School Quality, Literacy, and the Differences in Fertility across Regions*

Extended Abstract

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Abstract

Sub-Saharan Africa's fertility decline has progressed much slower than in other regions. Although many explanations have been advanced to explain this, there has so far been little focus on the potential role of differences in school quality. Partly motivated by the strong negative association between female education and fertility, many developing countries significantly expanded access to education starting in the 1970s. However, the quality of education often declined with the increased enrollment. This reduction in quality was especially severe for primary education, with Sub-Saharan Africa doing particularly badly. As a first step towards understanding the role of school quality on the relationship between female education and fertility, this paper examines whether the differential literacy skills acquired by grade levels across countries may help explain differences in fertility outcomes across regions. The data comes from all Demographic and Health Surveys (DHS) and Unicef's Multiple Indicator Cluster Surveys (MICS) from countries in East Asia, South Asia, Latin America, and Sub-Saharan Africa, collected between 1986 and 2022. Using data from approximately 5,000,000 women across the four regions, I plan on estimating individual-level fertility outcomes as a function of literacy, region, age, and cohort by area of residence.

JEL: J1, O1, I15, I25

Keywords: Education quality, mortality, cross-national, grade-level

1 Introduction

Most developing countries have seen astonishing declines in total fertility rates over the last half-century, moving from around six children to replacement level (Pörtner, 2018). Sub-Saharan Africa is the exception, with a current total fertility rate twice that of the other regions, as shown in Figure 1. However, despite long-standing interest, there is still significant disagreement about how, or even if, fertility behavior in Sub-Saharan Africa differs from other regions (van de Walle and Foster, 1990; Ainsworth, 1996; Casterline, 2017; Pörtner, 2024).[1]

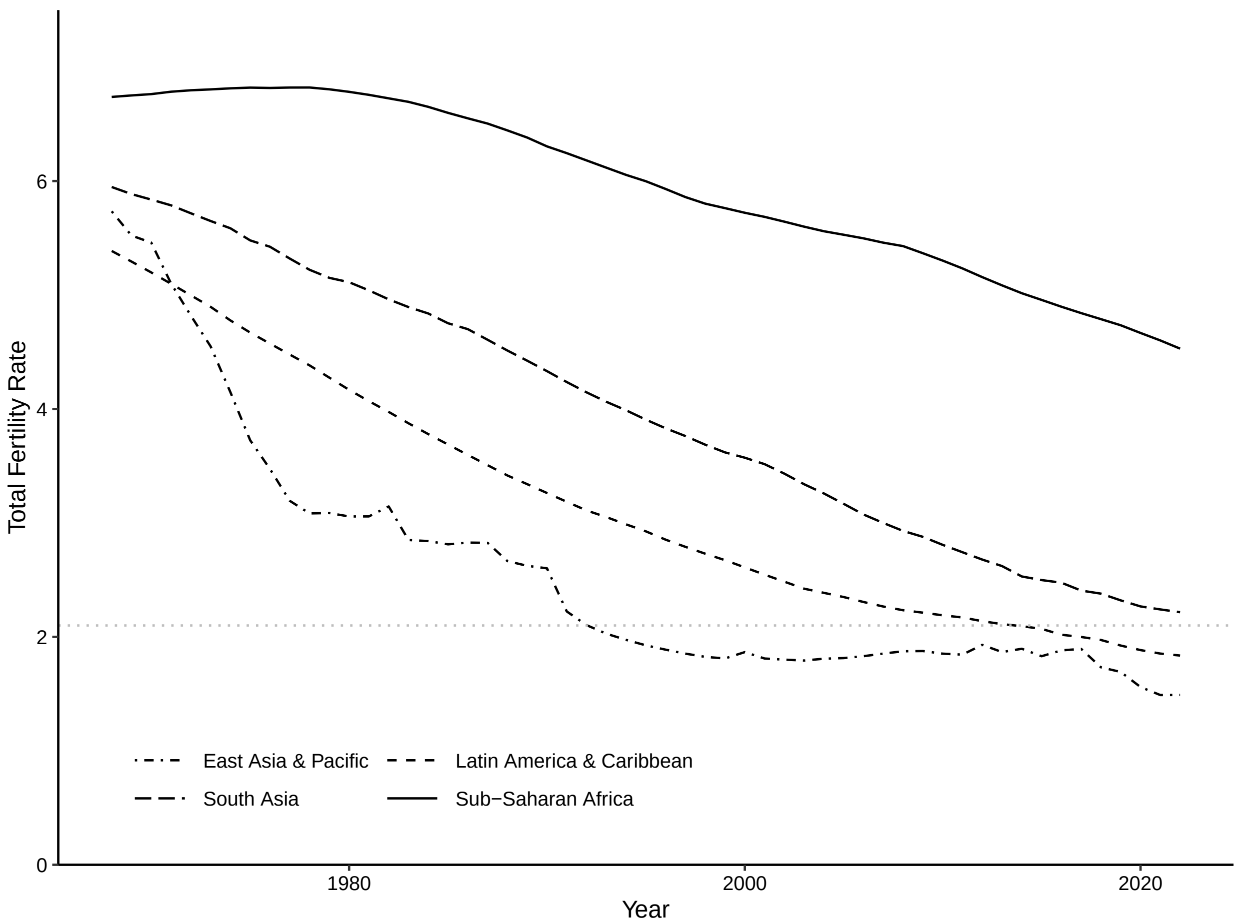

Figure 1: Total Fertility Rate by Region from 1970 to 2021. Source: World Bank World Development Indicators

[1]For a concise history of fertility decline in Sub-Saharan Africa and a more in-depth review of recent research, see Casterline (2017).

In prior work, I show that how fertility behavior in Sub-Saharan Africa differs from other regions depends critically on which region and education combinations are compared (Pörtner, 2024). Figure 2 shows that there are minimal differences in children ever born for women with approximately secondary school and above when comparing Sub-Saharan Africa with South and East Asia, and relatively little difference between Sub-Saharan Africa and Latin America when we compare no-education women. However, there are substantial and statistically significant differences for women with some primary education across all three comparison regions, and these differences are even evident for younger age groups. Using surviving children instead of children ever born reduces the differences, but the underlying patterns remain the same.

These results have two implications. First, to explain the differences in fertility between Sub-Saharan Africa and other regions, we need to understand why fertility differences are so large and increase with primary education. Second, when estimating the relationship between female education and fertility, the standard assumption that an extra year of schooling represents the same increase in human capital across time and space is unlikely to hold.

One potential explanation for the observed pattern in fertility is differences in school quality. Partly motivated by the strong effects of female education on fertility, many developing countries significantly expanded access to education starting in the 1970s. However, the quality of education declined with the increased enrollment. This reduction in quality was especially severe for primary education, with Sub-Saharan Africa doing particularly badly (Bold, Filmer, Martin, Molina, Stacy, Rockmore, Svensson, and Wane, 2017; World Bank, 2017; Bold, Filmer, Molina, and Svensson, 2019; Pritchett and Sandefur, 2020; Singh, 2019; Evans and Mendez Acosta, 2021; Nestour, Moscoviz, and Sandefur, 2023). The implication is that regions such as Sub-Saharan Africa, which, on average, have lower-quality schools, may not see the same reduction in fertility with increasing schooling as other regions would see with the same increase. The poor quality may explain why fertility begins

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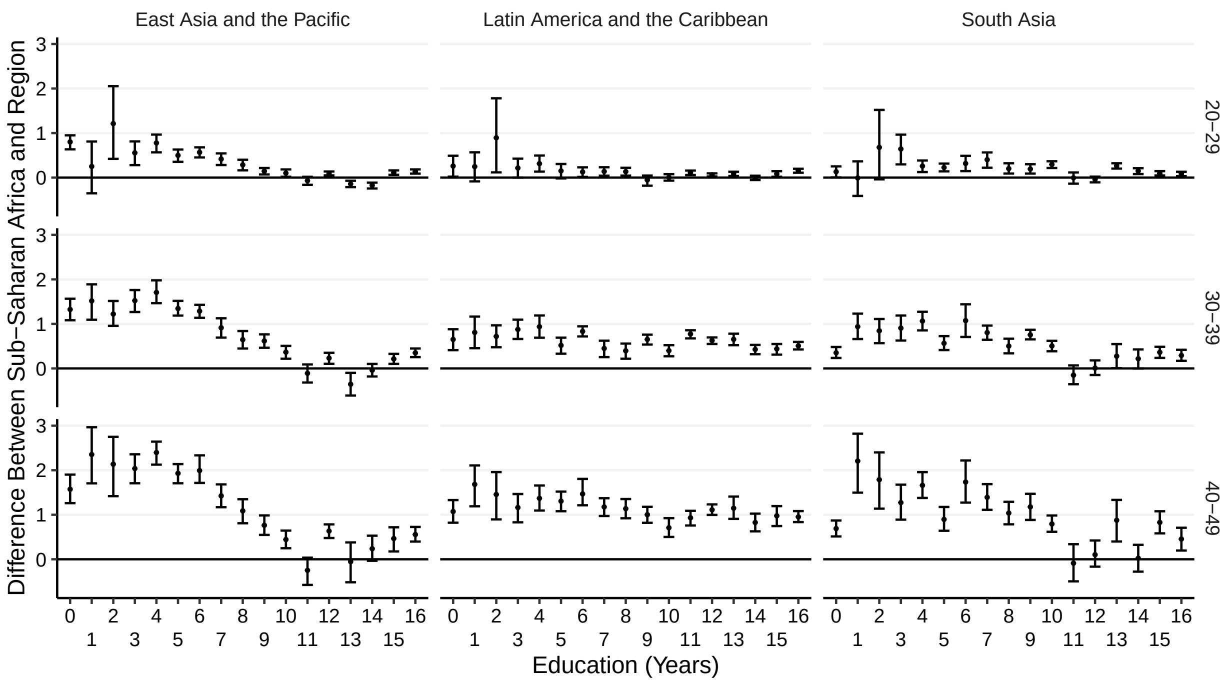

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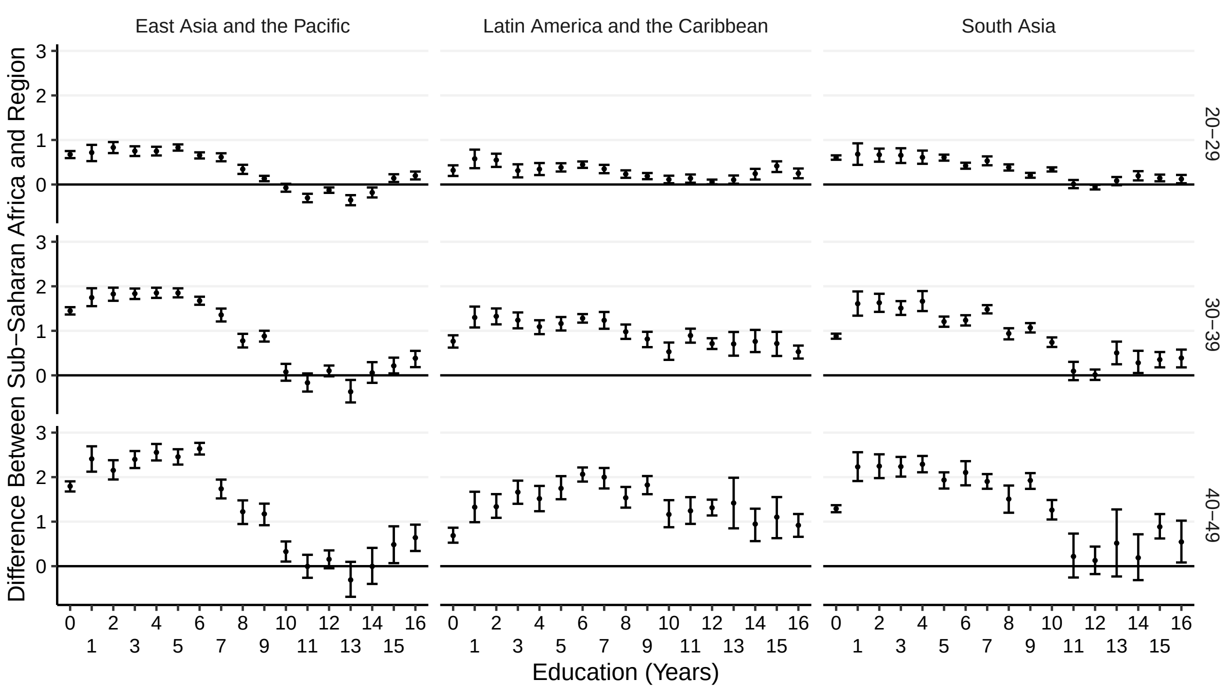


Figure 2: Differences in the number of children ever born between Sub-Saharan Africa and regions by area of residence and age group for three age groups, 20–29, 30–39, and 40–49, conditional on being born in or after 1990, 1980, and 1970, respectively, with 95% bootstrapped confidence intervals. Source: Author's analyses based on all Demographic and Health Surveys and Multiple Indicator Surveys collected from 2010 on.

to decline at higher levels of education in Sub-Saharan Africa than in the other regions (Martin, 1995; Ainsworth, Beegle, and Nyamete, 1996; Benefo and Schultz, 1996; Thomas and Maluccio, 1996; Schultz, 1997; Lloyd, Kaufman, and Hewett, 2000).

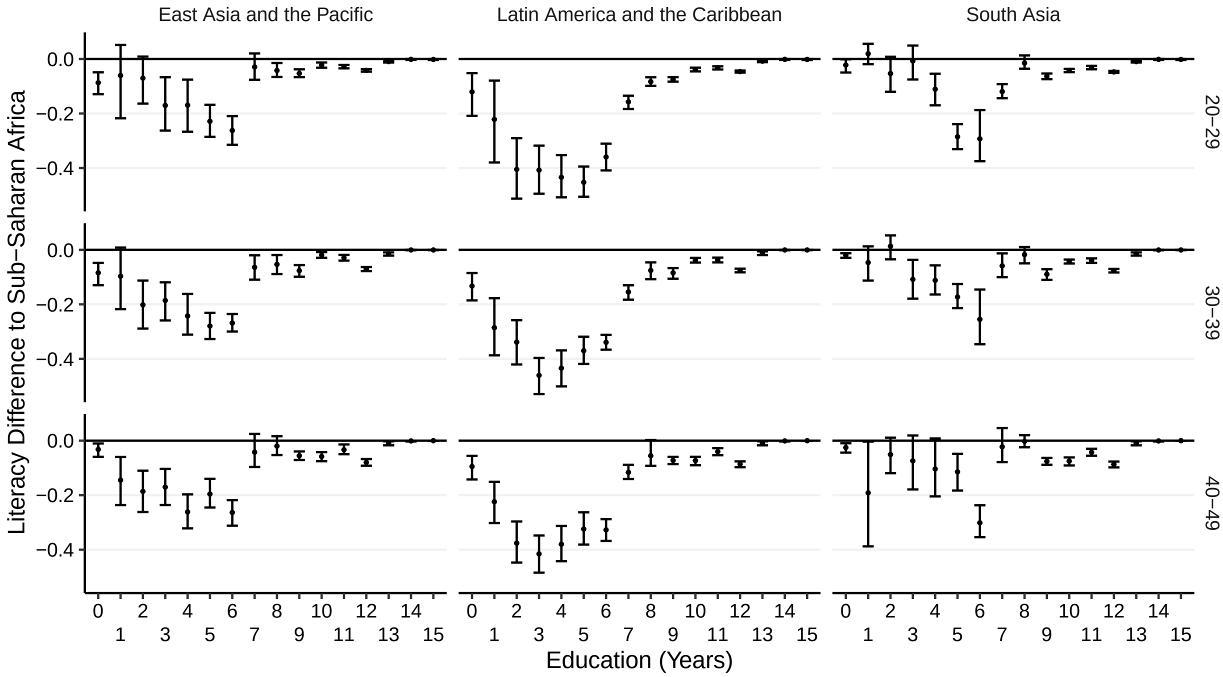
My prior work explored differences in literacy outcomes across regions as indirect evidence of school quality. Figure 3 shows the estimated differences in literacy rates between Sub-Saharan Africa and each region using the same estimation approach as above. The poor performance of Sub-Saharan African schools in teaching minimal literacy skills is evident, especially compared to Latin America and East Asia. At the peak differences, around third and fourth grades, 40 percentage points fewer women can read a simple sentence in Sub-Saharan Africa than in Latin America, and the difference to East Asia is around 30 percentage points. Even though the difference to South Asia is smaller, it is around ten percentage points for third and fourth grade and up to 30 percentage points for grade sixth.

Although my prior work suggests a relationship between fertility and school quality, measured by literacy, it did not test this relationship or establish how much of the differences in fertility could be explained by incorporating literacy. The proposed paper will, therefore, examine to what extent acquired literacy may explain the observed difference across regions. I will use women-level data from Demographic and Health Surveys (DHS) and Multiple Indicator Cluster Surveys (MICS) collected in East Asia, South Asia, Latin America, and Sub-Saharan Africa to estimate fertility outcomes by area of residence, incorporating grade level, literacy skill acquired, age, and cohort. The following sections discuss the data and the proposed estimation strategy.

2 Data and Estimation Strategy

The data comes from all Demographic and Health Surveys (DHS) and Unicef's Multiple Indicator Cluster Surveys (MICS) from countries in East Asia, South Asia, Latin America,

(a) Urban



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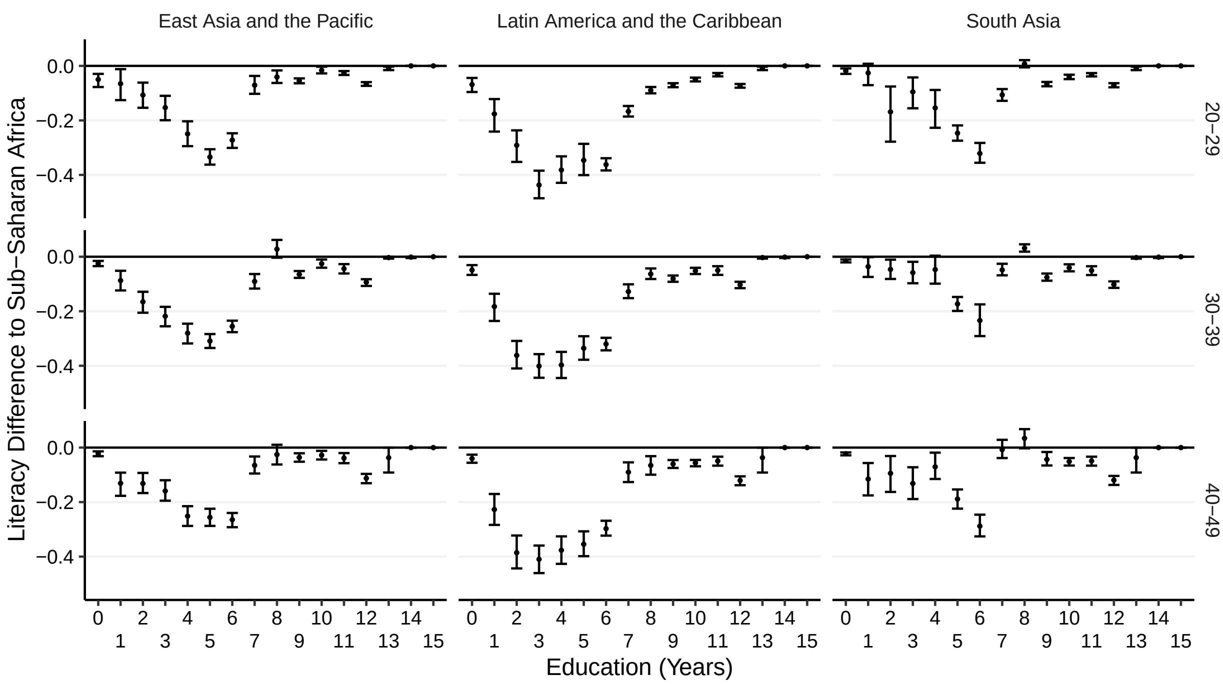


Figure 3: Differences in literacy between Sub-Saharan Africa and regions by area of residence and age group for three age groups, 20–29, 30–39, and 40–49, conditional on being born in or after 1990, 1980, and 1970, respectively, with 95% bootstrapped confidence intervals. Source: Author's analyses based on all Demographic and Health Surveys and Multiple Indicator Surveys collected from 2010 on.

and Sub-Saharan Africa, collected between 1986 and 2022, that contain the necessary information on fertility and literacy. Both DHS and MICS provide high-quality individual-level information on fertility histories, characteristics, and behaviors. The sample currently consists of 4,901,012 women aged 20 to 49.

The only school-quality-related information available in the data is the literacy variable, self-reported or tested by the enumerator. In the first three phases of the DHS surveys and the first two of the MICS surveys, the literacy question asks if the respondent can read a letter or newspaper easily, with difficulty, or not at all. Enumerator-tested literacy is only available for the later surveys (for the MICS surveys from phase 3 onward and the DHS surveys from phase 4 onward).

In the enumerator-tested literacy, the enumerator hands a card to the respondent in the respondent's preferred language and asks the respondent to read the sentence with the enumerator assessing whether the respondent cannot read at all, can read only part of the sentence, or able to read the whole sentence. Examples of sentences include "The child is reading a book," "The rains came late this year," "Parents must care for their children," and "Farming is hard work." (UNICEF, 2006, p. A2.14). Furthermore, there is an option for no card available in the requested language, and from phase 5 on, whether the respondent is blind or visually impaired.

A potential issue is a significant variation in which grade-level surveys ask respondents about literacy over time and across countries. Initially, many surveys only asked women with primary education or below about literacy, with most assuming that women who had finished primary were literate (two surveys even asked only up to grade 3). With concerns about low school quality levels, particularly in Sub-Saharan Africa, many surveys have expanded the grade levels for which they test literacy, even, in some cases, including women who report having completed secondary schooling.

The primary analyses, therefore, will restrict the sample of women to those with five or fewer years of education and to surveys where literacy is asked of everyone up to grade five. As Figure 4 shows, using only surveys collected from 2010, a substantial proportion of women still have five years of schooling or less, even among the 20–29 year-olds. The primary analyses will be supplemented with analyses that focus on more recent surveys that test literacy for grades higher than five. Although this will significantly limit the available sample of countries, the advantage is that it can shed light on the differences in fertility for women who have between six and ten years of education.

3 Estimation Strategy

The standard reduced-form equation for estimating the association between schooling and fertility often follows a set-up such as:

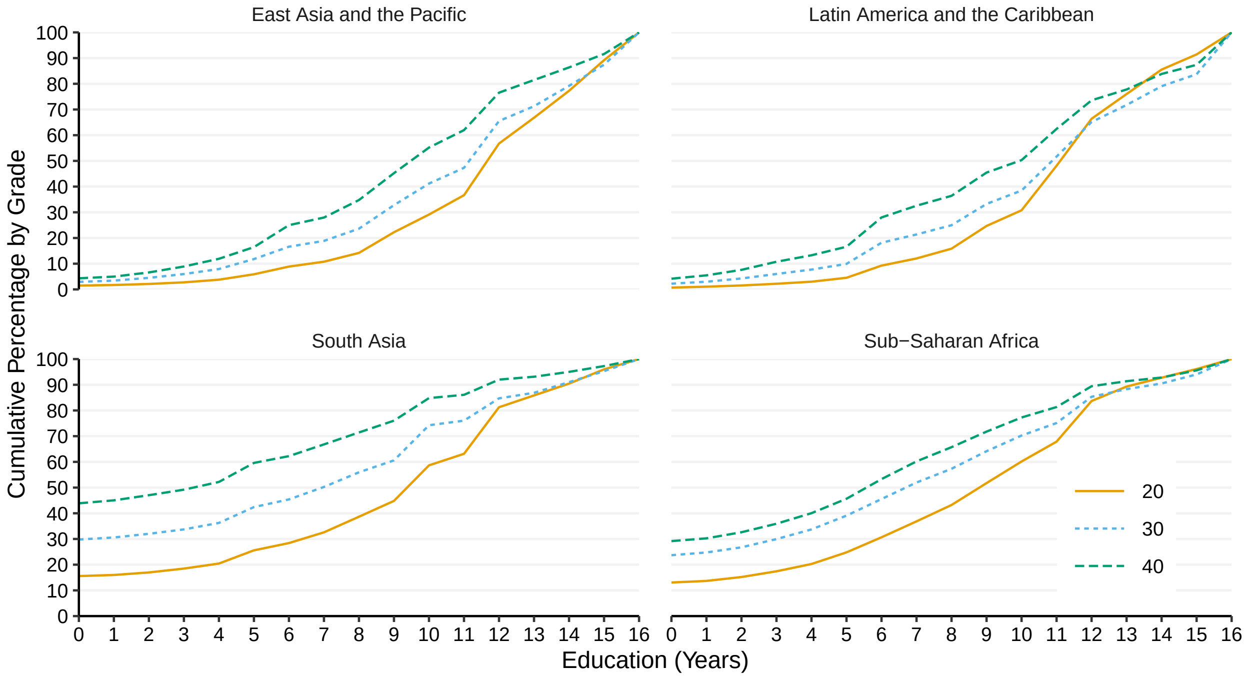
$$\text{CEB}_i = \beta_0 + \beta_1 \text{Educ}_i + \ldots + \epsilon_i, \tag{1}$$

where Y_i is the number of children ever born to woman i and Educ her number of years of schooling. In addition to not fully using the large-scale microdata available, my prior work shows that this fails to adequately capture the differences in fertility across regions by grade level.

To examine literacy skills' role in explaining fertility differences, I will estimate models with and without literacy included. A stylized version of the model that does not include literacy is

$$\begin{aligned} Y_{ir} = \alpha &+ \sum_{r \notin \text{SSA}} \beta_r 1[\text{Region}_i = r] + \sum_{g=1}^{5} \delta_g 1[\text{Educ}_{ir} = g] \\ &+ \left(\sum_{r \notin \text{SSA}} \sum_{g=1}^{5} 1[\text{Region}_i = r] \times 1[\text{Educ}_{ir} = g] \right)' \boldsymbol{\gamma} \\ &+ \text{X}_{ir}' \boldsymbol{\zeta} + \epsilon_{ir}, \end{aligned} \tag{2}$$

(a) Urban



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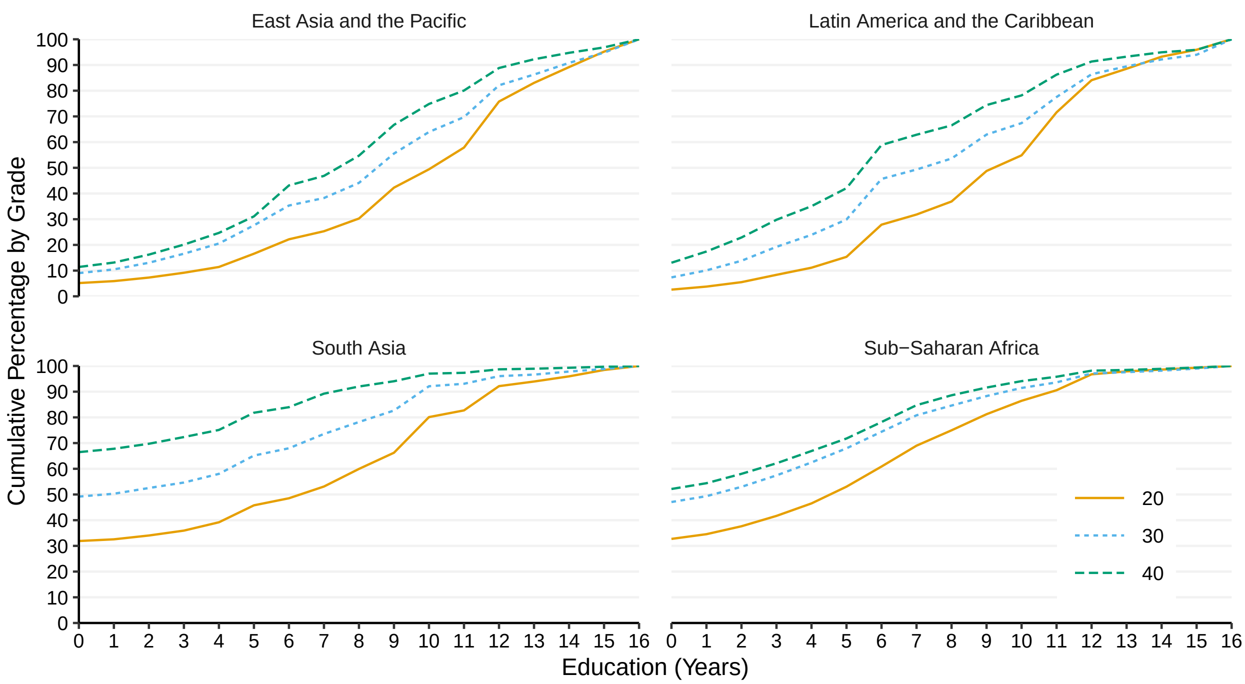

Figure 4: Cumulative distribution of education by age group, region, and area of residence for three age groups, 20–29, 30–39, and 40–49, conditional on being born in or after 1990, 1980, and 1970, respectively. Source: Author's analyses based on all Demographic and Health Surveys and Multiple Indicator Surveys collected from 2010 on.

where Y_{ir} is either children ever born or surviving children for woman i in region r and X are other individual characteristics.

The individual coefficients on regions, grade levels, and their interactions in Equation (2) allow me to establish a more formal test of grade-level differences than in my prior work. More importantly, the base model allows me to test whether the coefficients on education change when including literacy skills. For ease of interpretation, I use illiteracy, although this obviously does not affect the percentage of variation in fertility explained by the model. The stylized version of the model with literacy included is

$$\begin{aligned}
Y_{ir} = \alpha &+ \sum_{r \notin \text{SSA}} \beta_r 1[\text{Region}_i = r] + \sum_{g=1}^{5} \delta_g 1[\text{Educ}_{ir} = g] \\
&+ \left(\sum_{r \notin \text{SSA}} \sum_{g=1}^{5} 1[\text{Region}_i = r] \times 1[\text{Educ}_{ir} = g] \right)' \boldsymbol{\gamma} \\
&+ \eta D_i^{illiterate} + \left(D_i^{illiterate} \times \sum_{r \notin \text{SSA}} 1[\text{Region}_i = r] \right)' \boldsymbol{\theta} \\
&+ \left(D_i^{illiterate} \times \sum_{g=1}^{5} 1[\text{Educ}_{ir} = g] \right)' \boldsymbol{\iota} \\
&+ \left(D_i^{illiterate} \times \sum_{r \notin \text{SSA}} \sum_{g=1}^{5} 1[\text{Region}_i = r] \times 1[\text{Educ}_{ir} = g] \right)' \boldsymbol{\kappa} \\
&+ \text{X}_{ir}' \boldsymbol{\zeta} + \epsilon_{ir},
\end{aligned} \tag{3}$$

where $D_i^{illiterate}$ is an indicator variable that takes the value 1 if the woman cannot read the simple sentence and 0 otherwise.

Suppose illiteracy is an indicator of having attended a lower-quality school. In that case, we should expect the coefficients on the interactions between region and grade levels to be closer to zero in Equation (3) than in the base model. However, given that literacy acquisition is a relatively crude measure of school quality, it is unlikely that the coefficients will become insignificantly different from zero. Versions of these models will be estimated separately for urban and rural women and, as mentioned, using both children ever born and surviving children as the dependent variables.

Furthermore, I plan to estimate alternative models that incorporate alternative uses of the available literacy information instead of individual-level literacy. One option is the predicted percentage literate by grade five, as Nestour, Moscoviz, and Sandefur (2023) suggested. Another is to capture learning profiles, such as the grades at which, for example, 25%, 50%, and 75% of women have achieved literacy.

For all estimations, the goal is more to highlight the potential role of school quality in fertility differences across regions than to estimate the causal effects of literacy skills, school quality, or education on fertility. Specifically, two selection issues would be particularly thorny to address if the goal was a causal analysis of school quality. First, the likelihood of continuing in school depends on the return to an additional year of schooling. If the quality of schooling is low, the return is lower, and people are less likely to continue in school. Hence, in low-quality environments, we are more likely to observe those who were able to learn despite the low quality of the instruction. Correspondingly, in high-quality environments, those who drop out with only some primary school are likely those who may be less academically inclined. Second, the expansion of school enrollment may draw in "lower-quality" students, which would make it appear that the quality of instruction has declined even though only the distribution of students has changed In addition to these issues, there are more general issues of establishing school quality based on a simple measure of literacy.

3.1 Regression Weights

The DHS and MICS surveys provide weights to calculate nationally representative results (ICF International, 2012). The challenge lies in appropriately weighting observations across birth years and countries for the regression models. Within countries, women differ in their likelihood of being observed because birth years vary in their likelihood of being covered by multiple surveys. Across countries, modeling should account for differing population sizes since survey samples are not proportional to the populace. For instance, despite being one-third of Sub-Saharan Africa's population, Nigeria, Ethiopia, and the Democratic Republic of the Congo contribute fewer surveys than Senegal. Finally, the weighting should use the population size close to when fertility decisions were made, rather than, as is often done, more current population sizes, which skew results towards high fertility countries.

I will employ the following procedure for weighting. First, to overcome the differences in the likelihood of being surveyed by birth year and the differences in the number of surveys across countries, I rescale each country-cohort combination so weights add to one within each. Second, to incorporate differences in population size, I multiply the rescaled weights with the log of population size of the relevant area of residence when the women turned 20 (15 for the total fertility rate estimations). I chose age 20 because population size split by urban and rural is then available for all women in the sample and is still early in the women's reproductive ages. Each year's urban and rural population sizes are drawn from the World Bank Open Data using the "wbstats" R package.

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