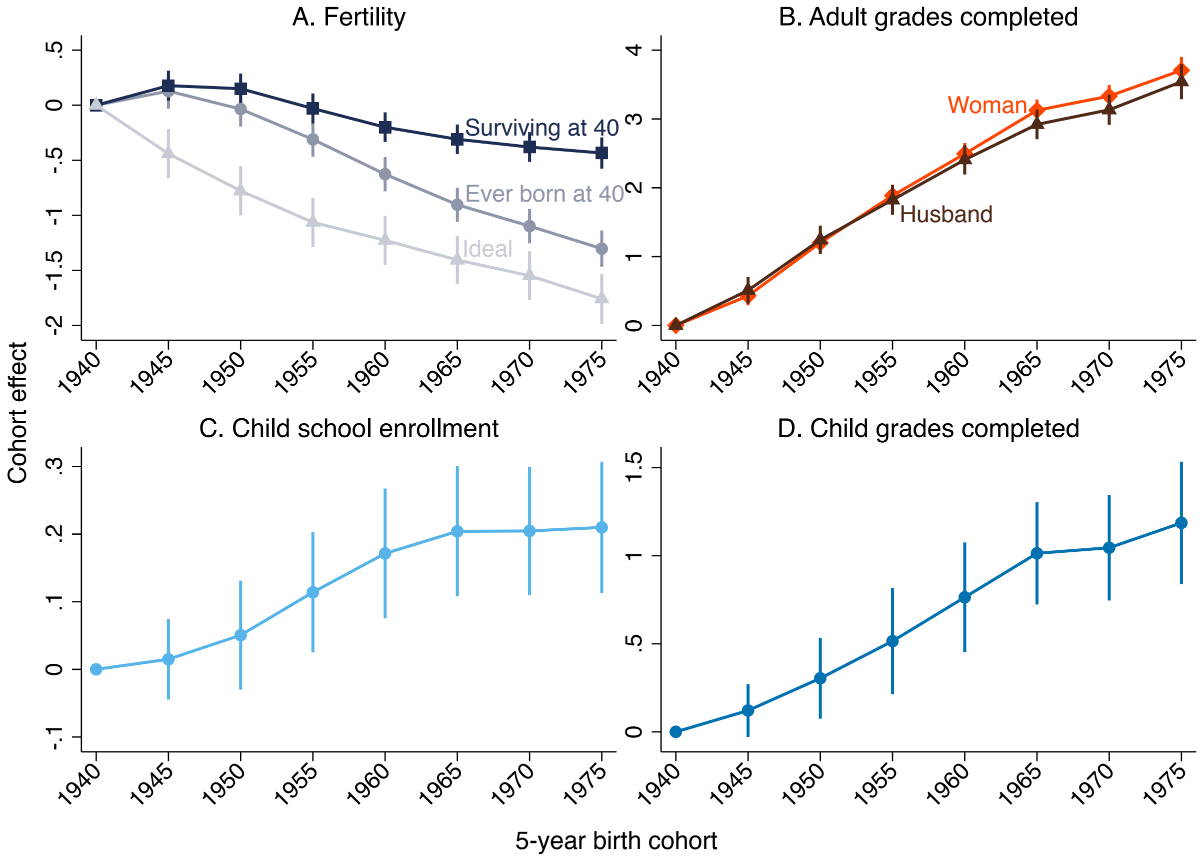
Notes: Sampling weights are rescaled by each survey's contribution to the overall sample. In Panel B, white lines indicate 45 degrees.

Figure 3: Fertility and Education across Cohorts and Space, Africa DHS



Notes: Curves are local linear regressions with bandwidths of 1. In the bottom center and bottom right panels, share in school and average grades (on the horizontal axis) are treated as dependent variables. Local linear regressions are weighted by the number of individual observations used to compute the dependent variable.

Figure 4: Cohort Effects on Fertility and Education, Africa DHS



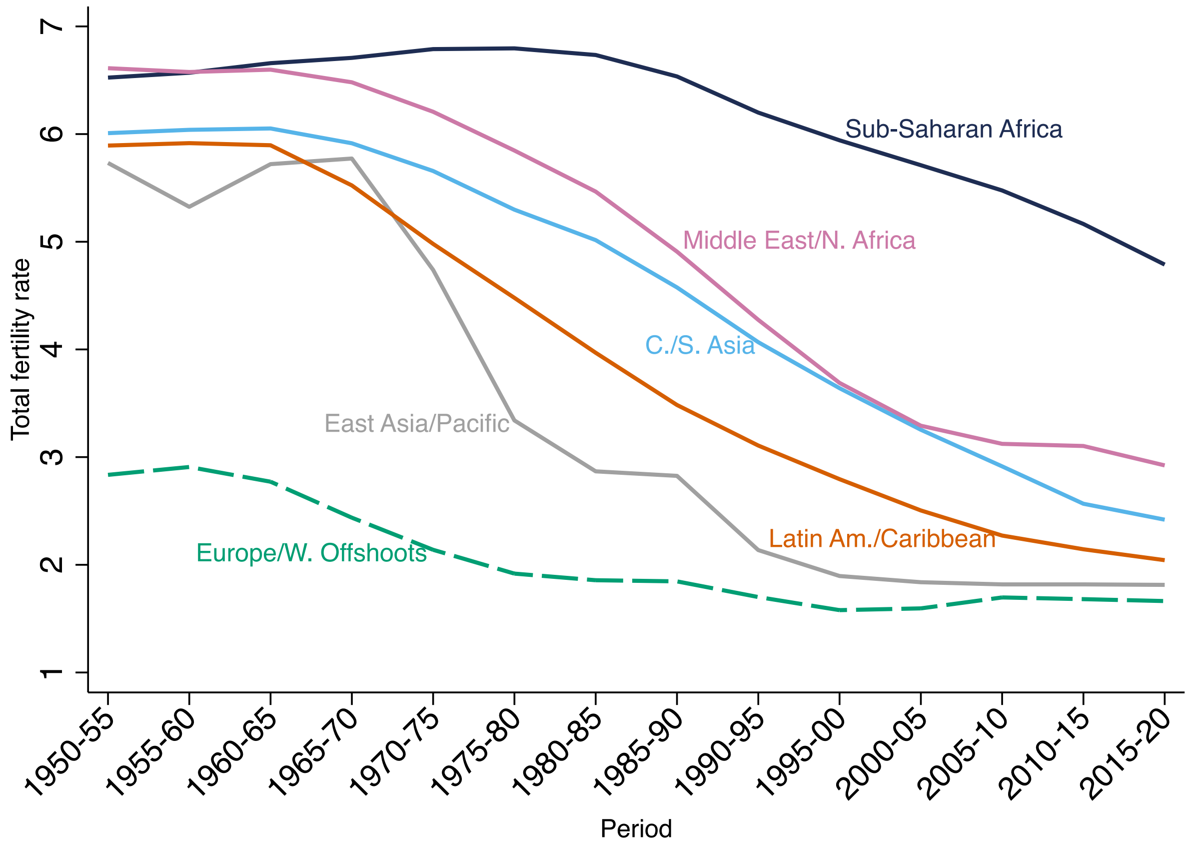
Notes: Coefficients and 95% confidence intervals on women's birth cohort indicators. Regressions for Panels A and B include country fixed effects; regressions for Panels C and D include country-by-child age fixed effects. Standard errors are clustered by primary sampling unit. Cohorts $t = \{1945, 1950, 1955, 1960, 1965, 1970, 1975\}$ include birth years from t to $t + 4$.

Table A1: Sample Size, Fertility, and Child Coresidence by Age of Respondent

		Mean woman characteristics								
		At least one child ever born	Children ever born	Living children	At least one 7-14 YO	7-14 YOs	Avg. age when 7-14 YOs born	Avg. birth order of 7-14 YOs	At least one coresident 7-14 YO	Coresident 7-14 YOs
Age	# women	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
20-24	242,197	0.67	1.24	1.11	0.07	0.08	15.42	1.12	0.05	0.06
25-29	224,128	0.88	2.57	2.27	0.49	0.72	18.44	1.39	0.38	0.57
30-24	179,426	0.94	3.85	3.35	0.79	1.59	21.76	2.06	0.67	1.29
35-39	152,065	0.96	4.97	4.24	0.85	1.86	26.22	3.24	0.75	1.57
40-44	115,575	0.97	5.77	4.81	0.81	1.72	30.87	4.65	0.73	1.48
45-49	95,574	0.97	6.33	5.09	0.7	1.37	35.68	6.08	0.63	1.18

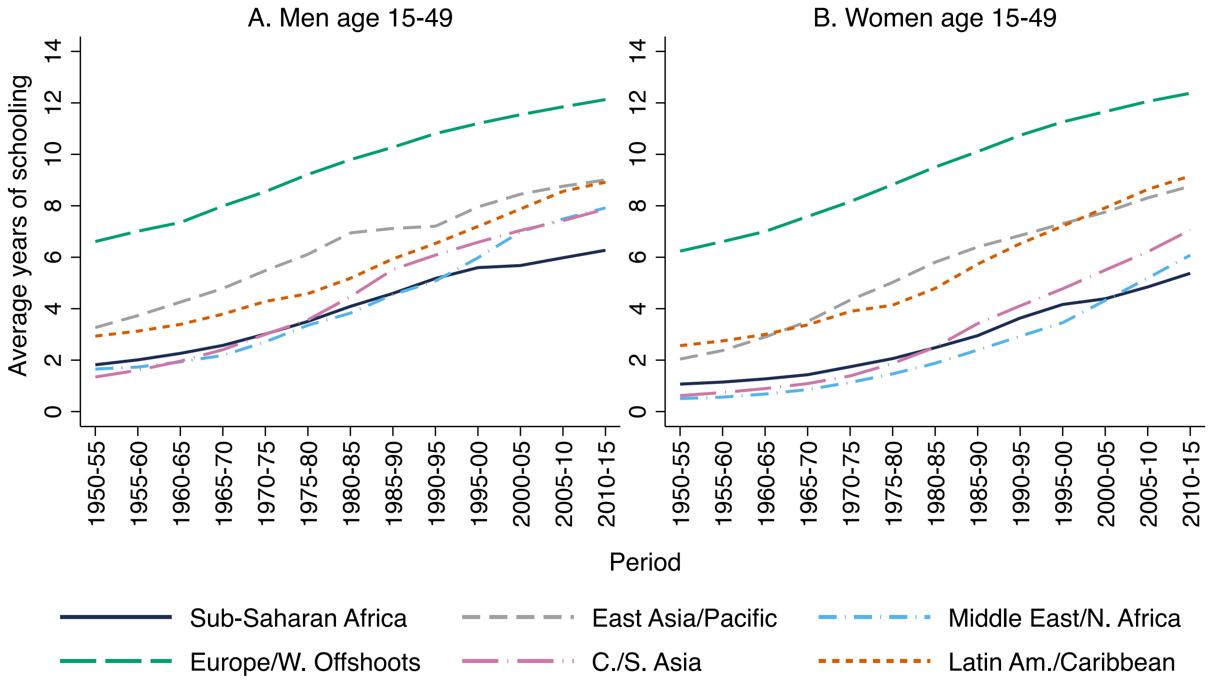
Notes: Sampling weights are rescaled by each survey's contribution to the overall sample. In columns (6)-(7), child characteristics are first averaged at the mother level and then averaged across mothers.

Figure A1: Total Fertility Rates over Time by World Region, UN Data



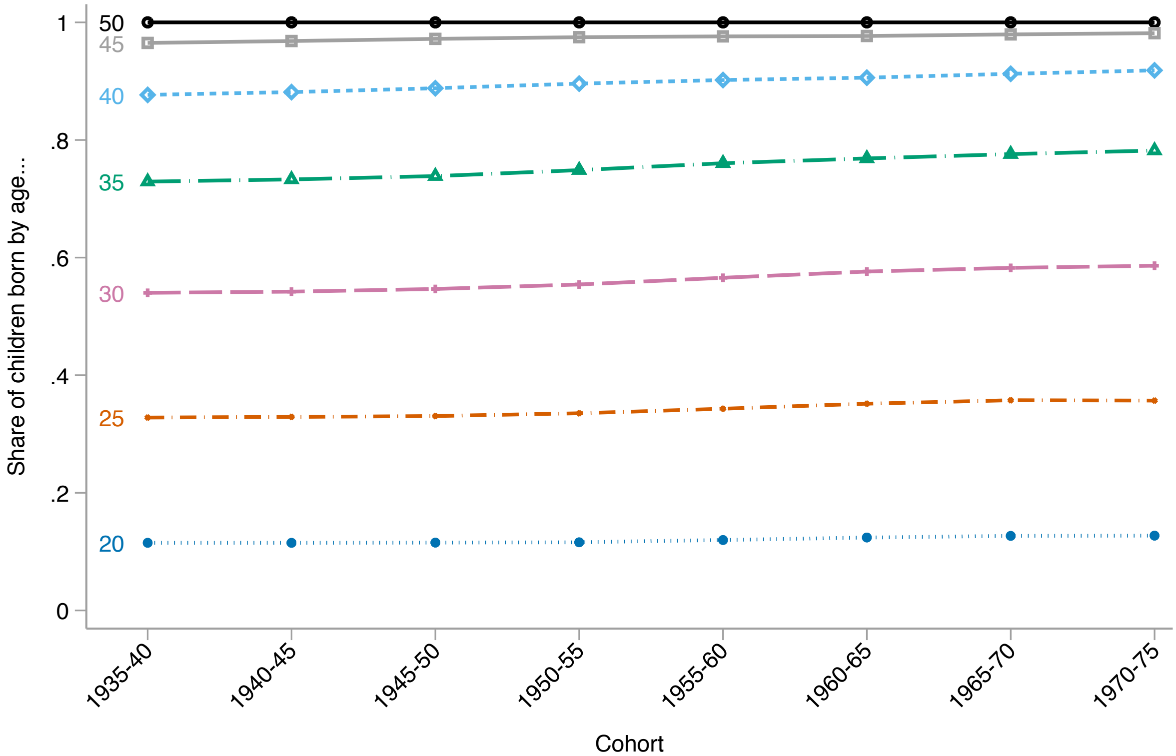
Notes: Population-weighted average total fertility rates across 235 countries from UN (2019).

Figure A2: Educational Attainment over Time by World Region, Barro-Lee Dataset



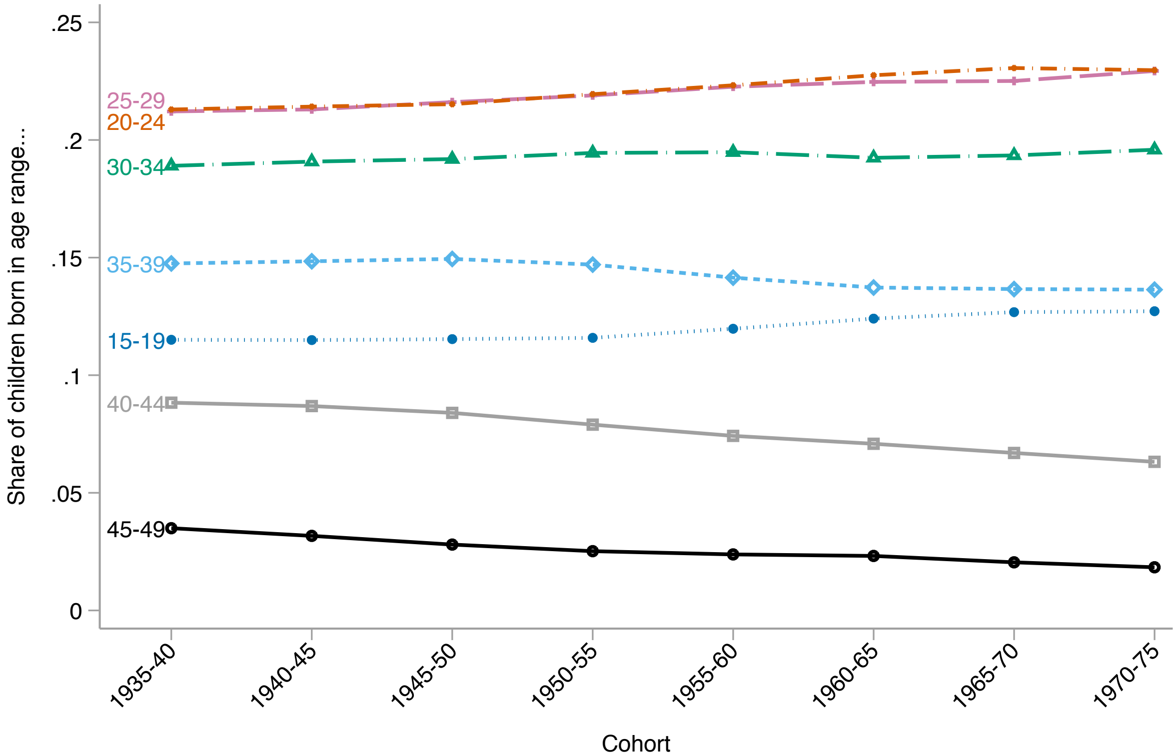
Notes: Population-weighted average years of schooling across 146 countries from Barro and Lee (2013).

Figure A3: Shares of Cohort Children Ever Born *by* Specific Ages, UN Africa Data



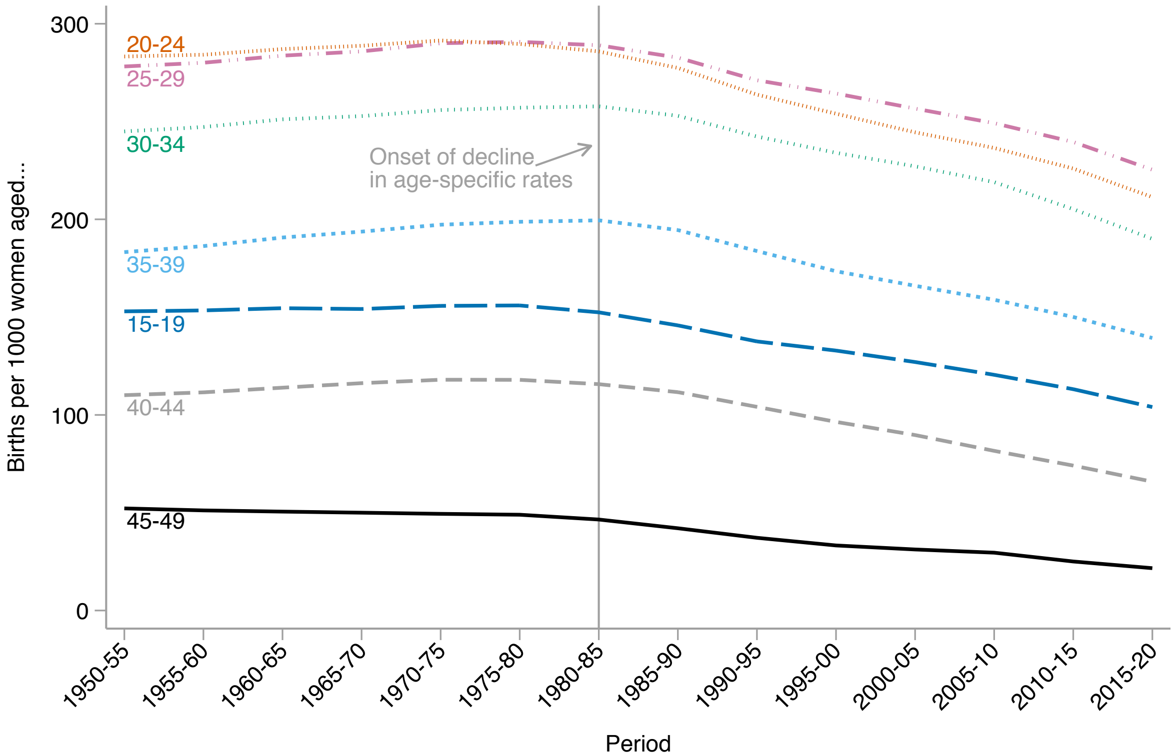
Notes: Cohort refers to the five-year period of birth. Average children ever born computed from age-specific fertility rates for each cohort in 51 sub-Saharan countries from UN (2019).

Figure A4: Shares of Cohort Children Ever Born *in* Specific Age Ranges, UN Africa Data



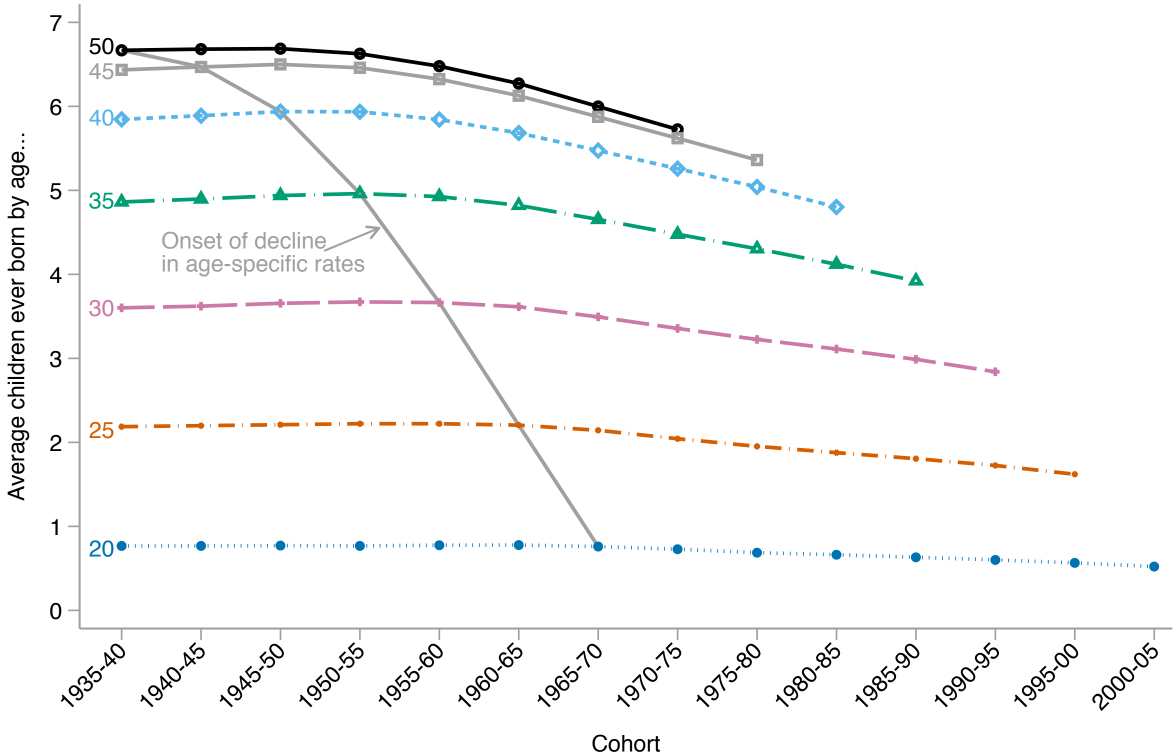
Notes: Cohort refers to the five-year period of birth. Average children ever born computed from age-specific fertility rates for each cohort in 51 countries from UN (2019).

Figure A5: Age-Specific Fertility Rates over Time, UN Africa Data



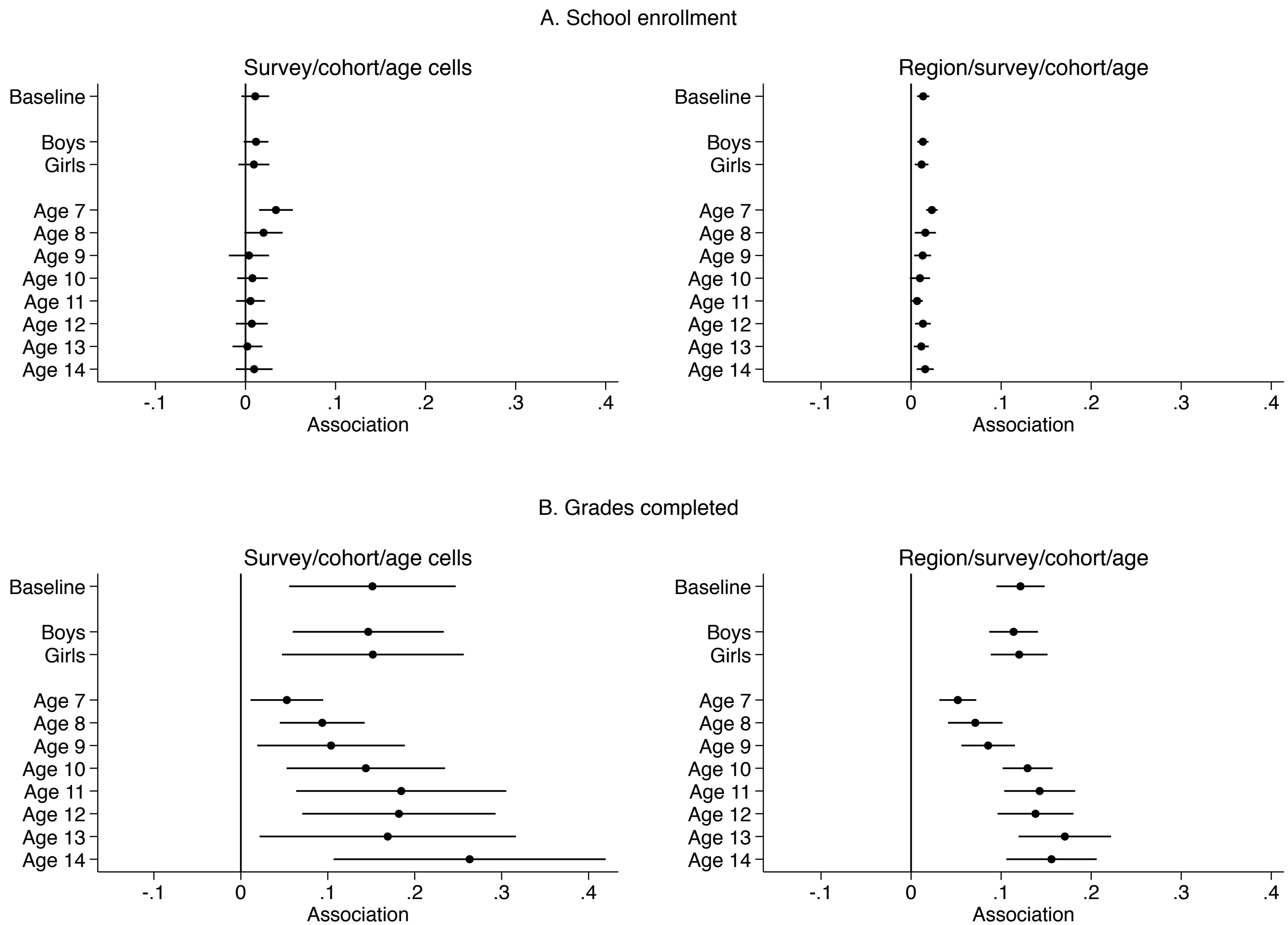
Notes: Average age-specific fertility rates weighted by age-group populations across sub-Saharan 51 countries from UN (2019). Gray "onset" line indicates the last period before most age-specific rates started declining.

Figure A6: Average Children Ever Born Across Cohorts, UN Africa Data



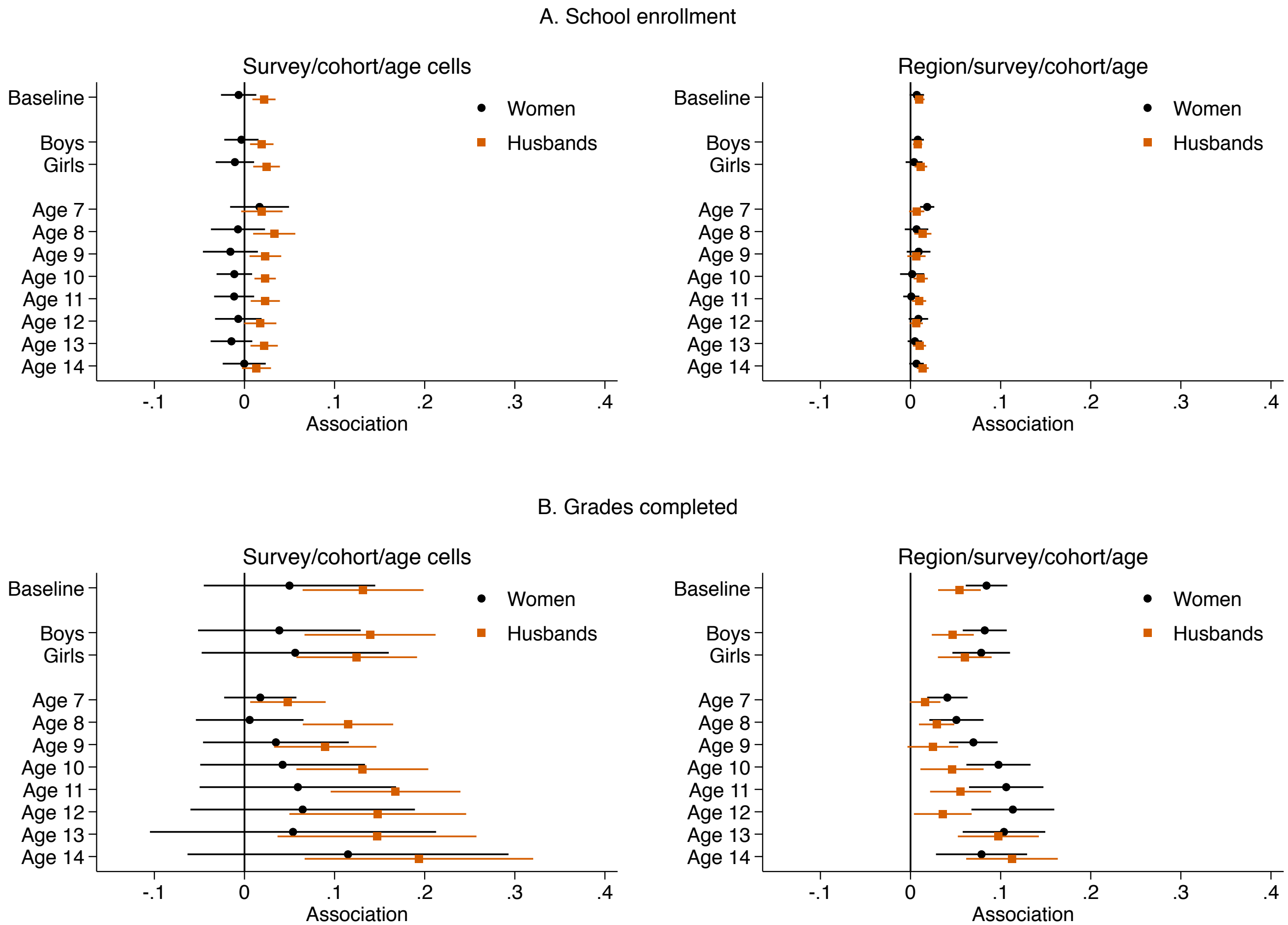
Notes: Cohort refers to the five-year period of birth. Average children ever born computed from age-specific fertility rates for each cohort in 51 sub-Saharan countries from UN (2019). Plot reflects the average across countries, weighted by cohort population at age 25-29. Gray "onset" curve indicates the last cohort to not exhibit declines in cumulative fertility at the specified age.

Figure A7: Heterogeneity in the Relation Between Women's Education and Child Education



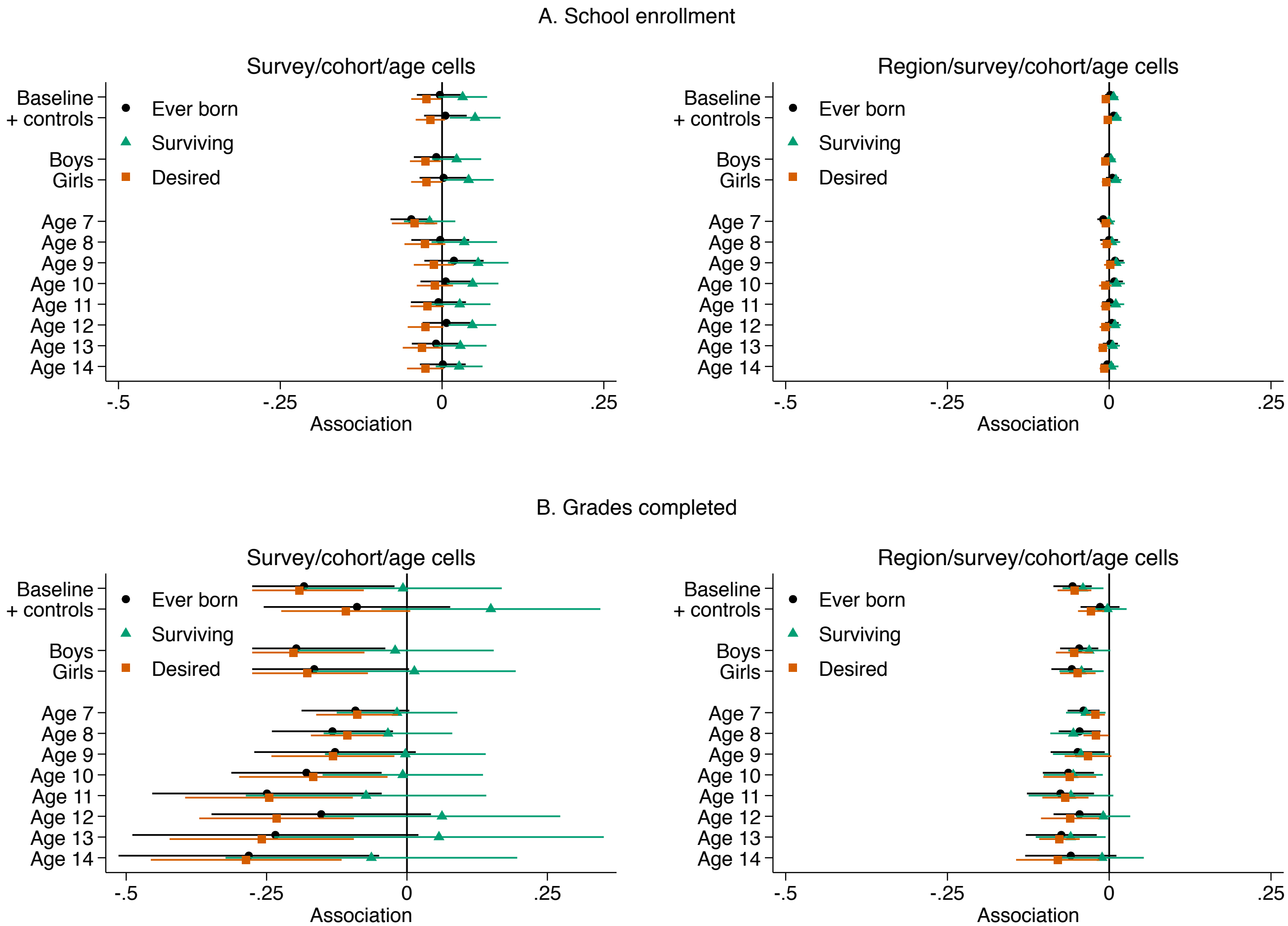
Notes: Point estimates and 95% confidence intervals (based on standard errors clustered by country). Regressions using survey/cohort/age cells include country-by-child age FE and cohort-by-child age FE. Regressions using region/survey/cohort/age cells include region-by-child age FE and survey-by-cohort-by-child age FE. Cells are weighted by the number of observations.

Figure A8: Heterogeneity in the Relation Between Adult Education and Child Education, Women vs. Husbands



Notes: Point estimates and 95% confidence intervals (based on standard errors clustered by country). Regressions using survey/cohort/age cells include country-by-child age FE and cohort-by-child age FE. Regressions using region/survey/cohort/age cells include region-by-child age FE and survey-by-cohort-by-child age FE. All regressions control for rates of current and never marriage. Cells are weighted by the number of observations.

Figure A9: Sensitivity and Heterogeneity in the Relation Between Fertility and Children's Education



Notes: Point estimates and 95% confidence intervals (based on standard errors clustered by country). Regressions using survey/cohort/age cells include country-by-child age FE and cohort-by-child age FE. Regressions using region/survey/cohort/age cells include region-by-child age FE and survey-by-cohort-by-child age FE. Cells are weighted by the number of observations. "Controls" include womens' average education, husbands' average education, and rates of current and never marriage.