Determinants and Consequences of High Fertility: A Synopsis of the Evidence

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Contents

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Acronyms and Abbreviations

AIDS	Acquired Immunodeficiency Syndrome
DHS	Demographic and Health Survey
GDP	gross domestic product
HIV	Human Immunodeficiency Virus
MDG	Millennium Development Goal
TFR	total fertility rate

Introduction

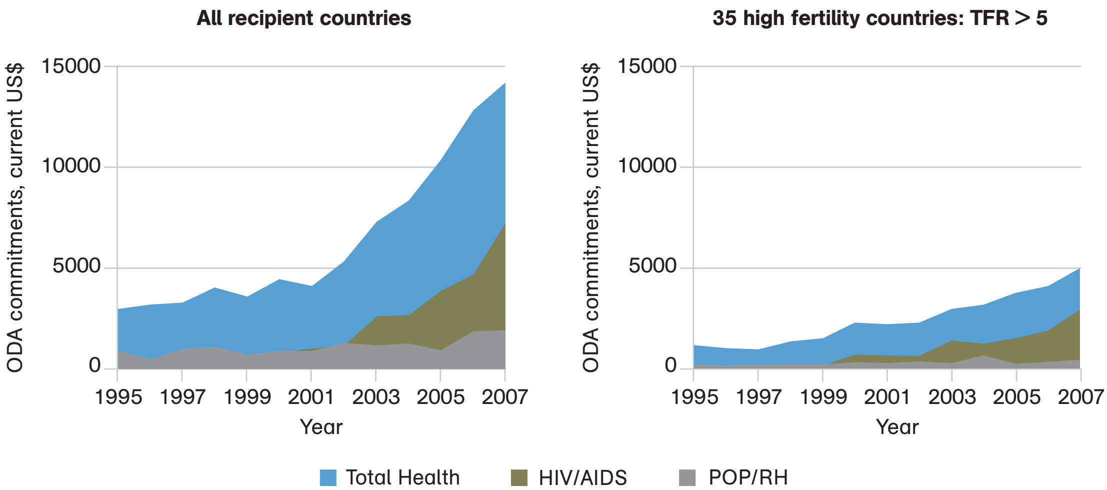
In the six decades since 1950, fertility has fallen substantially in developing countries. Even so, high fertility—defined as five or more births per woman over the reproductive career—characterizes 33 countries.[1] Twenty-nine of these countries are in Sub-Saharan Africa. High fertility poses health risks for children and their mothers, detracts from human capital investment, slows economic growth, and exacerbates environmental threats. These and other consequences of high fertility are reviewed in the first half of this paper. Recognizing these detrimental consequences motivates two inter-related questions that are addressed in the second half of the paper: Why does high fertility persist? and What can be done about it?

In recent years demographic concerns have shifted increasingly to the consequences of fertility decline, such as population aging, and to other demographic phenomena such as urbanization. Although high fertility persists in some countries, based on global experience since 1950 there is good reason to expect that these countries too will eventually experience substantial fertility decline. But uncertainty remains as to how rapidly that decline will occur, what policies and programs can accelerate decline, and whether fertility will fall to low levels (i.e., less that 2.5 births per woman) in all countries.

The high-fertility countries lag in many development indicators, as reflected for example in their rate of progress toward achievement of the Millennium Development Goals (MDGs). These countries have also received less development assistance for population and reproductive health than countries more advanced in their transitions to lower fertility, and the assistance they did receive increased only marginally from 1995 to 2007, a period during which commitments to both health and HIV/AIDS rose substantially, as shown in figure 1.

[1] This is as of 2000–2005, the last period for which the United Nations (2009) makes data-based estimates rather than relying on projections.

Figure 1 | Total ODA Commitments for Health, High-Fertility Countries, 1995–2007



Source: OECD DAC.

Consequences of High Fertility

High fertility is defined as a total fertility rate (TFR) of 5.0 or higher. The TFR represents the average lifetime births per woman implied by the age-specific fertility rates prevailing in one historical period. There are micro- and macro-level demographic concomitants of a high TFR. At the micro level, they include a relatively high incidence of births of order five and above, a relatively high fraction of women experiencing pregnancies of order five and above, and a greater likelihood of short inter-pregnancy intervals. At the macro level, the main demographic feature is relatively rapid population growth rate (and corresponding rapid growth in the size of successive birth cohorts). These micro- and macro-level demographic features have consequences that have been identified in a large body of research. The key conclusions from that research are summarized here.

Assessing the causal impact of high fertility is an analytical challenge because fertility is, to a greater or lesser extent, a choice, that is, it is endogenous. Covariation of fertility with other outcomes—health, social, and economic—may reflect deliberately chosen trade-offs rather than

Box 1 | Main Points on the Implications of High Fertility

Child health: The risk of mortality in infancy and early childhood is greater for higher-order births and closely-spaced births, and when the mother is over age 40.

Maternal health: The risk of maternal mortality is greater at higher parities, and younger and older ages. Moreover, fertility decline reduces the lifetime risk of maternal death simply by reducing the average number of pregnancies each woman experiences.

Child schooling: Children from large families attain less schooling. And successively larger birth cohorts—a feature of high fertility societies—detract from the quality of schooling by diluting the expenditure per pupil.

Economic growth: An exogenous drop in fertility raises productive output in the long-run. And the association between population growth and economic growth has become more negative since the 1980s.

Demographic dividend: Fertility decline assists economic growth via favorable changes in the age-structure—the "demographic dividend" of a larger concentration of the population in the working ages, thereby increasing per capita productivity. The "demographic dividend" contributed substantially to economic growth in East Asia and Latin America in the period since 1960.

Natural environment: High fertility (and the resulting population growth) is a direct and proximate cause of looming shortages of fresh water in many countries. Population growth has also contributed to global warming—the contribution may be as much as one-third—and fertility reduction via expanded family planning services is among the more cost-effective strategies for restraining global warming.

a straightforward causal effect of fertility. Most economic analyses adopt a multi-period model in which investment by adults in children and other items is driven by expected returns in the same and later periods (e.g., in old age). Both number and quality of children are arguments in the utility function, i.e. adults must decide how much to invest in number and in quality. The empirical research summarized below is sensitive to this analytical challenge, but research designs that support valid identification of causal effects are generally infeasible.

A key conclusion from more recent work on the linkages between population and development is the importance of being specific about the channels through which the linkages work. At the macro level, the impact of high fertility on other outcomes could be channeled through the size of the population (implications for the natural environment), the rate of population growth (implications for budgets), or the age distribution of the population (implications for economic productivity). At the household and individual level, high fertility means not only a large number of births by the end of most women's reproductive careers, but also typically a high incidence of pregnancies at young ages, of unplanned and unwanted pregnancies, and of closely-spaced pregnancies, all of which can affect household and individual welfare.

Consequences for Health (Child and Maternal)

Children from higher-order births are known to be at greater risk of dying during infancy and early childhood. One comparative analysis (Mahy 2003) of Demographic and Health Survey (DHS) data examines risk of death during four intervals: neonatal (0–4 weeks), infant (0–1 year), early childhood (1–4 years), and under-five (0–5 years). Birth orders 2 and 3 show the lowest rates. By comparison, at orders 7+ neonatal mortality is 43 percent higher and early childhood mortality is 11 percent higher.

Maternal mortality is also more likely at higher pregnancy orders. Some of the best evidence comes from the surveillance system data in Matlab thana, Bangladesh. These data reveal that women with five or more pregnancies have a significantly higher risk of dying due to maternal causes. Women at pregnancy orders five and six suffer roughly 50 percent higher mortality. This differential persisted even as mortality declined from high levels in the 1970s to much lower levels in the 2000s (Chen et al. 1974; DaVanzo et al. 2004). There is a further, less noticed return from avoiding high fertility: since pregnancy is an absolute requirement for maternal mortality, fewer pregnancies lowers the lifetime risk (Campbell and Graham 2006). This is one reason why a recent modeling exercise for India concludes that family planning would be the most effective intervention for reducing pregnancy-related mortality (Goldie et al. 2010).

In high-fertility regimes, short inter-pregnancy intervals occur more often than in low-fertility regimes. (The inter-pregnancy interval is the period between delivery and the next conception.) Applying multivariate analysis to DHS data from 52 developing countries, Rutstein (2008) shows that the optimal inter-pregnancy interval from a health standpoint is 36–47 months: adjusted mortality risk ratios for shorter intervals are always substantially higher. The population-attributable risk for under-five mortality for avoiding conceptions at less than 24 months after a birth is 0.13 (i.e., if there were no conceptions within 24 months of delivery, under-five deaths would fall by 13 percent). The analogous population attributable risk for avoiding inter-pregnancy intervals of less than 36 months is 0.25. These results are consistent with empirical evidence that short inter-pregnancy interval is a putative independent risk factor for low birth weight (less than 2.5 kg), preterm birth (less than 37 weeks gestation), and small size for gestational age.

In contrast to its effect on perinatal outcomes, there is little empirical evidence of the inter-pregnancy interval's effect on maternal health. An analysis of almost half a million Latin American women (Conde-Agudelo and Belizan 2000) indicates that short inter-pregnancy intervals (less than six months) are associated with higher risks of maternal death, anemia, third trimester bleeding, premature rupture of the membranes, and puerperal endometritis. But a more recent literature review (Conde-Agudelo et al. 2007) does not confirm this differential, which in any case refers to a small fraction of intervals.

Consequences for Human Capital Investment

Child health is one critical human capital investment; the research summarized above suggests that high fertility *per se* places children at higher health risk. The impact of high fertility on a second critical human capital investment, formal schooling, is considered next. This topic is bedeviled by the likely endogeneity of fertility decisions: under the quantity-quality trade-off model originally articulated by Gary Becker, parents consciously decide to have fewer children in order to invest more per child, with investment in schooling salient. Policy to lower fertility is as much an effort to encourage reproductive-age couples to make this choice as it is an effort to reduce the prevalence of large sibling-sets that are obstacles to the schooling of their members.

A large literature looks at the impact of fertility (number of siblings) on schooling outcomes in developing countries (see thorough reviews in Lloyd 1994, Kelley 1996, Lloyd 2005). The literature consists largely of multivariate analyses of household-level data. The large majority of these studies find that children from large families attain less schooling, an outcome usually attributed to resource dilution (i.e., less financial and time investment per child).

Unusual insight into the effect of fertility on child schooling is afforded by long-term analyses of the family planning experiment conducted in Matlab thana in Bangladesh. The treatment area experienced lower fertility than the control area for several decades, presumably because of the provision of family planning services. Joshi and Schultz (2007) show that children in the treatment area complete more schooling—roughly one-half standard deviation more for boys and one-third standard deviation more for girls (not statistically significant). These results are largely free of the endogeneity bias that damages most other research on this topic.

Another set of interrelations between fertility and schooling operates at the macro level. In high-fertility societies, the age structure of the population is young and, in particular, the fraction of the population that is school-age will be relatively large. Moreover, each birth cohort is larger than the previous cohort. Lam and Marteleto (2008) show that these macro-level demographic features persist for several decades after family sizes have begun to shrink at the micro level. This lends even more importance to the question of whether the population's demographic structure in itself affects educational attainment. The usual supposition is that relatively large (and growing) child cohorts exert downward pressure on schooling expenditure per child (World Bank 1984). But the macro-level evidence provides only mixed support. Kelley (2001) reviews the literature and notes that several well-conducted cross-country studies estimate that relative cohort size has no impact on the share of national budgets allocated to schooling. Most of the studies Kelley reviews, however, do not consider schooling outcomes. Several country-specific studies are suggestive. For example, Lam and Marteleto (2005) show that declines in the growth rate of its school-age population partly explain Brazil's large increase in school enrollment in the 1990s.

Consequences for Economic Growth

In general there is a negative correlation between fertility and economic growth. This simple correlation, however, cannot be regarded as revealing the true *causal* relationship between fertility and economic growth. Barro (1991) provides a theoretical framework for incorporating fertility (or population growth) in models of economic growth. In addition, his neoclassical growth model contains, as basic arguments, human capital investment and technological change.

Barro (1991, 1997) tests the model using panel data (1960–1990) from 100 countries and finds that fertility has a negative impact on productive output, reflecting expenditure on child-rearing rather than production of goods (income generation). Barro concludes that an exogenous drop in fertility raises productive output in the long run. Note that this research examines the effect of the overall level of fertility, and implicitly of the overall population growth rate, rather than growth rates of different age-strata of the population as has become common in the research literature of the past 15 years (i.e., the concept of "demographic dividend"—see below).

Barro's work has been followed by a flurry of empirical analyses in the past 15 years after a period of relatively little research on this topic in the late 1980s and early 1990s. One major conclusion that emerges from this recent literature is that the association between population growth and economic growth has become more negative since the 1980s (Headey and Hodge 2009). A second conclusion is that resource dilution effects are consequential (an inference from the fact that the effect of population growth on economic growth diminishes if one controls for investment or savings).

Economists now recognize that to assess the effect of fertility (and concomitant population growth rates) on economic growth one must take account of the population's age structure. Three age-strata are distinguished: children (pre-working-age); working-age adults; and the elderly. This categorization is applied to a stylized yet typical fertility transition that unfolds in three phases. In Phase I, fertility is high, and therefore the population is young (i.e., a relatively large fraction are children); where mortality has declined, this makes the population even younger on average. In Phase II, fertility has begun to decline, resulting in successively smaller birth cohorts and a bulge in the population in the working ages (due to high fertility in the past). In Phase

III, lower fertility has persisted for decades and the population becomes markedly older (i.e., a relatively large fraction are elderly).

The notion of a "demographic dividend" follows from this typical historical pattern of fertility transition. In fact, two "dividends" can be identified (Lee and Mason 2006). In Phase II there is growth, sometimes rapid, in the fraction of the population that is working-age; or, equivalently, there is a decline in the dependency ratio (the ratio of children and elderly to those of working-age). Everything else being equal, this relatively excessive weighting of the working-age population results in increased productivity per capita for the population as a whole and, therefore, in increased economic growth (Bloom and Williamson 1998, Bloom et al. 2003, Lee and Mason 2006). (Whether output per worker also grows is less certain; see Kelley and Schmidt (2005).) This phase ends when sustained lower fertility leads to a relatively smaller labor force and a return to higher dependency ratios. The increased productivity per capita during this phase is the "first dividend." Note that this dividend cannot be realized without a decline from high fertility; formal demographic models demonstrate that high fertility societies are necessarily characterized by high youth dependency. Note also that the opportunity to take advantage of this dividend is fleeting, although in some countries it may extend for as long as five decades; hence the term "demographic window."

A second dividend can be induced by the aging of the population if this age-structure change generates an incentive to save. As the elderly become more numerous in relative terms and if individuals recognize this demographic fact, confidence that adequate old-age support will be provided by state or kin mechanisms may wane. This in turn generates an incentive for individuals to accumulate assets that they may draw on once they retire from the labor force. The consequence is higher savings rates, which, all else being equal, produce increased economic growth. This is the "second dividend" (Bloom et al. 2003, Lee and Mason 2006). In contrast to the first dividend, the second dividend is not a direct consequence of fertility decline and it can last indefinitely.

Most research during the past decade has taken into account age-structure, often by examining the impact of the growth rates of age-strata (children, working-age, elderly) rather than the growth rate of the population as a whole. Kelley and Schmidt (2005) attempt a synthesis of the demographic impact on economic growth. Their main point is that this impact is multifaceted. Certain influences are negative, others are positive; some are felt immediately, some with lags of 10–20 years (or longer). In this vein, Kelley and Schmidt specify effects of fertility through dependency ratios and through population density and size (demographic features that change relatively slowly) as well as through the growth rate of the youth population and the working-age population (demographic features that change relatively rapidly). The empirical analysis uses data for 86 countries for the period 1960–1995. It reveals that, among the demographic variables, declines in youth dependency—a direct result of fertility decline—have had the strongest influence on output per capita. This result holds for all continents with the exception of Africa, where youth dependency has remained high throughout the second half of the 20th century due to persistent high fertility.

Demographic dividends are not automatic. Among the conditions that improve the prospects of realizing a dividend are human capital investment (i.e., a healthy and educated labor force) and government policy that creates a favorable environment for financial investments and encourages household savings (Bloom et al. 2003). In the absence of such conditions, growth in the working-age population may lead to high unemployment and attendant social ills. Bloom and Canning (2006) use the East Asian Tigers and Ireland to underscore how prior investments in schooling can foster larger dividends during the demographic window. In Ireland and in East Asia, the exceptional demographic dividend can almost certainly be attributed in part—perhaps in large part—to prior public investments in schooling, especially at the secondary level.

Consequences for the Natural Environment

The research base is less conclusive regarding the impact high fertility has on the natural environment than it is regarding the impact on economic growth. In part this reflects the relative infancy of systematic research on this issue. In fact this is a cluster of issues, since various aspects of the natural environment, such as land, air, fresh water, biodiversity, and global warming, must be distinguished. It is also clear that the effect of fertility and other demographic factors on the natural environment is heavily conditioned by institutional factors such as land-tenure regulations and agricultural practices and by consumption patterns, and that the effect varies markedly across regions and even between localities. These are the conclusions from many global and national studies, such as Heilig's (1997) assessment of land-use change in China. High fertility and population growth is an overarching factor whose effects on the natural environment may be profound but difficult to calculate with precision. In the following paragraphs, what is known about the impact of high fertility and concomitant rapid population growth on various aspects of the natural environment are reviewed in turn.

Undoubtedly, population growth leads to changes in *land-use patterns*: rural areas become more intensively farmed, grazed, or logged, while at the same time urban growth absorbs formerly rural areas. Population increase has led to reduced forest cover in Costa Rica (Rosero-Bixby and Palloni 1998), Ecuador (Pan et al. 2007), and Brazil (Vanwey et al. 2007). There is evidence of the same occurrence in Africa and Asia (Carr et al. 2005). But the net effect of population growth and population density on deforestation appears to be relatively weak (Angelsen and Kaimowitz 1999), and deforestation is a land-use change that is not unambiguously harmful, as it depends on the alternative uses to which the land is put. Desertification is more clearly an unwelcome development, but for this the determining role of demographic factors has not been ascertained even in vulnerable regions such as Sahelian Africa, North Africa, West Asia, and South Asia. There are numerous examples of deliberate efforts to improve land-use practices, organized locally or nationally; arguably, increasing population density is an incentive to engage in such efforts (as initially posited by Esther Boserup (1965)). But agricultural intensification also has limits. Analysis of data from 37 high-fertility countries in Africa reveals a significant relationship between population pressure, shortening of fallow, soil erosion, and soil nutrient depletion (Drechsel et al. 2001), a set of interrelations described on a larger scale by Pimentel and Pimentel (2006).

Degradation in the *quality of air* is primarily an urban phenomenon (industrial emissions, motor vehicle emissions), although agricultural practices (biomass burning) can also contribute. Poor air quality in large cities in developing countries is well established and can be attributed in part to the growth of these cities, which in turn is a function of overall national population growth. Among the more comprehensive analyses is Nagdeve's (2007) assessment of the impact of population growth on air pollution in India. Increased air pollution in urban areas is attributed to population growth and consumption patterns, and in rural areas to use of fuel wood, crop residues, animal dung, and low-quality coal. Biomass burning in rural areas is a major cause of air pollution; indeed, Gustafsson et al. (2009) show that biomass burning for both cooking and agricultural purposes accounts for almost two-thirds of the carbonaceous aerosols causing brown clouds over South Asia. But these practices that degrade the quality of air are not inextricably linked to population growth, and fertility decline *per se* in all likelihood makes a rather small contribution to long-term improvement in air quality.

Numerous studies confirm that population growth exacerbates the challenge of providing adequate *fresh water* to sustain human life. Although two-thirds of the earth's surface is water, the supply of fresh water is limited and finite. Hence as the world's population grows, the average amount of renewable freshwater available to each person declines. Each person daily needs about one liter of water for drinking, and more than 1,600 liters are required to produce the grain to feed each person daily (Pimentel and Wen 2004). Some of the high-fertility countries (Yemen, Afghanistan, Sahelian Africa) are located in arid regions, many of which already suffer from water scarcity. More generally, while in 2000 there were 31 countries with populations totaling 508 million experiencing water stress or scarcity, it is expected that by 2025, 48 countries with a combined population of 3 billion will experience water stress or scarcity (Bernstein 2002). This will include the two most populous South Asian countries, India and Pakistan. To be sure, available fresh water can be used more efficiently: in most countries, large amounts of fresh water are wasted in agricultural, industrial, and domestic practices. Even so, the finite amount of fresh water and its uneven distribution around the globe set undeniable constraints. There is little doubt that high fertility (and the resulting population growth) is a direct and proximate cause of current and looming shortages of fresh water in many countries.

Declines in *biodiversity* have multiple direct and indirect causes. The latter include global warming, which itself is due in part to population growth (see next paragraph). Population growth can have more direct impacts on biodiversity, chiefly through changes in land-use patterns (as discussed above) but also because of increased direct contact between humans and plant and animal species. Luck (2007) conducts a meta-analysis of 85 studies (encompassing 401 analyses) of the relationship between human population density and biodiversity. The clear conclusion is that an increase in population density leads to an increase in the number of threatened and endangered species that have specific environmental requirements (as do most species). It follows that fertility decline can contribute to the protection of biodiversity (Chu 2008).

No aspect of the ongoing changes in the natural environment garners as much attention as *global warming*, attention that is fully justified by the numerous and diverse repercussions that are forecast, including impacts on fresh water, biodiversity, agricultural production, human health, and human settlement patterns. Global warming is due primarily to the burning of fossil fuels, which releases carbon dioxide (CO2) and other greenhouse gases into the atmosphere. Growth in the emission of greenhouse gases during the past century has run far ahead of global human population growth. Even so, a substantial portion of the growth in greenhouse gases can be attributed to population growth (Dietz and Rosa 1997, York et al. 2003). In an early assessment, Bongaarts (1992) concludes that as much as 35 percent of the increase in the emission of greenhouse gases has been due to population growth. Even so, going forward the potential contribution of fertility is probably modest: Birdsall (2001) estimates that feasible reductions in fertility in developing countries will reduce global warming through 2050 by only 10 percent as compared to an unchanging-fertility scenario. But this modest contribution is quite cost-effective as compared to alternative strategies for restraining global warming, as demonstrated in recent calculations by Wire (2009), and therefore serves as an important rationale for further fertility decline.

Determinants of High Fertility

Vigorous scholarly investigation of the determinants of fertility in low-income settings extends back to the 1960s, and this has produced a rich theoretical and empirical literature. For the purpose of developing policies and programs to reduce fertility in the remaining high fertility societies, one can reasonably protest that while the amount of knowledge about fertility determinants is extensive it is undifferentiated. It is a challenge to distill a few key lessons from this overwhelming body of research. This synopsis focuses on concepts and empirical findings that are especially germane to the task of formulating strategies for reducing fertility in contemporary high-fertility societies, which are predominantly located in Sub-Saharan Africa.

The Easterlin Synthesis Framework (Easterlin 1975) provides the conceptual framework for this review. At issue is whether and when couples are prepared to exercise deliberate control over their childbearing via fer-

Box 2 | Main Points on the Determinants of High Fertility

High demand for children: The demand for children is high in most of the remaining high fertility countries (especially in Central and West Africa).

Unmet need for family planning: And yet many of the high fertility countries have moderate to high levels of unmet need for family planning—the prevalence typically ranges from one-fifth to one-third of married women.

Age at first union: Age at first union is relatively young in most high fertility societies (less than age 20 on average). Several years delay would contribute to fertility decline, and it would have other health and socioeconomic benefits.

Mortality: Improved child survival is perhaps the most powerful stimulant of fertility decline. In contrast, increased mortality due to the HIV-pandemic is having minimal overall impact on rates of fertility and population growth.

Education: Formal schooling is second only to mortality as a determinant of fertility.

Income: By contrast, income is a relatively weak predictor of fertility decline, net of mortality and education. Poor economic performance is **not** in itself an obstacle to fertility decline.

Obstacles to contraception: Non-access obstacles (cultural, social, psychic) appear to be robust in some settings but are not well quantified.

Family planning services: The evidence on access obstacles is less ambiguous: in diverse settings expanded provision of family planning services has had an impact on fertility, typically 10%–25% net reduction in fertility.

tility regulation behavior (contraception, induced abortion). This includes limiting childbearing to a small number, that is, less than four children. Fertility regulation behavior is posited as a direct function of two constructs, namely *motivation to regulate* and *cost of regulation*. Motivation to regulate in turn is determined by the *demand for children* (e.g. desired number of children) in relation to the current *supply of children*; when the current supply matches or exceeds the demand for children, there is motivation to take actions to avoid becoming pregnant. Note that motivation is driven primarily by the demand for children but is also affected by biological factors, themselves conditioned by social and cultural factors, and that these biological factors affect the pace of childbearing (i.e. *supply of children*) once a woman becomes physically capable of conceiving. The more rapid the pace, the more likely a woman will at any given moment have a stock of children that matches or exceeds her desired number. Age at first birth and inter-pregnancy intervals (as determined by postpartum behaviors) are direct determinants of the supply of children. *Cost of regulation* is broadly defined to include not only costs of accessing family planning services (financial, time) but other social and psychic costs, including concern about detrimental health side-effects due to contraceptive methods.

Child survival rates can influence the motivation to regulate by affecting both the stock of living children and the demand for children. Economic and social factors bear on both the motivation to regulate fertility, primarily through the demand for children, and the cost of regulation; the former has received far more attention in the literature. Population policies may be intended to affect either the motivation to regulate, by influencing the demand for children, or the cost of regulation, whereas family planning programs are designed mainly to reduce the cost of regulation. At the same time, there has been a lively debate about whether programs can also affect the demand for children (see Freedman 1997).

Supply of Children

A fundamental direct determinant of the pace of childbearing after the onset of the biological capacity to reproduce is the age at first birth, which in turn is typically heavily determined by the age at entrance to a formal union. An inverse association between age at first union and lifetime number of births is one of the most established relationships in the research literature (Bongaarts 1982). Contemporary high-fertility countries are characterized by early age at first union and a resulting early age at first birth. DHS data reveal that in those countries where the TFR is 5.0 or higher, the median age at first marriage averages 17.7 years, almost two years younger than in moderate fertility countries and two-and-a-half years younger than in low-fertility countries. While age at first union appears to be increasing in the high- fertility countries, the pace is relatively slow. Were the average age at onset of childbearing to increase in the high-fertility countries, almost certainly reduction in the overall fertility rate (TFR) would follow. Because the ages at first union and first birth are young in these societies, there is much scope for fertility reduction due to this mechanism.

Inter-pregnancy intervals are determined by behaviors such as breastfeeding (the primary determinant of the length of postpartum amenorrhea) and coital frequency (especially postpartum abstinence). These behaviors have a substantial effect on individual-level reproductive patterns as well as societal levels of fertility (Bongaarts 1982). But they do not provide opportunities for interventions to reduce fertility in contemporary high-fertility countries because long durations of breastfeeding and postpartum abstinence are the norm in most of these countries. Indeed, a concern is that erosion of the extended postpartum durations of breastfeeding and abstinence will, all else being equal, lead to an *increase* in fertility.

More generally, it is usually assumed that substantial fertility decline does not come about due to changes in the spacing of births—i.e., a lengthening of interbirth intervals—but, rather, will only occur when there is widespread adoption of behaviors, usually contraception, intended to terminate childbearing after a certain number of living children has been attained (Van De Walle 1992). Timaeus and Moultrie (2008) have challenged this presumption, demonstrating in analysis of survey data from South Africa that postponement of births has contributed substantially to the country's fertility decline. Whether the same could be replicated elsewhere in Africa is uncertain; if this potential exists, it has direct implications for the formulation of population policy and programs in the large number of high- fertility countries that are African.

Motivation: Mortality Change

The high fertility countries are characterized by relatively poor child survival. According to United Nations estimates for the period 2000–2005, in two-thirds of these countries the infant mortality rate exceeded 100 deaths per 1,000 births, a level observed in only one of the countries with a TFR below 5.0. Would an improvement in child survival in the high-fertility countries, a desirable health outcome in its own right, be a force towards fertility decline?

Mortality decline and fertility decline are entwined in classical demographic transition theory, with mortality decline leading and motivating subsequent fertility decline. From a societal perspective, lower fertility seems an inevitable, though often delayed, response to lower mortality; otherwise population will grow relentlessly. Taking this argument to its logical conclusion, Cleland (2001) argues that mortality decline is the necessary and sufficient condition for fertility decline. However, there is no supra-individual mechanism to guarantee a fertility response to mortality decline.

At the individual level, a complex of biological and behavioral factors ties individual fertility to infant and child mortality. Physiologically, the death of an infant affects subsequent fertility by leading to a sudden termination of breastfeeding, triggering resumption of menses and ovulation, and leaving the woman exposed to the risk of conceiving again. For this reason alone, improved child survival should reduce the number of live births. Complementing this physiological response, three volitional responses have been suggested: a replacement response, an insurance response, and a quality-quantity tradeoff. First, parents may attempt to replace a child who dies young in an effort to attain a desired number of children. Second, they may protect their childbearing goals against possible deaths by having extra children, an insurance response. Third, and perhaps most important, as survival prospects improve, parents are more likely to invest time and money in their children, leading to a quality-quantity tradeoff. There is empirical evidence that all four of these mechanisms (physiological and volitional) are operative, although there is debate about their relative magnitudes.

More germane to this report is how these individual-level responses aggregate into fertility decline. A recent country-level econometric analysis for the period 1960–2000 (Angeles 2010) concludes that mortality changes have a large impact on fertility, indeed can account for a major part of observed fertility decline in the period since 1960 and substantially more than can be attributed to growth in GDP per capita and urbanization. It appears that fertility decline lags mortality decline by 10–20 years on average. This research provides some basis for expecting that improved child survival in the high-fertility countries will motivate fertility decline. Consistent with this expectation, the African countries with substantial fertility declines in the 1980s and 1990s were also countries that enjoyed some success in reducing infant and child mortality, namely Botswana, Ghana, and Kenya.

Because most of the high-fertility countries are African and because the HIV/AIDS pandemic is most severe in this region, the question naturally arises whether the pandemic has any bearing on the course of fertility transition. This question can be refined by considering separately HIV-positive and HIV-negative women. The former are known to have diminished fertility—estimates range from 10 percent to 50 percent—due primarily to higher fetal loss (Gray et al. 1998, Zaba and Gregson 1998, Lewis et al. 2004). This diminished fertility among the HIV-positive has made a large contribution to the fertility decline in some African settings, for example accounting for 12 percent of the fertility decline in South Africa (Camlin et al. 2004) and one-quarter of the fertility decline in Zimbabwe since the 1980s (Zaba et al. 2003). Still, meaningful fertility decline in the high-fertility countries cannot come about via this mechanism alone: Zaba and Gregson (1998) and Lewis et al. (2004) both estimate that each percentage-point increase in HIV prevalence among adult females is linked to a 0.4 percent reduction in fertility, which implies that a one-birth reduction from a TFR of 5.0 (20 percent reduction) would require a 50 percentage-point increase in HIV prevalence, an entirely far-fetched explosion of the pandemic.

Are there also fertility responses among uninfected women, driven perhaps by concerns about HIV infection? This is an active topic of research, and even the direction of the effect (if it exists) is uncertain. Some changes in sexual behavior can be documented in particular settings, especially a delay in sexual debut among women and a reduction in number of sexual partners due to HIV/AIDS-related concerns (see Gregson et al. 2009 and papers cited therein). Whereas the former change is related to lower fertility, the impact of the latter is unclear. Other changes, such as a delay in first marriage, can have effects difficult to sort out, such as greater premarital activity or greater marital stability. An increase in condom use also has problematic effects, increasing contraceptive protection only if it does not substitute for more effective hormonal contraceptive methods. That the evidence is so cloudy suggests there is no reason to believe that the HIV/AIDS pandemic will motivate substantial fertility decline.

Demand for Children: Economic and Social Determinants

A vast literature examines the effect on fertility of economic and social factors, from both a macro-level and a micro-level perspective. The most prominent factors are income (e.g., GDP per capita), urbanization, and educational attainment.

At the country level, measures of income and fertility are strongly associated cross-sectionally (Schultz 2006), but the same association is not evident in analyses of fertility change. In Angeles' (2010) regression analysis of fertility decline in the period 1960–2000, for example, GDP per capita has the expected negative coefficient but its estimated effect is far weaker than mortality and education. One possible explanation for this relatively weak estimated effect is that the true effect of income growth on fertility is heterogeneous, raising the demand for children in some subgroups and lowering it in others (as economic theory would predict). It is also possible that Angeles' and other analyses have shortchanged the effect of income by not fully accounting for indirect effects (through other determinants such as mortality and education). But even allowing for some under-accounting for the full causal effect of income, the bulk of the empirical evidence suggests that income growth *per se* is not essential for fertility decline.

Fertility is almost always lower in urban as compared to rural areas. So too is the demand for children (e.g., desired number of births) lower in urban areas. The urban-rural differential typically persists with controls for confounding variables such as educational attainment. Urbanization figures less prominently in empirical analyses of fertility decline, in part because generally it changes far more gradually than fertility. Angeles (2010) estimates a significant net effect of urbanization on fertility decline that is smaller in magnitude than the effects of mortality decline and educational increase but larger in magnitude than the effect of income growth.

With very few exceptions, research in developing countries reveals an inverse relationship between the amount of formal schooling and fertility. In cross-sectional analyses, education indicators are often the strongest single correlates of fertility at both the macro level and the micro level. (Reviews of the empirical research include Cochrane 1979, Castro Martin 1995, Jejeebhoy 1995, and Bledsoe et al. 1999.) There has been less explicit analysis of the contribution of educational change to fertility decline, but the existing research shows robust effects. In Angeles' analysis, for example, educational change is second only to mortality decline as a predictor of fertility decline.

Income, urbanization, and formal schooling are key items in a bundle of factors that together comprise "socioeconomic development" as conventionally understood. A common theme in the research literature of the 1980s and 1990s, epitomized by Bongaarts and Watkins (1996), was that socioeconomic development is weakly linked to fertility decline, both in the European past and in contemporary developing countries, and indeed might even be secondary to "ideational change" and social diffusion (of fertility attitudes, of knowledge of modern contraception). But the past decade has witnessed a re-establishment of the fundamental determining role of socioeconomic factors such as schooling, and the fact that fertility remains high in most countries that rank low on development indicators, chiefly African countries, has been an important reason for this revival of earlier theory of the causes of fertility decline. Bryant (2007) demonstrates that the relationship of conventional development indicators to fertility decline is strong and, further, that key results in Bongaarts and Watkins (1996) are methodological artifacts.

Demand for Children: Current Patterns in High Fertility Countries

Scholars and policy-makers examine fertility declines in the past for lessons that can be applied to the remaining high-fertility societies. But the relevance of past experience, chiefly Asian and Latin American, to contemporary high-fertility societies, which are concentrated in Sub-Saharan Africa, is far from certain. The prominent demographer John Caldwell has repeatedly cautioned that Asian experience might not be applicable to Sub-Saharan Africa (Caldwell and Caldwell 1988, Caldwell et al. 1992). One indication of the distinctiveness of African reproductive regimes is the high demand for children. DHS data show that the mean desired number of children exceeds 4.0 in all high-fertility African countries and sometimes is greater than 6.0 (Westoff 2010). Similarly, among women who have already given birth to four children, the fraction stating a preference to have no further births is less than 50 percent in most of the high- fertility African countries. Demand for children is especially high in Western and Central Africa. While the comprehensive standardized survey record provided by the DHS for contemporary African societies is not available for Asian and Latin American societies at the onset of their fertility declines in the 1950s–1970s, the few pieces of empirical evidence suggest that in general the demand for children was not as high (Mauldin 1965, Lightbourne 1985).

Successive DHS surveys (from 1990 to 2008) reveal change in the demand for children in Eastern and Southern African countries but little change in Central or Western African countries, especially the Sahelian countries of Western Africa (Casterline 2009). A key concept is unmet need for family planning. This describes the condition of wanting to avoid pregnancy (temporarily or indefinitely) but not practicing family planning. That is, the concept of unmet need juxtaposes reproductive desires and behaviors; it is non-use of contraception conditional on a desire to postpone or terminate childbearing. Demographic survey data, such as the DHS, provide estimates of the prevalence of unmet need among women of reproductive age. Note that unmet need has been adopted as an indicator for MDG 5.

While DHS data document high demand for children in the high-fertility African societies, the same surveys also reveal levels of unmet need for family planning that are at least modest and in some countries relatively high (DHS 2010) (i.e. ranging from 15 percent to 40 percent of women currently in union). This indicates that some fertility decline could be achieved without changes in fertility demand. This opportunity notwithstanding, it should be recognized that substantial decline in the demand for children is probably a prerequisite if most of the remaining high-fertility countries are to experience a decline in fertility to a low level. In this respect, their fertility declines may well differ in character from the fertility declines that occurred in Asia and Latin America during the period from the 1960s to the present; in these declines, changes in the demand for children were rather modest (Casterline 2010). While the Asian and Latin American declines consisted largely of the realization of existing demand for small families (Feyisetan and Casterline 2000, Casterline 2010), future declines in the high-fertility countries will necessarily more nearly resemble the demand-driven decline postulated by Pritchett (1994).

It follows that if decline in the demand for children is a requirement, then fertility decline in the remaining high-fertility societies will be especially sensitive to changes in factors such as mortality, schooling, and urbanization that are known to be strong correlates of fertility demand. The inference is that these factors will be even more decisive for fertility decline in the remaining high-fertility societies than they were for fertility declines in the past. But change in these factors is not easily accomplished, and hence additional policy levers must be sought. One scenario, described below, is that increased capacity to control fertility (due to easier access to family planning services) will itself drive down the demand for children.

Costs of Fertility Regulation

Non-access obstacles to contraceptive use—the social and psychic factors that figure heavily in anecdotal accounts of unmet need for contraception—are rarely investigated with rigor. Where they have been given due consideration, they have been shown to explain a considerable portion of the unexplained unmet need (see review in Casterline and Sinding 2000). Social barriers (e.g., husbands, in-laws) and fear of health side-effects predominate in some societies. At present there is almost no systematic research on the non-access obstacles in the high fertility societies, but it would be surprising if such obstacles are not of some significance.

There is far more research into access obstacles (e.g., financial costs, time costs). Indeed, family planning programs, the intervention most clearly identified with organized attempts to reduce fertility, have as their first goal the reduction of access costs. The effect on fertility of family planning programs has been investigated in multiple settings over the course of five decades. A useful summary of their performance is offered by Robinson and Ross (2007), who draw on an extensive earlier literature and the experience of practitioners and analysts familiar with many separate programs. They assemble studies of 22 countries from each of the major regions. Their conclusion is that for the most part these programs have had a net impact on fertility that ranges from 6 percent (weak programs) to 32 percent (strong programs).

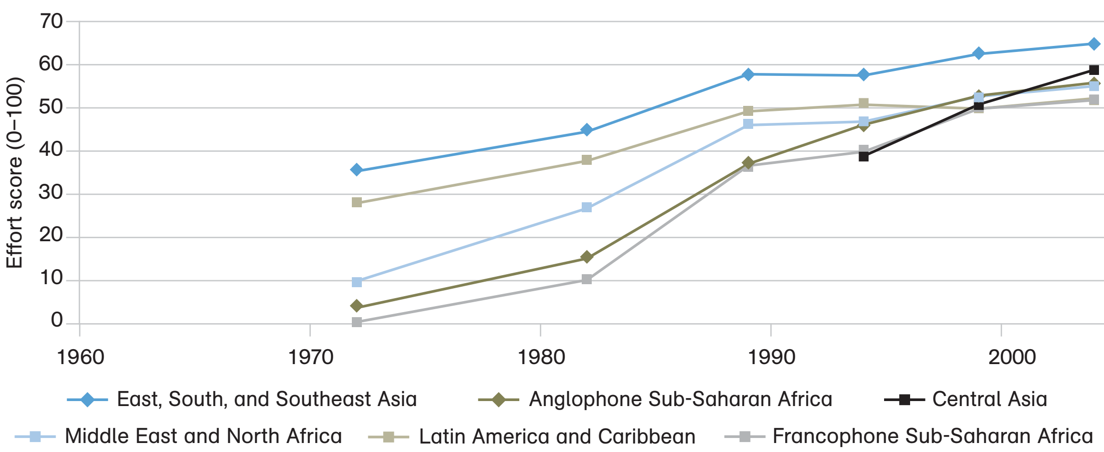
The best evidence concerning the effect that enhanced provision of family planning services has on reproductive behavior is provided by field experiments. There is a long list of locations in Asia and Africa where family planning experiments, most of them short-term, have been conducted. In most instances, the treatment of enhanced family planning services yielded more contraceptive use, lower fertility, or both. The most thoroughly analyzed field experiment was conducted in Matlab thana, Bangladesh. An intense family planning effort there began in 1977 and led to steadily rising contraceptive prevalence in the treatment areas that far outpaced the increase in the control areas (Phillips et al. 1988) and also produced sustained fertility decline (Phillips et al. 1988, 1996). More recently, Joshi and Schultz (2007) have returned to the data from the

Matlab experiment and, after carefully taking into account initial differences between treatment and control areas, calculate that the number of surviving children (reflecting both fertility and child survival) was 18 percent lower in the treatment area after five years and remained 10 percent lower 14 years after that.

An unresolved issue, possibly of critical importance to fertility decline in the high fertility countries, is whether enhanced provision of family planning services affects fertility demand. A plausible argument is that increased capacity to exercise control over reproduction lowers the demand for children. That is, making smaller family size more feasible also makes it more desirable (a self-efficacy effect). The authoritative review on the subject (Freedman 1997) concludes that the empirical record does not provide consistent support for this argument. This is a discouraging conclusion in light of the evidence reviewed above that the remaining high-fertility societies are characterized by high average desired family size. Possibly the relatively exceptional demand for children in these societies will be more responsive to an increased ability to limit family size via modern contraception than evidently was the case in Asian and Latin American societies in the past.

What is the quality of family planning programs in the high-fertility countries? Country-specific "program effort" has been assessed periodically since the early 1970s using informed observers in each country (Ross et al. 2007). Figure 2 shows the trend in the program effort scores (on a scale from 0 to 100) averaged for five major regions. Program effort improved substantially in all regions over the three-decade period. The figure shows that program effort scores in Sub-Saharan Africa, where most of the high- fertility countries are located, have lagged in the Anglophone countries and more so in the Fran-

Figure 2 | Family Planning Program Effort Scores for Major Developing Regions (percent maximum)



Source: Ross, John, John Stover, and D. Adelaja. 2007. "Family Planning Programs in 2004: New Assessments in a Changing Environment." International Family Planning Perspectives 33:22–30.

cophone countries. Even so, as of 2004 the average program effort score in Africa matches the level in Asia and Latin American during their periods of most rapid fertility decline in the 1980s and 1990s. Whether this can be taken as a favorable portent for future increases in contraceptive use (and decline in fertility) is uncertain because the health and socioeconomic context is on balance less favorable in the high-fertility countries in Sub-Saharan Africa. Experimental interventions that have succeeded (such as the Navrongo experiment in northern Ghana, analyzed in Debpuur et al. 2002) have entailed more intensive effort than national programs can mount.

Policy Options

The synopsis of the research literature presented above, and especially the review of the major determinants of fertility (previous section), provides a framework for considering policy options. Over the years a range of policy options for promoting fertility decline have been suggested, encompassing not only family planning programs but also human capital investment (health, schooling) not to mention interventions that would promote gender equity and empower women. Many of the policies are desirable on multiple grounds and not only for their fertility consequences.

The underlying fertility determinant targeted by the policies varies. Some measures, such as education, are directed at reducing the demand for children. Others, such as encouragement of later start of childbearing, influence fertility by reducing exposure to the risk of conception. Finally, family planning services are designed to address the costs of regulating fertility, and hence might be expected first of all to reduce unwanted fertility. Judging from the cumulative experience of the past five decades, effective implementation of any one of these measures can contribute to fertility decline However, the high-fertility countries that have been the focus of this review have tried few if any of these interventions. Family planning is one intervention many have tried, though often with indifferent commitment and insufficient resources The most effective interventions will be those that are tailored to the nature of the reproductive regime, in particular whether the demand for children is high or low and whether or not there is substantial unmet need for family planning.

One might conclude from the evidence presented above that the first order of business in most of the high-fertility countries is the implementation of policies that reduce the demand for children. In such settings improved access to reproductive health services may be insufficient; instead there must also be multisectoral interventions that will, among other outcomes, reduce the demand for children. But effective interventions that are also affordable within current resource constraints are difficult to identify. Substantial improvement in child survival and mass schooling (with attendant labor force opportunity upon graduation) would probably drive down desired family size, but collectively these are extremely expensive. Developing alternative, more affordable policies to reduce the demand for children is of high priority, and no doubt will require some imagination.

Most immediately, providing family planning services remains a relatively inexpensive and targeted fertility reduction policy. While the demand for children is high in these countries, there is also unmet need for family planning, as indicated by survey data and also by the high incidence of induced abortion in some countries. Addressing this unmet need is desirable on health grounds and imperative if women and men are to have the ability to make voluntary and informed decisions about fertility. Addressing the unmet need would also translate into fertility reduction – demographic survey data indicate potential for small to modest reduction in most of the high fertility countries.

Whether the demand for children will be downwardly responsive to improved capacity to exercise fertility control remains an untested possibility. Information campaigns and population education that deliberately target high desired family size could reinforce this possibility and are clearly mandated in this set of countries, and in fact are already integral to most family planning programs. They might also accelerate fertility decline where it is already underway. Explicit and visible political commitment at the highest level comes with no financial cost and would reinforce the information and education messages. Together, these efforts could set off a virtuous circle in which initial fertility limitation generates incentives for further fertility limitation, thereby reducing the demand for children. A dynamic of this sort probably accounts for the rapid fertility declines witnessed in many Asian and Latin American countries in recent decades (Casterline 2001). When this dynamic is operative, the public cost of effective fertility policy can fall dramatically. This stands as the most promising scenario for the high fertility countries, and it begins with relatively affordable investment in reproductive health services that address unmet need for family planning while also improving maternal and child health.

Policy and programs must also be responsive to the marked inequalities in reproductive health outcomes that are endemic in most of these countries. The demand for children is generally higher among the poor, as noted in the literature review above. Unmet need is a more complicated matter, because it is a function of both the demand for children and contraceptive behavior. In the early stages of fertility decline, the decline in desired fertility often out-paces the increase in contraceptive practice among the middle and upper strata of society, resulting in higher unmet among those who are wealthier and better educated. But one might presume that these strata possess resources to close the gap between reproductive desires and behaviors, albeit with a lag. After the early stages of fertility decline, however, the more common predicament that emerges is higher unmet need among the poor, and this can become a chronic condition that is not readily alleviated without public provision of reproductive health services. Hence equity considerations become another important rationale for investment in such services.

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