Chapter 4
Socio-Economic Determinants of Fertility

4.1 Introduction

Conventional demographic and economic theories of the fertility transition emphasize the demand driven nature of reproductive change. These theories propose that socio-economic development raises the cost of children and reduces their benefits, thus leading parents to decrease their desired family size and to practice contraception or abortion to achieve lower fertility. A weakness of conventional theories about fertility transitions is its generality. Many socio-economic indicators such as GDP per capita, life expectancy, child survival, education, and urbanization are correlated with fertility in bivariate cross-sectional comparisons of countries, but for many decades there was no agreement on the dominant driver of fertility decline.

More recently, however, the extensive literature on this topic has increasingly emphasized the central role of education and especially women's education (Cleland, 2009; Cochrane, 1979; Gaylor, 2005; Hadden & London, 1996; Jejeebhoy, 1995; Kravdal, 2002; Lloyd, 2003; Lutz & Skirbekk, 2014; Murtin, 2013; Schultz, 1994; Summers, 1992a, 1992b). A comprehensive regression analysis of the determinants of fertility using time series of data from 1870 to 2000 by Murtin (2013) concludes that "…average years of primary schooling among the adult population, rather than income standards, child mortality, or total mortality rates, drive fertility down by about 40 percent to 80 percent when those years grow from zero (no literacy) to six years (full literacy). This result is robust to a variety of specifications, samples, and econometric models" (Murtin, 2013: 617). Similarly, Cleland (2009: 183) concludes: "Education of adults persistently emerges as the single most powerful predictor of their demographic behavior." Lutz and Skirbekk (2014: 15) agree: "…educational attainment is not just one of many socio-economic factors that matter…[it] is the single most important source of empirically observable population heterogeneity."

Several causes have been proposed for the effect of women's education on fertility, including greater autonomy in decision-making, more knowledge about reproduction and contraception, higher potential for earnings, and rising opportunity costs of

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childbearing (Diamond et al., 1999; Jejeebhoy, 1995; Lloyd, 2003). A related set of studies examines the role of mass schooling which may lower fertility in developing countries by reducing the children's potential to work in or outside the home, raising the costs of children, speeding up cultural change, and propagating middle-class values (Caldwell, 1980).

While there is a growing consensus about the key role of education as a cause of fertility decline, as well as about the minor roles of GDP per capita and percent urban, there is less agreement about the effect of child mortality. Several authors argue for a role of mortality decline as a determinant of fertility (Angeles, 2010; Canning et al., 2015; Cleland, 2001b), but others find little effect or point to methodological shortcomings of past studies thus leaving the question of the impact of mortality decline on fertility decline unresolved (Angeles, 2010; Murtin, 2013; Wolpin, 1998). It is possible that Notestein's original views, that mortality decline is a necessary but not sufficient condition for fertility decline and that social and economic changes are needed to bring about reproductive change, are correct (Notestein, 1945). The "necessary but not sufficient" hypothesis is consistent with the pattern observed in a number of the least developed contemporary Western African countries (e.g., Chad, Congo DR, Mali, and Niger), where child mortality has declined by half since the 1950s, but these improvements have only been followed by minor changes in fertility (United Nations, 2019).

This chapter begins by examining the evidence on the potential roles of several socio-economic variables as causes of fertility trends in the developing world from 1960 to 2015. The analysis confirms that female education is the dominant socio-economic driver of fertility transitions in the developing world. Next, a more in-depth examination of the fertility effects of education at different stages of the transitions reveals several unexpected findings, demonstrating that socio-economic changes alone provide only a partial and often inadequate explanation for fertility trends. The concluding section aims to explain these anomalies by resorting to diffusion theory, social influence, and family planning programs.

4.2 Data

The dependent variable in the regression analyses presented below is the total fertility rate. Estimates from 1960 to 2015 are taken from the United Nations fertility data base (United Nations Population Division, 2019). Other indicators such as the onset of the transition are derived from TFR trends (see Chap. 2).

The explanatory variables consist of the following country-level socio-economic indicators:

- Education, as measured by the average years of schooling among women aged 20–39 (Wittgenstein Center for Demography and Global Human Capital, 2015),[1]

[1] It should be emphasized that the number of years of schooling does not measure the quality of education.

- Child mortality, ages 0–4 (United Nations Population Division, 2019)
- Real GDP per capita (PPP[2]) taken from the Penn World Table (Feenstra et al., 2015)
- Percent of population that is urban (United Nations Population Division, 2018).

4.3 Which Socio-Economic Variable is the Main Driver of Fertility Transitions?

Population level fertility correlates with many socio-economic variables. To illustrate, Fig. 4.1 plots the 2015 cross-sectional relationship between the total fertility rate and four socio-economic indicators (womens' education, child mortality, GDP/capita, and percent urban) for 97 developing countries. All four correlations are in the expected direction and are highly statistically significant.

The key question now is whether these correlations are causal or simply due to collinearity. Answering this question requires a multivariate statistical analysis. We

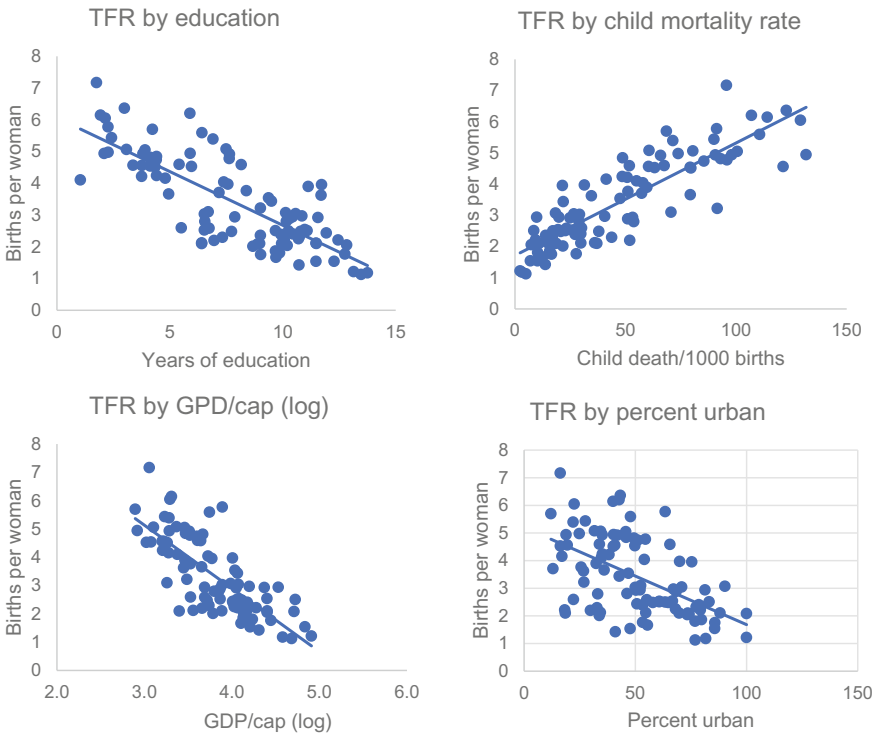


Fig. 4.1 Total fertility rate by socio-economic indicators for 97 developing countries in 2015

[2] PPP refers to purchasing power parity.

Table 4.1 Results of four fixed effects regression models with TFR as dependent variable. Data from 1960 to 2015

Dependent variable: total fertility rate				
	All countries		SS.Africa	Asia/NA/L.America
	Model 1	Model 2	Model 3	Model 4
Education	−0.42[a]	−0.41[a]	−0.35[a]	−0.38[a]
Child mortality	0.005[a]	0.005[a]	0.002[b]	0.008[a]
Log GDP/cap (PPP)	−0.001			
Percent urban	−0.001			
Constant	6.59	6.54	6.77	5.99
N	597	647	254	393
R^2	0.73	0.72	0.64	0.69

[a]$p < 0.001$, [b]$p < 0.01$, [c]$p < 0.05$, [d]$p < 0.1$

rely on fixed effect regression models which are the preferred approach when dealing with panel data such as we have with estimates of time series of the TFR and the explanatory variables for most countries from 1960 to 2015.

Table 4.1 presents the results of several such regressions in which the TFR is the dependent variable. Model 1 in this table summarizes the regression in which all four explanatory variables are included. The coefficients for education and child mortality are statistically significant ($p < 0.001$), while the effects of GDP/per capita and percent urban are not ($p > 0.1$). Model 2 represents the reduced model which drops these non-significant variables and again confirms that education and child mortality have a highly significant impact on fertility. Model 3 and 4 present the regional regression results for, respectively, SS.Africa and Asia/N.Africa/Latin America, with similar results except that the coefficient for child mortality is much smaller in SS.Africa than in Asia/N.Africa/L.America. The latter finding may be attributable in part to the AIDS epidemic which led to elevated levels of child mortality in much of SS.Africa after 1990.

The effect of education on the fertility level of a country can be estimated from the regression coefficient for education. For example, in model 1 this coefficient equals −0.42 which implies that an increase in years of education by 1 year leads on average to a decline in fertility of 0.42 births per woman. Similarly, a 10-year improvement in education would result in a decline of 4.2 births per women. The education coefficients for education in models 2, 3 and 4 are similar, although slightly smaller.

The regression coefficients presented in Table 4.1 are unstandardized. This means that their sizes cannot be usefully compared with one another because the variables are expressed in different units (e.g., years of education vs. child deaths per 1000 births). To assess which of the explanatory variables is most important as a determinant of fertility we calculated the standardized regression coefficients. In Model 2 for all countries the standardized coefficient equals 0.90 for education and 0.17 for child

mortality (not shown in Table 4.1). This implies that education is five times more important than child mortality as an explanatory variable for fertility trends. The standardized regression coefficients for models 3 and 4 also show a dominance of education in SSAfrica (ninefold) and in Asia/N.Africa/L.America (threefold). Based on these findings we focus below on the effects of education on fertility transition patterns.

4.4 Education and Fertility Transition Patterns

Figure 4.2 plots trends in education (i.e., the number of years of schooling for women aged 20–39) for 97 developing countries from 1960 to 2015. As expected, large gains have been achieved since 1960 in almost all countries. Improvements in L.America and in Asia/N.Africa were most rapid with average years of schooling tripling from around three years to over nine years. Gains in SS.Africa were also substantial with the average education level moving from 0.9 to 5.4 years. Trends in individual countries are almost all smooth and steady, with a few exceptions due to crisis periods.

Classical demographic transition theory and other conventional theories of fertility change assume a direct link between development indicators and fertility. If a development indicator changes by a certain amount, then fertility is assumed to respond in a more-or-less predictable way. Given the smooth trends in education one would therefore expect relatively steady declines in fertility associated with improvements in education over the course of the transition.

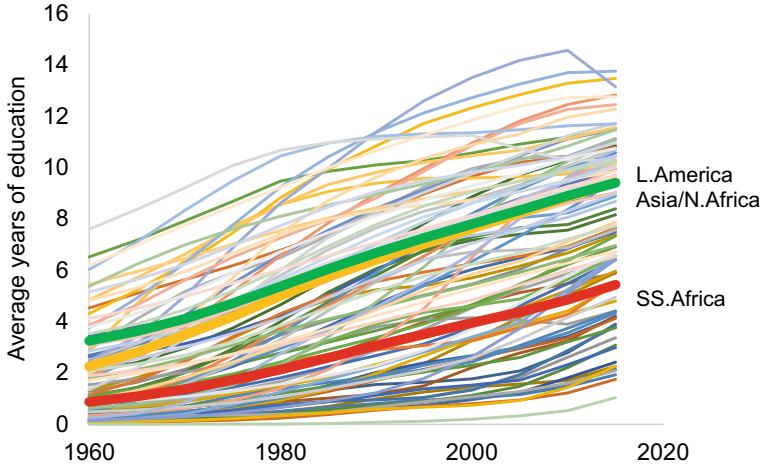


Fig. 4.2 Trends in education (years of schooling, women aged 20–39) from 1960 to 2015, 97 developing countries

Figure 4.3a–c examine this assumption. They present longitudinal trajectories of fertility by level of education for individual countries in the three major regions (only countries with a population size over 5 million are included). Each line in each figure represents the trajectory of one country with observations from 1960 to 2015. To simplify these figures, relative fertility (i.e., fertility as a proportion of maximum pre-transition fertility) is plotted to remove variation caused by differences in natural fertility.

As expected, in all regions the trend is one of declining fertility with rising education levels, but there is much variation in country trajectories. If education were the only determinant of fertility, then all countries would follow the same trajectory represented by the solid black regression line.[3] Any country's fertility level would solely be determined by its level of education and fluctuations in trends would solely be due to fluctuations in education. This clearly is not the case because a substantial proportion of variation in fertility is not explained by the level of education indicated by the regression line. For example, in SS.Africa the relative fertility of countries with 5 years of education ranges from 0.5 to 1.

Instead of random variations around a common trajectory over the course of the transition, clear patterns of deviation are visible. As the level education rises, fertility initially remains high and unchanged, followed by the transition's onset after which fertility declines rapidly through the middle of the transition. A slower pace of decline appears again near the transition's end as the country approaches replacement fertility.

There are several anomalies in the relationship between education and fertility. Such anomalies occur when the fertility response to a given increase in education is much larger or much smaller than expected. Most of these anomalies are evident in the panels of Fig. 4.3

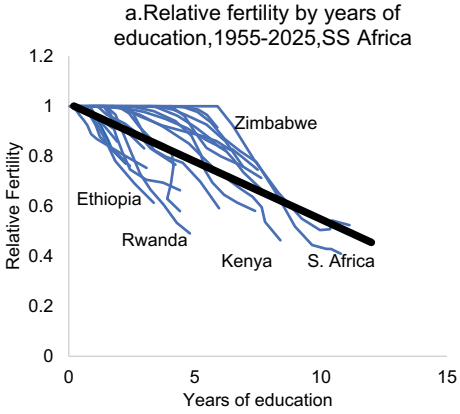
***Anomaly 1*: Before the onset of the transition fertility is unresponsive to increases in education**. In the first phase of a country's development process fertility typically remains high and unchanged as the education level improves. The duration of this flat section can last up eight years of education.

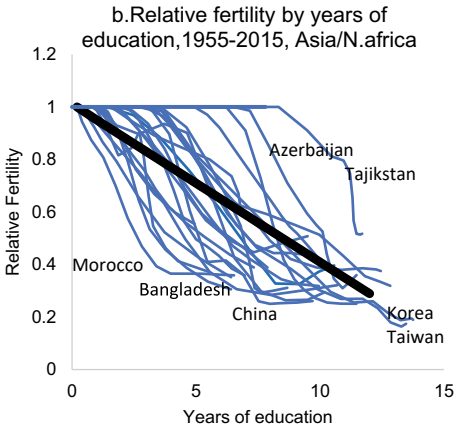
***Anomaly 2*: The level of education at the onset of transitions ("the threshold") varies very widely among countries**. The education threshold for entering the transition ranges from a year or less in Ethiopia, Morocco and Haiti to as high as eight years for Tajikistan.

***Anomaly 3*: The pace of change in fertility in mid-transition is faster than expected from the regression line**. This is the case even in a few countries with low levels of education (e.g., Bangladesh, Ethiopia, Morocco and Rwanda).

***Anomaly 4*: Once a country in a region has entered the transition, neighboring countries follow suit even when they have lower levels of education**. The first countries to begin a sustained fertility decline within a region typically do so only after relatively high levels of education have been attained. Once a few countries have entered the transition, the threshold drops for the remaining countries and their

[3] Linear OLS regression lines are fitted to all data in the figure.





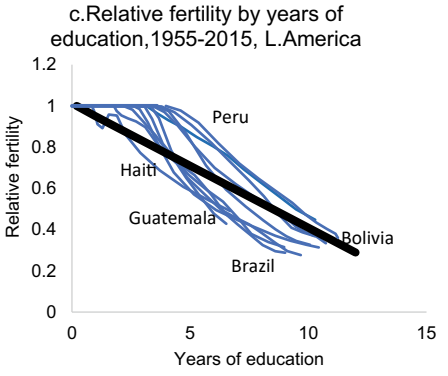


Fig. 4.3 Relative fertility by years of education, 1960–2025, 59 developing countries with population size above 5 million

probability of entering a transition rises over time. The last countries to enter the transition have significantly lower levels of development than the region's "leaders." For example, in Asia levels of education in the early onset countries Korea and Taiwan were substantially higher than the threshold in Bangladesh and Pakistan. South Africa and Kenya started transitions at higher education levels than later transitions in Ethiopia, Malawi and Rwanda.

4.5 Explanations of Anomalies

The above anomalies have been documented in previous research in both historical European countries (Coale & Watkins, 1986) and in transitions in the developing world in recent decades (Bongaarts & Watkins, 1996; Cleland & Wilson, 1987). To explain these anomalies researchers have developed theories employing concepts that were neglected in conventional demographic theories: diffusion processes, social norms and family planning programs.

The *diffusion of innovations* refers to the process by which new information, technologies, ideas, behaviors, and attitudes spread within a population through a variety of mechanisms such as social networks, opinion leaders, and media (e.g., Bongaarts & Watkins, 1996; Casterline, 2001; Cleland, 2001a; Cleland & Wilson, 1987; Montgomery & Casterline, 1993, 1996; Rogers, 1973, 2003; Watkins, 1987). This spread is most rapid within linguistically and culturally homogeneous populations and it can be largely independent of social and economic changes. The closely related term of *social interaction* emphasizes the active role individuals can play in diffusing information by, for example, discussing new ideas and their benefits and costs.

Social norms and social influence refer to the effects that the views and beliefs of others have on an individual's behavior. An individual's behavior does not depend only on his or her characteristics, preferences and circumstances, but also on community norms. Deviating significantly from these norms carries a cost that most people try to avoid. Community institutions are designed in part to enforce these norms.

Family planning programs represent organized efforts by governments or NGOs to assist women with implementing their reproductive preferences and avoiding unplanned pregnancies. These goals are achieved in part by providing access to contraceptive methods and services. In addition, family planning programs undertake information and education campaigns to accelerate the diffusion of information about methods of contraception and about the costs and benefits of children thus contributing to a decline in desired family size. A more detailed discussion of the role of family planning programs is provided in Chap. 6.

These concepts help explain the anomalies identified in the previous section:

(1) *Pre-transitional fertility is not responsive to development*. In traditional patriarchal societies deviation from social norms is disapproved. This is an important

obstacle to the introduction of new behaviors such as contraceptive use in societies where it has been absent. As a result, the rise in education at the beginning of the development process initially leads to no change in fertility as women prefer not to deviate from traditions that support high fertility. Social influence thus acts initially as a constraint on the adoption of innovative behavior by individuals who prefer to limit childbearing.

(2) *The level of education at the onset of transitions ("the threshold") varies widely among countries.* As noted, threshold level of education ranges from less than one to eight years. The low thresholds in certain countries can be attributed to several factors. First, countries differ in their social resistance to new ideas, for example, due to conservative or religious traditions supporting high fertility and patriarchal family life. Second, countries differ greatly in the heterogeneity of their cultural, ethnic and linguistic composition. Ideas about contraception and the benefits of smaller families spread more rapidly in homogenous than in heterogeneous societies. Third, a country benefits from having earlier transitions in neighboring countries from which ideas might diffuse (see discussion below). Fourth, the early introduction of a government family planning program also accelerates the onset of transitions.

(3) *Rapid pace of decline in mid transition countries.* Several factors may be operating. First, the diffusion of information about methods of contraception and the costs and benefits of children can happen rapidly without much change in socio-economic conditions. Second, family planning programs accelerated the pace of the transition. Third, if the transition onset is delayed until a country has reached a relatively high level of education, there may be penned up demand for contraception, which can be implemented quickly thus leading to rapid fertility decline.

(4) *Once a country in a region has entered the transition, neighboring countries follow sooner than expected from their level of education.* This anomaly is a result of a decline over time in the threshold level of education at the onset of the transition. Figure 4.4 presents average education levels at the onset of the transition in successive decades by region. This threshold level has declined substantially over time. In the sixties and seventies, the onset of fertility occurred on average at about 4 years of education in Asia and L.America and above 5 years in SS Africa. But from the 1980s onward, transition onsets have occurred at substantially lower levels near two years. This trend is evident within each major region.

This moving threshold would likely not occur if countries were isolated from one another. However, countries are linked through a variety of channels of social interaction: personal and institutional links exists among communities within the same country and among countries, facilitating diffusion and social interaction. Consequently, as time goes by, the probability of entering the transition rises for those communities and countries that have not yet done so. For example, Bangladesh was one of the last countries in Asia to enter its fertility transition and therefore had many regional examples of countries where transitions were already underway (e.g., Korea, Taiwan, Malaysia). These earlier transitions

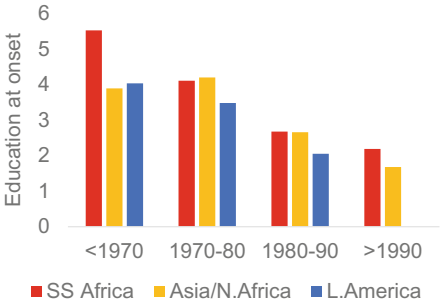


Fig. 4.4 Average years of education at transition onset by region and decade of onset

in neighboring countries demonstrated to governments that family planning programs could be successful.

An interesting implication of this declining threshold is that the difference in the timing of transitions between early- and late-starting countries in a given region is reduced from many decades to just two or three. For example, Bangladesh's transition would have been delayed by several decades if it had to wait until it achieved the same level of development as Taiwan and Korea had in 1960. Because of the moving threshold, transition onsets in Asia/N.Africa and Latin America have been concentrated in the 1960 and 1970s and in the 1980 and 1990s for SS Africa.

In sum, before the transition onset, social norms can inhibit fertility change. But once innovative fertility behavior has been adopted by a group of individuals within a community, by a community within a country, or by a few countries within a region, norms change and social interaction can become a powerful force that stimulates its onset elsewhere and accelerates the pace of transition in the rest of the community, the nation, or the world. Family planning programs accelerate all these processes.

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